The Dynamics of Asian Financial Integration

Facts and Analytics

Edited by
Michael B. Devereux, Philip R. Lane, Cyn-Young Park and Shang-Jin Wei
The book assesses financial integration in emerging East Asia at both regional and global levels. It studies the factors driving the progress of regional financial integration in relation to financial globalization and identifies the relevant policy challenges facing emerging market economies in the region. Chapters look into three broad aspects of regional and global financial market integration: (i) measurement of regional and global financial integration; (ii) understanding the dynamics of regional financial integration versus global financial integration; and (iii) welfare implications from regional financial market integration amid financial globalization. Against this context, academics, policy makers, and other readers will appreciate the rigorous research contribution provided by this book.

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<td>2SLS</td>
<td>two-stage least squares</td>
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<tr>
<td>AR(1)</td>
<td>first-order autoregressive</td>
</tr>
<tr>
<td>ARIMA</td>
<td>autoregressive integrated moving average</td>
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<tr>
<td>ASEAN</td>
<td>Association of Southeast Asian Nations</td>
</tr>
<tr>
<td>ASEAN+3</td>
<td>ASEAN plus the People’s Republic of China, the Republic of Korea, and Japan</td>
</tr>
<tr>
<td>ASEAN-4</td>
<td>four middle-income ASEAN economies: Indonesia, Malaysia, the Philippines, and Thailand</td>
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<tr>
<td>BIBOR</td>
<td>Bangkok Interbank Offered Rate</td>
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<td>BIS</td>
<td>Bank for International Settlements</td>
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<tr>
<td>CAPM</td>
<td>capital asset pricing model</td>
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<tr>
<td>CES</td>
<td>constant elasticity of substitution</td>
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<td>CIP</td>
<td>covered interest parity</td>
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<td>COV</td>
<td>coefficient of variation</td>
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<td>CPI</td>
<td>consumer price inflation</td>
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<td>CPIS</td>
<td>Coordinated Portfolio Investment Survey</td>
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<td>DCC</td>
<td>dynamic conditional correlation</td>
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<td>EU</td>
<td>European Union</td>
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<td>FDI</td>
<td>foreign direct investment</td>
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<tr>
<td>G-3</td>
<td>Group of Three (European Union 15, Japan, and the United States)</td>
</tr>
<tr>
<td>G-7</td>
<td>Group of Seven (Canada, France, Germany, Italy, Japan, the United States, and the United Kingdom)</td>
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<tr>
<td>GAAP</td>
<td>Generally Accepted Accounting Principles</td>
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<tr>
<td>GARCH</td>
<td>general autoregressive conditional heteroskedasticity</td>
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<tr>
<td>GDP</td>
<td>gross domestic product</td>
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<td>HARA</td>
<td>harmonic absolute risk aversion</td>
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<td>HIBOR</td>
<td>Hong Kong Interbank Offered Rate</td>
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<tr>
<td>IMF</td>
<td>International Monetary Fund</td>
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<tr>
<td>IV</td>
<td>instrumental variable</td>
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<td>JBA</td>
<td>Japanese Bankers Association</td>
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<td>KLIBOR</td>
<td>Kuala Lumpur Interbank Offered Rate</td>
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<td>Labuan IOFC</td>
<td>Labuan International Offshore Financial Centre</td>
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<td>LIBOR</td>
<td>London Interbank Offered Rate</td>
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<td>MA</td>
<td>moving average</td>
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<tr>
<td>NIE</td>
<td>newly industrialized economy</td>
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<tr>
<td>NYSE</td>
<td>New York Stock Exchange</td>
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<tr>
<td>OECD</td>
<td>Organisation for Economic Co-operation and Development</td>
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<tr>
<td>OIS</td>
<td>overnight index swap</td>
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<tr>
<td>OLS</td>
<td>ordinary least squares</td>
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<tr>
<td>PPI</td>
<td>producer price inflation</td>
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<tr>
<td>PRC</td>
<td>People’s Republic of China</td>
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<tr>
<td>$R^2$</td>
<td>$R$ squared</td>
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<tr>
<td>SIBOR</td>
<td>Singapore Interbank Offered Rate</td>
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<tr>
<td>SIC</td>
<td>standard industrial classification</td>
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<td>TIBOR</td>
<td>Tokyo Interbank Offered Rate</td>
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<td>TIC</td>
<td>treasury international capital</td>
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<td>US</td>
<td>United States</td>
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<td>VAR</td>
<td>vector autoregression</td>
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Michael B. Devereux
Philip R. Lane
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Foreword

The global financial crisis has manifested a remarkable degree of global financial integration and its implications for emerging Asian financial markets. Although the crisis clearly demonstrates that financial liberalization and integration are not without risks, such an event will not and should not deter the progress that the region has made toward financial openness and integration.

The crisis presents a timely opportunity for the region’s policy makers to rethink their strategies for financial deregulation and liberalization and to reconsider the next steps to integrate emerging Asia’s financial markets further. In this light, emerging Asian economies’ growing financial ties – both regional and global – have motivated us to look closer at the repercussions of growing financial integration and to evaluate the benefits of risk-sharing and better access to international capital markets against the costs of cross-border financial contagion.

The Asian Development Bank (ADB) adopted its strategy for regional cooperation and integration in 2006 as regional integration was identified as one of the priority areas of its operations. As promoting monetary and financial integration in the region became an important component of furthering regional cooperation and integration, ADB is committed to playing an important role in enhancing regional financial market development and providing technical assistance in this important area. To date, ADB’s efforts have involved enhancing market infrastructure, broadening and deepening capital markets across the region, strengthening market surveillance, and building relevant research.

To support its ongoing initiatives, ADB’s Office of Regional Economic Integration led the implementation of a technical assistance project to study the factors driving the progress of regional financial market integration in relation to financial globalization, and to identify the relevant policy challenges facing emerging market economies in the region. The 11 chapters included in this book trace the progress of regional financial market integration in a rapidly globalizing landscape and present empirical evidence on the degree of regional financial market integration vis-à-vis global financial market integration. The chapters also explore the dynamics underlying financial market integration at the regional and global levels in the context of the multiple dimensions of financial market integration. They also discuss welfare implications.
The pace and path of Asian financial market integration will have important consequences for the region’s financial developments and its economic growth. Moreover, as the center of gravity of the global economy is shifting toward Asia, integrated Asian financial markets will have greater repercussions beyond the region and an impact on the world as a whole. Hence, to contribute to both Asian and global welfare, it is important to have a clear understanding of regional financial market integration and how to manage its effects.

This book provides a rigorous research background to the relevant issues and brings its readers a step closer to appreciating the nuances of financial market integration. I am confident that the book will help Asia to reassess its strategies for regional financial market integration.

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Asian Development Bank
Executive summary and overview

Michael B. Devereux, Philip R. Lane, Cyn-Young Park, and Shang-Jin Wei

Why is financial integration an important topic for Asia?

Cross-border capital flows (measured by gross capital inflows worldwide) have been growing at an average rate of 16% a year since 1994 (Figure ES.1), much faster than world trade or world gross domestic product (GDP). With the volume of cross-border capital flows on the rise, cross-border holdings of financial assets have also increased sharply (Figure ES.2). In theory, integrating financially with the world economy can bring numerous benefits to a country, from a lower cost of capital and enhanced risk-sharing to greater discipline of the government, banks, and non-bank corporations. In practice, however, the positive effects of financial integration on economic growth have proven elusive to identify convincingly in the data. After surveying a vast literature of empirical studies, Kose et al. (2003, 2010) concluded that there is no strong, robust, and causal effect of financial integration on economic growth for a typical developing country.

Past financial crises highlight the risks engendered by unfettered capital flows. For example, both the Asian financial crisis of 1997–8 and the global financial crisis of 2008–9 have shown that there are potential risks as well as benefits associated with greater financial integration. Economies with a relatively high degree of financial openness also appear to have been more affected by the effects of financial contagion.

However, avoiding financial integration is not realistic. The wave of financial deregulation, innovation, and liberalization since the early 1990s continues to drive cross-border financial integration. Some notable progress in financial innovation and globalization – including the spread of securitization, the use of offshore special-purpose vehicles by financial institutions, and the rise of hedge funds and institutional investors – have contributed to the secular trend of cross-border financial integration.

Asia has been no exception to this trend of financial globalization. Since the breakdown of the Bretton Woods, most advanced economies have by and large eliminated capital controls. Many emerging market economies, including those in Asia, that aspire to attain a high-income status, have followed suit. Furthermore, in an environment where trade and financial markets are rapidly globalizing, even when a country chooses to limit financial integration, de facto integration may still
Figure ES.1 Financial accounts inflows – world (% of GDP).
Source: authors’ calculations using data from the International Monetary Fund, Balance of Payments Statistics Online and World Economic Outlook Database.
Note: “Other investment” includes derivatives. GDP = gross domestic product.

Figure ES.2 Foreign assets and liabilities – world (% of GDP).
Source: authors’ calculations using the updated and extended version of the External Wealth of Nations Mark II database developed by Lane and Milesi-Ferretti (2007).
Note: GDP = gross domestic product.
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take place via insipient capital flows through mis invoiced exports or imports, or through outright evasion of capital controls.

It is widely known that comovement across national financial markets has increased significantly over time. Figure ES.3 shows stock market correlations for emerging East Asia including the People’s Republic of China (PRC) with the United States (US). A visible increase in stock market correlations may be attributed to the greater financial openness in recent decades and hence greater financial integration. For example, the volume of capital flows to (from) emerging East Asia rose to 12.3% (12.5%) of GDP in 2007 from 4.5% (2.9%) in 1990 (Figure ES.4). The region’s gross external assets and liabilities as a share of GDP (Figure ES.5) also reached 129% and 105%, respectively, in 2007, up from 81% and 70% in 1990 (Lane and Milesi-Ferretti 2007).

Cross-border financial integration has also accelerated at the regional level. Figure ES.6 shows the average of pair-wise stock market return correlations among emerging East Asian countries. This shows that comovements of regional stock market returns have increased significantly in recent years, especially with the PRC. Likewise, regional bond markets show increased comovements. Figure ES.7 shows the average standard deviation of government bond yields. This also indicates the convergence among regional government bond yields. Asian investors’ portfolio investment in regional assets also rose significantly, from about 15% of total assets in 2001 to about 25% in 2008. Furthermore, the G-7 countries (Canada, France, Germany, Italy, Japan, the US, and the

Figure ES.3 Stock returns correlations (2-year rolling correlations).

Sources: authors’ calculations using Morgan Stanley Capital International (MSCI) Barra, Bloomberg, and CEIC Data Company.

Notes: PRC = People’s Republic of China, US = United States. Emerging East Asia includes the PRC; Hong Kong, China; Indonesia; the Republic of Korea; Malaysia; the Philippines; Singapore; Taipei, China; and Thailand. Stock returns are computed as log difference of grouped and individual country index.
Figure ES.4  Financial account flows – emerging East Asia (% of GDP).
Sources: authors’ calculations using data from the International Monetary Fund, International Financial Statistics Online; and CEIC Data Company.
Notes: Emerging East Asia includes the People’s Republic of China; Hong Kong, China; Indonesia; Republic of Korea, Malaysia; the Philippines; Singapore; Taipei,China; and Thailand. “Other investment” includes derivatives. Data for Hong Kong, China begin in 1998.

Figure ES.5  Foreign assets and liabilities – emerging East Asia (% of GDP).
Source: authors’ calculations using the updated and extended version of the External Wealth of Nations Mark II database developed by Lane and Milesi-Ferretti (2007).
Note: Emerging East Asia includes the People’s Republic of China; Hong Kong, China; Indonesia; the Republic of Korea; Malaysia; the Philippines; Singapore; Taipei,China; and Thailand.
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0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0.9

Emerging East Asia excluding the PRC
Emerging East Asia

Mar-92 Sep-93 Mar-95 Sep-96 Mar-98 Sep-99 Mar-01 Sep-02 Mar-04 Sep-05 Mar-07 Sep-08 Apr-10

Figure ES.6 Average pair-wise correlation of stock returns (2-year rolling correlations).
Source: authors’ calculations using data from Bloomberg.
Notes: PRC = People’s Republic of China. Emerging East Asia includes the PRC; Hong Kong, China; Indonesia; the Republic of Korea; Malaysia; the Philippines; Singapore; Taipei, China; and Thailand. Data for PRC begins in 1992. Data represent average pair-wise correlations of stock returns. Stock returns are computed as log difference of individual country index.

Figure ES.7 Average standard deviation of emerging East Asian government bond yield spreads over United States (US) treasuries.
Source: authors’ calculations using data from Bloomberg.
Notes: Average standard deviation (61-day) of government bond spreads with US Treasuries of nine emerging East Asian countries including the People’s Republic of China; Hong Kong, China; Indonesia; the Republic of Korea; Malaysia; the Philippines; Singapore; Taipei, China; and Thailand.

United Kingdom) account for about 53% of the region’s liabilities in 2008, down from 68% in 2001 (Figure ES.8).
Asian financial integration also reflects policy choices by the region’s authorities. Asian authorities strengthened regional financial links in line with their broader financial deregulation and liberalization efforts, by removing the barriers
to cross-border flows of capital and financial services, improving cross-border information and communication, and promoting the harmonization of financial rules and standards. Especially in the aftermath of the 1997–8 financial crisis, Asian authorities commenced various regional initiatives to strengthen and deepen local currency bond markets as a way to reduce their economies’ reliance on external funding and to increase their financial resilience. The Asian Development Bank (ADB) also adopted its Regional Cooperation and Integration Strategy on 25 July 2006, promoting monetary and financial integration as a focus of furthering regional cooperation and integration (ADB 2006).

Interestingly, even with these conscious efforts, emerging Asian financial markets appear to have, in general, a higher degree of integration with global markets than with each other (Kim et al., 2010). For example, correlations among regional stock markets are generally lower than those between them and the US. Moreover, data on cross-border financial asset holdings show that emerging Asia still allocates more of its portfolio investment to the G-7 markets than within the region. Given this pattern, one important question that this book investigates is how financial and business cycle shocks are transmitted to Asian economies via the regional and global financial channels.

The experience of financial crises has graphically illustrated the risk of globalized finance. Financial integration often makes it possible for a shock from one market to travel rapidly across borders. As finance is rapidly globalized, a worsening condition of the world financial market could also make local funding

Figure ES.8 Emerging East Asia’s portfolio investment (% of total foreign assets and liabilities).

Source: authors’ calculations using data from International Monetary Fund, Coordinated Portfolio Investment Survey.

Notes: G-7 includes Canada, France, Germany, Italy, Japan, United Kingdom, and United States. Emerging East Asian countries include the People’s Republic of China; Hong Kong, China; Indonesia; the Republic of Korea; Malaysia; the Philippines; Singapore; Taipei, China; and Thailand.
more difficult, potentially dampening corporate profits and in turn affecting broader economic activity. This can be particularly damaging for emerging market economies, especially in places where the business environment was less friendly to start with.

Regional financial integration could help address some of these issues by allowing emerging Asian economies to tap financial resources within the region as an alternative to the global financial market. While Asia as a whole runs a large current account surplus (i.e. regional saving exceeds regional investment), many individual Asian economies remain dependent on external borrowing for long-term investment, thus vulnerable to currency and maturity mismatches. This raises the question of whether it is sensible to enhance regional financial integration, and direct the region’s savings to meet its longer term investment needs.

Ultimately, knowing the patterns of financial integration is just a stepping stone in the process of assessing the impact of regional and global integration on the well-being of the economies in the region. This knowledge in turn is a prerequisite for authorities to design “smart” policies to improve upon a country’s experience with financial integration. As the consequences of financial integration are myriad, and possibly dependent on the type of integration, one needs to investigate whether and how patterns of financial integration affect a country’s vulnerability to the contagion of external financial shocks, its ability to absorb and diffuse shocks, and the sensitivity of other macroeconomic outcomes that affect a country’s economic well-being.

What do we try to achieve with this book?

This book attempts to achieve two goals by assessing the degree of regional and global financial integration and unveiling the drivers of such integration. First, it lays out analytical frameworks that are foundations for answering the following questions. How does one assess the degree of integration in the financial asset market and direct investment flows? How does one measure business cycle synchronization and financial contagion, and compute consumption and output risk-sharing? How can regional versus global integration be captured separately? How does one assess the welfare implications of different types of financial integration? How can the onset and international transmission of a liquidity crunch be measured? How is the effect of a financial crisis on non-financial firms in Asia and elsewhere quantified?

Second, by applying the rigorous frameworks, the book provides an up-to-date assessment of the extent of financial integration in Asia, documenting the complexity in the patterns of the integration and quantifying some of its consequences. For example, what are the degrees of capital mobility within Asia and between Asia and the rest of the world from a quantity (volume of capital flows) perspective? What are the degrees of Asian economies’ integration with regional and world money and stock markets from an asset price perspective? What do they imply for these economies’ vulnerability to contagion from external financial shocks in the event of a global financial crisis? Does the composition
of capital flows matter to financial stability? How different is the composition of capital inflows to Asia from that to other regions and what does the 2008–9 crisis experience tell us? What is the degree of business cycle comovement within Asia and between Asia and high-income countries in Europe and North America? How has business cycle synchronicity evolved over time and what have been the drivers – trade or financial linkages?

The global financial crisis illustrates vividly how advanced financial globalization has become. The countries most affected include those with relatively more advanced financial integration such as extensive foreign participation in local equity markets, banking systems that depend more on short-term foreign currency funding, and those running external current account deficits. Volatility in foreign portfolio investment flows – short-term funds placed in stocks, bonds, and banks’ overseas borrowing – also presented a significant risk. Exposures to short-term external funds have badly affected the performance of the region’s currencies amid greater uncertainty about the continuity and stability of these foreign currency funds.

The global financial crisis presents a timely opportunity for emerging East Asian economies to rethink their strategies for financial deregulation and liberalization, and carefully reconsider a next step for further integration among regional financial markets and beyond. An ultimate question is whether and to what extent financial integration is beneficial for economic growth. For many regional economies that have been actively opening up their financial markets and have experienced two episodes of financial crisis, another highly pertinent question is whether the degree or geographical extent of financial integration matters. What lessons can the region’s policy makers draw from the post-crisis experience in determining the future course of financial integration for their economies?

Reinforcing regional cooperation to enhance financial stability could be one answer. National mechanisms to stem the spread of financial panic were found inadequate, ineffective, and inefficient in the face of massive deleveraging in advanced economies, tightened global liquidity conditions, and worsening growth prospects. Some Asian economies experienced severe disruptions in their currency and asset markets due to difficult access to external funding sources. Although economies with sufficiently large international reserves were able to provide liquidity support to their banks and financial systems, holding vast reserves for rainy days also has costs, and is often blamed for having contributed to global imbalances. Having multiple layers of protection against a “sudden stop” either through bilateral swap lines with foreign central banks or multilateral agreements with regional or global financing facilities, where available, could help relieve market stress during liquidity crisis.

A resilient financial system is essential for a country to ensure the effective management of capital flows and to allocate financial resources efficiently (ADB 2010). Reflecting the lessons learned during the 1997–8 crisis, many emerging Asian economies have therefore moved to enhance the resilience of their financial sectors so they can better absorb volatile capital flows and provide alternative sources of financing for domestic business. To create a resilient
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Financial environment, a country needs to take policy action on several fronts, including: (1) putting in place strong prudential and regulatory frameworks; (2) promoting depth and diversity in domestic capital markets so that they can fill the funding gaps when needed; (3) encouraging the development of local currency bond markets to help reduce currency and maturity mismatches associated with external liabilities; (4) ensuring that small borrowers that depend on banks for their funds can be served in times of crisis; and (5) permitting more active foreign participation to increase competition and introduce new products and best practices into the domestic market.

Given Asia’s vast size, tremendous diversity, and fast economic growth, lessons from Asia may be useful for other regions as well. For example, in Africa, many economies appear to have a lower level of financial integration than those in Asia, at least on a de facto basis. How should one accurately capture the intricacies of their patterns of financial integration? Should they emulate Asia’s approach to financial integration? If so, which aspects are worth emulating, which aspects should be avoided, and which aspects should be kept on a continue-to-monitor list? In Latin America, one might say that the overall level of financial integration is not lower than that in Asia, but Asia and Latin America show interesting differences in their patterns of financial integration. In particular, at the risk of over-simplification, a typical Latin American country appears to rely relatively more on international bank lending than a typical Asian economy. Does it make a difference for macroeconomic outcomes? Both the conceptual frameworks and empirical estimates in this book provide a building block to study these questions. Thus, the book can be a useful tool for Asian policy makers and analysts, as well as those whose primary interests are in other regions of the world.

What is the key content?

This book begins by presenting a conceptual framework for analyzing financial integration at different geographical levels. The ensuing chapters broadly comprise three parts that attempt to answer three questions: (1) What is the extent of capital mobility for emerging Asia and how has it evolved both within and beyond the regional border? (2) What is the degree of financial asset market integration and how has it progressed for emerging Asia? Finally, (3) has financial integration affected the transmission mechanisms of external shocks and business cycle movements? A rigorous assessment of financial integration in Asia is important for the economies in the region, and the methodologies and empirical findings provided here are also important for economics as a science.

In Chapter 1, ‘Regional and global financial integration: an analytical framework’, Philippe Martin provides a conceptual framework for understanding the differences between global and regional dimensions of international financial integration. In a multicountry model with transaction costs for trading financial assets, financial integration increases financial market size, and thus affects asset prices and the cost of capital. Global financial integration is characterized by a symmetric decrease in transaction costs on financial markets between all countries,
whereas regional financial integration is characterized by a decrease in transaction costs in a subset of countries.

In such a setup, market size matters: larger and richer countries benefit from a financial home bias that leads to a higher demand for assets and higher asset prices, and, in turn, to a greater number of assets when these are endogenous. Global financial integration lowers market segmentation and leads to an increase in relative asset prices for small countries. Regional financial integration increases market size and generates a higher demand for assets issued on those markets and leads to higher asset prices and greater diversification in the integrated area. The model generates testable implications of a financial gravity equation for cross-border financial trade. Overall, the empirical results suggest that Asian financial integration may be more advanced than is often believed. However, these regressions are preliminary and represent simply an invitation to go further in analyzing the specificity of Asian financial integration.

Martin also analyzes the location of financial market activity and finds that financial integration, both global and regional, leads to agglomeration in the largest economy of the integrated area. This may not be detrimental to the countries that experience a decline in local financial market activity, because the concentration of financial markets generates efficiency gains. Agglomeration may, however, raise some political questions for small markets.

Finally, taking into account the possibility of financial crises, Martin finds that financial integration between countries very different in size and development (which may characterize global rather than regional financial integration) generates more gains in “good” times but increases the possibility of a financial crisis. The reason is that global financial integration may increase the possibility of a financial crisis triggered by self-fulfilling expectations and capital flight to the rich/large economy. Martin also finds that trade integration between countries lowers the probability of a financial crisis because trade makes firms’ profits and asset prices less dependent on expectations concerning domestic economic conditions. This finding suggests that regional trade integration is an important prerequisite to regional financial integration. Martin’s results also suggest a trade-off: while global integration generates larger gains in “good” times than does regional integration, the latter may be more stable in that the risk of a financial crisis may be lower.

The next three chapters are quantity-based analyses, with a focus on characterizing the extent of regional and global financial integration for Asian economies.

In Chapter 2, ‘International capital mobility of East Asian economies: is domestic investment financed by regional or global saving?’, Soyoung Kim, Sungkyun Henry Kim, and Cyn-Young Park extract information about the relative importance of regional and global capital flows for East Asia by developing an expanded version of the classic Feldstein and Horioka (1980) model of international capital mobility. In particular, Kim, Kim, and Park investigate the extent to which domestic investment in East Asian countries has been financed by domestic, regional aggregate, and global aggregate saving during the period
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1980–2007. If capital mobility is zero, domestic investment must be fully financed by domestic saving. In contrast, international capital mobility allows domestic investment to be financed by foreign saving. The innovation in Chapter 2 is the examination of the relative importance of regional saving versus global saving in funding the component of domestic investment in East Asia that is not funded by domestic saving. If domestic saving is more highly correlated with regional saving than with global saving, then regional financial integration matters more than global financial integration for the dynamics of domestic investment.

Using a variety of panel econometric techniques, Kim, Kim, and Park find that regional financial integration has played a significant role in funding domestic investment in East Asia, with no additional role played by saving rates in the rest of the world. Japan has been the most important regional source of saving during this period, with shifts in the level of excess saving in Japan associated with shifts in investment rates in other East Asian economies. Moreover, the role of Japanese saving in financing East Asian investment has increased over time.

In Chapter 3, ‘The evolution of regional and global risk-sharing in East Asian economies’, Pierfederico Asdrubali and Soyoung Kim provide a related analysis by comparing the comovements between domestic macroeconomic variables (consumption, investment, output, income) and regional and global macroeconomic variables. Under international risk-sharing, domestic consumption may be insulated from domestic macroeconomic shocks for three reasons. First, international financial diversification and hedging operations can limit the sensitivity of domestic wealth to domestic macroeconomic risk. Second, the ability to engage in cross-border borrowing and lending allows a country to smooth consumption in the face of output fluctuations. And third, adjusting the level of domestic investment can also limit the impact of output shocks on domestic consumption.

Asdrubali and Kim estimate an econometric model that incorporates the three channels of risk-sharing (i.e. international capital market, international credit market, and domestic credit market) for a panel of emerging East Asian countries during the period 1971–2008. A key finding is that regional financial integration is more important than global financial integration for East Asia. The main regional channel is cross-border lending and borrowing, rather than the diversification of income streams. This situation may change over time to the extent that increasing levels of cross-border foreign direct investment (FDI) and portfolio equity investment increase the comovement of national incomes across East Asia.

In Chapter 4, ‘Regional and global drivers of the portfolio holdings of Asian investors’, Philip R. Lane investigates the geographical shifts in the international portfolios of Asian investors during the period 2001–7. While considerable literature has explored the cross-sectional variation in bilateral portfolio holdings, there is relatively little research on the evolution of bilateral patterns over time. Lane exploits the growing availability of portfolio data from the International Monetary Fund’s Coordinated Portfolio Investment Survey to obtain new empirical evidence on the time series evolution of portfolio positions for a group of Asian investor nations.
To identify factors that might help explain portfolio dynamics, Lane focuses on two main driving forces. First, time variation in bilateral trade linkages may be associated with shifts in portfolio positions. Second, a change in the level of currency volatility may also prompt portfolio reallocations, with the expectation that greater stability in bilateral exchange rates should be associated with a higher level of bilateral portfolio holdings.

Lane also examines whether regional factors are important in explaining shifts in portfolio patterns. Many elements of greater regional integration may be difficult to measure in a precise way, but a general regional indicator variable may pick up these unobserved components of regional integration.

By examining the potential determinants of time variation in geographical portfolio allocations, it is possible to gain some insights into the relative contributions of the global and regional dimensions of international financial integration. In particular, regional initiatives that boost intraregional trade or reduce intraregional currency volatility may help stimulate regional financial integration. In this way, the debate about regional financial integration is intimately connected to the debates on regional trade and regional exchange rate arrangements.

Lane finds a significantly positive association between growth in bilateral trade and growth in portfolio equity holdings. In addition, there is some evidence that an increase in exchange rate stability does increase the level of bilateral bondholdings. Moreover, exchange rate stability seems especially important for Asian economies with a lower level of financial development. Finally, there is indeed a significant regional boost from common membership in the ASEAN+3 group, which includes the members of the Association of Southeast Asian Nations (ASEAN) – Brunei Darussalam, Cambodia, Indonesia, the Lao People’s Democratic Republic, Malaysia, Myanmar, the Philippines, Singapore, and Thailand – plus the PRC, the Republic of Korea, and Japan.

Further insights on regional and global financial integration can be obtained by examining trends in asset price data, which is carried out in Chapters 5–7.

In Chapter 5, ‘Regional and global short-term financial market integration in Asia: evidence from the interbank markets under the crises’, Shin-ichi Fukuda explores the dynamic integration of the Asian money markets with the international money market. After matching the currency denomination, Fukuda investigates how each Asian interbank rate has been synchronized with the London Interbank Offered Rate (LIBOR) since the 1990s. To the extent that the Asian market segments are highly integrated with the world, the Asian interbank rates would show synchronization with LIBOR. However, if there are substantial differences in risk characteristics, the interbank rates may not show synchronization with LIBOR. Moreover, the level of synchronization may vary over time, with the level of integration possibly changing during periods of financial crises.

The Asian money markets explored in Chapter 5 are the interbank markets in Hong Kong, China; Malaysia; Singapore; Thailand; and Tokyo. Money markets in Hong Kong, China; Singapore; and Tokyo are the three major money centers in East Asia. In contrast, those in Malaysia and Thailand have had limited trading
Executive summary and overview

volume. Accordingly, this chapter explores how both advanced and less-developed Asian money markets have been integrated with the global money market.

Fukuda’s analysis includes two crisis periods: the 1997–8 Asian financial crisis and the 2008–9 global financial crisis. The author finds that both the Hong Kong, China and Tokyo markets as well as offshore markets in Malaysia and Singapore were highly synchronized with the London market in non-crisis periods. However, onshore markets in Malaysia, Singapore, and Thailand were less correlated with the London market and their interbank offered rates frequently showed substantial deviations from the covered interest parity. More interestingly, each Asian interbank rate showed a substantially different degree of integration with LIBOR in the two crisis periods. The author finds that, during the global financial crisis, the Singapore Interbank Offered Rate remained highly integrated with the dollar-denominated LIBOR. However, other Asian markets showed remarkably asymmetric responses in how to reflect regional risk premiums under the global financial crisis. The asymmetric impacts in the markets denominated by the dollar and by local currency had a “home bias” feature in reflecting liquidity premiums during the financial crisis.

In Chapter 6, ‘Stock market integration and financial contagion’, Kee-Hong Bae examines regional and global factors that drive stock market returns. Using daily stock market returns, Bae finds that the degree of global and regional integration has increased over the years for most countries. However, there is considerable variation across Asia. The PRC’s stock market shows the least integration, while the biggest increase in integration is found in the Republic of Korea. The degree of global and regional integration in Asia is similar to that in Latin America. In addition, the international financial integration of Asian stock markets has been boosted by stock market development and foreign ownership of domestic shares.

Bae also examines whether the degree of integration has any bearing on the likelihood of financial contagion. Financial contagion is identified by joint occurrence of extreme returns on a particular trading day, which is labeled “co-exceedance.” When countries are more integrated, they are found to be more likely to experience co-exceedances. However, the quantitative effect of integration on contagion is small.

A principal measure of international financial market integration is the comovement in stock market returns. In Chapter 7, ‘Stock market integration: emerging East Asia’s experience’, Marthe Hinojales and Cyn-Young Park follow that approach to provide a comprehensive account of the pattern of financial integration in emerging East Asian equity markets, at both regional and global levels. Financial integration is described by an examination of the dynamic conditional correlation of stock returns both within the region and between the region and the rest of the world, with returns from Japan and the US used as proxies for the rest of the world. Hinojales and Park further study the nature of financial integration at a deeper level by breaking down total equity returns into sector components, comparing returns to the financial sector with those to the industry sector. Finally, they employ factor analysis to distinguish between global and regional drivers of total returns.
The chapter’s central message is that financial integration between emerging East Asia and the rest of the world is greater than integration within emerging East Asian economies. This remains true even though both measures of financial integration have been increasing over time. In addition, as might be expected, integration between the PRC and the rest of the world, as measured by returns correlations, remains much lower than the equivalent measure for emerging East Asia. Hinojales and Park also find that returns correlations with the rest of the world are higher for the Asian newly industrialized economies (Hong Kong, China; the Republic of Korea; Singapore; and Taipei, China) than for the four middle-income Asian economies (Indonesia, Malaysia, the Philippines, and Thailand). Interestingly, when returns are broken down by sector, the authors find that the correlation between emerging East Asian and global returns is higher for industry than for financial sectors. This suggests that the integration of emerging East Asia with the global economy is underpinned more strongly by trade linkages than by linkages among financial institutions. Finally, the separate identification of regional and global factors corroborates the authors’ initial findings from the correlation analysis: for the region as a whole and for all individual countries, the global factor is substantially greater than the regional factor. Moreover, the global factor increases during the sample period, while the regional factor remains relatively constant. Overall, the results of the study suggest that emerging East Asian financial markets remain significantly exposed and vulnerable to developments in financial markets in the rest of the world.

Finally, Chapters 8–11 examine the implications of financial integration in terms of propagation of shocks, financial contagion, and (eventually) business cycle comovements.

Chapter 8, ‘Global and regional financial accelerator integration’, by Woon Gyu Choi and David Cook presents a novel application of the financial accelerator literature to the study of regional and global financial integration. A large body of recent research has stressed the importance of agency costs in financial markets, and their consequences for credit constraints, investment, and overall macroeconomic volatility. The seminal work of Bernanke and Gertler (1989) incorporates agency costs between lenders and borrowers at the micro level into a full dynamic stochastic general equilibrium macroenvironment, and shows how this can generate a “financial accelerator” mechanism whereby the impact of macroeconomic shocks on asset prices and balance sheets can amplify and prolong the effects of the shocks themselves.

Substantial empirical evidence supports the role of balance sheet effects in the propagation of business cycles, both in industrialized countries and in emerging market economies, especially during episodes of financial crises. Choi and Cook construct a theoretical model in which entrepreneurs finance the acquisition of capital partly through debt, but are subject to balance sheet constraints arising from the risk of default. The cost of capital for an entrepreneur is determined by a risk premium that is increasing in the leverage ratio that itself is varying over time. The basic idea behind the study is that the degree of balance sheet integration across countries will determine the risk premium faced by entrepreneurs. Integration of
balance sheets can benefit a small economy because domestic shocks, which do not affect the global balance sheet position of investors, will leave the risk premium unchanged, and hence integration has a stabilizing effect. But the response to external shocks will be sensitive to whether balance sheet integration is at the regional or the global level. If integration is at the global level, external shocks that cause movements in the risk premium will also affect the global risk-free interest rate. The authors also explore the consequences of alternative types of financial integration for the conduct of monetary policy. The main policy implication from this is that targeting producer price inflation is the better policy under regional integration, but targeting consumer price inflation is preferable under global integration.

In Chapter 9, ‘Financial contagion and vulnerability of Asian financial markets’, Michael B. Devereux and James Yetman present a theoretical and empirical study of the vulnerability of Asian financial markets to international macroeconomic developments. While Asian economies have benefited substantially from access to international financial markets, the experience of the Asian crisis in the late 1990s and the 2008–9 global financial crisis shows that financial linkages can act as first-order propagators of macroeconomic shocks.

The hypothesis in Chapter 9 is that there is a fundamental trade-off between the efficiency benefits of international financial integration on the one hand, and the contagion effects of international financial market interdependence on the other. By affecting borrowers’ net worth, movements in asset prices can have substantial effects on access to capital markets. With interconnected balance sheets among financial institutions across countries, shocks that cause a fall in asset prices in one country may precipitate deleveraging effects that spill over into the balance sheets of institutions in other countries.

Devereux and Yetman first present evidence on the extent of deleveraging among financial institutions in the US in their Asian portfolios during the 2008 financial crisis. During the crisis, negative shocks to asset prices in the US are associated with increased correlation of asset prices across countries. They also show that the propagation of the recent global downturn has been more important for countries with financial linkages than for those with trade linkages. This holds especially for countries that are financially vulnerable because their sovereign bond ratings are relatively low.

The authors then construct a theoretical model of international financial linkages in the presence of leverage constraints. Leverage constraints lead to a separate financial transmission mechanism of business cycle shocks that is completely independent of trade linkages. The combination of such constraints with international portfolio linkages gives rise to the possibility of very strong positive macroeconomic comovement. The key reason is that financial integration leads to interdependence of portfolios across countries, and, with binding leverage constraints, the returns on portfolios, by affecting net worth, have independent effects on the degree of access to capital markets. In particular, a negative shock to domestic asset returns, in the presence of portfolio integration, leads to a fall in the domestic asset price, which leads to a reduction in net worth in both the
home and foreign economy. The implications for a comparison of regional versus global financial integration depend on the degree of financial vulnerability in each dimension. Integrating with global financial markets where financial institutions may be vulnerable to balance sheet collapse driven by asset prices may expose countries to substantial macro risk, diluting the additional risk-sharing benefits of global relative to regional financial integration.

In Chapter 10, ‘Not all financial integration is created equal: the composition matters’, Shang-Jin Wei looks more deeply at the nature of financial integration between developing economies and the rest of the world. Wei argues that the composition of capital flows matters for a country’s experience with global or regional financial integration. In addition, he shows how the underlying institutional features of developing countries affect the composition of capital flows. Like Devereux and Yetman in the previous chapter, Wei suggests that financial integration is a double-edged sword. In good times, financial integration benefits developing countries in providing risk-sharing and investment financing, but in bad times, a financially integrated economy is more exposed to external shocks. However, among countries with an equally high level of financial integration, some appear to suffer from an external crisis more easily than do the others. Not all capital flows are equal; international direct investment appears to be more robustly associated with a positive effect on economic growth than is private foreign debt.

Wei first shows that, both in normal times and during the global financial crisis, capital inflows to developing countries in the form of FDI are significantly more stable and less prone to reversal than inflows in the form of portfolio investment or direct lending. Then, using a disaggregated dataset of sector returns during the global financial crisis for a sample of developing economies, Wei shows that precrisis dependence on FDI financing ameliorated the decline in returns. Hence, sectors and countries more reliant on FDI financing were less vulnerable during the financial crisis.

Finally, Wei goes on to examine the determinants of FDI financing relative to other forms of capital inflows and argues that institutional quality is a key explanatory variable. Countries that are afflicted with weak institutions are more dependent on non-FDI forms of capital inflows, have more volatile inflows, and are more exposed to external shocks during crisis times than those with strong institutions. The chapter’s policy message is that improvement in institutional quality, beyond its direct benefits, may also have indirect benefits by enhancing financial stability and the quality of capital inflows.

In Chapter 11, ‘What happened to the East Asian business cycle?’, Jean Imbs provides a rich analysis of the evolution of the bilateral business cycle correlations for East Asian economies, and compares this cycle with the time pattern of correlations in developed economies and among Latin American economies. There is overwhelming evidence that bilateral business cycle correlations have risen for all countries since the 1980s. The East Asian countries represent a special case, however, in that the increase in their bilateral business cycle synchronization is associated with the Asian crisis in 1997. For the non-Asian countries in the sample,
the major upward shift in business cycle correlations is associated with the 2008–9
global financial crisis. In contrast, the East Asian economies show only a slight
increase in the post-2007 data, beyond that dating back to the Asian crisis.

Imbs also links the dynamics of bilateral cycle correlations during the recent
crisis to changes in goods trade and financial linkages. Because trade and financial
linkages are themselves clearly endogenous to business cycle outcomes during
crises, the author does not attempt to draw causal conclusions. Instead, he presents
these results simply as an analysis of variance and documents the different margins
of adjustment in trade and financial flows that occurred in response to the global
financial crisis. The results highlight a fascinating contrast between East Asian
economies and the other countries in the sample as regards the association between
evolving trade and financial linkages and business cycle correlations. For the
non-East Asian economies, the dramatic increase in business cycle correlations
during the crisis is negatively associated with measures of financial trade. In
contrast, among the East Asian economies that had a significant increase in
business cycle synchronization during the global financial crisis, the measures
of bilateral correlations are negatively associated with trade in goods rather than
with financial trade. While this is not taken as a causal mechanism, the results
suggest that the international transmission patterns of the global financial crisis
operated in quite different ways in East Asia than in the rest of the world. In
East Asia, trade linkages were paramount, and the decline in trade was associated
with the synchronous nature of the regional downturn. In contrast, for non-East
Asian economies the sudden global downturn was associated with rapid financial
deleveraging and a reduction in measures of financial trade.

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1 Regional and global financial integration: an analytical framework

Philippe Martin

The last two decades have been characterized by a dramatic increase in international financial integration, documented in particular by Lane and Milesi-Ferretti (2001, 2007, 2008a, 2008b). They pointed to the fact that different regions and groups of countries have all experienced an increase in cross-border trade in assets, but that this wave of financial globalization has not been uniform. In particular, they pointed to the importance of regional financial integration in Europe for explaining the particularly large decrease in financial home bias among European Union (EU) countries, especially in the eurozone. The creation of the euro and of a single market in financial services has led to unprecedented integration of money and credit markets across the member countries. In fact, Lane and Milesi-Ferretti reported that, during the period 1999–2006, the increase in intra-euro area holdings fully explains the increase in the industrialized countries’ share in world cross-border asset holding.

Conversely, Asia is often presented as a region with a relatively low level of regional financial integration. This is how Lee (2008) interpreted the negative impact of the Asian dummy in his regressions exploring whether, controlling for a standard set of explanatory variables, bilateral investment patterns within Asia are significantly different from patterns of other country pairs.

The objective of this chapter is to present a simple theoretical model that facilitates the understanding of some of the consequences of financial integration (i.e. a fall in transaction costs for cross-border trade in financial assets) in its global and regional forms. These issues have been studied extensively for trade in goods from both theoretical and empirical points of view. In particular, the choice of regional versus global trade liberalization for Asian economies has been analyzed by Lee and Shin (2005). Asset flows and the impact of financial integration on the cost of capital and the breadth of financial markets have been comparatively less well researched. What are the implications for risk-sharing and asset returns of being part of a large and financially integrated area?

This chapter starts with a simple model in which market size matters. Without the effects of size, the difference between the two forms of integration would be less interesting. For market size to matter, the following assumptions are needed: (1.1) assets are imperfect substitutes, (1.2) cross-border asset trade entails some transaction costs, and (1.3) the investment technology is indivisible. With these
characteristics, size and integration of financial markets are powerful determinants of asset prices, the cost of capital, and risk diversification. The results in this chapter are mainly drawn from a set of recent papers (Martin and Rey 2000, 2004, 2006; Coeurdacier and Martin 2009).

The chapter analyzes the effects of global and regional financial integration on cross-border asset trade, asset prices, financial market development, risk diversification, the geography of asset markets, and financial crises. The theoretical framework used allows analysis of these issues, which are particularly important for Asian countries. Some of the conclusions drawn are certainly specific to the type of model presented, but other conclusions are fairly general (such as on cross-border trade in assets). One interesting aspect of this analysis is that it generates a theory-driven financial gravity equation that can then be tested.1 The chapter also reports some empirical findings on the euro that support the results found on the effect of regional financial integration on cross-border trade in assets.2 And the chapter provides some preliminary empirical findings on the financial gravity equation for Asian countries by analyzing the determinants of Asian financial integration.

The model used for this chapter predicts that a decrease in transaction costs between two financial markets, which is the way financial integration is modeled, increases demand for assets and asset prices in the area, induces agents to develop more risky projects, and increases the number of assets so that risk diversification increases. This happens because a decline in transaction costs increases demand for assets in the area, so that the effective size of the market is enlarged. The presence of transaction costs and of imperfect substitutability translates this size and demand effect into a price effect. Because the number of assets can be made endogenous in the model, changes in the structure of financial markets also have an impact on the degree of incompleteness of financial markets and on aggregate risk. Financial integration (lower transaction costs between markets) leads to some convergence between asset prices across markets. Financial market segmentation means that there is a financial home market effect favorable to large markets. Both regional and financial integration means that smaller and poorer countries gain. The greater the difference (in size and development) among markets, the greater is this gain.

What is the impact of regional financial integration on the rest of the world? This chapter shows that, when two countries form a financially integrated area, which is similar to an increase in the size of their market, the welfare impact for the rest of the world is ambiguous: on the one hand, there is a positive impact because the increase in the total number of assets enables agents to diversify risk better as markets become less incomplete; on the other hand, the financial terms of trade of the country left outside the financial bloc deteriorate because the price of assets in the integrated area increases.

What happens to the geography and the relative importance of financial centers when allowing for international cross-listings of companies, or, in other words, when the location of financial markets is endogenized? In this case, small and poor countries may experience a process of financial agglomeration toward
larger markets. The results are therefore more ambiguous than when financial
geography is given. An entrepreneur’s decision to list on one or several markets
depends on the relative sizes of the various economies, as well as the relative
magnitudes of the fixed and variable transaction costs that the entrepreneur faces.
Fixed costs can be interpreted as differences of accounting procedures, legislation,
and information asymmetries across countries. Variable costs can be linked to
proportional commissions and fees charged by financial intermediaries, including
foreign exchange transaction costs, as well as other types of informational
asymmetries. The framework used for this chapter delivers implications for
the price of capital under dual listing, which depends on the relative sizes of
economies.

Two competing forces determine the decision to issue shares on a financial
market and, ultimately, the shape of financial geography. On the one hand, the
fixed cost of issuing means firms want to minimize the number of markets on
which they issue shares. This pushes toward financial geography agglomeration.
On the other hand, cross-listing enables firms to sell shares directly to investors
of a country on their financial markets, and this means that transaction costs on
cross-border asset trade disappear.

Cross-listing therefore increases the demand for shares and leads to a price
increase due to the fall in transaction costs. Cross-listing acts like an increase
in the demand for the assets of the firm. The chapter shows this implies that, as
transaction costs fall, firms will stop issuing on the smaller markets and concentrate
issuing on larger markets. This pattern resembles the “new economic geography”
This resemblance is not surprising as the chapter’s framework relies on the same
type of mechanisms: fixed costs, which give an incentive to issue on a smaller
number of markets, and transaction costs, which segment financial markets and
give an incentive to issue on the largest markets. This change in incentives
holds both for global and regional financial integration. Indeed, regional financial
integration, in the form of lower transaction costs, leads to a more concentrated
financial geography inside the region that integrates. Again, this is because firms
can issue on the largest market (where they get the highest price), save on issuing
fixed costs, and sell relatively easily (because of lower transaction costs inside
the integrated zone) to investors in the small market. This financial agglomeration
process may not be detrimental to countries from which financial markets delocate
because the concentration of financial markets generates efficiency gains. It may,
however, raise some political questions for small markets.

Finally, motivated by the present financial crisis and the question of the role of
financial integration in it, the chapter analyzes the impact of financial integration
on the possibility of a specific form of financial crisis in the framework used:
crisis generated by self-fulfilling expectations of a crash in a context where
capital flight to a “safe haven” – a large and rich economy – is possible. One can
interpret regional financial integration as financial integration between countries
of similar development and size (without a large and rich safe haven toward
which capital flies during a crash). The framework employed, based mostly on
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Martin and Rey (2006), suggests this type of financial integration is less risky than financial integration between countries that are very different in size and development. Financial integration between such countries can be thought of as more characteristic of global financial integration. Hence, a trade-off may appear: gains from global financial integration (between very different countries) may be larger for small/poor countries in good “normal” times but the risk of increasing the probability of crises may be greater than when financial integration takes place between similarly sized countries, which may be more characteristic of regional financial integration. The chapter also argues that it is legitimate to think of trade and financial integration as two complementary processes that should come together. Trade integration is a stabilizing factor that reduces the likelihood of a financial crisis that can be increased by financial integration.

The next section introduces a simple theoretical framework that is based on several papers (Martin and Rey 2000, 2004, 2006; Coeurdacier and Martin 2009) and is used in the rest of the chapter. Section 1.2 analyzes the main effects of global financial integration. Section 1.3 compares them with regional financial integration. Section 1.4 reports some empirical results that are consistent with some of the predictions in Section 1.3 on cross-border flows in the case of European financial integration. Section 1.5 endogenizes the geography of financial markets. Section 1.6 shows how the possibility of financial crises in the present framework is affected by financial integration.

1.1 A simple model of global and regional financial integration

The current chapter uses a simplified version of the model developed by Martin and Rey (2000, 2004, 2006) to derive the demands for financial assets. The present model focuses on the main assumptions, results, and mechanisms, and derives some results through a graphical analysis. Some of the functional forms are important for certain results. This section does not analyze the possibility of financial crises that could be generated by self-fulfilling expectations, which is analyzed in Section 1.3.

For readers familiar with new trade theory, many of the mechanisms that will be derived will seem familiar. This is not by chance. Some ingredients are indeed common to the two sorts of models (trade and finance) that imply that market size is important. The reason is that assets are imperfect substitutes and transaction costs exist to trade those assets across markets. Hence, markets are not perfectly integrated. This means that the size of the aggregate demand will affect asset prices, contrary to a classic model where asset prices are solely determined by dividends.

The assumption is that there are \( N \) economies populated with \( L_i (i \in N) \) risk-averse agents who live for two periods. Agents can develop projects and assets that correspond to claims on the projects. In equilibrium, the focus is on a representative agent (consumer and investor). The number of traded projects/assets is \( n_j \) for country \( j \). The number of shares per asset is normalized to 1. The cost of an asset
issued by an agent in country \( j \) and bought by an agent in country \( i \) is \( p_j \tau_{ij} \), where \( p_j \) is the price of the asset and \( \tau_{ij} \) is the bilateral financial transaction cost between the two countries. As in the trade literature, the simplifying assumption is that this cost takes an iceberg form, meaning that the transaction fee is paid in units of the asset itself. A very broad interpretation of these transaction costs is used, which includes currency risk, costs related to trading and liquidity, taxation differentials, differences in accounting and legal standards, and information asymmetry. Financial transaction costs inside a country are assumed to be lower than those between countries: \( \tau_{ii} < \tau_{ij} \). In fact, to simplify expressions, the former are assumed to be zero, so that: \( \tau_{ii} = 1 \). All results remain unchanged as long as \( \tau_{ii} < \tau_{ij} \).

In the second period, there are \( Z \) exogenous and equally likely states of nature (the number of states of nature is assumed to be larger than the number of traded assets), and the realization of the state of nature is revealed at the beginning of that period after all decisions have been taken. As in Acemoglu and Zilibotti (1997) and Martin and Rey (2004), the technology implies that each project gives dividends in only one state of nature. In all other states of nature, the dividends are zero. All risky claims to operating profits are traded on the stock market at the end of period one, so that each claim corresponds to an Arrow–Debreu asset. No duplication occurs in equilibrium so that each investment/asset in the world is unique. This modeling introduces a simple incentive for agents to diversify their portfolios. Importantly for the results, assets are imperfect substitutes.

A representative agent in country \( i \) maximizes utility subject to the first period budget constraint (in the second period, consumption is the dividend of shares purchased in the first period):

\[
MaxE(U_i) = \ln C_{1i} + \beta \ln \left[ \frac{1}{Z} \sum_{z=1}^{Z} C_2(z) \right]^{1-1/\varepsilon}
\]

\[
= \ln C_{1i} + \beta \ln \left[ \sum_{h=1}^{N} \sum_{l=1}^{n_l} (d_{lh} s_{il}) \right]^{1-1/\varepsilon}
\]

s.t. \( y_i = C_{1i} + \sum_{h=1}^{N} \sum_{l=1}^{n_l} \tau_{ih} p_h s_{il} \),

which is of the non-expected form introduced by Epstein and Zin (1989) and Weil (1990). This allows the intertemporal elasticity of substitution (which is assumed to be 1, for simplicity) to be different from the coefficient of relative risk aversion \( (1/\varepsilon) \). \( C_{1i} \) and \( C_{2i} \) are consumption in the first and second periods, respectively; \( y_i \) is per capita income; and \( s_{ij} \) is the demand by an agent of country \( i \) for the asset of agent \( j \) of country \( j \). Remember that assets are all different in the sense that they give dividends \( (d) \) in different states of nature (this is the reason why agents want to diversify their portfolio and buy all existing assets) but they are symmetric in
the sense that they all give dividends in only one state of nature. This symmetry implies that the “typical” demand by an agent of country $i$ for an asset of country $j$ can be denoted as $s_{ij} = s_{ji}$.

Note that for the second period, this utility function is similar to the one introduced by Dixit and Stiglitz (1977) to represent preferences for differentiated products and $\varepsilon$ can be interpreted as the elasticity of substitution between assets. In what follows, $\varepsilon > 1$ is imposed to have a financial home bias and therefore realistic asset demands.

If $r_j = d_j/p_j Z$ is the expected return of asset $j$, it can be shown that utility maximization gives the following value of the aggregate demand by country $i$ agents for assets issued in country $j$ (exclusive of transaction costs):

$$Asset_{ij} = L_i p_j n_j s_{ij} = \frac{\beta L_j y_j n_j}{1 + \beta} \left( \frac{r_j Q_i}{\tau_{ij}} \right)^{\varepsilon - 1}, \quad Q_i = \left[ \sum_{h=1}^{N} n_h \left( \frac{r_h}{\tau_{ih}} \right)^{\varepsilon - 1} \right]^1/\varepsilon.$$

(1.1)

This is known in the literature as the financial gravity equation. Note that, as in the trade literature, a “price index”, $Q_i$, specific to each country appears in the demand for assets. In the present context, this may be thought of as a financial price index for all assets that compete with the imported asset. The price index, $Q_i$, measures financial remoteness [see Anderson and van Wincoop (2004) and Head and Mayer (2004) for the trade version]. A country with a low $Q_i$ (e.g. because its own financial markets are very diversified and it issues many assets) is a country to which (for a given relative return and bilateral transaction cost) it is difficult to sell financial assets.

Equation (1.2) can be tested directly and is the finance equivalent of the gravity equation derived in the theoretical trade literature. This is also a way to understand how financial integration (regional and global) can affect bilateral financial flows.

The aggregate bilateral demand by country $i$ agents for assets issued in country $j$ is (exclusive of transaction costs), following equation (1.1),

$$X_{ij} = L_i n_j p_j s_{ij} = \frac{\beta L_j y_j n_j}{1 + \beta} \left( \frac{r_j Q_i}{Z \tau_{ij}} \right)^{\varepsilon - 1}.$$

(1.2)

The value of the demand for an individual asset of country $j$ is given by the sum of the demands of domestic and foreign agents:

$$p_j s_j = \frac{\beta}{1 + \beta} \left[ L_j y_j \left( \frac{r_j Q_i}{\tau_{ij}} \right)^{\varepsilon - 1} + \sum_{i=1, i \neq j}^{N} L_i y_i \left( \frac{r_j Q_i}{\tau_{ij}} \right)^{\varepsilon - 1} \right].$$

(1.3)

Suppose the supply of each asset is exogenous and normalized to unity. Any increase in demand will then increase the asset price and lower the asset return.
First, note that in a context where assets are imperfect substitutes and where financial markets are imperfectly integrated, market size matters for asset prices and returns. Indeed, from equation (1.3) one can see that a larger or richer country (high $L_jy_j$) benefits from a higher aggregate demand for its assets as long as transaction costs exist ($\tau_{ij} > 1$), that is, as long as domestic demand has a larger weight in aggregate demand than does foreign demand. This is a direct effect of the home financial bias, a counterpart to the home bias in trade.

Consequently, it can be shown that countries that are larger (i.e. they have a greater number of agents, or $L_i$) and richer (i.e. they have higher income per capita, or $y_i$) have higher asset prices. The size effect comes from the combination of transaction costs and imperfect substitutability of assets. International trading costs induce agents to increase the purchase of domestic assets rather than of foreign assets. This hurts the assets of the poorer/smaller economy because it relies more heavily on foreigners to purchase its shares. If international transaction costs were zero ($\tau_{ij} = 1$) and dividends were equal, then asset prices would be equal in all countries and market size differences would not matter.

To see this simply, take a two-country world (countries A and B). In this case, the market equilibrium (the total demand for an asset equals the supply of this asset, normalized to unity) implies

\[
P_A = \frac{\beta}{1+\beta} \left[ L_A y_A \left( \frac{r_A Q_A}{\tau_{AB}} \right)^{\varepsilon-1} + L_B y_B \left( \frac{r_B Q_B}{\tau_{AB}} \right)^{\varepsilon-1} \right],
\]

(1.4)

\[
P_B = \frac{\beta}{1+\beta} \left[ L_B y_B \left( \frac{r_B Q_B}{\tau_{AB}} \right)^{\varepsilon-1} + L_A y_A \left( \frac{r_A Q_A}{\tau_{AB}} \right)^{\varepsilon-1} \right],
\]

(1.5)

where, internal financial transaction costs are zero ($\tau_{AB} = 1$). The financial price indexes are, in this case

\[
Q_A = \left[ n_A r_A^{\varepsilon-1} + n_B \left( \frac{r_B}{\tau_{AB}} \right)^{\varepsilon-1} \right]^{1/\varepsilon} \\
Q_B = \left[ n_B r_B^{\varepsilon-1} + n_A \left( \frac{r_A}{\tau_{AB}} \right)^{\varepsilon-1} \right]^{1/\varepsilon}.
\]

(1.6)

Note again that if transaction costs do not segment financial markets, then prices are equalized by arbitrage, do not depend on market size, and simply depend on relative dividends:6

\[
P_A/P_B = \left( \frac{d_A}{d_B} \right)^{(\varepsilon-1)/\varepsilon}.
\]

(1.7)

Remember that the elasticity between assets $\varepsilon$ is assumed to be more than 1. If the assumption shifts to the other extreme of financial autarky due to infinite
financial transaction costs \((\tau_{AB} \to \infty)\), then demands for assets are domestic only and domestic market size has the maximum effect on relative asset prices:

\[
p_{A}/p_{B} = \frac{L_{A}y_{A} n_{B}}{L_{B}y_{B} n_{A}}.
\]  

(1.8)

Hence, larger \((L_{A} > L_{B})\) and/or richer \((y_{A} > y_{B})\) countries have higher asset prices and a lower cost of capital.\(^7\)

Figure 1.1 shows the demand and equilibrium prices for a small and a large economy. Here, what matters is the size of aggregate income, which determines the size of aggregate savings. In the present model, savings is a linear function of income. The asset price is higher in the larger economy. This has several positive welfare consequences. A country with a higher asset price is richer because, when it trades assets, it benefits from higher financial terms of trade.

Higher asset prices also lead to a higher number of assets if this is made endogenous. How the number of projects/assets is determined has not yet been specified. Suppose, as in Martin and Rey (2006), that the marginal cost of projects (then floated on the stock market) is increasing in the number of projects – written as a classic convex cost function, for example \(\frac{1}{2} n_{i}^{2}\), so that the marginal cost is \(n_{i}\). It is easy to see that maximizing profits for an investor implies \(p_{i} = n_{i}\), so that, quite intuitively, the number of assets increases with asset prices. Hence, larger/richer countries have a higher number of assets not only because of a higher number of investors but also because each investor invests more and this leads to a higher number of assets. In turn, this also has a positive welfare effect because it reduces

![Diagram](image-url)

*Figure 1.1* Market size, asset demand, and prices.

Source: author.
market incompleteness (remember that each asset gives dividends in one state of nature). This benefit of better risk diversification is shared both by the large country and the other countries.

1.2 Global financial integration

Suppose now that the world experiences financial integration at the global level in the form of lower transaction costs between all markets (i.e. $\tau_{ij}$ falls for all country pairs by the same percentage). That the price difference between any two countries decreases when expected dividends (firms’ profits) are equalized across countries can be checked.

**Result 1.** In relative terms, the asset price of the poorer/smaller economies increases with global financial integration when expected dividends are not too different across countries.

The reason is that lower transaction costs enable the rich/large economy to buy more assets of the poor/small economy. These assets are cheaper (for a given dividend) owing to the financial home bias effect, and lower transaction costs enable investors to arbitrage this difference. Agents of the poor/small economy can also buy more assets of the rich/large economy. However, owing to the large size of the rich/large economy, the first effect dominates and there is a net increase in the demand for the assets of the poor/small economy and asset prices in the poor/small economy rise. In essence, lower financial transaction costs imply that market segmentation is weakened and that the difference in market size matters less than fundamentals such as dividends.

Martin and Rey (2006) showed that a possible exception to result 1, that global financial integration relatively favors the poor economy, occurs when there is a large difference in expected dividends $d_j/Z$ between the two economies. When dividends (or firms’ profits) are much smaller in the poor/small economy, global financial integration can lead to a decrease in the relative price in the poor/small economy. This is because, in this case, the assets are fundamentally unattractive. With financial opening, agents in the poor/small economy can buy better performing assets in the rich/large economy and this leads to “capital flight” and a fall in the demand for the assets of the poor/small economy. If this difference in expected dividends is large enough compared with the difference in market size (aggregate income and saving), then global financial integration can lead to a fall in the relative asset price of the poor/small country. Interestingly, this can be the case when the country that integrates financially is not well integrated in goods markets, for example, because of high trade barriers.

What happens to financial market development in this case? One consequence is on the number of projects/assets $n_i$. Remember that $n_i$ increases with asset prices.

**Result 2.** The number of assets floated in the poorer/smaller economies increases with global financial integration when expected dividends are
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not too different across countries. The size of financial markets in the poorer/smaller economies therefore increases.

This means that markets become less incomplete in this case because the difference between the number of assets and the number of states of nature decreases. Again, if projects/assets of the poor/small country have lower dividends/performance than in the large/rich country, this result may be overturned. Overall, global financial integration in this context reduces the segmentation of financial markets and asset prices move closer to their fundamental value. Hence, market size matters less and dividends (and, more generally, asset performance) matter more.

In this case, welfare improves for different reasons. In the poor/small countries, if their relative asset price increases with financial opening, there is a positive financial terms-of-trade effect: the cost of capital falls and the number of investment projects (and assets) increases. Another gain, this time for both sets of countries, is that the fall in transaction costs makes it less expensive to diversify risk when buying foreign assets. Finally, again for both sets of countries, because the number of assets rises, financial incompleteness falls. Remember that each investment project/asset covers one state of nature. In equilibrium, markets are incomplete because some states of nature are not covered by assets. As the total number of assets rises, the number of these “uncovered” states of nature falls.

1.3 Regional financial integration

What are the effects of regional financial integration in this theoretical context? The effects can most obviously be interpreted as a decrease in transaction costs, $\tau_{ij}$, between two countries, $i$ and $j$, inside a specific zone. Although the full general equilibrium implications of such a policy change are not analyzed for this chapter (because this would involve analyzing the policy change’s impact on all asset prices in the world and, in return, all financial price indexes in the world), some of the most direct effects can be analyzed.

Result 3. Cross-border trade in assets in the region that experiences financial integration rises as do asset prices in the countries of the financially integrated region.

This result is clear from equations (1.1) and (1.3). As transaction costs fall between the two countries, agents buy more assets of the other countries in the region. This shifts demand to the right on Figure 1.2. In effect, regional integration is similar to an increase in market size.

If regional financial integration takes place between countries of different sizes, then the same conclusion arises as for global financial integration: because segmentation is reduced, asset prices reflect fundamentals (dividends) more and market size less. From this point of view, the small country gains more than the large one.
Another possible interpretation of regional financial integration (although less transparent in this situation) is that integration decreases financial transaction costs not only inside the region but also for outsiders to buy assets of the region. This could be, for example, because financial institutions that manage a diversified portfolio want to be able to rebalance quickly and easily between different countries of a region before investing in the region. In other words, regional financial integration should increase the liquidity of the regional financial markets. In this case, the interpretation is that regional financial integration increases outsiders’ demand for the region’s assets. Again, this shifts the demand rightward and increases the price of assets in the region.

Does regional integration lead to diversion in the sense that countries that integrate trade less assets with the rest of the world when they trade more among themselves? The impact of regional financial integration on diversion can be analyzed by investigating its impact on the financial price index of the countries in the region, $Q_i$. When transaction costs, $\tau_{ih}$, to trade assets between countries $i$ and $h$ fall, then the financial price index in these countries (e.g. country $i$) also falls. This can be seen from the second part of equation (1.3) and the definition of the price index,

$$Q_i = \left[ \sum_{h=1}^{N} n_h \left( \frac{r_h}{\tau_{ih}} \right)^{\varepsilon-1} \right]^{\frac{1}{1-\varepsilon}}.$$
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This is intuitive: lower transaction costs mean that it is easier for agents in country $i$ to buy assets and diversify risk, which translates into a lower price index. This also implies that a diversion effect exists. For country $i$ in the region that integrates financially, this fall in the financial price index lowers the demand for assets of countries outside the integrating zone. This can be seen from the first part of equation (1.3), where $x_h$, the total demand for an asset of country $j$,

$$\sum_{i=1}^{N} L_i y_i \left( \frac{r_j Q_i}{\tau_{ij}} \right)^{\varepsilon - 1},$$

increases with the financial price indexes of all the countries to which it sells. Hence, regional financial integration and the lower transaction costs and price index it produces mean that it becomes relatively more difficult to sell assets to the countries in the region. The reason is not that transaction costs for outsiders to sell assets in that region have increased but that, because assets are imperfect substitutes, agents redirect their demand toward less costly assets.

Result 4. Regional financial integration generates a diversion effect in the sense that agents redirect their asset demand from the rest of the world to the assets of the region that integrates.

These results have several welfare consequences. For countries inside the integrated region, financial integration is unambiguously beneficial: higher asset prices lead to a lower cost of capital and an increase in financial terms of trade (the relative price each country trades its assets with the rest of the world). Owing to this increase in asset prices, financial markets develop in the sense that there is an incentive to create new assets. This itself reduces market incompleteness. For countries outside the integrating zone, the implications are more ambiguous. On the one hand, the financial terms of trade deteriorate: it becomes relatively more expensive to buy assets from the integrating zone. On the other hand, the financial development of the integrating zone benefits all countries in the zone because it becomes easier to diversify risk. Martin and Rey (2000) analyzed these results in more detail.

1.4 Empirical implications: the case of the euro and some preliminary results for Asia

Some of the implications of financial integration this chapter analyzes cannot be tested easily, such as implications for prices, financial development, risk diversification, and welfare. But some of the implications of financial integration for cross-border asset trade (i.e. asset demands) can be analyzed. Equation (1.1), which is a financial gravity equation, has been tested by several authors and some
of the results are reported here. Taking the log of equation (1.1), one gets the financial version of the gravity equation for the holdings of assets of country $j$ by country $i$ (ignoring constants):

$$\log(Asset_{ij}) = \log L_i y_i + \log n_j - (\varepsilon - 1) \log \tau_{ij} + (\varepsilon - 1) \log r_i + (\varepsilon - 1) \log Q_i. \tag{1.9}$$

The first term is a size factor and corresponds to the gross domestic product (GDP) of country $i$. The second term is the number of assets in country $j$. This variable may be related not only to economic size (GDP and market capitalization) but also to the financial sophistication of the country that may be linked to its status as a recognized financial center. The third term indicates that transaction costs between the two countries have a negative impact on asset cross-border holdings. The effect depends on the elasticity of substitution, which may be different for different assets: typically, the effects are greater for bonds than for equities. The fourth term implies that countries with high expected returns should get more demand for their assets. The last term is the financial price index, which is specific to each country. Note that only one variable is country-pair specific: the bilateral transaction costs. All other terms are country specific. Note also that, in a given class of assets (bonds or equities), the reaction of the demand to a change in transaction costs depends on $\varepsilon$, the elasticity of substitution between assets. The equation therefore assumes that this elasticity is not affected by the change in the transaction cost itself.

Coeurdacier and Martin (2009) tested the type of model this chapter presents and focused on one important example of regional financial integration – the impact of the euro – which is interpreted as a fall in transaction costs between a subset of countries. The data set used concerns the year 2001 and the sample contains 27 “source” countries (those that buy assets and export capital) and 61 “destination” countries (those that sell assets). The Coordinated Portfolio Investment Survey provided by the International Monetary Fund (IMF) is the main data source for bonds and equities (IMF various years).

As previously explained, financial integration may have several effects on the cost of transacting assets: on transactions inside the zone, and on purchases of assets in the zone by countries outside it. As in trade theory, these changes in transaction costs may also have resulted in diversion. In addition, and as noted by Lane (2006), regional financial integration such as the creation of the euro may increase the elasticity of substitution between assets of the zone. Coeurdacier and Martin (2009) found evidence that the euro has affected both transaction costs and the elasticity of substitution, but the effect is different for different classes of assets and is different whether countries are in or out of the eurozone. In particular, they found that transaction costs had decreased inside the eurozone.

The estimates suggest that the euro has had a large effect on cross-border trade in assets. The portfolio bias toward the eurozone is large: for equities, investors hold about 60% more euro assets than predicted by the usual gravity variables.
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and this number rises to about 100% for bonds and banking assets. These are very large numbers, and one may think that, as for the early Rose effects of the single currency on trade, they are too large to be true. However, this number is not driven by the fact that euro countries are more financially developed, have better institutions, and are closer to the other main financial markets (or more integrated in product markets). The estimates of Coeurdacier and Martin (2009) controlled for these observable characteristics of euro countries as much as possible. One could also argue that this result is not due to the euro but to some empirical regularity among European countries: Europe is for some unobservable reasons more attractive for investors than other regions in the world. However, regional dummies of destination, and in particular a dummy for “broad” Europe, are controlled for.

Second, the euro works like a preferential financial agreement. The average country exhibits a euro bias but this bias is significantly larger when the two countries are in the eurozone. Quantitatively this effect is also very large but varies across specifications and across assets: the euro increases by 150% bilateral bondholdings between two euro countries while equity holdings rise by around 45%.

The results confirm those of Lane (2006) on the euro’s positive role on bondholdings between countries of the eurozone. Quantitatively, the estimated effect on bondholdings is, however, smaller than in Lane (150% versus around 230%). The euro effect holds not only for bonds but also for equities, although with a smaller coefficient. This is not surprising because currency risk is a much larger part of the asset risk for bonds than for equities. Moreover, the euro effect is interpreted as a decrease in the transaction costs (due to currency risk); given that bonds are closer substitutes than equities, the impact of the elimination of currency risk can be expected to be larger on bonds than on equities.

Interestingly, these two regularities resemble the results obtained in the recent literature (Baldwin 2006, Flam and Nordstrom 2003) on the impact of the euro on trade in goods: the euro acted as a decrease in transaction costs not only between euro countries but also between euro countries and the rest of the world.

The results also suggest that the transaction costs to buy assets from the eurozone have decreased. Indeed, equation (1.9) can be used to estimate the fall in transaction costs consistent with the increase in asset demand. For this, the elasticity of demand, ε, for an asset must be estimated. Coeurdacier and Martin (2009) found this elasticity to be equal to 4 for equities and 6.5 for bonds. As expected, estimates of this elasticity are higher for bonds than for equities. These numbers are in the range of other estimates in the literature [see Shleifer (1986), Loderer, Cooney, and Van Drunen (1991), Wurgler and Zhuravskaya (2002), and Martin and Rey (2006), for a short survey of those elasticities].

The fall of the transaction costs to trade euro assets due to the euro is estimated at about 17% for equity and 14% for bonds. This has benefited countries that are in and outside of the eurozone: the transaction cost, τij, to buy assets in country i (in the eurozone) has fallen for all countries that buy these assets (whether j is in the eurozone or not). On top of this effect, those countries
inside the eurozone benefited from a 17% decrease of transaction costs for bonds and 10% for equities. Hence, for a country inside the eurozone, the transaction cost for the cross-border purchase of a euro bond and equity has decreased by 31% and 24%, respectively. Thus, the euro can be interpreted as both preferential and unilateral financial liberalization. This resembles some recent results (Baldwin 2006, Flam and Nordstrom 2003) on the euro effect on trade in goods.

In contrast, Coeurdacier and Martin (2009) found no evidence that the euro has decreased the transaction cost for euro economies of purchasing assets outside the eurozone. In fact, for equities there is some evidence that diversion has taken place in the sense that euro countries buy less equities from outside the eurozone. The comparison of asset trade between eurozone countries and the Nordic countries in (Finland) and out (Denmark, Norway, Sweden) of the eurozone suggests that, for equity holdings, some trade diversion has occurred due to the introduction of the euro. This diversion effect does not come from an absolute increase in transaction costs for buying assets from the rest of the world but from a relative cost effect.

Finally, the empirical analysis of Coeurdacier and Martin (2009) suggested that the elasticity of substitution between bonds inside the eurozone is higher than between bonds denominated in different currencies. The estimate is that it is almost three times higher.

These results confirm some of the predictions of the theoretical section on a specific example of regional financial integration, namely, European financial and monetary financial integration: that reducing transaction costs increases cross-border trade in assets and the demand for assets of the integrating zone. The demand increases not only from countries inside the zone but also from the rest of the world. The price effect of regional financial integration has not been tested but it should be clear that, if the hypothesis that assets are imperfect substitutes is accepted, the increased demand for assets should generate an increase in asset prices.

The same data used by Coeurdacier and Martin (2009) is now used to check whether Asian countries' financial trade in equity and bonds differs from that of the rest of the world. Both Coeurdacier and Martin and the present chapter use the IMF's Coordinated Portfolio Investment Survey of 2001 (IMF various years), which geographically breaks down securities holdings (bonds and equities). The associated dependent variables are Equityij, which is the log of aggregate equity holdings in country j of investors in country i (in United States (US) dollars), and Bondsij, which is the log of aggregate bondholdings in country j of investors in country i (in US dollars).

The following equation is estimated using country i (the source country that buys the asset) fixed effects, \( \alpha_i \). The GDP of country j, GDPj, is used for the market size, \( n_j \), of the destination country (the country that sells the asset and imports capital). The financial sophistication of market j is proxied by the ratio of stock market capitalization over GDP: MktCap/GDPj. The market size, \( L_{ij} \), for the source country (the country that buys the assets and exports capital) does not
require a proxy because the market size is included in the fixed effect, $\alpha_i$. Expected returns in country $j$ are approximated by the log of the average gross equity return in US dollars over the period 1990–2001, $\log r_j$. This variable is employed only for equity, not for bonds.

The result is the following equation:

$$
\log(\text{Asset}_{ij}) = \alpha_i + \beta \log(GDP_j) + \gamma \left( \frac{MktCap}{GDP_j} \right) + (\varepsilon - 1) \log Z_{ij} + (\varepsilon - 1) \log r_j,
$$

where $Z_{ij}$ is the transaction costs on international financial markets. The specific functional form assumed is

$$
Z_{ij} = \text{Distance}_{ij}^{\delta_1} \exp(\delta_2 \text{euro}_{ij} + \delta_3 \text{commonlang}_{ij} + \delta_4 \text{legal}_{ij} \ldots),
$$

where Distance$_{ij}$ is the bilateral distance, and euro$_{ij}$, commonlang$_{ij}$, and legal$_{ij}$ are dummies that indicate that both countries belong to the eurozone and share a common language and legal system.

The use of fixed effects in the source country dimension $i$ allows one to control for the financial price index, $Q_i$. Indeed, as shown by Anderson and van Wincoop (2004) (see also Baldwin and Taglioni 2006), this strategy allows one to control for the “multilateral resistance term,” $Q_i$, which has been shown to also exist for the financial gravity equation. Because transaction costs affect the financial price index, the omission of source country fixed effects might bias the estimated coefficients. This specification has the main advantage of keeping variability in two dimensions (country $j$ and a bilateral dimension). Strictly speaking, this equation is the exact counterpart of equation (1.9). In this specification, the financial remoteness of country $i$ is controlled for and a reasonable number of parameters to estimate are kept. However, without fixed effect in the country $j$ dimension, one might not control perfectly for some unobservable country-specific factors that can affect international asset holdings. To deal with this issue, a large set of control and dummy variables are added in the country $j$ dimension (financial sophistication, corruption index, and presence of tax havens and financial centers in the sample).

Table 1.1 presents the results. In a first regression, in addition to the fixed effect on the $i$ dimension (the country that buys the asset), one simply adds the two most basic gravity determinants: GDP (in the $j$ dimension) and the bilateral distance. In this basic regression, a dummy, Asia$_{ij}$, is added when both destination and source countries are Asian countries, in order to check whether Asian financial integration is different from what is predicted by basic gravity determinants. Regression 1 shows that Asian countries trade no more equity among themselves than what is predicted by the two basic gravity variables. For bond trade, Asia appears less integrated, as the dummy is negative and significant. This last result is consistent with Lee (2008).
Table 1.1 Financial gravity equation – equities and bonds

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Equity$_{ij}$</th>
<th>Bond$_{ij}$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
</tr>
<tr>
<td>GDP$_j$</td>
<td>1.196***</td>
<td>1.211***</td>
</tr>
<tr>
<td></td>
<td>(0.051)</td>
<td>(0.024)</td>
</tr>
<tr>
<td>Mktcap/GDP$_j$</td>
<td>0.657***</td>
<td>0.635***</td>
</tr>
<tr>
<td></td>
<td>(0.081)</td>
<td>(0.081)</td>
</tr>
<tr>
<td>Ret$_j$</td>
<td>1.511*</td>
<td>1.785**</td>
</tr>
<tr>
<td></td>
<td>(0.843)</td>
<td>(0.817)</td>
</tr>
<tr>
<td>Trade$_{ij}$</td>
<td>0.524***</td>
<td>0.488***</td>
</tr>
<tr>
<td></td>
<td>(0.054)</td>
<td>(0.056)</td>
</tr>
<tr>
<td>Distance$_{ij}$</td>
<td>-0.839***</td>
<td>-0.064</td>
</tr>
<tr>
<td></td>
<td>(0.079)</td>
<td>(0.075)</td>
</tr>
<tr>
<td>Legal$_{ij}$</td>
<td>0.252**</td>
<td>0.244**</td>
</tr>
<tr>
<td></td>
<td>(0.101)</td>
<td>(0.099)</td>
</tr>
<tr>
<td>Commonlang$_{ij}$</td>
<td>0.343**</td>
<td>0.372**</td>
</tr>
<tr>
<td></td>
<td>(0.140)</td>
<td>(0.133)</td>
</tr>
<tr>
<td>Corruption$_{ij}$</td>
<td>-0.227***</td>
<td>-0.242***</td>
</tr>
<tr>
<td></td>
<td>(0.025)</td>
<td>(0.027)</td>
</tr>
<tr>
<td>Tax haven$_j$</td>
<td>1.332***</td>
<td>1.386***</td>
</tr>
<tr>
<td></td>
<td>(0.160)</td>
<td>(0.157)</td>
</tr>
<tr>
<td>Fin center$_j$</td>
<td>0.078</td>
<td>-0.087</td>
</tr>
<tr>
<td></td>
<td>(0.103)</td>
<td>(0.094)</td>
</tr>
<tr>
<td>Asia$_{ij}$</td>
<td>0.872</td>
<td>1.821**</td>
</tr>
<tr>
<td></td>
<td>(0.637)</td>
<td>(0.693)</td>
</tr>
<tr>
<td>euro$_{ij}$</td>
<td>0.854***</td>
<td>0.845***</td>
</tr>
<tr>
<td></td>
<td>(0.184)</td>
<td>(0.180)</td>
</tr>
<tr>
<td>Trade$<em>{ij}$ · Asia$</em>{ij}$</td>
<td>-0.200**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.007)</td>
<td></td>
</tr>
<tr>
<td>Legal$<em>{ij}$ · Asia$</em>{ij}$</td>
<td>0.576**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.264)</td>
<td></td>
</tr>
</tbody>
</table>

N: 1099 1034 1034 1097 1031 1031
R$^2$: 0.38 0.63 0.64 0.43 0.59 0.60

Source: author.

Notes: Equity$_{ij}$ = log of aggregate equity holdings in country j of investors in country i (in US dollars); Bond$_{ij}$ = log of aggregate bondholdings in country j of investors in country i (in US dollars); GDP$_j$ = gross domestic product of country j; Mktcap/GDP$_j$ = ratio of stock market capitalization over gross domestic product; Ret$_j$ = log of the average gross equity return in US dollars over the period 1990–2001 in country j; Trade$_{ij}$ = bilateral trade ratio; Distance$_{ij}$ = distance between countries i and j; Legal$_{ij}$ = dummy variable indicating that countries i and j share a common legal system; Commonlang$_{ij}$ = dummy variable indicating that countries i and j share a common language; Corruption$_{ij}$ = dummy indicating level of corruption in country j; Tax haven$_j$ = dummy variable indicating presence of tax havens in country j; Fin center$_j$ = dummy variable indicating presence of financial centers in country j; Asia$_{ij}$ = dummy variable indicating that countries i and j are located in Asia; euro$_{ij}$ = dummy variable indicating that countries i and j belong to the eurozone.

* Statistically significant at the 10% confidence level; ** at 5%; and *** at 1%; estimation with robust standard errors.

Gravity models on world asset holdings with source-country fixed effects. Standard errors in parentheses. Observations are clustered within destination.
In regression 2, several other financial gravity variables and controls are added: the ratio of market capitalization to GDP, the return for equities for the destination economy, the bilateral trade ratio, the legal distance between the two countries, the existence of a common language, the level of corruption, the existence of a financial center or tax haven in the destination country, and the fact that both countries belong to the eurozone. With these controls, the Asia dummy becomes positive for equity and insignificant for bonds. One should however be cautious about the interpretation because the data contain few source economies that are Asian (only four: Hong Kong, China; Japan; Malaysia; and Singapore) and many poorer Asian countries are excluded. Interestingly, the inclusion of the corruption index in the $j$ dimension (the destination country that sells the asset) makes the $Asia_{ij}$ dummy positive and significant in all the equity regressions. The corruption index, not surprisingly, has a strong negative impact on asset trade for all countries. The fact that the $Asia_{ij}$ dummy becomes positive when the corruption dummy is included suggests, however, that corruption is higher in Asian countries. Hence, the interpretation of this $Asia_{ij}$ dummy requires caution as it is very dependent on this corruption index.

In regression 3, two interaction terms are added, on bilateral trade and the common legal system, which can be interpreted partially as the result of integration policies. For Asian countries’ bilateral trade in equity, bilateral trade integration has a lower impact than for the rest of the world. However, a common legal system seems to have a larger effect for Asian countries than for the rest of the world. For bonds, the evidence is more mixed and somewhat different. In the first specification without the interaction terms, intra-Asian trade in bonds seems well predicted by the standard financial gravity variables as the Asia dummy is insignificant. However, in the specification with interaction terms, the dummy is again positive and significant, as for the equity trade equation. Note that, contrary to equity, bond trade among Asian countries seems to be more positively affected by trade in goods than is the case for the rest of the world.

Overall, the results suggest that Asian financial integration may be more advanced than what is often believed. However, these regressions should be seen as very preliminary and simply an invitation to go further to analyze the specificity of Asian financial integration. Lee (2008), whose paper estimates a financial gravity model with a focus on East Asia, found that East Asia is less integrated than Europe. His paper is certainly richer than the preliminary estimates presented here but does not consider the impact of corruption on financial flows. Kim, Lee, and Shin (2008) also examined the degree of regional versus global financial integration of East Asian countries. Their results suggest that East Asian financial markets, particularly compared with the European ones, are less integrated with each other than with global markets. The low financial integration within East Asia is attributed to the low incentives for portfolio diversification within the region, the low degree of development and deregulation of financial markets, and the instability in monetary and exchange rate regime, which are not considered in this chapter.
1.5 Financial market geography and financial integration

To this point, the assumption is that financial market location is given exogenously. Firms in a country issue their stocks on the financial market of their country. A Japanese or an American investor who wants to buy the shares of an Indonesian firm has to transact on the Indonesian stock market to buy the shares and therefore has to pay the relevant cross-border transaction costs. In a sense, the results of the preceding section can be interpreted as describing the impact of financial integration on asset prices and market capitalization in the short-to-medium run when financial market location is best thought to be given by historical factors. However, there are reasons to believe that, in the long run, financial market location is endogenous and that financial integration can therefore affect this location. Making the geography of financial markets endogenous will be seen drastically to change some of the results.

Several issues are of interest in this context: in particular, the effect of financial integration on the geography of financial markets and the status of peripheral or small financial centers. These were questions that arose with the euro.

To make the question relevant, one needs to assume that there exists some cost to issue shares on multiple financial centers, which, to simplify the analysis, are limited to three. If this were not true, then firms would issue on all world financial centers, which clearly is not the case. Hence, firms have to pay an issuing cost, \( I \), per market. There is also an extra fixed cost to issue on a foreign market, \( I_F \). This cost reflects, in particular, the changes in accounting standards and procedures required to list on other stock exchanges. For example, compliance with the US Generally Accepted Accounting Principles (GAAP) is a major fixed cost for non-US companies wishing to be listed on the New York Stock Exchange (NYSE). These fixed costs do not depend on the amount of shares sold, just on the number of assets issued. Therefore, the fixed cost if a firm issues only on its own market is \( I \) per asset issued. The cost is \( I + I_F \) per asset if issued only in a foreign market, \( 2I + I_F \) per asset issued on the domestic and one foreign market, and \( 3I + 2I_F \) if issued on three markets. To simplify the analysis and concentrate on the issue of market size and transaction costs, the analysis assumes that dividends are equalized across firms and countries. This section only sketches the argument behind the main results.

Transaction costs must also exist for the question of financial geography to be relevant. If transaction costs did not exist, to minimize issuing costs, firms would issue on only one market and the identity of this market would be completely irrelevant.

The decision to issue on a market depends on relative profitability. Suppose that a firm’s choice is between issuing its shares on its own domestic market and on a foreign market. In both cases, it can be shown that the profit increases with the price of the asset. The asset price is higher on the largest market.

Two competing forces determine the decision to issue shares on a financial market. On the one hand, the fixed cost of issuing means firms want to minimize
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the number of markets on which they issue shares. This pushes toward financial geography agglomeration. On the other hand, cross-listing enables a firm to sell shares directly to investors of a country on their financial markets and this means that transaction costs on cross-border asset trade disappear. Therefore, one assumes that, if an Indonesian firm lists its shares on the Japanese stock market, the transaction costs that a Japanese investor pays to buy those shares when the firm is listed only on the Indonesian stock market disappear. Clearly, if one thinks that the transaction costs that a Japanese investor pays when buying an Indonesian share are mostly informational (and not linked to differences in liquidity, taxation, or legal treatment) then there would be little benefit to issuing on a foreign stock market.

Cross-listing therefore increases the demand for shares and leads to a price increase due to the fall in transaction costs. Cross-listing acts like a rightward shift in the demand for assets, as in Figure 1.2. This is in line with empirical evidence on cross-listing, as surveyed in Karolyi (1998), for example. Cross-listing is found to be associated with a small but significant decrease in the cost of capital. The model presented here predicts a positive effect on asset price in the case of double (or triple) listing owing to a demand effect. The positive price effect is stronger the larger the new financial area in which equities are issued, and stronger the higher the transaction costs between the financial area where the stock was previously issued and the new financial area. Alexander, Cheol, and Janakiraman (1988) studied the effect of international listing on stock prices. They looked at non-US firms listed on the NYSE and found that their prices increased significantly when they became listed. When Alexander, Cheol, and Janakiraman split their sample into Canadian and non-Canadian firms, they found the effects to be much weaker for the Canadian firms than for the others. This is what the present model would predict if one believes that Canada’s financial markets are relatively better integrated (lower transaction costs) with the US markets than are the other countries’ markets. Miller (1999) looked at Depositary Receipts to estimate the impact of international cross-listings. Based on a sample of 181 firms from 35 countries, Miller found a strong positive price effect of cross-listing. He also found that the effect is larger in magnitude when the dual cross-listing takes place with a large stock exchange (on the NYSE or NASDAQ, versus PORTAL).

Hence, the impact of financial integration on financial market geography depends on how financial integration affects fixed costs and transaction costs. Higher fixed costs tend to foster agglomeration whereas higher transaction costs foster dispersion. Even though, from an empirical point of view, this distinction may not be precise, it is useful from a theoretical point of view.

The full analysis of all possible issuing choices is very complicated as there are many alternatives (e.g. issuing on all markets, on your own market, and on a subset of markets) and the financial geography itself affects financial price indexes, demands, and asset prices. Therefore the current analysis only explains the main mechanisms and refers to Martin and Rey (2000) for formal proofs of the arguments.
The first assumption for the analysis is that financial integration only affects transaction costs to trade assets but not fixed costs of issuing. First, remember that larger/richer countries have a higher demand for assets so that asset prices in those markets are higher. This clearly gives an incentive to issue on such markets. How do lower transaction costs affect this incentive?

To see the impact of a fall in transaction costs clearly, the analysis starts from an extreme situation where transaction costs are very high to trade assets across markets, at least relative to issuing fixed costs. In this case, firms will clearly want to issue on many markets to save on these transaction costs and sell directly to local investors. Now, suppose transaction costs fall at least relative to issuing fixed costs. To save on fixed costs, firms can now issue on fewer markets and sell to investors from those markets. On which markets will they stop issuing? The preceding section has shown that smaller/poorer markets have lower demand and lower asset prices because transaction costs mean that markets are segmented. Everything else being equal, it is always less profitable to issue on smaller markets. Clearly this implies that, as transaction costs fall, firms will stop issuing on the smaller markets and concentrate on issuing on larger markets. This pattern resembles the “new economic geography” analyzed in Krugman (1991) in the context of the integration of goods markets. The result is not surprising, as the framework of the current analysis relies on the same type of mechanisms: fixed costs, which give an incentive to issue on a smaller number of markets, and transaction costs, which segment financial markets and give an incentive to issue on the largest markets.

Result 5. Financial integration in the form of lower transaction costs leads firms to issue on the largest markets. The financial geography becomes more concentrated.

This result holds both for global and regional financial integration. Indeed, regional financial integration, in the form of lower transaction costs, leads to a more concentrated financial geography inside a zone that integrates. Again, this is because firms can issue on the largest market (where they get the highest price); save on issuing fixed costs; and sell relatively easily (because of lower transaction costs inside the integrated zone) to the investors in the small market. This means that the financially concentrated geography that may emerge from financial integration may not come at a cost to firms of the small market that cease to list on their domestic market and start to list on the large one. Indeed, they also gain from issuing on larger markets through higher asset prices (lower cost of capital) and saving on issuing fixed costs on multiple markets. This is exactly the case for firms in Beijing, which can live with the fact that Shanghai or Hong Kong, China are the two financial centers of the People’s Republic of China. Agglomeration generates efficiency gains and this is also the case for financial markets. However, if there are positive externalities for local economic activity to have local financial markets, then firms in small markets may lose from this agglomeration process.
One also can ask what happens to cross-listing incentives between the integrated zone and the rest of the world. If the fixed cost of issuing has not been modified, then the incentive for firms to list in the integrated area increases. The reason is simply that financial integration between countries $i$ and $j$ means that the overall market size and asset demand of $i$ and $j$ has increased relative to the rest of the world (see the previous section). Another way to say this is that, with financial integration in the eurozone, an American firm has a stronger incentive to list in Frankfurt or Paris as it can sell its shares easily to German, French, and other investors from either financial center.

**Result 6. Regional financial integration in the form of lower transaction costs leads firms from the rest of the world to increase issuing in the integrated area.**

Financial integration may also be interpreted as a fall in the cost of cross-listing. This could be due to harmonization of institutional structures. For example, integration may lead to harmonization of accounting standards and financial regulations between countries $i$ and $j$ that are part of the integrated area. With this interpretation in mind, one assumes that if country $i$ agents issue shares in country $j$ (or vice versa), the fixed cost of issuing on the other market decreases. In this case, it is clear that financial integration generates more cross-listing inside the integrated area. This is the case for both the small and the large markets.

**Result 7. Regional financial integration in the form of lower cost of cross-listing leads to more cross-listing.**

Note, therefore, that once the financial geography is made endogenous, some of the results on financial integration have to be amended. In particular, the impact on small and large markets is different. When financial geography is exogenous, the consequence of either global or regional financial integration is that small markets benefit from higher demand and higher asset prices. Financial development follows. When financial market geography is endogenous, the conclusion becomes more ambiguous. Agglomeration of financial markets may actually lead to concentration of financial activities in the largest markets. The welfare implications of such financial concentration are ambiguous. On the one hand, the presence of local financial markets may help local development so that small markets may lose from financial agglomeration. On the other hand, like any process of agglomeration, financial agglomeration brings efficiency gains because of economies of scale.

### 1.6 Regional and global financial integration and financial crises

So far, the chapter has investigated the effect of the two types of financial integration in the case where “things go well.” Clearly, the financial crisis of
1997–8 in Asian markets and the global financial crisis of 2008–9 show that inquiring as to the impact of financial liberalization on the possibility of a crisis is relevant. Such an inquiry also goes beyond the scope of this chapter, but a brief analysis of how regional and global financial integration can affect the possibility of financial crises and derive some policy implications for the case of East Asia is of interest.

In the context of the model presented in this chapter, where the financial geography is given, financial crises generated by self-fulfilling expectations are indeed possible, as shown in Martin and Rey (2006). A crisis is defined as a situation where, due to a change of expectations from optimistic to pessimistic, no firm has an incentive to invest given that no other firm is investing. This will be the case when the expected asset price is low enough (a “crash”) so that no firm indeed finds it profitable to invest because the cost of capital becomes too high. This is what Martin and Rey (2006) called the pessimistic equilibrium. To be more precise, for such a crash to be a possible equilibrium, a fixed cost to start investing must be introduced.12 Hence, the profit to invest in a project and issue an asset attached to this project is:

\[ E(\pi_i) = E(p_i n_i - \frac{1}{2} n_i^2 - F), \]

where \( p_i \) is the asset price, \( n_i \) is the number of investment projects/assets, \( F \) is the fixed cost to start investing, and \( \frac{1}{2} n_i^2 \) is the proportional quadratic cost for investment. If investment is non-zero, profit maximization means that the number of investment projects/assets developed and issued by firms is such that the marginal cost of investment is equal to its revenue/price: \( n_i = p_i \), so that the total expected profit of investing is:

\[ E(\pi_i) = E(\frac{1}{2} p_i^2 - F) \]

and increases with the expected asset price. The crash (a situation such that \( E(\pi_i) < 0 \) so that no investment takes place) is generated by a self-fulfilling expectation mechanism: suppose that expected asset prices, \( E(p_i) \), are low so that the operating profit of starting investment projects does not cover the fixed cost, \( F \). This implies that expected aggregate investment (the investment of the representative agent) and the investment payoff fall to zero in this equilibrium. This in turn reduces aggregate income. Aggregate income is equal to aggregate wages plus the aggregate investment payoff:

\[ L_i y_i = L_i w_i + L_i \pi_i. \]

In a crisis, where expected aggregate investment payoff is zero, it is therefore reduced to \( L_i w_i \). The total demand for domestic assets [see equation (1.3)] therefore falls. Importantly, owing to transaction costs on the purchase of foreign assets and the home financial bias that is created, the fall in the demand for assets is
concentrated on domestic assets. Hence, the fall in the demand for domestic assets validates the fall in expected domestic asset prices and the crash in asset prices, investment, and income.

When is such a self-fulfilling, crash-generated equilibrium possible; that is, when can a situation where no agent invests, given that all expect the others not to invest, be an equilibrium from which no agent has an incentive to deviate? The condition is such that the expected profit to deviate (invest) is negative when no other agent is expected to invest

\[ E(n_i) = 0 : E [\pi_i(n_i = 0) < 0]. \]

Martin and Rey (2006) showed that intermediate financial openness between a rich country and an emerging market (characterized by lower productivity and income) makes this equilibrium possible. To understand why intermediate levels of financial integration are necessary, take the two extremes. In a situation without capital flows or financial autarky (very high transaction costs), where agents can only save by buying domestic assets, a self-fulfilling expectations-driven crash is not possible. The reason is that this puts a floor on the demand for domestic financial assets and their expected price as capital flight (buying foreign assets) is not possible. To see this, note that, in financial autarky, when \( \tau_{ij} \) goes to infinity, \( Q_i \) goes to infinity when \( n_i = 0 \), so the price of the asset/investment of a single investor who invests while nobody else does goes to infinity. In the situation of the present analysis, a crash is not possible in financial autarky.

At the other extreme, in a situation with zero transaction costs on financial flows and no segmentation, arbitrage implies that agents in the industrialized economy would rush to buy the assets in the event of a crash in the emerging market. The price of an asset in the emerging market cannot differ from the price of a similar asset in the industrialized economy. The absence of some form of financial market transaction costs and segmentation rules out the possibility of a crash. This non-linear effect of financial integration is depicted in Figure 1.3, where expected profits of investing when all agents are pessimistic and expect a crash (so \( n_i = 0 \)) are shown as a U-shaped function of financial integration, as shown in Martin and Rey (2006). When financial integration is low (financial transaction costs, \( \tau_{ij} \), are high), the expected profit of investing when all other other agents do not invest as well, \( E [\pi_i(n_i = 0)] \), is high and above zero; so a crash is not possible. However, as financial integration proceeds (\( \tau_{ij} \) falls so \( \tau_{ij}^{1-\varepsilon} \) increases), expected profits, when all other agents are pessimistic, become negative; so no agent has an incentive to deviate from the crash equilibrium and the crash indeed becomes possible. Note that this zone is such that two equilibria exist: a “boom” equilibrium with investment and no capital flight and a “crash” equilibrium where investment, income, and asset prices crash and there is capital flight. As financial transaction costs fall further, arbitrage takes place and foreign capital comes in when agents turn pessimistic, lifts asset demand and prices, reduces the cost of capital, and makes investing profitable. In this case, a self-fulfilling expectations-driven crash is not possible. Only one equilibrium is possible.
A key point is that when financial markets are segmented and assets are
imperfect substitutes, the fall in the demand for assets during a crash affects
local assets disproportionately. Emerging markets are more vulnerable to this
type of crash. The rich country benefits from higher income (and saving) in
the rich country, so that the demand for assets (and therefore asset prices),
even when depressed by pessimistic expectations, is always higher than in the
emerging market. In Figure 1.3, this means that the pessimistic expected profit
investment schedule is shifted upward in a large/rich country and this reduces
(or even eliminates for large and sufficiently rich countries) the area where a
crash is possible. Size therefore matters also for the possibility of a self-fulfilling,
expectations-driven crash with capital flight, which is important for the debate on
financial integration.

What, then, is the effect of financial integration in this context? Martin and
Rey (2006) show that it has an ambiguous effect when it takes place between an
emerging market and a rich country; as shown in Figure 1.3, financial integration
means that the country moves from 0 (autarky) to 1 (perfect financial integration)
on the horizontal axis. One can think of an emerging market as a country
that, because of asymmetric information, higher instability, and other factors,
precludes perfect international arbitrage (the extreme right position where financial
integration takes its maximum value). The reason that financial integration is risky
in this context is that lower transaction costs, $\tau_{ij}$, between the two countries $i$ and $j$,
make capital flight easier during a crash. This implies that, if expectations turn
pessimistic in the emerging market (on domestic asset prices, investment, and
income), agents save by switching to foreign assets easily in a process that validates
the pessimistic expectations. That financial integration takes place between two countries with different levels of productivity and income is important. Indeed, if countries are identical in terms of income level, such a crash is not possible. The reason is that capital flight to the country more immune to a self-fulfilling, expectations-driven financial crash (the rich country with a higher demand for assets even in the pessimistic equilibrium) is essential to the possibility of a crash in the emerging market. The possibility of a safe haven (a rich/large country) to which capital may fly during a crash makes it easier for such a crash to materialize.

This result has an important consequence for analyzing the difference between regional and global financial integration. One way to think of this difference is that regional financial integration takes place between countries that are more similar than in the case of global financial integration. Hence, the results of Martin and Rey (2006) suggest that financial integration between a group of countries of similar development level (say, emerging markets) and size does not raise the risk of a financial crash as much as does financial integration between countries of dissimilar development level and size. Again, the main reason is that a crash is made easier by the possibility of capital flight to a safe haven (i.e. a rich and or large country). In fact, given that larger/richer countries are more immune to this type of crash (because the size of demand for domestic assets is large even when agents turn pessimistic), the creation of a financially integrated area between small and similar countries reduces the likelihood of a crash with capital flight between this group of countries and the rest of the world. Another way to say this is that small similar countries have indeed an interest in integrating to form a larger and therefore more stable financial area.

Two important caveats must however be stressed. First, the gains from financial integration in “normal times” (i.e. in situations where financial crises do not occur, as in Section 1.1) are larger when countries are more different, at least when the financial geography is given. This is also one of the results in Martin and Rey (2006). This result is not very surprising as it just replicates, in the financial arena, the result that gains from trade are larger the more different countries are. In the specific model presented here, financial integration between a rich country and an emerging market means that the emerging market benefits both from an increased number of financial assets (financial markets become less incomplete) and from increasing financial terms of trade (the relative asset price of the emerging market increases). What emerges, then, is a trade-off: regional financial integration between more similar countries (for a given financial geography) generates fewer welfare gains than between dissimilar countries in “normal” times. However, financial integration between countries with similar development levels may increase the risk of financial crises less than is the case with integration between dissimilar countries.

A second important caveat pertains to the focus of this analysis on a specific type of financial crisis where self-fulfilling expectations and market size play key roles because of the possibility of capital flight. Financial crises, as will presently be shown, come in very different forms, and the results of the foregoing analysis may not be robust in other types of financial crises.
A final important point is the relation between financial crises and trade integration. Recent empirical work had shown that openness in goods trade influences the frequency of crashes in emerging markets. Cavallo and Frankel (2004) found that trade openness (instrumented by gravity variables) reduces the vulnerability of countries to sudden stops. Argentina in the 1990s is often presented as a typical example of a financially open economy relatively closed to goods trade. It has suffered heavily from sudden stops (Calvo, Izquierdo, and Mejia 2004, Calvo and Talvi 2005).

These contradictory effects of financial and trade globalization are illustrated in Table 1.2. The table reports the average number of financial crashes per year for developed and emerging economies, dividing each group along the dimensions of financial and trade openness.13

Table 1.2 suggests that opening to capital movements is very positively correlated with the frequency of crashes in emerging markets but not in industrialized economies. This is consistent with the theoretical model analyzed above, although the global financial crisis, which has hit both industrialized and emerging markets, may change the picture. Trade openness [whether measured by the trade-to-GDP ratio or following Sachs and Warner (1995)], however, is associated with a large decrease in the frequency of crashes in emerging markets.14 Hence, according to Table 1.2, being an emerging market open to financial flows while closed to goods flows maximizes the frequency of crashes.

Martin and Rey (2006) provided a theoretical explanation for the stabilizing effect of trade openness on the possibility of a financial crash. The circular causality at the core of the possibility of a crash is reduced if trade costs are low because firms’ profits and dividends in more open economies are less dependent on the level of local demand. The firms are therefore less at risk when expectations turn pessimistic. This also suggests that it is legitimate to think of trade and financial integration as two complementary processes that should come together. Trade integration reduces the likelihood of a financial crisis that can be increased by financial integration. Hence, from this point of view, financial integration between countries that are very open to trade with each other makes sense. If capital from country A flies during a crash to country B, the crash will be weakened or even eliminated, if countries A and B trade a lot. The reason is that the capital inflow in country B will increase income and imports from country A. In turn, this will

Table 1.2 Frequency of crashes and openness

<table>
<thead>
<tr>
<th>Trade in goods</th>
<th>Emerging markets</th>
<th>Developed markets</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>More closed</td>
<td>More open</td>
</tr>
<tr>
<td>Financially closed</td>
<td>0.35</td>
<td>0.15</td>
</tr>
<tr>
<td>Financially open</td>
<td>0.76</td>
<td>0.57</td>
</tr>
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</table>

increase profits and dividends in country A. Hence, trade integration between two countries is a financial stabilization mechanism for both. This can be viewed as a legitimate reason to favor regional financial integration accompanied by regional trade integration.

1.7 Conclusion and implications for Asian countries

A common theme of this chapter is that size matters in financial markets and that, therefore, regional financial integration, by creating large financially integrated zones, has an impact on asset demands, prices, and the likelihood of financial crashes with capital flight. This chapter has reviewed, with the help of a single theoretical framework, the main differences between regional and global financial integration. When not taking into account financial geography or the possibility of a crisis, financial integration, either global or regional, is always a good thing. The more different countries are (in terms of financial development, size, or income), the better. This result in a sense reproduces some well-known results from trade theory. The gains of trade are larger when countries are more different. From this (classical) point of view, regional financial integration is good but global financial integration is better. Note also that, in this case, small poor countries gain more than large rich countries because segmentation of financial markets, and the market size effect that follows, hurts small and poor countries more than others.

Things become more complicated when financial market geography is endogenous: in this case, countries, especially if they are not large and rich, may prefer regional to global financial integration. The reason is that, with financial integration, firms may prefer to issue their assets on the largest markets and the consequent financial market agglomeration may penalize financial development of smaller markets. However, if regional financial integration takes place between countries of very different size and development, financial agglomeration to the largest markets is also predicted toward the largest markets of the region.

Finally, the chapter also analyzes the impact of financial integration on the possibility of a specific form of financial crises: those generated by self-fulfilling expectations of a crash in a context where capital flight to a safe haven (a large and rich country) is possible. With this issue in mind, financial integration between countries of similar development and size (without a large and rich safe haven toward which capital flies during a crash) is suggested to be less risky. Hence, a trade-off may appear: gains from global financial integration may be larger in good times but the risk of facilitating crises with financial integration may be lower at the regional than at the global level. This trade-off is a natural implication of the chapter’s theoretical setup but has not been tested empirically in this analysis—an important question that is left for future research.

Several implications can be derived from this theoretical work on the case of Asian economies. First, compared with trade integration, financial integration appears more ambiguous. Trade integration in this chapter’s framework is
unambiguously stabilizing in the sense that it reduces the probability of a financial crisis with capital flight. Given the region’s history of financial crises (especially the 1997–8 crisis), Asian economies should give priority to trade integration. The analysis suggests a gradualist approach where trade integration comes before financial integration.

As for financial integration, the framework suggests both advantages and drawbacks to regional (relative to global) integration for Asian economies. The main advantage is that (given a sufficiently high level of regional trade integration), if there is more similarity among Asian countries than between them and the rest of the world, then the risk of a financial crash is lower with regional than with global financial integration. This can also be seen as a gradualist strategy: first integrate regionally, then globally. However, one challenge for Asian countries is the high degree of heterogeneity in terms of their development level and size, especially compared with European countries.

This suggests that Asian financial integration will generate concentration of financial centers. As suggested by the framework presented by this chapter, financial integration may be more efficient for Asian firms (even for small countries that would lose their financial markets) that can finance themselves on large and liquid international markets. However, the political economy consequences of a very concentrated Asian financial geography may be more difficult to handle as some countries may resent seeing their financial markets relocate to larger regional markets. As suggested by the framework, this regional heterogeneity may also mean that even regional financial integration can lead to financial crises (but is less likely to do so than global financial integration).

The challenge of integrating heterogeneous Asian countries can lead to two different roads that need not be mutually exclusive. One is to start financial integration among the most similar and richest countries of the zone. The second is to help the poorer and richer countries of the zone converge. Here, theory, empirics, and the European experience suggest that trade integration is a very powerful tool for convergence.

Appendix: Economies included in the data on world asset holdings

Source economies (i)
Australia, Austria, Belgium, Canada, Chile, Denmark, Finland, France, Germany, Hong Kong (China), Ireland, Italy, Japan, Luxembourg, Malaysia, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Singapore, Switzerland, United Kingdom, United States, and South Africa.

Destination economies (j)
Africa. Algeria, Côte d’Ivoire, Egypt, Morocco, Nigeria, South Africa, and Tunisia.
Asia. The People’s Republic of China, Hong Kong (China), India, Indonesia, Japan, Malaysia, the Philippines, Singapore, the Republic of Korea, Taipei, China, and Thailand.

Central and South America. Argentina, Brazil, Chile, Colombia, Peru, Uruguay, Venezuela, Costa Rica, Mexico, and Panama.

Europe. Austria, Belgium, Bulgaria, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Lithuania, Luxembourg, the Netherlands, Norway, Poland, Portugal, the Russian Federation, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, and United Kingdom.

Oceania. Australia and New Zealand.

North America. Canada and United States.

Notes

1 Okawa and van Wincoop (2009) recently proposed an alternative theoretical model that generates a similar financial gravity equation.

2 Empirical evidence on the effect of financial integration on asset prices also exists. Among others, Henry (2000) provided an event study of 12 liberalizations and found abnormal returns of 4.6% per month on the average in the 4 months before and the 3 months after the liberalization date (with a total cumulative average return of 36.8%).

3 In Martin and Rey (2006), where the number of assets is endogenous, this is shown to be an equilibrium as agents have no incentive to replicate an existing asset.

4 Martin and Rey (2000, 2006) showed how to endogenize this supply and how it increases with the asset price. This does not change any of the qualitative results of the present paper, which thus retains the assumption of an exogenous supply. Another way to think about it is that entrepreneurs float the entire project on the stock market.

5 In Martin and Rey (2000), with a slightly different utility function, the financial price index, $Q_i$, did not enter the expression of the demand for assets. In this case, the relation between asset prices and market size is very simple.

6 Martin and Rey (2006) showed, however, that if profits (and dividends) are higher in larger markets because of economies of scale and transaction costs on goods markets, then asset prices may differ due to market size, even without transaction costs on financial markets.

7 If the number of assets is made endogenous and increases with asset prices, as in Martin and Rey (2000), the relation between asset prices and market size is not changed qualitatively. See following text for a quadratic cost function that yields $p_i = n_i$.

8 Bondholdings include long-term debt securities and short-term debt securities.

9 Aviat and Coeurdacier (2007) analyzed in detail the relation between trade in goods and trade in assets.

10 The appendix to this paper provides the full list of source economies.

11 A Depositary Receipt is a certificate issued by a depositary bank for non-US securities that are held by a custodian in the home market of the non-US country. Depositary Receipts trade like any other US security.

12 In Martin and Rey (2006), monopolistic trade in goods was also introduced, but is not a necessary condition for a crash to be possible.
More precisely, emerging markets are defined as those having GDP per capita equal to or below that of the Republic of Korea. The sample coverage for those countries starts at the earliest in 1975 and ends in 2001. A crash is defined as a monthly drop in the stock index (in US dollars) larger than two standard deviations of the average monthly change. The sample is divided into periods for which countries were financially open and financially closed, following Kaminsky and Schmukler (2001). Hence, among the 62 countries (34 emerging countries), 31 appear twice as they changed status during the sample years. Countries are also classified in terms of their openness to trade measured by the average of exports plus imports over GDP during the period considered. This measure of openness captures the degree of dependence of the economy on local demand. An open country is one in which the openness ratio is above the median of its group; a closed country is one with a ratio below the median.

This is not the case in developed countries, for which the frequency of crashes is low overall. For developed economies, the ratio of trade to GDP is used as the measure of openness. According to the Sachs–Warner measure, only two industrialized countries are classified as closed at some point so the result is not reported.

References


Philippe Martin


Regional and global financial integration: an analytical framework


2 International capital mobility of East Asian economies: is domestic investment financed by regional or global saving?

Soyoung Kim, Sunghyun H. Kim, and Cyn-Young Park

While the degree of international capital mobility in East Asia has increased significantly in recent decades, whether this trend has been attained at the regional level is not yet clear. With the removal of legal and other barriers to capital flows and with improved access to global information, financial liberalization of domestic capital markets has substantially raised the degree of capital mobility in East Asian economies since the 1990s. However, it is hard to find evidence that the recent financial market liberalization increased the degree of capital mobility within East Asia.

Various signs suggest that capital mobility within East Asia may not be as high as the degree of capital mobility between East Asian and developed economies. Earlier studies showed that East Asia’s financial markets are more integrated with global financial markets than among themselves despite impressive progress in the region’s economic integration. The recent buildup of global imbalances may also reflect the tendency of East Asia’s capital for “international” mobility. For example, while many developing economies in East Asia continue to face significant infrastructure and investment deficits, they also accumulate large current account surpluses, which have been used to finance the current account deficit of the United States (US) for a very low return.

In theory, freely mobile international capital flows can enhance economic welfare in various ways. High capital mobility allows countries to smooth their consumption when faced with temporary declines in income and/or to finance productive investment at home without being constrained by the amount of domestic saving. Economic theories aside, however, experience shows that high international capital mobility in an inadequately developed domestic financial system may incur substantial economic and social costs. Massive capital inflows and outflows often associated with capital account liberalization tend to increase the risk of financial/currency crises and destabilize financial markets and the real economy by, for example, contributing to boom–bust cycles.

Likewise, net welfare effects of increased capital mobility and financial integration within a region remain uncertain for the region’s individual economies.
That is, an increase in the degree of regional capital mobility may not improve welfare for certain economies in the region. Economies do not need regional capital markets once they are fully integrated with global capital markets. Moreover, increased funding through regional capital markets may decrease potential gains from external capital flows into the region. Nevertheless, increased capital mobility within a region may provide additional benefits to the economies in the region. For example, increased capital mobility may help reduce a region’s reliance on external funding, thus decreasing the region’s vulnerability to the vagaries of international investors and their funding conditions.

This chapter documents the evolution of saving and investment relations for East Asian economies; such relations are considered to be an important macroeconomic consequence of internationally mobile capital flows. In particular, the chapter examines the role of regional versus global capital markets by measuring the extent to which domestic investment is financed by domestic saving, regional saving, and global saving. Based on such relations, the chapter will address how regional or global saving have contributed to financing domestic investment of East Asian economies as their international capital mobility increased in recent years.

Since the seminal contribution of Feldstein and Horioka (1980), numerous studies have investigated the degree of international capital mobility based on the relation between domestic investment and domestic saving. Intuitively, under financial autarky, domestic investment and domestic saving should be perfectly correlated as domestic investment is fully constrained by domestic saving. However, if capital is perfectly mobile internationally, domestic investment and domestic saving do not have to be correlated because capital can move freely to any place with a high return.

Subsequent studies have questioned whether a simple saving–investment relation truly represents the degree of capital mobility. Therefore, it may be difficult to argue that international capital mobility has increased or decreased based on the saving–investment relation. However, the methodology can still be extended to understand the role of regional and global capital markets in financing domestic investment by examining the relationship between it and domestic, regional, and global saving. In this chapter, the extended methodology (developed by Kim and Kim 2009) is applied to investigate the role of regional and global capital markets in financing domestic investment of East Asian economies.

This chapter adds value to the previous literature on East Asia’s experience of capital account liberalization and financial integration in two aspects. First, while past studies have used various measures to document different degrees of regional versus global capital mobility and financial market integration in East Asia, no studies have focused on the saving–investment relation. Second, although some studies (i.e. Kim, Kim, and Wang 2007; Kim, Oh, and Jeong 2005; Sinha 2002) investigated the saving–investment relation in East Asia, no studies have examined the issue from the comparative perspective of regional versus global capital markets of East Asia.
The rest of the chapter comprises the following sections: Section 2.1 briefly reviews the progress of financial integration in East Asia since the 1990s; Section 2.2 explains the empirical methodology; Section 2.3 presents the empirical results; and Section 2.4 provides a conclusion.

2.1 Financial integration and capital flows in East Asia

Since the early 1990s, financial integration in East Asia has gathered pace along with financial deregulation and capital account liberalization. Although there is no undisputed and universal definition of financial integration, it is often closely associated with financial openness and the free movement of capital. In East Asia, where financial markets are rapidly developing and integrating both regionally and globally, the evolution of the degree of capital mobility is likely to be multidimensional. With financial globalization, international capital mobility is rising. In recent years, however, the region’s authorities have been making conscious efforts to promote financial market integration within East Asia.

In the aftermath of the 1997–8 financial crisis, East Asian economies took various steps to improve domestic financial systems and promote capital account liberalization. Indeed, the 1997–8 crisis played a catalytic role in accelerating regional financial cooperation and integration, in part not only to safeguard the region’s financial markets against the spillover of global market instability, but also to promote financial market development in the region. There have been several important regional initiatives, such as the Association of Southeast Asian Nations (ASEAN) Surveillance Process, Chiang Mai Initiative, Asian Bond Markets Initiative, and Asian Bond Fund [Asian Development Bank (ADB), 2008]. Despite these efforts, however, regional financial integration seems to be lagging behind the region’s trade and economic integration. Several studies also found that the financial markets in East Asia are more integrated with the global market than with each other.

Capital inflows and outflows in East Asia have risen sharply since the 1990s (Figure 2.1). Reflecting the recent trend of financial globalization, international capital mobility accelerated in the few years prior to the 2008–9 crisis. With the volume of cross-border capital flows on the rise, cross-border holdings of financial assets also have increased sharply. The region’s gross external assets and liabilities as a share of gross domestic product (GDP) reached 235% in 2007, up from 151% in 1990, according to Lane and Milesi-Ferretti (2007).

While still slow in its integration with global markets, East Asia’s regional financial integration appears to be making steady progress. An interesting question to ask is whether an increase in regional financial integration complements or substitutes for global integration. For example, with increased regional financial integration, East Asian economies may finance their investment from regional, rather than from global, sources. Although data on cross-border capital flows remain limited, data from the Coordinated Portfolio Investment Survey by the International Monetary Fund reveals an interesting trend (Figure 2.2) in this regard. The region’s portfolio investment in regional assets rose from 14.8% of total assets...
International capital mobility of East Asian economies

Figure 2.1 Emerging East Asia’s financial account flows (% of GDP).
Sources: Authors’ calculations using data from the International Monetary Fund, International Financial Statistics Online; and CEIC Data Company.
Notes: Emerging East Asia includes the People’s Republic of China; Hong Kong, China; Indonesia; Republic of Korea, Malaysia; the Philippines; Singapore; Taipei, China; and Thailand. Other investments include derivatives. Data for the People’s Republic of China begin in 1982; for Hong Kong, China in 1998.

Figure 2.2 Emerging East Asia’s portfolio investment (% of total).
Source: authors’ calculations using data from the International Monetary Fund’s Coordinated Portfolio Investment Survey.
Notes: Emerging East Asia includes the Brunei Darussalam; Cambodia; People’s Republic of China; Hong Kong, China; Indonesia; the Republic of Korea; the Lao People’s Democratic Republic; Malaysia; Myanmar; the Philippines; Singapore; Taipei, China; Thailand; and Viet Nam. G-3 includes the 15 countries of the European Union, Japan, and the United States. Data for assets include Hong Kong, China; Indonesia; the Republic of Korea; Malaysia; the Philippines; Singapore; and Thailand only.
in 2001 to about 24.6% in 2008, while G-3 economies (European Union 15, Japan, and the US) account for about 64.3% of the region’s liabilities in 2008, down from 77.5% in 2001.

2.2 Empirical method

2.2.1 Basic empirical model

While the original Feldstein–Horioka saving–investment \( \pi \) correlation puzzle is based on cross-sectional regression analysis, the current chapter starts from the following saving–investment regression that is widely used by studies in a time-series or panel regression setup:

\[
\frac{I_{it}}{Y_{it}} = \alpha_i + \beta \frac{S_{it}}{Y_{it}} + \epsilon_{it},
\]

where \( I \) is domestic investment, \( S \) is domestic saving, \( Y \) is domestic income, the subscript \( i \) indicates economy \( i \), and the subscript \( t \) indicates time \( t \). The coefficient \( \beta \) represents how saving rate is related to investment rate, called the “saving retention coefficient” in the previous studies. Under perfect international capital mobility, a simple theoretical model suggests that investment decision is independent of saving decision, so \( \beta \) should be close to zero under perfect capital mobility. On the other hand, investment should be equal to saving in a closed economy, so saving and investment should be perfectly correlated and \( \beta \) should be close to 1. Therefore, some studies interpret that a low value of \( \beta \) implies a high degree of capital mobility.

The regression may also be interpreted as showing how investment is financed by domestic saving. A small (or large) \( \beta \) suggests that only a small (or large) fraction of domestic investment is financed by domestic saving. If domestic investment is not fully financed by domestic saving, a fraction of domestic investment is likely to be financed by foreign saving, which implies a non-zero degree of international capital mobility. In the following, this interpretation is explicitly extended in order to evaluate the relative role of regional versus global capital markets (or saving) in financing domestic investment.

From equation (2.1), regional and global saving rates are added as explanatory variables:

\[
\frac{I_{it}}{Y_{it}} = \alpha_i + \beta \frac{S_{it}}{Y_{it}} + \gamma \frac{S^R_{it}}{Y^R_{it}} + \delta \frac{S^G_{it}}{Y^G_{it}} + \epsilon_{it},
\]

where \( I^R, S^R, \) and \( Y^R \) are East Asian regional aggregate (excluding own economy) investment, saving, and income, and \( I^G, S^G, \) and \( Y^G \), are global aggregate (excluding East Asian economies) investment, saving, and income. The regression shows how the domestic investment rate is related to domestic, East Asian aggregate, and global saving rates. \( \beta \) can be interpreted as the usual saving
retention coefficient. Further, \( \gamma \) and \( \delta \) may be interpreted as how domestic investment is financed by East Asian aggregate and global saving, which implies the relative role of regional and global capital markets that contribute to financing domestic investment, respectively. Further, if the interpretation that a low \( \beta \) implies a high degree of international capital mobility is extended, a high \( \gamma \) (a high \( \delta \)) can be interpreted as a high degree of regional (global) international capital mobility, because domestic investment is likely to be less related to domestic saving but more related to foreign saving when the degree of international capital mobility is high.

Another type of regression is considered: one that highlights the relative role of regional versus global capital markets. Suppose that domestic investment is fully financed by domestic saving, East Asian aggregate saving, and global saving. Then, \( \beta + \gamma + \delta \) should equal 1. By subtracting \( S_t/Y_t \) from both sides of equation (2.2), the following equation is obtained:

\[
I_t - S_t/Y_t = \alpha_i + \gamma \left( S_t^R/Y_t - S_t/Y_t \right) + \delta \left( S_t^G/Y_t - S_t/Y_t \right) + \epsilon_{it}.
\] (2.3)

Equation (2.3) may have a practical advantage over equation (2.2) because the degree of freedom and the multicollinearity problems are less likely to be present.

One potential problem in interpreting the estimated \( \beta \) as the (inverse of the) degree of international capital mobility is that changes in saving are not exogenous to changes in investment. That is, changes in investment may affect changes in saving. Furthermore, a structural shock may affect saving and investment simultaneously. For example, studies have suggested that saving and investment can be positively correlated even under perfect capital mobility in the presence of some structural shocks such as technology shocks (e.g. Baxter and Crucini 1995). In such a case, \( \beta \) in equation (2.1) may not reflect the degree of international capital mobility because \( \beta \) can be close to 1 even under perfect international capital mobility. This presents a similar problem to that in interpreting \( \gamma \) and \( \delta \) in equations (2.2) and (2.3) as a measure of relative regional versus global capital mobility.

However, one can still interpret the coefficients \( \beta, \gamma, \) and \( \delta \) as a simple relationship between saving and investment. The estimated \( \beta \) shows how domestic saving and investment are correlated and can provide some information on the low bound of the degree of international capital mobility. Further, the chapter employs two methods to obtain a measure that closely estimates the degree of international capital mobility. To control for the effects of productivity shocks that may concurrently affect saving and investment, the chapter uses the method developed by Kim (2001) and Kim, Kim, and Wang (2007). First, the residuals from the regressions of saving and investment on productivity shocks are derived; the residuals are then used to re-estimate equations (2.1), (2.2), and (2.3). Second, the instrumental variable regression is run. By using the instruments, the potential
endogeneity problem can be reduced. Kim and Kim (2009) provide more detailed explanations of the empirical methodology.

### 2.2.2 Data and estimation

The chapter analyzes 11 East Asian economies: the People’s Republic of China (PRC); Hong Kong, China; Indonesia; Japan; the Republic of Korea; Malaysia; the Philippines; Singapore; Thailand; Taipei, China; and Viet Nam. Data are from 1980 to 2007. Saving is defined as GDP minus government consumption and private consumption. Investment is gross fixed capital formation plus changes in stocks. Both nominal saving and investment rates are calculated by dividing them by nominal GDP. Most of the national income account data are taken from the International Monetary Fund’s International Financial Statistics. Additional sources of data are from the Asian Development Bank, Ministry of Finance in Japan, and Taipei, China.

To compute East Asian regional aggregate data, first, the local currency data of saving, investment, and GDP of each economy are converted into the US dollar amount using period average exchange rates. Then, the sum of these values, excluding “own country,” is used to calculate the total East Asian aggregate saving, investment, and GDP data for each sample economy. Taking the ratio of East Asian aggregate GDP, East Asian regional aggregate saving and investment rates are calculated:

\[
\frac{S^r_t}{Y^r_t} = \frac{\sum_{j=E} S^t_j}{\sum_{j=E} Y^t_j},
\]

where \( j = 1, \ldots, N \), excluding own country, and \( E \) is the exchange rate against the US dollar. The same method is used to calculate global saving and investment rates. In fact, the aggregate data of seven major global countries (the G-7) are used for global data.9

Productivity shocks are defined as annual percentage changes in productivity. Solow residuals are used for the productivity measure. The share of labor in manufacturing output is assumed to be 0.6. Real GDP data are used for output and employment data for labor input. East Asian aggregate and G-7 productivity shocks are the weighted averages of the individual economies’ productivity shocks. Nominal GDP is used to calculate relative weights.

The ordinary least-squares estimation method is used in cross-section and time-series regressions, and fixed-effects panel regressions are used for panel regressions. Standard errors are corrected for heteroskedasticity. Instrumental variable regressions include one period lagged values of all variables in the estimated equation because lagged values of domestic investment rate and domestic, regional, and global saving rates can help predict saving rates.
2.3 Empirical results

2.3.1 Basic statistical properties of saving and investment

Table 2.1 reports main statistical properties of saving and investment (as a ratio of GDP) in East Asia. The first column reports the statistics of the whole period (1980–2007). Average saving and investment rates of the 11 East Asian economies are 31.3% and 28.7%, respectively. Singapore shows the highest saving rate (about 45%) among the 11 economies, while the PRC shows the highest investment rate of 37.7%. The Philippines and Viet Nam have the lowest saving and investment rates: 15.4% and 20.8%, respectively. The average saving rate is higher than the average investment rate in all economies except for the Philippines and Viet Nam.

The whole sample period is divided into 1980–9, 1990–9, and 2000–7. In three economies (the PRC, Malaysia, and Viet Nam), both saving and investment rates increase significantly over time. Conversely, both rates decrease over time in Japan and Taipei, China. Average statistics are also reported for subgroups.

Table 2.1 Properties of saving and investment (percentage, period average)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>S/Y</td>
<td>I/Y</td>
<td>S/Y</td>
<td>I/Y</td>
</tr>
<tr>
<td>PRC</td>
<td>39.1</td>
<td>37.7</td>
<td>34.6</td>
<td>35.2</td>
</tr>
<tr>
<td>Hong Kong, China</td>
<td>32.4</td>
<td>27.1</td>
<td>33.5</td>
<td>28.2</td>
</tr>
<tr>
<td>Indonesia</td>
<td>30.1</td>
<td>27.5</td>
<td>31.0</td>
<td>28.8</td>
</tr>
<tr>
<td>Republic of Korea</td>
<td>33.2</td>
<td>32.0</td>
<td>31.0</td>
<td>30.3</td>
</tr>
<tr>
<td>Malaysia</td>
<td>38.7</td>
<td>30.5</td>
<td>33.3</td>
<td>30.7</td>
</tr>
<tr>
<td>Philippines</td>
<td>19.1</td>
<td>20.8</td>
<td>23.0</td>
<td>22.2</td>
</tr>
<tr>
<td>Singapore</td>
<td>45.0</td>
<td>34.1</td>
<td>41.6</td>
<td>42.4</td>
</tr>
<tr>
<td>Taipei,China</td>
<td>28.6</td>
<td>22.9</td>
<td>32.9</td>
<td>24.1</td>
</tr>
<tr>
<td>Thailand</td>
<td>31.1</td>
<td>31.0</td>
<td>26.0</td>
<td>29.4</td>
</tr>
<tr>
<td>Viet Nam</td>
<td>15.4</td>
<td>23.6</td>
<td>3.3</td>
<td>14.5</td>
</tr>
<tr>
<td>Japan</td>
<td>29.5</td>
<td>27.8</td>
<td>31.7</td>
<td>29.8</td>
</tr>
<tr>
<td>Average</td>
<td>31.1</td>
<td>28.6</td>
<td>29.3</td>
<td>28.7</td>
</tr>
<tr>
<td>Big 3a</td>
<td>33.9</td>
<td>32.5</td>
<td>32.4</td>
<td>31.8</td>
</tr>
<tr>
<td>ASEANb</td>
<td>32.8</td>
<td>28.8</td>
<td>31.0</td>
<td>30.7</td>
</tr>
<tr>
<td>Greater Chinac</td>
<td>38.8</td>
<td>33.0</td>
<td>36.6</td>
<td>35.2</td>
</tr>
<tr>
<td>Emerging East Asia d</td>
<td>31.3</td>
<td>28.7</td>
<td>29.0</td>
<td>28.6</td>
</tr>
</tbody>
</table>

Source: authors.

Notes: ASEAN = Association of Southeast Asian Nations, GDP = gross domestic product, PRC = People’s Republic of China, S/Y = savings divided by real GDP, I/Y = investment divided by real GDP.

a includes the PRC, Japan, and the Republic of Korea.
b includes Indonesia, Malaysia, the Philippines, Singapore, and Thailand.
c includes the PRC; Hong Kong, China; and Singapore.
d includes the PRC; Hong Kong, China; Indonesia; Republic of Korea; Malaysia; the Philippines; Singapore; Taipei, China; Thailand; and Viet Nam.
of economies: emerging East Asia (the ten East Asian economies, excluding Japan); the big three (the PRC, Japan, and the Republic of Korea); ASEAN – Indonesia, Thailand, the Philippines, Malaysia, and Singapore; and “greater China” (the PRC); Hong Kong, China; and Taipei, China. Both saving and investment rates of the big three, “greater China”, and emerging East Asia are larger than the average of all 11 economies. The average saving rate of all 11 economies tends to increase over time. The average investment rate of all 11 increases from the 1980s to the 1990s but decreases from the 1990s to the 2000s.

Some studies examined the cross-sectional saving and investment relationship to infer the degree of long-run capital mobility. The present study also reports the estimation results of cross-sectional regressions of the saving–investment correlation, using the ordinary least squares estimation method in Table 2.2, for the ten East Asian economies and ten emerging East Asian economies, to infer the degree of long-run capital mobility. Cross-sectional data are constructed by taking averages of saving and investment rates over different periods. Table 2.2 provides the regression coefficients of investment (as a ratio of GDP) on saving (as a ratio of GDP). That is, the coefficient $\beta$ is from the regression

$$\frac{I_i}{Y_i} = \alpha + \beta \frac{S_i}{Y_i} + \varepsilon_i$$

From the regression of the whole data period, the saving–investment correlation is 0.50, while in the 1980s it is 0.63, it decreases to 0.51 in the 1990s, and it decreases further to 0.35 in the 2000s. The rolling saving–investment correlation is calculated with a 15-year window. The results show that the saving–investment correlation consistently decreases over time: from 0.63 in the 1980–94 period to 0.39 or 0.38 in 1993–2007. All these results confirm that the saving–investment correlation decreases significantly over time in East Asia, which may indicate that long-run capital mobility has increased over time in the region.

Before running the panel regression, panel unit root and panel cointegration tests were used to find the appropriate data form for regressions. Table 2.3 reports the results. The panel unit root test results, based on Levin, Lin, and Chu (2002) and Im, Pesaran, and Shin (2003), show that the null hypothesis of unit root can be rejected for the first differenced data of saving and investment rates, but not for the level data. The panel cointegration test based on Pedroni (1999) shows that the null hypothesis of no cointegration cannot be rejected. This implies that the first differenced data should be used, and a cointegrating relation does not need to be considered.10

### 2.3.2 Investment and foreign saving

Table 2.4 reports the panel regression results for the regression of domestic investment on domestic, regional, and global saving rates [in equation (2.2)]. The results of the regression with fixed effect and the instrumental variable regression
Table 2.2 Saving–investment correlation (cross-section)

\[ \frac{I_t}{Y_t} = \alpha_i + \beta \frac{S_t}{Y_t} + \epsilon_t \]

<table>
<thead>
<tr>
<th>Period</th>
<th>Emerging East Asia(^a)</th>
<th>East Asia(^b)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980–2007</td>
<td>0.50</td>
<td>0.50</td>
</tr>
<tr>
<td></td>
<td>(0.12)</td>
<td>(0.11)</td>
</tr>
<tr>
<td>1980–9</td>
<td>0.63</td>
<td>0.63</td>
</tr>
<tr>
<td></td>
<td>(0.13)</td>
<td>(0.12)</td>
</tr>
<tr>
<td>1990–9</td>
<td>0.51</td>
<td>0.51</td>
</tr>
<tr>
<td></td>
<td>(0.09)</td>
<td>(0.09)</td>
</tr>
<tr>
<td>2000–7</td>
<td>0.35</td>
<td>0.35</td>
</tr>
<tr>
<td></td>
<td>(0.26)</td>
<td>(0.24)</td>
</tr>
<tr>
<td>1980–94</td>
<td>0.63</td>
<td>0.63</td>
</tr>
<tr>
<td></td>
<td>(0.11)</td>
<td>(0.10)</td>
</tr>
<tr>
<td>1981–95</td>
<td>0.63</td>
<td>0.63</td>
</tr>
<tr>
<td></td>
<td>(0.11)</td>
<td>(0.11)</td>
</tr>
<tr>
<td>1982–96</td>
<td>0.62</td>
<td>0.62</td>
</tr>
<tr>
<td></td>
<td>(0.12)</td>
<td>(0.11)</td>
</tr>
<tr>
<td>1983–97</td>
<td>0.61</td>
<td>0.60</td>
</tr>
<tr>
<td></td>
<td>(0.11)</td>
<td>(0.11)</td>
</tr>
<tr>
<td>1984–98</td>
<td>0.58</td>
<td>0.58</td>
</tr>
<tr>
<td></td>
<td>(0.11)</td>
<td>(0.10)</td>
</tr>
<tr>
<td>1985–99</td>
<td>0.55</td>
<td>0.55</td>
</tr>
<tr>
<td></td>
<td>(0.10)</td>
<td>(0.09)</td>
</tr>
<tr>
<td>1986–2000</td>
<td>0.53</td>
<td>0.53</td>
</tr>
<tr>
<td></td>
<td>(0.09)</td>
<td>(0.09)</td>
</tr>
<tr>
<td>1987–2001</td>
<td>0.50</td>
<td>0.50</td>
</tr>
<tr>
<td></td>
<td>(0.09)</td>
<td>(0.09)</td>
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<tr>
<td>1988–2002</td>
<td>0.49</td>
<td>0.49</td>
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<td></td>
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<td>(0.09)</td>
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<tr>
<td>1989–2003</td>
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<td>0.46</td>
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<td></td>
<td>(0.11)</td>
<td>(0.10)</td>
</tr>
<tr>
<td>1990–2004</td>
<td>0.44</td>
<td>0.44</td>
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<tr>
<td></td>
<td>(0.12)</td>
<td>(0.11)</td>
</tr>
<tr>
<td>1991–2005</td>
<td>0.43</td>
<td>0.43</td>
</tr>
<tr>
<td></td>
<td>(0.13)</td>
<td>(0.12)</td>
</tr>
<tr>
<td>1992–2006</td>
<td>0.40</td>
<td>0.40</td>
</tr>
<tr>
<td></td>
<td>(0.15)</td>
<td>(0.14)</td>
</tr>
<tr>
<td>1993–2007</td>
<td>0.38</td>
<td>0.39</td>
</tr>
<tr>
<td></td>
<td>(0.16)</td>
<td>(0.15)</td>
</tr>
</tbody>
</table>

Source: authors.

Notes: Numbers in parentheses are standard errors. All coefficients are significant at the 1% confidence level.

\(^a\) The People’s Republic of China; Hong Kong, China; Indonesia; Republic of Korea; Malaysia; the Philippines; Singapore; Thailand; Taipei, China; and Viet Nam.

\(^b\) Emerging East Asia plus Japan.
Table 2.3 Unit root and cointegration tests

(A) Panel unit root test

<table>
<thead>
<tr>
<th>Variable</th>
<th>Test statistic</th>
<th>Change in variable</th>
<th>Test statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>$S/Y$</td>
<td>0.17</td>
<td>$\Delta(S/Y)$</td>
<td>-9.58**</td>
</tr>
<tr>
<td>$I/Y$</td>
<td>0.27</td>
<td>$\Delta(I/Y)$</td>
<td>-11.19**</td>
</tr>
</tbody>
</table>

Im, Pesaran, Shin test

<table>
<thead>
<tr>
<th>Variable</th>
<th>Test statistic</th>
<th>Change in variable</th>
<th>Test statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>$S/Y$</td>
<td>0.30</td>
<td>$\Delta(S/Y)$</td>
<td>-9.05**</td>
</tr>
<tr>
<td>$I/Y$</td>
<td>-0.32</td>
<td>$\Delta(I/Y)$</td>
<td>-10.39**</td>
</tr>
</tbody>
</table>

(B) Panel cointegration test for $S/Y$ and $I/Y$ (Pedroni residual cointegration test with maximum lag length of 2 years)

<table>
<thead>
<tr>
<th>Test statistic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>v-Statistics</td>
<td>0.75</td>
</tr>
<tr>
<td>rho-Statistics</td>
<td>-0.56</td>
</tr>
<tr>
<td>Phillips and Perron statistics</td>
<td>-0.88</td>
</tr>
<tr>
<td>Augmented Dickey–Fuller statistics</td>
<td>0.33</td>
</tr>
</tbody>
</table>

Sources: authors.

Notes: $S/Y = $ savings divided by real gross domestic product. $I/Y = $ investment divided by real gross domestic product. Cointegration test statistics for the four variable cases are for the null hypothesis that none of the variables are cointegrated. Panel unit root and cointegration test results used the data of ten emerging East Asian countries.

** Denotes that the null hypothesis is rejected at the 1% confidence level.

are reported. Four types of regressions are used over the whole sample period: (1) only domestic saving rate as a regressor; (2) domestic and East Asian aggregate saving rates as regressors; (3) domestic and saving rates of the G-7 minus Japan as regressors; and (4) domestic, East Asian aggregate, and saving rates of the G-7 minus Japan as regressors. The regression coefficients of the East Asian aggregate and saving rates of the G-7 minus Japan are also reported, using subperiod analysis with regression (4). Japan is treated as one of the East Asian economies and is excluded from the global aggregate.

First, the estimated coefficient of the domestic saving rate, $\beta$, ranging from 0.38 to 0.41, is significant in all panel regressions. If $\beta$ is interpreted as the (inverse of the) degree of international capital mobility, the estimated coefficient implies that the degree of international capital mobility of East Asia is far from perfect, which is consistent with the findings in past studies (e.g. Kim, Kim, and Wang 2007).

Most interestingly, the coefficient of the East Asian aggregate saving rate is significant in all regressions but the coefficient of the saving rate of the G-7 minus Japan is not significant in any panel regressions. The estimated coefficient of
Table 2.4 Domestic investment regressions: the role of domestic, regional, and global saving – with Japan in the East Asia aggregate

\[
I_{it} = \alpha_i + \beta \frac{S_{it}}{Y_{it}} + \gamma \frac{S^R_{it}}{Y_{it}} + \delta \frac{S^G_{it}}{Y_{it}} + e_{it}
\]

(A) Full period regression

<table>
<thead>
<tr>
<th>Regression</th>
<th>Fixed effect</th>
<th>Instrumental variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression 1</td>
<td>( \beta )</td>
<td>0.41**</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.08)</td>
</tr>
<tr>
<td>Regression 2</td>
<td>( \beta )</td>
<td>0.38**</td>
</tr>
<tr>
<td></td>
<td>( \gamma )</td>
<td>0.43*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.20)</td>
</tr>
<tr>
<td>Regression 3</td>
<td>( \beta )</td>
<td>0.41**</td>
</tr>
<tr>
<td></td>
<td>( \delta )</td>
<td>0.04</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.32)</td>
</tr>
<tr>
<td>Regression 4</td>
<td>( \beta )</td>
<td>0.38**</td>
</tr>
<tr>
<td></td>
<td>( \gamma )</td>
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<td>( \delta )</td>
<td>−0.21</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.34)</td>
</tr>
</tbody>
</table>

(B) Subperiod regression (fixed effect)

<table>
<thead>
<tr>
<th>Period</th>
<th>( \beta )</th>
<th>( \gamma )</th>
<th>( \delta )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980–94</td>
<td>0.36**</td>
<td>−0.29</td>
<td>0.32</td>
</tr>
<tr>
<td>1981–95</td>
<td>0.33**</td>
<td>−0.17</td>
<td>0.20</td>
</tr>
<tr>
<td>1982–96</td>
<td>0.29**</td>
<td>−0.36</td>
<td>0.03</td>
</tr>
<tr>
<td>1983–97</td>
<td>0.28*</td>
<td>−0.35</td>
<td>−0.05</td>
</tr>
<tr>
<td>1984–98</td>
<td>0.33**</td>
<td>−0.02</td>
<td>0.57</td>
</tr>
<tr>
<td>1985–99</td>
<td>0.22</td>
<td>1.15**</td>
<td>0.36</td>
</tr>
<tr>
<td>1986–2000</td>
<td>0.18</td>
<td>1.03**</td>
<td>−0.11</td>
</tr>
<tr>
<td>1987–2001</td>
<td>0.34**</td>
<td>1.19**</td>
<td>−0.49</td>
</tr>
<tr>
<td>1988–2002</td>
<td>0.39**</td>
<td>1.21**</td>
<td>−0.28</td>
</tr>
<tr>
<td>1989–2003</td>
<td>0.37*</td>
<td>1.10**</td>
<td>−0.31</td>
</tr>
<tr>
<td>1990–2004</td>
<td>0.38**</td>
<td>0.75**</td>
<td>−0.16</td>
</tr>
<tr>
<td>1991–2005</td>
<td>0.44**</td>
<td>0.70*</td>
<td>−0.17</td>
</tr>
<tr>
<td>1992–2006</td>
<td>0.43**</td>
<td>0.69*</td>
<td>−0.14</td>
</tr>
<tr>
<td>1993–2007</td>
<td>0.33*</td>
<td>0.79*</td>
<td>−0.11</td>
</tr>
</tbody>
</table>

Source: Authors.

Notes: East Asia regional aggregate includes the People’s Republic of China; Hong Kong, China; Indonesia; Japan; Republic of Korea; Malaysia; the Philippines; Singapore; Taipei, China; Thailand; and Viet Nam. Global aggregate includes Canada, France, Germany, Italy, the United Kingdom, and the United States. The numbers in parentheses are standard errors.

** Significant at the 1% confidence level.

* Significant at the 5% confidence level.
the East Asian aggregate saving rate is 0.48 (fixed effect) and 0.71 (instrumental variable) in the regression including all three regressors. The estimated coefficient is significant at the 5% and 1% levels, respectively. This result suggests that a large fraction of domestic investment of individual East Asian economies has been financed by regional saving but not by global saving, which implies a strong role of the East Asian regional capital market.

It is also interesting to compare the size of estimated coefficients of the East Asian aggregate saving rate and that of estimated coefficients of the domestic saving rate. The coefficient of the East Asian aggregate saving rate is as large as the coefficient of domestic saving rates in all types of regressions, which indicates a strong role of East Asian regional saving in financing domestic investment. However, this does not necessarily imply that changes in East Asian regional saving rates explain the variations of changes in investment rates of individual East Asian economies more than changes in domestic saving rates of individual economies. In the panel regression, the standard deviation of the East Asian aggregate saving rate is 0.87, while that of the individual saving rate is 2.07. Changes in the East Asian aggregate saving rate are less volatile than changes in individual saving rates of individual East Asian economies. Therefore, the role of changes in the individual saving rate in explaining the actual changes in the individual investment rate is still larger than the role of changes in the regional aggregate saving rate.11

The subperiod panel regressions show that the estimated coefficients of East Asian aggregate saving increased substantially in the later period. For earlier subperiods (from 1980–94 to 1984–98), the estimated coefficients are negative and not significant, but for later subperiods (from 1985–99 to 1993–2007), the estimated coefficients are positive and significant.

Table 2.5 reports the results for the modified regression [equation (2.3)]. The results in general support the main findings in the original regression. The estimated coefficient of the East Asian aggregate saving rate (minus the domestic saving rate) is positive (0.54–0.74) and significant, which supports the strong role of the regional capital market in financing the investment of East Asian economies. On the other hand, the estimated coefficient of the saving rate of the G-7 minus Japan (minus the domestic saving rate) is positive and significant in the regression including only the saving rate of the same six countries as a regressor, but it is close to zero and not significant when the East Asian aggregate saving rate is added as a regressor, which implies a small role of global financial markets in financing domestic investment.

Table 2.6 shows the results for the ten emerging East Asian economies. In the regression, Japan is not included in the aggregate East Asian saving rate, but is included in the G-7 saving rate. Interestingly, now the role of G-7 saving tends to be more important than the emerging East Asian aggregate saving. The coefficients of the G-7 and the emerging East Asian aggregate saving rates are not estimated to be significant in most cases, but the point estimate of the G-7 saving rate is larger than that of the emerging East Asian aggregate saving rate (which is close to zero). In addition, the estimated coefficient of the G-7 saving
Table 2.5 The role of regional and global saving

\[ \frac{I_t}{Y_t} - \frac{S_t}{Y_t} = \alpha_i + \gamma \left( \frac{S^R_t}{Y^R_t} - \frac{S_t}{Y_t} \right) + \delta \left( \frac{S^G_t}{Y^G_t} - \frac{S_t}{Y_t} \right) + \epsilon_{it} \]

<table>
<thead>
<tr>
<th>Regression</th>
<th>( \gamma )</th>
<th>( \delta )</th>
<th>( \gamma )</th>
<th>( \delta )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression 1</td>
<td>0.60**</td>
<td>(0.08)</td>
<td>0.61**</td>
<td>(0.08)</td>
</tr>
<tr>
<td>Regression 2</td>
<td>0.58**</td>
<td>(0.09)</td>
<td>0.59**</td>
<td>(0.09)</td>
</tr>
<tr>
<td>Regression 3</td>
<td>0.54**</td>
<td>(0.20)</td>
<td>0.74**</td>
<td>(0.23)</td>
</tr>
<tr>
<td></td>
<td>0.07</td>
<td>(0.21)</td>
<td>-0.13</td>
<td>(0.23)</td>
</tr>
</tbody>
</table>

** Source: authors.

Notes: East Asia regional aggregate includes the People’s Republic of China; Hong Kong, China; Indonesia; Japan; Republic of Korea; Malaysia; the Philippines; Singapore; Taipei, China; Thailand; and Viet Nam. Global aggregate includes Canada, France, Germany, Italy, the United Kingdom, and the United States. The numbers in parentheses are standard errors.

* Significant at the 1% confidence level.

rate in the instrument variable regression that includes all three regressors is 0.80 and significant at the 5% level. The subperiod estimation results show that the coefficients of the regional aggregate saving rate are small and not significant at all, but the coefficients of the global aggregate saving rate are positive in the later period and estimated to be significant for the subperiods from 1985–99 to 1988–2002.

The results show that East Asian aggregate saving plays a more important role than global aggregate saving when Japan is included in East Asia (Table 2.5), but global aggregate saving plays a more important role than East Asian aggregate saving when Japan is included in the global aggregate. Therefore, Japan is likely to be the key country that helps to finance investment in emerging East Asian economies. To confirm this conjecture, one may run a regression that includes the Japanese saving rate as a separate regressor, as follows:

\[ \frac{I_t}{Y_t} = \alpha_i + \beta \frac{S^R_t}{Y^R_t} + \gamma \frac{S^R_t}{Y^R_t} + \delta \frac{S^G_t}{Y^G_t} + \rho \frac{S^J_t}{Y^J_t} + \epsilon_{it}, \]

where \( S^J \) and \( Y^J \) are Japanese saving and output, respectively. East Asia includes the ten emerging East Asian economies (excluding Japan) and the global aggregate includes the G-7 economies, minus Japan. Table 2.7 confirms the conjecture. The coefficient of Japanese saving is positive and significant at the 1% level, but the coefficient of the global saving rate is not estimated to be significant.
Table 2.6: Domestic investment regressions: the role of domestic, regional, and global saving – with Japan in the global aggregate

\[
I_{it} = \alpha_i + \beta \frac{S_{it}}{Y_{it}} + \gamma \frac{S_{it}^{R}}{Y_{it}} + \delta \frac{S_{it}^{G}}{Y_{it}} + \varepsilon_{it}
\]

(A) Full period regression

<table>
<thead>
<tr>
<th>Regression</th>
<th>Fixed effect</th>
<th>Instrumental variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression 1</td>
<td>$\beta$</td>
<td>0.40**</td>
</tr>
<tr>
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<td></td>
<td>(0.09)</td>
</tr>
<tr>
<td>Regression 2</td>
<td>$\beta$</td>
<td>0.39**</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.09)</td>
</tr>
<tr>
<td></td>
<td>$\gamma$</td>
<td>0.11</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.19)</td>
</tr>
<tr>
<td>Regression 3</td>
<td>$\beta$</td>
<td>0.37**</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.09)</td>
</tr>
<tr>
<td></td>
<td>$\delta$</td>
<td>0.55</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.35)</td>
</tr>
<tr>
<td>Regression 4</td>
<td>$\beta$</td>
<td>0.37**</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.09)</td>
</tr>
<tr>
<td></td>
<td>$\gamma$</td>
<td>$-0.01$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.21)</td>
</tr>
<tr>
<td></td>
<td>$\delta$</td>
<td>0.55</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.38)</td>
</tr>
</tbody>
</table>

(B) Subperiod regression (fixed effect)

<table>
<thead>
<tr>
<th>Period</th>
<th>$\beta$</th>
<th>$\gamma$</th>
<th>$\delta$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980–94</td>
<td>0.38**</td>
<td>$-0.22$</td>
<td>$0.08$</td>
</tr>
<tr>
<td>1981–95</td>
<td>0.33**</td>
<td>$-0.11$</td>
<td>$0.06$</td>
</tr>
<tr>
<td>1982–96</td>
<td>0.31**</td>
<td>$-0.17$</td>
<td>$-0.42$</td>
</tr>
<tr>
<td>1983–97</td>
<td>0.29*</td>
<td>$-0.07$</td>
<td>$-0.39$</td>
</tr>
<tr>
<td>1984–98</td>
<td>0.32**</td>
<td>$-0.12$</td>
<td>$0.61$</td>
</tr>
<tr>
<td>1985–99</td>
<td>0.17</td>
<td>$-0.32$</td>
<td>$2.56**$</td>
</tr>
<tr>
<td>1986–2000</td>
<td>0.14</td>
<td>$-0.22$</td>
<td>$2.87**$</td>
</tr>
<tr>
<td>1987–2001</td>
<td>0.31*</td>
<td>$-0.29$</td>
<td>$2.40**$</td>
</tr>
<tr>
<td>1988–2002</td>
<td>0.33*</td>
<td>$-0.26$</td>
<td>$2.06*$</td>
</tr>
<tr>
<td>1989–2003</td>
<td>0.33*</td>
<td>$-0.03$</td>
<td>$1.54$</td>
</tr>
<tr>
<td>1990–2004</td>
<td>0.35*</td>
<td>0.03</td>
<td>$1.39$</td>
</tr>
<tr>
<td>1991–2005</td>
<td>0.41**</td>
<td>0.09</td>
<td>$1.32$</td>
</tr>
<tr>
<td>1992–2006</td>
<td>0.41**</td>
<td>0.10</td>
<td>$1.32$</td>
</tr>
<tr>
<td>1993–2007</td>
<td>0.32*</td>
<td>0.08</td>
<td>$1.35$</td>
</tr>
</tbody>
</table>

Source: authors.

Notes: Emerging East Asia regional aggregate includes the People’s Republic of China; Hong Kong, China; Indonesia; Republic of Korea; Malaysia; the Philippines; Singapore; Taipei, China; Thailand; and Viet Nam. Global aggregate includes Canada, France, Germany, Italy, Japan, the United Kingdom, and the United States. The numbers in parentheses are standard errors.

** Significant at the 1% confidence level.

* Significant at the 5% confidence level.
Table 2.7 The role of Japanese saving

\[ \frac{I_t}{Y_t} = \alpha_t + \beta \frac{S_{it}}{Y_t} + \gamma \frac{S_{Rt}}{Y_t} + \delta \frac{S_{Gt}}{Y_t} + \rho \frac{S_{Jt}}{Y_t} + \epsilon_{it} \]

(A) Full period regression

<table>
<thead>
<tr>
<th>Coefficient</th>
<th>Fixed effect</th>
<th>Instrumental variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \beta )</td>
<td>0.38**</td>
<td>0.32**</td>
</tr>
<tr>
<td></td>
<td>(0.09)</td>
<td>(0.09)</td>
</tr>
<tr>
<td>( \gamma )</td>
<td>-0.05</td>
<td>-0.27</td>
</tr>
<tr>
<td></td>
<td>(0.20)</td>
<td>(0.24)</td>
</tr>
<tr>
<td>( \delta )</td>
<td>-0.37</td>
<td>-0.48</td>
</tr>
<tr>
<td></td>
<td>(0.38)</td>
<td>(0.47)</td>
</tr>
<tr>
<td>( \rho )</td>
<td>0.70**</td>
<td>1.11**</td>
</tr>
<tr>
<td></td>
<td>(0.25)</td>
<td>(0.29)</td>
</tr>
</tbody>
</table>

(B) Subperiod regression (fixed effect)

<table>
<thead>
<tr>
<th>Period</th>
<th>( \beta )</th>
<th>( \gamma )</th>
<th>( \delta )</th>
<th>( \rho )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980–94</td>
<td>0.36**</td>
<td>-0.27</td>
<td>0.41</td>
<td>-0.26</td>
</tr>
<tr>
<td>1981–95</td>
<td>0.32**</td>
<td>-0.12</td>
<td>0.22</td>
<td>-0.16</td>
</tr>
<tr>
<td>1982–96</td>
<td>0.29**</td>
<td>-0.24</td>
<td>-0.01</td>
<td>-0.32</td>
</tr>
<tr>
<td>1983–97</td>
<td>0.27*</td>
<td>-0.13</td>
<td>-0.09</td>
<td>-0.33</td>
</tr>
<tr>
<td>1984–98</td>
<td>0.32**</td>
<td>-0.02</td>
<td>0.58</td>
<td>-0.02</td>
</tr>
<tr>
<td>1985–99</td>
<td>0.21</td>
<td>-0.05</td>
<td>0.25</td>
<td>1.23**</td>
</tr>
<tr>
<td>1986–2000</td>
<td>0.17</td>
<td>-0.05</td>
<td>-0.14</td>
<td>1.24**</td>
</tr>
<tr>
<td>1987–2001</td>
<td>0.31*</td>
<td>-0.18</td>
<td>-0.34</td>
<td>1.34**</td>
</tr>
<tr>
<td>1988–2002</td>
<td>0.34*</td>
<td>-0.21</td>
<td>-0.26</td>
<td>1.46**</td>
</tr>
<tr>
<td>1989–2003</td>
<td>0.32*</td>
<td>-0.14</td>
<td>-0.36</td>
<td>1.41**</td>
</tr>
<tr>
<td>1990–2004</td>
<td>0.32*</td>
<td>-0.25</td>
<td>-0.26</td>
<td>1.32**</td>
</tr>
<tr>
<td>1991–2005</td>
<td>0.37*</td>
<td>-0.33</td>
<td>-0.45</td>
<td>1.54**</td>
</tr>
<tr>
<td>1992–2006</td>
<td>0.36*</td>
<td>-0.31</td>
<td>-0.40</td>
<td>1.52**</td>
</tr>
<tr>
<td>1993–2007</td>
<td>0.19</td>
<td>-0.97*</td>
<td>-0.43</td>
<td>2.59**</td>
</tr>
</tbody>
</table>

Source: authors.

Notes: East Asia regional aggregate includes ten East Asian countries, excluding Japan. Global aggregate includes the G-7 countries, but excluding Japan. The numbers in parentheses are standard errors.

** Significant at the 1% confidence level.

* Significant at the 5% confidence level.

The subperiod estimation shows that the coefficients of the Japanese saving rate are positive and significant in the later subperiods (from 1985–99 to 1993–2007).

Table 2.8A shows the estimation results for the modified regression that includes only two regressors. As in Table 2.6, East Asia includes ten emerging East Asian economies, excluding Japan, but the global aggregate includes G-7 countries,
Table 2.8: The role of regional, global, and Japanese saving

(A) Including Japan in the G-7

\[
\frac{I_{it}}{Y_{it}} - \frac{S_{it}}{Y_{it}} = \alpha_i + \gamma \left( \frac{S_{it}}{Y_{it}} - \frac{S_{it}}{Y_{it}} \right) + \delta \left( \frac{S_{it}}{Y_{it}} - \frac{S_{it}}{Y_{it}} \right) + \varepsilon_{it}
\]

<table>
<thead>
<tr>
<th>Regression</th>
<th>Fixed effect</th>
<th>Instrumental variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression 1</td>
<td>$\gamma$</td>
<td>0.54** (0.09)</td>
</tr>
<tr>
<td>Regression 2</td>
<td>$\delta$</td>
<td>0.63** (0.09)</td>
</tr>
<tr>
<td>Regression 3</td>
<td>$\gamma$</td>
<td>0.00 (0.20)</td>
</tr>
<tr>
<td></td>
<td>$\delta$</td>
<td>0.63** (0.22)</td>
</tr>
</tbody>
</table>

(B) Excluding Japan from the G-7

\[
\frac{I_{it}}{Y_{it}} - \frac{S_{it}}{Y_{it}} = \alpha_i + \gamma \left( \frac{S_{it}}{Y_{it}} - \frac{S_{it}}{Y_{it}} \right) + \delta \left( \frac{S_{it}}{Y_{it}} - \frac{S_{it}}{Y_{it}} \right) + \rho \left( \frac{S_{it}}{Y_{it}} - \frac{S_{it}}{Y_{it}} \right) + \varepsilon_{it}
\]

<table>
<thead>
<tr>
<th>Regression</th>
<th>Fixed effect</th>
<th>Instrumental variable</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\gamma$</td>
<td>-0.01 (0.19)</td>
</tr>
<tr>
<td></td>
<td>$\delta$</td>
<td>-0.12 (0.26)</td>
</tr>
<tr>
<td></td>
<td>$\rho$</td>
<td>0.75** (0.25)</td>
</tr>
</tbody>
</table>

Source: authors.

Notes: Global aggregate (G-7) includes Canada, France, Germany, Italy, Japan, United Kingdom, and the United States. In both panels, the emerging East Asia regional aggregate includes the People’s Republic of China; Hong Kong, China; Indonesia; Republic of Korea; Malaysia; the Philippines; Singapore; Taipei, China; Thailand; and Viet Nam. In (A) the global aggregate includes the G-7 economies, including Japan. In (B) the global aggregate excludes Japan. The numbers in parentheses are standard errors.

** Significant at the 1% confidence level.
* Significant at the 5% confidence level.

including Japan. The coefficient of the G-7 saving rate (minus the own saving rate) is positive and estimated to be significant, but the coefficient of the regional aggregate saving rate (minus own saving rate) is close to zero and insignificant. Table 2.8B shows the estimation results for the modified regression that includes
the Japanese saving rate separately but uses only three regressors. Again, only the coefficient of the Japanese saving rate (minus the own saving rate) is positive and significant.

### 2.3.3 Controlling structural shocks

Table 2.9 shows the coefficients estimated from the regressions of saving and investment rates on productivity shocks, without lag and with one lag. The signs of the coefficients are as expected in most cases: an increase in productivity has positive effects on investment and saving. Coefficients of lag variables are in general smaller than the coefficients of contemporaneous variables. Therefore, the regression without lags is used for the following regressions. In fact, the results with and without lags are similar. The new saving and investment rate data are constructed by taking the residuals of these regressions of saving and investment rates on productivity shocks.

Table 2.10A reports the results for the regression of the investment rate on the domestic, East Asian aggregate (including Japan) and G-7 (minus Japan) saving rates, after controlling for productivity shocks. As in the case without controlling for productivity shocks, the coefficient of the East Asian aggregate saving rate is larger than the coefficient of the saving rate of the G-7 minus Japan. However, the coefficient of the East Asian aggregate saving rate is not estimated to be significant. Table 2.10B reports the results for the modified regression with only two regressors. Now the coefficient of the East Asian aggregate saving rate (minus the domestic saving rate) is positive and significant at the 1% level.

Table 2.11 reports the results for the case in which the global aggregate includes Japan but East Asia excludes Japan (emerging East Asia), after controlling for productivity shocks. In the regression that includes three regressors (Table 2.11A), coefficients of the emerging East Asian and global aggregate saving rates are not estimated to be significant. In the regression that includes only two regressors (Table 2.11B), coefficients of the emerging East Asian and global aggregate saving rates are positive and estimated to be significant.

Table 2.12 reports the results that include Japanese savings rate separately. In the regression that includes four regressors (Table 2.12A), the coefficient of the Japanese saving rate is positive, but the coefficients of the regional aggregate and global saving rates are either non-positive or insignificant. In the regression that includes three regressors (Table 2.12B), the coefficient of the Japanese saving rate is positive and significant, but the other coefficients are not estimated to be significant.

Overall, although less clear-cut than the results from basic regressions, these regression results, after controlling for productivity shocks, confirm that the Japanese saving rate played the most important role in financing investment in emerging East Asian economies and that global saving, excluding Japan, did not help finance East Asian investment at all.
Table 2.9 Effects of productivity shocks on saving and investment

\[
\Delta \left( \frac{I}{Y} \right)_t = \alpha I + \beta I \Delta \text{prodsh}_t
\]

\[
\Delta \left( \frac{S}{Y} \right)_t = \alpha S + \beta S \Delta \text{prodsh}_t
\]

<table>
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<tr>
<th></th>
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<tr>
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<td>0.06</td>
<td>0.23*</td>
<td>0.21*</td>
<td>0.45**</td>
<td>0.48**</td>
<td>0.17</td>
<td>0.21*</td>
<td>0.54**</td>
<td>0.20*</td>
<td>0.18**</td>
<td>0.20**</td>
<td>0.22</td>
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<tr>
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<td>(0.08)</td>
<td>(0.13)</td>
<td>(0.11)</td>
<td>(0.10)</td>
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<td>(0.07)</td>
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<td>0.06</td>
<td>0.07</td>
<td>0.28**</td>
<td>0.12*</td>
<td>0.28**</td>
<td>0.05</td>
<td>0.12</td>
<td>0.16**</td>
<td>0.13*</td>
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</tr>
<tr>
<td>(0.02)</td>
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<td>(0.10)</td>
<td>(0.06)</td>
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<td>(0.07)</td>
<td>(0.06)</td>
<td>(0.06)</td>
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</tr>
<tr>
<td>( \beta_I )</td>
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<td>0.16</td>
<td>0.23*</td>
<td>0.26**</td>
<td>0.51**</td>
<td>0.49**</td>
<td>0.17</td>
<td>0.21*</td>
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<td>(0.10)</td>
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<td>(0.10)</td>
<td>(0.13)</td>
<td>(0.03)</td>
<td>(0.08)</td>
<td>(0.12)</td>
<td>(0.11)</td>
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<td>0.05</td>
<td>0.06</td>
<td>−0.01</td>
<td>−0.02</td>
<td>−0.04</td>
<td>0.11</td>
<td>0.16</td>
<td>0.04</td>
<td>0.11**</td>
<td>−0.01</td>
<td>−0.06</td>
<td>−0.05</td>
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<td>(0.08)</td>
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<td>(0.10)</td>
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<td>(0.10)</td>
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<td>(0.07)</td>
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<td>0.06</td>
<td>0.09</td>
<td>0.06</td>
<td>0.04</td>
<td>0.26**</td>
<td>0.12*</td>
<td>0.27**</td>
<td>0.02</td>
<td>0.20</td>
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<td>(0.09)</td>
<td>(0.06)</td>
<td>(0.06)</td>
<td>(0.15)</td>
<td>(0.02)</td>
<td>(0.06)</td>
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<tr>
<td>( \beta_{S-1} )</td>
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<td>−0.01</td>
<td>0.03</td>
<td>−0.01</td>
<td>0.00</td>
<td>0.04</td>
<td>0.00</td>
<td>−0.02</td>
<td>0.06</td>
<td>−0.12</td>
<td>0.10**</td>
<td>0.03</td>
<td>0.00</td>
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<tr>
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<td>(0.06)</td>
<td>(0.09)</td>
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Source: authors.

Notes: PRC = People’s Republic of China; HKG = Hong Kong, China; INO = Indonesia; KOR = Republic of Korea; MAL = Malaysia; PHI = the Philippines; SIN = Singapore; TAP = Taipei, China; THA = Thailand; VIE = Vietnam; JPN = Japan. East Asia includes the 11 economies listed above. The G-7 includes Canada, France, Germany, Italy, Japan, the United Kingdom, and the United States. “G-6” is G-7 less Japan. The numbers in parentheses are standard errors.

* Significant at the 5% confidence level.

** Significant at the 1% confidence level.
Table 2.10 Investment rate regressions: the role of domestic, regional, and global saving – with Japan in the regional aggregate (controlling for shocks)

(A) Investment rate regression

\[
\frac{I_{it}}{Y_{it}} = \alpha_i + \beta \frac{S_{it}}{Y_{it}} + \gamma \frac{S^R_{it}}{Y^R_{it}} + \delta \frac{S^G_{it}}{Y^G_{it}} + \epsilon_{it}
\]

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<tr>
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<th>Fixed effect</th>
<th>Instrumental variable</th>
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<tr>
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<td>$\gamma$</td>
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<tr>
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<td></td>
<td>(0.21)</td>
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</table>

(B) Modified regression

\[
\frac{I_{it}}{Y_{it}} - \frac{S_{it}}{Y_{it}} = \alpha_i + \gamma \left( \frac{S^R_{it}}{Y^R_{it}} - \frac{S_{it}}{Y_{it}} \right) + \delta \left( \frac{S^G_{it}}{Y^G_{it}} - \frac{S_{it}}{Y_{it}} \right) + \epsilon_{it}
\]

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<td></td>
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<tr>
<td></td>
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<td>(0.15)</td>
</tr>
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</table>

Source: authors.

Notes: East Asia regional aggregate includes the People’s Republic of China; Hong Kong, China; Indonesia; Japan; Republic of Korea; Malaysia; the Philippines; Singapore; Taipei, China; Thailand; and Viet Nam. Global aggregate includes Canada, France, Germany, Italy, the United Kingdom, and the United States. For instrumental variable regressions, the lagged savings rate is used as an instrument. The numbers in parentheses are standard errors.

\*\* Significant at the 1% confidence level.

\* Significant at the 5% confidence level.
Table 2.11 Investment rate regressions: the role of domestic, regional, and global saving – with Japan in the global aggregate (controlling for shocks)

(A) Investment rate regression

\[
\frac{I_t}{Y_{it}} = \alpha_i + \beta \frac{S_t}{Y_{it}} + \gamma \frac{S^R_t}{Y_{it}} + \delta \frac{S^G_t}{Y_{it}} + \epsilon_{it}
\]

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<th>Regression</th>
<th>Fixed effect</th>
<th>Instrumental variable</th>
</tr>
</thead>
<tbody>
<tr>
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<td>0.20** 0.20**</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.08) (0.07)</td>
</tr>
<tr>
<td>Regression 2</td>
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<td>0.19** 0.20**</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.08) (0.07)</td>
</tr>
<tr>
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<td>$\gamma$</td>
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<tr>
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<tr>
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<td>$\beta$</td>
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<tr>
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<tr>
<td>Regression 4</td>
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<td></td>
<td>$\delta$</td>
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<tr>
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<td>(0.31) (0.31)</td>
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</tbody>
</table>

(B) Modified regression

\[
\frac{I_t}{Y_{it}} = \alpha_i + \gamma \left( \frac{S^R_t}{Y_{it}} - \frac{S^G_t}{Y_{it}} \right) + \delta \left( \frac{S^G_t}{Y_{it}} - \frac{S_t}{Y_{it}} \right) + \epsilon_{it}
\]

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Source: authors.

Notes: Emerging East Asia regional aggregate includes the People’s Republic of China; Hong Kong, China; Indonesia; Republic of Korea; Malaysia; the Philippines; Singapore; Taipei,China; Thailand; and Viet Nam. Global aggregate includes Canada, France, Germany, Italy, Japan, the United Kingdom, and the United States. The numbers in parentheses are standard errors.

** Significant at 1% confidence level.
* Significant at the 5% confidence level.
Table 2.12 Investment rate regressions: the role of Japanese saving (controlling for shocks)

(A) Investment rate regression

\[ \frac{I_t}{Y_t} = \alpha_i + \beta \frac{S_t}{Y_t} + \gamma \frac{S^R_t}{Y_t} + \delta \frac{S^G_t}{Y_t} + \rho \frac{S^J_t}{Y_t} + \varepsilon_{it} \]

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<td>(0.08)</td>
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<tr>
<td>( \gamma )</td>
<td>-0.02</td>
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<td>(0.38)</td>
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<tr>
<td>( \rho )</td>
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</table>

(B) Modified regression

\[ \frac{I_t}{Y_t} - \frac{S_t}{Y_t} = \alpha_i + \gamma \left( \frac{S^R_t}{Y_t} - \frac{S_t}{Y_t} \right) + \delta \left( \frac{S^G_t}{Y_t} - \frac{S_t}{Y_t} \right) + \rho \left( \frac{S^J_t}{Y_t} - \frac{S_t}{Y_t} \right) + \varepsilon_{it} \]

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<th>Fixed effect variable</th>
<th>Instrumental variable</th>
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<td>( \delta )</td>
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<td>( \rho )</td>
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Source: authors.

Notes: Emerging East Asia regional aggregate includes the People’s Republic of China; Hong Kong, China; Indonesia; Republic of Korea; Malaysia; the Philippines; Singapore; Taipei, China; Thailand; and Viet Nam. Global aggregate includes Canada, France, Germany, Italy, the United Kingdom, and the United States. The numbers in parentheses are standard errors.

** Significant at the 1% confidence level.
* Significant at the 5% confidence level.

2.4 Conclusion

Following capital account liberalization and financial market deregulation in the early 1990s, East Asian economies experienced a surge in international capital flows. Theoretically, improved international capital mobility can provide a benefit by efficiently allocating worldwide saving to the place with appropriate
investment opportunities. This chapter investigates the extent to which the domestic investment of East Asian economies is financed by domestic, regional, and global saving, in order to infer the role of regional and global capital markets in funding domestic investment.

The empirical results are as follows. First, global saving (as proxied by G-7 saving, minus that of Japan) has not played a role in financing the domestic investment of emerging East Asian economies. Since the 1990s, capital flows between East Asian economies and industrial countries have been large. These large capital flows have often been considered to be a source of currency crisis and instability of asset prices and financial systems in East Asian economies. Despite the drawbacks of high international capital mobility, theories suggest that global capital markets can also provide a benefit. However, the empirical results presented in this chapter show that huge international capital flows between major industrial countries and East Asian economies have not really been a meaningful source of domestic investment in East Asia.

Second, the East Asian capital market including Japan has been successful in financing domestic investment. Japanese saving appears to have played the most important role in financing the domestic investment of emerging East Asian economies. This result is interesting, as past studies have often suggested that East Asian regional capital markets are not very integrated. However, when the coverage of the regional capital market is extended to include Japan, the regional market is found to be rather well integrated and effective in funding the investment of individual economies in the region.

Third, the role of Japanese saving (or East Asian aggregate saving including Japan) in financing East Asian investment has increased from the 1980s to the 2000s. East Asian economies have taken steps to improve regional financial cooperation and integration since the Asian financial crisis. Improved regional financial cooperation, together with various measures to facilitate the market liberalization and deregulation process, has likely contributed to this increased role of the regional financial markets.

Notes

1 For example, see Kim, Kim, and Wang (2007).
2 Eichengreen and Park (2004) and Kim, Lee, and Shin (2007) documented that financial market integration within East Asian economies has been far slower than that between East Asia and advanced economies.
3 See Rodrik and Subramanian (2009) for a survey of the costs and benefits of capital account liberalization.
5 See Kim and Kim (2009) for more detailed discussion of methodology and applications to more general samples.
6 For example, see Eichengreen and Park (2004); Kim, Lee, and Shin (2007); Kim and Lee (2008); Kim, Kim, and Wang (2004).
7 The original 15 members of the European Union were Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden, and the United Kingdom.
8 The list of possible sources that may make the sum be not equal to 1 follows. First, regional or global investment may affect domestic investment. For example, a drop in regional or global investment may contribute to an increase in domestic saving. However, investments were not included in the regression because it is hard to interpret the coefficients of investments, especially in relation to the role of regional and global financial markets. Second, if the per capita income is different across economies, the sum may not be equal to 1. Third, the chapter uses investment and saving rate data on country, regional aggregate, and global aggregate levels, and these scales may not be the same, especially when global saving rates affect investment rates of East Asian economies differently from those of the world’s other economies. Fourth, the foreign data may not include all the economies in the world. Fifth, there can be some measurement errors.

9 The G-7 countries are Canada, France, Germany, Italy, Japan, the US, and the United Kingdom.

10 This result may imply that the current account is non-stationary. Although many studies have assumed that the current account is stationary, this is unclear from the data. Faruqee and Lee (2009) interpreted this result as follows: (1) unit root and stationarity tests tend to have lower power in a finite sample; and (2) the current account is generally a very persistent series, making it difficult to distinguish between non-stationary and stationary alternatives over limited time spans.

11 For a rough comparison, if the standard deviation of each variable is multiplied by the coefficient of the variable, $(2.07)(0.38) = 0.787$ is obtained for the individual saving rate, and $(0.87)(0.48) = 0.418$ for the East Asian aggregate saving rate.

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Soyoung Kim, Sunghyun H. Kim, and Cyn-Young Park

Since East Asian economies have undertaken measures of financial deregulation from the early 1990s, their financial markets have tended to become more integrated internationally. International financial market integration can bring various benefits: economies can smooth consumption in the face of temporary falls in income and finance domestic investment in excess of domestic saving. They can also hedge country-specific risks via international financial markets. However, integrated international financial markets can also have a negative effect: economic shocks can easily be transmitted among countries, as shown by the 2008 global financial crisis. Contagion effects have also been important sources of financial and/or currency crises.

This chapter examines risk-sharing properties of East Asian economies, which is an important consequence and/or measure of financial market integration. In other words, the chapter examines how each country can hedge country-specific consumption and income risks by trading financial assets internationally, given uncertain income streams.

While the degree that East Asian financial markets are integrated has tended to increase recently, it is not clear that recent capital account and financial market liberalization contributed to financial market integration within East Asia (Eichengreen and Park 2004, Kim, Lee, and Shin 2007). In a similar vein, whether the degree of regional risk-sharing of East Asian economies has increased in recent years is unclear, especially in comparison with the degree of global risk-sharing (Kim, Kim, and Wang 2004, Kim, Lee, and Shin 2007).

While it is rather clear that a higher degree of (global) risk-sharing in general can enhance an economy’s welfare, it is not certain that a higher degree of regional risk-sharing is always beneficial. A higher degree of regional risk-sharing can contribute to the formation of monetary integration in the region by decreasing the costs of monetary integration as risk-sharing would provide an important stabilizing mechanism within the region. However, a country that is fully integrated with global financial markets may not need to use a regional financial market. Further, an increase in regional risk-sharing may substitute for global risk-sharing.

To shed light on these issues, this chapter documents the evolution of risk-sharing properties for East Asian economies. Estimating the degree of regional
versus global risk-sharing is of particular interest. The chapter also identifies the channels of risk-sharing (the international capital market, international credit market, and domestic credit market), with more attention to the role of international financial markets (the international capital and credit markets). Identifying the channels may help to derive policy suggestions on risk-sharing channels that appear more successful at the regional or international level. To implement these ideas, the empirical methodology developed by Asdrubali and Kim (2009) is applied.

Some studies document risk-sharing properties of East Asian economies. Kim, Kim, and Wang (2006) estimated the degree of consumption risk-sharing and the channels of consumption risk-sharing among ten East Asian economies. They showed that risk-sharing is far from complete, and only credit markets play some role. Kim, Kim, and Wang (2004), Kim, Lee, and Shin (2007), and Kim and Lee (2008) estimated the degree of regional versus global risk-sharing in East Asia. While Kim, Kim, and Wang (2006) concluded that the results differ among economies, Kim, Lee, and Shin (2007) and Kim and Lee (2008) concluded that regional risk-sharing tends to be smaller than global risk-sharing. While Kim, Kim, and Wang (2006) did not compare global versus regional risk-sharing, the other studies did not discuss the channels of risk-sharing. The current chapter documents various risk-sharing properties of East Asian economies (e.g. regional versus global risk-sharing, channels of risk-sharing, evolution of risk-sharing, and the relationship between regional and global risk-sharing).

The chapter is organized as follows: Section 3.1 summarizes the relevant literature on risk-sharing, Section 3.2 illustrates the empirical methodology, Section 3.3 presents the empirical results, and Section 3.4 provides the conclusions.

3.1 The risk-sharing literature

Since the works of Arrow (1953, 1964) and Debreu (1959) on general equilibrium under uncertainty, it has become clear that agents facing an uncertain income realization can insure their consumption by trading, in principle, output claims contingent on the state of nature; by sharing their individual risks, agents are thus able to smooth their marginal utility of consumption across states of nature. Full consumption insurance obtains in a competitive equilibrium when financial markets are complete or when institutions exist that implement the optimal allocation. A major implication of the theory is that, with HARA preferences, agents’ consumption will no longer depend on individual (idiosyncratic) resources, but will mutually covary, and hence covary with aggregate consumption.

Lucas (1982) pioneered a dynamic version of the model applied to a world economy, where, under some restrictions on the model specification, countries can achieve an allocation with efficient risk-sharing by diversifying their financial portfolios across a restricted number of assets. In such a dynamic setting, full risk-sharing (i.e. complete smoothing of consumption across states of nature) entails full intertemporal smoothing (i.e. complete smoothing of consumption over time).
Successive theoretical contributions have mainly focused on the characterization of equilibrium allocation in the presence of market incompleteness and/or market imperfections of various types.

Empirical studies on risk-sharing have grown rapidly in recent years. The formal literature started by testing the null hypothesis of full risk-sharing at various aggregation levels, such as among individuals in a village (Townsend 1994); among households (Altug and Miller 1990, Cochrane 1991, Mace 1991, Hayashi, Altonji, and Kotlikoff 1996); and among countries (Canova and Ravn 1996, Lewis 1996). These seminal papers were essentially based on cross-sectional regressions of idiosyncratic consumption on idiosyncratic income (and possibly on other idiosyncratic variables), often controlling for aggregate consumption. As Hayashi, Altonji, and Kotlikoff (1996: 261) noted, “Testing full risk-sharing across a set of households simply requires examining the cross-section correlation between their changes in consumption and their changes in resources.” The emphasis on the cross-sectional relationship is even clearer in Cochrane (1991: 957), who explains that the risk-sharing main proposition “can be viewed as a cross-sectional counterpart to the permanent income hypothesis: full insurance implies that consumption should not vary across individuals in response to idiosyncratic shocks, just as constant borrowing and lending opportunities imply that consumption should not vary over time in response to forecastable shocks.” A recent application of this idea can be found in Asdrubali and Kim (2008b) who, by exploiting econometric properties of panel data, analyzed a regression using the method of Hayashi, Altonji, and Kotlikoff, by measuring its risk-sharing properties through a cross-sectional decomposition and estimation as well as its intertemporal smoothing properties through a time-series decomposition and estimation.

This initial work originated two strands of empirical macroeconomic literature. One line of research, firmly based on theoretical foundations, has allowed for the possibility of incomplete risk-sharing and has focused on its precise measurement (e.g. Obstfeld 1994, Crucini 1999, Crucini and Hess 2000, Athanasoulis and van Wincoop 2001). These studies usually focused on the degree of risk-sharing across regions (mutual insurance across states of nature against idiosyncratic regional risks) and adopted a single-equation specification that typically tested the main implication of the theory by regressing country consumption on idiosyncratic income and aggregate consumption/income. In particular, Crucini (1999) assumed market imperfection in that agents will choose different groups with which they want to pool their risks: conational and foreigners. Hence, a country’s consumption may depend in part on domestic income and in part on aggregate consumption.

If risk-sharing is incomplete, then market trades based on portfolio diversification may be complemented by other market or institutional mechanisms. Thus, a second line of risk-sharing research, started with a paper by Asdrubali, Sørensen, and Yoshia (1996), focused on integrating various risk-sharing channels in a single framework. Using an output variance decomposition method, they were able to break down cross-sectional consumption smoothing into successive “channels,” whose contribution equals overall risk-sharing. They calculated that an output
change in a United States state is smoothed on average 39% by interstate asset income, 13% by fiscal risk-sharing, and 23% by credit markets through cross-state lending and borrowing. The remaining 25% is by definition the unsmoothed fraction of income change. Sørensen and Yosha (1998) repeated the analysis for countries of the Organisation for Economic Co-operation and Development (OECD) and confirmed the “home bias” result of French and Poterba (1991), while revealing that all international smoothing (about 30% of a shock to a country’s output) takes place through domestic credit markets [and mostly through budget deficits, as Arreaza, Sørensen, and Yosha (1999) documented]. Several papers have refined Asdrubali, Sørensen, and Yosha’s methodology, and a map is being created of the scope and capability of several economies’ shock absorption, and that of their regions. The pattern that emerges is one of scarce international risk-sharing, where asset home bias prevails and smoothing takes place essentially through domestic saving; and of richer intranational risk-sharing, where the role of capital markets can sometimes be preponderant.

Asdrubali and Kim (2009) merged these two lines of research in their risk-sharing estimations. Their model extends the idea of varying degrees of income pooling, proposed by Crucini (1999), by considering three geographical risk-sharing dimensions: world, regional, and domestic (i.e., no risk-sharing, from a country’s perspective), and breaks down each dimension into the type of channels proposed by Sørensen and Yosha (1998). The connection between the two models is firmly established through a rigorous decomposition of the single equation into a multi-equation setting.

3.2 The empirical method

Asdrubali and Kim (2009) developed the empirical method used here to estimate the regional and global degree of risk-sharing achieved by various risk-sharing channels.

3.2.1 The model

Following Crucini (1999) and Asdrubali and Kim (2008a, 2009), consider a set of world economies, each populated by different groups of expected-utility maximizing agents who insure the stochastic stream of their exogenous income flows by pooling their resources at different aggregation levels. The group of agents that share their income risks at the world level will be entitled, in equilibrium, to a fraction $\lambda$ of the world income pool available for consumption; the group of agents that share their income risks at the regional level will be entitled, in equilibrium, to a fraction $\lambda_R$ of the regional income pool available for consumption; finally, the group of agents that share their income risks at the domestic level will be entitled, in equilibrium, to a fraction $(1 - \lambda_R - \lambda)$ of the domestic income pool available for consumption. From the point of view of the representative agent, each economy $i$ sells fraction $\lambda_R$ of its income stream, $Y_i$, in exchange for a claim to the pooled income streams of economies in its region, while the economy sells
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fraction $\lambda$ of its income stream, $Y_i$, in exchange for a claim to the pooled income streams of all economies in the world. The average time $t$ amount in the pool of the world is $Y_t \equiv \sum_{i=1}^I Y_{it}/I$, while the average time $t$ amount in the pool of the region is $Y_{R,t} \equiv \sum_{j=1}^J Y_{jt}/J$. $I$ is the number of economies in the world while $J$ is the number of economies in the region ($J < I$).

Each country $i$ is entitled to a share of the regional and world pools based on the fractions of the income stream it has invested in the pools, that is, $\lambda R Y_{R,t}$ and $\lambda Y_t$ respectively. Therefore, the flow of country $i$’s income after risk pooling at time $t$ is

$$Y_{it} \equiv \lambda R Y_{R,t} + \lambda Y_t + (1 - \lambda R - \lambda) Y_t.$$  

(3.1)

Several market and non-market mechanisms can implement this allocation and yield a “disposable income” $Y_{it}$ available for consumption. Agents can own claims to other countries’ output stream, so that cross-border interest, dividend, and rental income – and partly total consumption – will covary with foreign income (relative to domestic income); such international risk-sharing via cross-border ownership of productive assets will be reflected in national accounts data as the difference between gross domestic product and gross national income (i.e. net factor income). Similarly, agents’ saving (measured by the difference between gross disposable income and total consumption) may ensure that a country’s total consumption will comove more with foreign income (relative to domestic income). Such saving may be used either in the international credit market (measured by the current account) or in the domestic credit market (measured by investment).

Hence the transformation of $Y_{it}$ into $Y_{it}$ can be broken down in several stages, each identifying a risk-sharing channel. Let $Y_{it}^k, (k = 1, 2, \ldots, K)$ and $Y_{it}^1 = Y_{it}$ indicate the income flow at risk-sharing level $k$ (i.e. after $k$ channels of risk-sharing have operated). For example, if $Y_{it}$ is gross domestic product, then $Y_{it}^1$ can indicate gross national income (the difference being net factor income flows), $Y_{it}^2$ can indicate domestic absorption (the difference being the current account balance) and so on. Then,

$$Y_{it} - Y_{it}^1, Y_{it}^1 - Y_{it}^2, \ldots, Y_{it}^{K-1} - Y_{it}^K$$

represents income flows from various channels of risk-sharing. Note that both world and regional risk-sharing arrangements can contribute to income flows from various channels of risk-sharing. Then,

$$Y_{it} - Y_{it}^1 = \lambda R (Y_{it} - Y_{R,t}) + \lambda (Y_t - Y_t),$$

(3.2)

$$Y_{it}^1 - Y_{it}^2 = \lambda R (Y_{it} - Y_{R,t}) + \lambda (Y_t - Y_t),$$

$$\ldots$$

$$Y_{it}^{K-1} - Y_{it}^K = \lambda R (Y_{it} - Y_{R,t}) + \lambda (Y_t - Y_t),$$
where $\lambda^1, \ldots, \lambda^K$ shows the extent of world risk-sharing provided by each channel, $\lambda^1_R, \ldots, \lambda^K_R$ shows the extent of regional risk-sharing provided by each channel, and $\lambda^1 + \ldots + \lambda^K = \lambda$ and $\lambda^1_R + \ldots + \lambda^K_R = \lambda_R$ can be demonstrated.

After all $K$ channels of risk-sharing have operated, an economy’s “disposable income” is assumed to be available for consumption. Then, total consumption of economy $i$ is

$$c_{it} = \lambda_R Y_{R,t} + \lambda Y_t + (1 - \lambda_R - \lambda)Y_{it}. \quad (3.3)$$

To implement an econometric specification, equation system (3.2) and equation (3.3) are differenced and reorganized, so that equation system (3.4) can be estimated to infer the role of world and regional risk-sharing achieved by various channels:

$$\Delta Y_{it} - \Delta Y^1_{it} = -\lambda^1 \Delta Y_t - \lambda^1_R \Delta Y_{R,t} + (\lambda^1 + \lambda^1_R)\Delta Y_{it}, \quad (3.4)$$

$$\Delta Y^1_{it} - \Delta Y^2_{it} = -\lambda^2 \Delta Y_t - \lambda^2_R \Delta Y_{R,t} + (\lambda^2 + \lambda^2_R)\Delta Y_{it},$$

$$\vdots$$

$$\Delta Y^{K-1}_{it} - \Delta Y^K_{it} = -\lambda^K \Delta Y_t - \lambda^K_R \Delta Y_{R,t} + (\lambda^K + \lambda^K_R)\Delta Y_{it},$$

$$\Delta C_{it} = \lambda \Delta Y_t + \lambda_R \Delta Y_{R,t} + (1 - \lambda_R - \lambda)\Delta Y_{it},$$

where $\lambda^1 + \ldots + \lambda^K = \lambda, \lambda^1_R + \ldots + \lambda^K_R = \lambda_R$.

To save degrees of freedom and to reduce potential multicollinearity problems, equation system (3.4) can be reorganized as follows:

$$\Delta Y_{it} - \Delta Y^1_{it} = -\lambda^1 (\Delta Y_t - \Delta Y_{it}) - \lambda^1_R (\Delta Y_{R,t} - \Delta Y_{it}). \quad (3.5)$$

$$\Delta Y^1_{it} - \Delta Y^2_{it} = -\lambda^2 (\Delta Y_t - \Delta Y_{it}) - \lambda^2_R (\Delta Y_{R,t} - \Delta Y_{it}),$$

$$\vdots$$

$$\Delta Y^{K-1}_{it} - \Delta Y^K_{it} = -\lambda^K (\Delta Y_t - \Delta Y_{it}) - \lambda^K_R (\Delta Y_{R,t} - \Delta Y_{it}),$$

$$\Delta C_{it} - \Delta Y_{it} = \lambda (\Delta Y_t - \Delta Y_{it}) + \lambda_R (\Delta Y_{R,t} - \Delta Y_{it}),$$

where $\lambda^1 + \ldots + \lambda^K = \lambda, \lambda^1_R + \ldots + \lambda^K_R = \lambda_R$.

The risk-sharing parameters $\lambda^K$ and $\lambda^K_R$ constitute an efficient metric for the degrees of risk-sharing engaged by each country with the rest of the world and with its region via each channel. The role of each channel sums to $\lambda$ for risk-sharing with the rest of the world, and to $\lambda_R$ for risk-sharing with its region. For example, when domestic consumption comoves with world (regional) income, irrespective of domestic income, the parameter $\lambda(\lambda_R)$ will reflect that relation linearly. In turn, that risk-sharing relation can be broken down into the contribution of $\lambda^1$ and $\lambda^1_R$ (risk-sharing through the first channel with the rest of the world and with the
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region), \( \lambda_2 \) and \( \lambda_2^R \) (risk-sharing through the second channel with the rest of the world and with the region), and \( \lambda_3 \) and \( \lambda_3^R \) (risk-sharing through the third channel with the rest of the world and with the region).

3.2.2 Data and estimation

This analysis of inter-regional and international risk-sharing of East Asian economies uses annual national accounts data for 13 economies [Association of Southeast Asian Nations (ASEAN) members excluding Myanmar plus the People’s Republic of China; Hong Kong, China; Japan; and the Republic of Korea] from the United Nations’ National Accounts Main Aggregates Database, for the period 1970–2008. The variables for the current analysis are defined using variables in national accounts as follows:

- GDP (gross domestic product);
- GNI (gross national income) = GDP + net factor income from abroad;
- DA (domestic absorption) = C + I;
- C (total consumption) = private consumption + public consumption;
- I (gross capital formation) = gross fixed capital formation + change in inventories.

Thus, in the empirical specification, \( Y_{it} \) is measured through an economy’s annual GDP, \( Y_t \) and \( Y_{R,t} \), through appropriately weighted measures of world and regional (East Asia) GDP; \( Y_{1it} \), as GNI; \( Y_{2it} \), as DA; \( I_{it} \), as I; and \( C_{it} \), as C. The variables are all in real per capita terms. Since income and consumption series do not follow exactly linear homoskedastic processes, an empirical test of an equation such as (3.5), which is cast in level-differences, is not entirely appropriate. Thus, this analysis follows the literature in taking the log approximation of the equation, as in Asdrubali and Kim (2008a) and along the lines suggested by Campbell and Mankiw (1989, 1990), Obstfeld (1994), and Crucini (1999), so that the results here will be comparable with theirs. Hence, the current estimating relations will be

\[
\begin{align*}
\Delta y_{it} - \Delta y_{1it}^{\Delta} &= -\lambda_1 \Delta y_{t} - \lambda_1^R \Delta y_{R,t} + (\lambda_1 + \lambda_1^R) \Delta y_{1it}, \\
\Delta y_{1it}^{\Delta} - \Delta y_{2it}^{\Delta} &= -\lambda_2 \Delta y_{t} - \lambda_2^R \Delta y_{R,t} + (\lambda_2 + \lambda_2^R) \Delta y_{2it}, \\
&\quad \ldots \\
\Delta y_{K-1it}^{\Delta} - \Delta y_{Kit}^{\Delta} &= -\lambda_K \Delta y_{t} - \lambda_K^R \Delta y_{R,t} + (\lambda_K + \lambda_K^R) \Delta y_{Kit}, \\
\Delta C_{it} &= \lambda \Delta y_{t} + \lambda_R \Delta y_{R,t} + (1 - \lambda_R - \lambda) \Delta y_{it}
\end{align*}
\]

and

\[
\begin{align*}
\Delta y_{it} - \Delta y_{1it}^{\Delta} &= -\lambda_1 (\Delta y_{t} - \Delta y_{it}) - \lambda_1^R (\Delta y_{R,t} - \Delta y_{Rit}), \\
\Delta y_{1it}^{\Delta} - \Delta y_{2it}^{\Delta} &= -\lambda_2 (\Delta y_{t} - \Delta y_{it}) - \lambda_2^R (\Delta y_{R,t} - \Delta y_{Rit}).
\end{align*}
\]
\[
\begin{align*}
\Delta y_{it}^{K-1} - \Delta c_{it} &= -\lambda^K (\Delta y_{it} - \Delta y_{it}) - \lambda^R (\Delta y_{R,t} - \Delta y_{it}), \\
\Delta c_{it} - \Delta y_{it} &= \lambda (\Delta y_{it} - \Delta y_{it}) - \lambda_R (\Delta y_{R,t} - \Delta y_{it}),
\end{align*}
\]

where lowercase letters indicate logs. Besides addressing possible non-stationarity of national accounts variables, the use of log-differences allows the interpretation of regression coefficients in percentage terms, a natural avenue to measure the fractions of shocks smoothed through the various mechanisms. Deflating variables by population and consumer price indexes, as well as using logs and first differences, contributes to minimizing \textit{ex ante} heteroskedasticity and autocorrelation issues. Finally, the adoption of panel data improves the efficiency of estimations in general and curbs the multicollinearity problem. Tests of any remaining problems of heteroskedasticity and autocorrelation have been carried out through appropriate diagnostics, whereas ancillary instrumental variable estimations have ruled out endogeneity issues.

Equation system (3.6) could be estimated through a seemingly unrelated regression system as in Asdrubali, Sørensen, and Yosha (1996), where the estimate of each equation can be interpreted as the weighted average of cross-section estimates. However, the presence of two income measures among the regressors risks bringing about multicollinearity issues in cross-sectional estimations. To further reduce the associated inefficiency, and to allow for a time-varying estimation of the system, the 38-year time dimension used is thoroughly exploited through a rolling regression estimation, and letting the world and regional regressors capture the cross-sectional dimension of the relations that characterize the risk-sharing arrangement. A moving 15-year window is used, which allowed the running of 24 replications of the panel estimations, thereby tracing the evolution of risk-sharing over time.

3.3 Results

The results of the rolling estimations for the 13 economies in the sample are illustrated in Tables 3.1 and 3.2 and Figures 3.1–3.4.

<table>
<thead>
<tr>
<th>Table 3.1 Estimates of world and regional risk-sharing (1971–2008)</th>
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<tbody>
<tr>
<td></td>
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<tr>
<td>Point estimate</td>
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<tr>
<td>Standard error</td>
</tr>
<tr>
<td>AR(1) coefficient</td>
</tr>
<tr>
<td>Correlation ($\lambda, \lambda_R$)</td>
</tr>
</tbody>
</table>

Source: authors.

Notes: AR(1) = first-order autoregressive; $\lambda$ = world risk-sharing; $\lambda_R$ = regional risk-sharing.
The evolution of regional and global risk-sharing in East Asian economies

Table 3.2 Estimates of world and regional risk-sharing channels (1971–2008)

<table>
<thead>
<tr>
<th>( \lambda^1 )</th>
<th>( \lambda^1_R )</th>
<th>( \lambda^2 )</th>
<th>( \lambda^2_R )</th>
<th>( \lambda^3 )</th>
<th>( \lambda^3_R )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Point estimate</td>
<td>-0.01</td>
<td>0.01</td>
<td>-0.20</td>
<td>0.18</td>
<td>0.33</td>
</tr>
<tr>
<td>Standard error</td>
<td>(0.01)</td>
<td>(0.00)</td>
<td>(0.06)</td>
<td>(0.06)</td>
<td>(0.07)</td>
</tr>
<tr>
<td>AR(1) coefficient</td>
<td>0.06</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Correlation ( (\lambda, \lambda_R) )</td>
<td>-0.92</td>
<td>-0.88</td>
<td>-0.88</td>
<td>-0.88</td>
<td>-0.88</td>
</tr>
</tbody>
</table>

Source: authors.

Notes: AR(1) = first-order autoregressive; — = not applicable; \( \lambda \) = world risk-sharing; \( \lambda_R \) = regional risk-sharing.

Figure 3.1 Evolution of world and regional risk-sharing (1971–2008).
Source: authors.

3.3.1 Overall estimation

Table 3.1 presents the relevant parameters of the overall estimation, across risk-sharing channels and over the entire 1971–2008 period.

Both world \( (\lambda) \) and regional \( (\lambda_R) \) sharing have played a non-negligible and statistically significant role in East Asian economies’ financial integration: the former has allowed each economy to share 14% of its income with the other economies in the region, whereas the latter has pooled 11% of each economy’s income with economies outside the region. However, the dynamics of overall world and regional risk-sharing are much richer, as illustrated in Figure 3.1. The gray lines show the degree of world risk-sharing and the black lines show the degree of regional risk-sharing. Every year in Figure 3.1 represents the end period of a 15-year rolling window. The evolution of regional and world risk-sharing has been highly non-linear since 1971, and characterized by a strong
negative correlation. Starting from the 1971–85 period, regional risk-sharing increases, with a setback entering the 1990s, followed by a steady decline after the 1982–96 period, just before the Asian financial crisis. Conversely, world risk-sharing decreases slowly over time after 1971 but increases abruptly from the 1991–2005 period. It is also interesting that regional risk-sharing is more volatile
over subperiods than world risk-sharing. For regional risk-sharing, the highest value (0.37) is found in the 1982–96 period, while the lowest value (−0.08) is found in 1994–2008. For global risk-sharing, the highest value (0.27) is found in the 1994–2008 period while the lowest value (0%) is found in 1974–88. To provide a very rough order of magnitude for the regional risk-sharing estimate, recall that regional risk-sharing for G-7 economies, as estimated by Crucini (1999), ranges between 0.37 and 0.60.

To put the results in perspective, compare the method employed here with various special cases. First, when the degree of world risk-sharing is restricted to zero \((\lambda = 0)\), the estimate of the degree of regional risk-sharing \((\lambda_R)\) is biased upward (compared with the unrestricted case). Similarly, when the degree of regional risk-sharing is restricted to zero \((\lambda_R = 0)\), the estimate of the degree of world risk-sharing \((\lambda)\) is biased upward. These results vindicate the multivariate approach, for they stem from the omission of the world income growth variable (in the first case) or of the regional income growth variable (in the second case) among the regressors, as confirmed by the positive covariance between regional income growth and world income growth. To formally confirm the substitutability between world and regional risk-sharing, the correlation between the two coefficients is computed, and it is firmly negative \((-0.81, \text{see Table 3.1})\). The substitutability of the two insurance mechanisms seems to have favored world risk-sharing in the period of financial liberalization that marked the “Washington consensus,” especially the early 1990s and the years prior to the 2008 global crisis, and a retrenchment to regional risk-sharing in turbulent periods, such as those following the two oil shocks of the 1970s and the Asian financial crisis.
One might wonder whether the nature of income growth shocks has played any role in the variability of risk-sharing responses over time in the sample used. Although the risk-sharing metric measures the fraction of income growth insured, shock size effects might still exert a non-linear influence on the capability of an economy to absorb disturbances. For this reason, the analysis examines the relative volatility of the regional and the world income growth variables in equation system (3.7) over two subperiods, comparing the results with the evolution of the degree of risk-sharing. The estimates show that regional and world income growth have exhibited similar degrees of volatility, which have declined from a variance of 32 and 30, respectively, in the 1971–89 subperiod to a variance of 12 and 15, respectively, during 1990–2008. These results suggest, in line with this analysis’ interpretation, that larger shocks are likely to be addressed through regional risk-sharing, while the “moderation” of the last 18 years has favored relatively more the development of risk-sharing mechanisms at the world level.

3.3.2 Channel estimation

The overall coefficients $\lambda_R$ and $\lambda$ can be broken down into the $\lambda^K_R$ and $\lambda^K$ coefficients that assess the extent of risk-sharing carried out by the three channels under analysis: capital market risk-sharing, international credit market risk-sharing, and domestic investment risk-sharing.\(^9\)

The estimates of the parameters $\lambda^1$ and $\lambda^1_R$, which can be interpreted as measures of capital market risk-sharing, suggest that East Asian economies have overall engaged in very little portfolio diversification, yet have done so more intensely within the region than with the rest of the world (Table 3.2). This is consistent with the casual observation that much of the international equity flows in Asian countries are from developed markets (notably the United States and Western Europe), because capital market risk-sharing, or, for that matter, international credit market risk-sharing, is not the only motive to engage in international equity transactions.\(^10\) Also, this result must be qualified with a detailed analysis of the evolution over time of the phenomenon, which reveals important variations.

Figure 3.2 illustrates how, starting from the 1979–93 period, portfolio diversification has been gradually increasing at the regional level and declining at the world level. The latest period, ending with the global crisis, exacerbates this trend, featuring a sharp decline of international capital market risk-sharing in favor of an even deeper regional insurance. In the 1994–2008 period, regional risk-sharing through portfolio diversification reaches about 0.10, while global risk-sharing through portfolio diversification ends up with about $-0.075$. Also in this case, the coefficient of correlation between the two parameters is a whopping $-0.92$, which suggests a strong substitutability between regional and world risk-sharing.

Along the same lines, the results for international credit market risk-sharing can be interpreted through foreign lending and borrowing ($\lambda^2$ and $\lambda^2_R$). Thanks to this standard mechanism, East Asian economies have been able to delink their consumption stream from their idiosyncratic income and from the fortunes of the world, sharing it more with their own region’s. Figure 3.3 emphasizes how the
The evolution of regional and global risk-sharing in East Asian economies

Regional insurance mechanism increased its role through the 1980s (insuring at times more than 60% of a domestic income growth shock), and has declined in importance ever since.

Domestic investment risk-sharing, an equally important shock-absorbing mechanism, as measured by $\lambda^3$ and $\lambda^3_R$, has instead taken place essentially in parallel with the world level, rather than at the regional level. The magnitude of the world phenomenon increases entering the late 1990s, reaching a $\lambda^3$ coefficient beyond 0.60 in the interval through 2007 (Figure 3.4). A possible explanation for this strong relation may be found in the behavior of domestic output growth (relative to the world’s) since the inception of the 1997 crisis: in several East Asian economies, the recession was accompanied by heavy disinvestments and capital withdrawals, which in fact lay at the basis of the risk-sharing result. The same did not happen at the regional level: thanks to the mutual lending facilities developed during those years, output growth differentials with the region did not have to impact domestic investment, but were smoothed through the international credit market mechanisms traced in Figure 3.3.

Note the difference between domestic investment and international credit market risk-sharing: while the latter is an actual channel through which domestic consumption can be linked to foreign income, on the contrary, domestic investment risk-sharing can take place even in autarky, and the increase in domestic investment in booms (like disinvestment in recessions) may represent a purely domestic response.

Also of interest is analyzing the correlation among the three risk-sharing channels (international capital markets, international credit markets, and domestic investment), in order to establish their substitutability. Thus, the study computed the correlation matrix of cross-equation residuals from an uncorrected seemingly unrelated regression, and confirmed that the correlation across risk-sharing channels is negative for all: it is strongest between the two credit channels ($-0.41$), and lower between the capital market and international credit channels ($-0.17$), possibly suggesting a strong backup role played by the domestic investment channel when international economic conditions worsen or, as outlined above, vice versa.

3.4 Conclusions

This chapter investigates one important dimension of financial integration of East Asian economies: their capability of sharing income risks among themselves, rather than with the rest of the world. The degrees of regional and world risk-sharing (via capital markets, international credit markets, and domestic investment) are compared across time, in order to assess their relative magnitudes, their evolution, and their relations.

The panel rolling regression results indicate that, in the period 1971–2008, about one-fourth of the output growth shocks of the average East Asian economy has been insured on average, with overall regional risk-sharing slightly larger than world risk-sharing. The two spatial dimensions exhibit a strong
negative correlation over time, with regional risk-sharing appearing to be a safer mechanism, activated in periods of crisis, and world risk-sharing appearing to play the role of a more hazardous undertaking, to be pursued in periods of rapid financial development. The main channel contributing to regional risk-sharing is constituted by international credit markets, which allow residents to lend to and borrow from foreign economies, through current account surpluses and deficits. The main channel contributing to world risk-sharing is represented by domestic investments, which allow residents to invest domestically in periods of boom and disinvest domestically during recessions. Capital market risk-sharing, pursued through portfolio diversification, is instead hardly significant for East Asia, both at the regional and at the world levels.12

Notes

1 Risk-sharing can be achieved through channels other than financial markets. For example, fiscal risk-sharing is an important channel analyzed in the literature on intranational risk-sharing (e.g. Asdrubali, Sørensen, and Yoshia 1996; Sala-i-Martin and Sachs 1992). However, in international risk-sharing, such a channel would play at best a very minor role owing to the nature and fiscal ineffectiveness of supranational institutions.

2 HARA = harmonic absolute risk aversion; the HARA preference is a formal correspondence between linear risk tolerance.

3 As in previous studies, such as Crucini (1999) and Asdrubali and Kim (2008a), this chapter assumes that all countries in the world are identical ex ante. The main feature of a country’s share in pooled income in a risk-sharing arrangement is its constancy over time (see e.g. Obstfeld and Rogoff 1996). As for its cross-sectional variation, the current chapter captures part of the difference in risk-sharing patterns by assuming three groups: (1) agents sharing risk globally; (2) agents sharing risk regionally; and (3) agents sharing risk nationally.

4 The international and domestic credit market channels are often considered intertemporal smoothing mechanisms, rather than risk-sharing mechanisms. However, when viewed in a cross-sectional perspective, they must be labeled as risk-sharing channels by definition. Of course, this does not imply that those channels do not work as a device for intertemporal smoothing too.

5 The current analysis adopted the Rollreg2 program, recently developed for Stata to apply rolling regressions to panel data.

6 By including two time-varying aggregate regressors in equations (3.6) and (3.7) one is essentially including time effects coefficients. In this way, the cross-sectional relationship is captured in the empirical model.

7 The authors also experimented with a sample without Japan, but the results are virtually identical, only losing some significance.

8 The Group of Seven (G-7) are Canada, France, Germany, Italy, Japan, the United Kingdom, and the United States.

9 The $\lambda_R$ coefficients do not sum exactly to $\lambda_R$ owing to equation-by-equation corrections for non-spherical errors. Autocorrelation estimates are reported in the tables.

10 Other reasons include the counterpart of commercial trades, currency arbitraging and speculation, “flight to quality,” and so on.

11 In equation system (7), the sum of $\lambda$ and $\lambda_R$ shows the extent to which domestic income shocks are smoothed.

12 Ancillary regressions show that the rate of nominal exchange rate depreciation plays a statistically insignificant part in determining the degree of consumption risk-sharing.
The evolution of regional and global risk-sharing in East Asian economies

analyzed here. Given the findings in Hess and Shin (2010) on the crucial role of nominal exchange rate changes to explain anomalies in consumption smoothing estimates, one can conclude that the results presented here are not affected by the Backus–Smith puzzle.

References


4 Regional and global drivers of the portfolio holdings of Asian investors

Philip R. Lane

The aim of this chapter is to investigate the geographical shifts in international portfolio patterns of Asian investors during the 2001–7 period. While a considerable literature explores the cross-sectional variation in bilateral portfolio holdings, there has been relatively little research on the evolution of bilateral patterns over time. The current chapter exploits the growing availability of portfolio data from the Coordinated Portfolio Investment Survey (CPIS) of the International Monetary Fund (IMF) in order to obtain new empirical evidence on the time-series evolution of portfolio positions of a group of Asian investor economies.

In terms of identifying factors that might help to explain portfolio dynamics, the chapter focuses on two main driving forces. First, time variation in bilateral trade linkages may be associated with shifts in portfolio positions. Second, a change in the level of currency volatility may also prompt portfolio reallocations, with the expectation that greater stability in bilateral exchange rates should be associated with a higher level of bilateral portfolio holdings. The chapter also examines whether regional factors are important in explaining shifts in portfolio patterns. Many elements of greater regional integration may be difficult to measure in a precise way, so that a general regional indicator variable may pick up these unobserved components of regional integration.

By examining these potential determinants of time variation in geographical portfolio allocations, it is possible to gain some insights into the relative contributions of the global and regional dimensions of international financial integration. In particular, regional initiatives that boost intraregional trade or reduce intraregional currency volatility may help to stimulate regional financial integration. In this way, the debate about regional financial integration is intimately connected to the debates on regional trade and regional exchange rate arrangements.

The literature that empirically analyzes bilateral investment patterns has grown in recent years. While Ghosh and Wolf (2000) and Portes and Rey (2005) examined the drivers of bilateral capital flows, most of the more recent literature has focused on bilateral patterns in portfolio holdings, with a primary emphasis on explaining
the cross-sectional variation in the data. A partial list includes Lane (2006), Lane and Milesi-Ferretti (2007, 2008), and Aviat and Coeurdacier (2007).

In relation to Asia-specific empirical studies that exploit the CPIS, two important recent contributions are Lee (2008) and García-Herrero, Woldridge, and Yang (2009). The former examined data for 2001–3. The main emphasis was on exploring whether, controlling for a standard set of explanatory variables, bilateral investment patterns within Asia were significantly different than those of other economy pairs. In addition, Lee explored whether global factors were more important for Asia than for other regions such as Europe. The study interpreted the negative impact of the Asian dummy to signal a relatively low level of regional financial integration. Among the factors that may explain the low level of regional financial integration, Lee highlighted a high level of bilateral exchange rate volatility and the low level of financial market development. In terms of an econometric approach, Lee did not include country fixed effects, so that some of the variables may be explaining, in part, whether a given source or destination country is characterized by a relatively high level of aggregate investment, rather than just explaining the pure bilateral dimension of the data.

García-Herrero, Woldridge, and Yang examined panel data for 2001–5, mainly focusing on destination-specific variables. In particular, they highlighted that the low liquidity of Asian financial markets represents a barrier to regional financial integration. However, because the authors did not control for (time-varying) country fixed effects, it is difficult to interpret destination-specific variables. In particular, it is not clear whether factors such as low liquidity depressed cross-border investment from all sources or whether such factors disproportionately affected regional investment patterns.

Relative to these recent studies, the current chapter innovates by more fully exploiting the time-series dimension in the data. Moreover, by controlling for (time-varying) source- and destination-country fixed effects, the empirical specifications used for the present analysis are designed to more precisely identify the contribution of regional factors in determining portfolio allocations.

In relation to international macroeconomics, understanding the bilateral composition of international portfolios is important for several reasons. First, the scope for international risk-sharing depends on the geographical composition of the international balance sheet, as shown by Fratzscher and Imbs (2009). Second, by the same token, bilateral positions also influence the international transmission of financial shocks. Third, the composition of the international investor base is also influential in determining the level and stability of demand for the liabilities issued by a given country.

The structure of the rest of the chapter is as follows. Section 4.1 lays out the reasons why trade integration and currency stability may boost portfolio shares. Section 4.2 describes the CPIS data set that is the source of the portfolio data in this study, and some basic stylized facts are presented in Section 4.3. Section 4.4 describes the econometric model and presents the empirical results. Some conclusions are offered in Section 4.5.
4.1 Conceptual framework

As indicated in the introduction, the recent literature on the geographical distribution of international portfolio positions has mainly focused on explaining the cross-sectional variation. A basic theme is that informational frictions mean that there will be a tendency to invest in international locations that are familiar to the domestic investor.

Along these lines, “gravity-type” factors such as distance, a common language, and a common cultural heritage have been found to boost bilateral portfolio holdings (Lane and Milesi-Ferretti 2008). However, because these characteristics do not vary over time, they are unlikely to play an important role in explaining the dynamics of portfolio allocations.

One candidate time-varying variable that may play a role is the level of bilateral trade. Bilateral trade may influence portfolio choices for a number of reasons. First, it is possible that a high level of bilateral trade improves the level of financial information about trading partners. Second, even if trade does not substantially increase the level of information, it may improve investor familiarity with the foreign destination, which is an important factor according to the behavioral finance literature. Third, following Obstfeld and Rogoff (2001), the management of macroeconomic risk for an open economy suggests that bilateral equity positions should positively covary with the level of bilateral imports. In particular, owning equity in trading partners may act as a hedge against terms of trade shocks, since the wealth loss from higher import prices may be offset by a higher return on the foreign equity position.

A second relevant time-varying variable is the level of bilateral currency volatility. As reviewed by Lane and Shambaugh (2010a, 2010b), foreign-currency bonds can play an important role in optimal portfolios, since nominal exchange rates may systematically covary with key macroeconomic factors. However, as shown by Kim (2002) and Devereux and Sutherland (2009), the optimal holding of foreign currency bonds decreases with increasing volatility of the nominal exchange rate.

The abolition of bilateral currency volatility through common membership in a monetary union has been shown dramatically to increase cross-border bondholdings (Lane 2006, 2009). In line with Coeurdacier and Martin (2009), the elimination of currency volatility not only reduces transactions costs but also increases the elasticity of substitution between assets issued by member countries. Accordingly, the net effect is ambiguous: a decline in transaction costs should increase cross-border holdings, while the increase in the elasticity of substitution reduces the scope for diversification. However, as indicated, the empirical evidence from Europe in relation to the introduction of the single currency is clear: the reduction in transactions costs dominates.

The open question is whether a reduction in currency volatility has similar qualitative effects to the elimination of currency volatility. A related question is whether the effect may be non-linear, with a positive impact on bond positions only if the level of currency volatility falls below some threshold value.
It is not so clear that nominal exchange rate uncertainty should be a major factor in determining optimal equity portfolios, in view of the low covariance between exchange rate movements and the excess return on home equity versus foreign equity, relative to the variance of excess returns (Adler and Dumas 1983, Coeurdacier and Martin 2009, Engel and Matsumoto 2009, Van Wincoop and Warnock 2009). However, even if the covariance between the exchange rate and equity return differentials is low during normal periods, the covariance could increase during periods of sharp economic dislocation, so that a long-term investor that seeks to limit exposure to catastrophic events may have a preference for domestic currency holdings.

4.2 Portfolio data

This chapter analyzes the bilateral distribution of portfolio asset holdings. The data are from the CPIS, which has been running since 2001. Accordingly, the sample range covers 7 years of data (2001–7). Thirteen Asian economies participate as reporters in the CPIS and data are available on the bilateral portfolio holdings of these economies vis-à-vis a large number of destinations (220 territories). The CPIS reports three categories: portfolio equity assets, long-term portfolio debt assets, and short-term portfolio debt assets.

It is important to be aware of the limitations of the CPIS data (see also the extensive discussion in Lane and Milesi-Ferretti 2008). First, the CPIS is intended to cover the portfolio allocations of entities resident in a given reporting country. However, in turn, a resident entity may be owned by foreign investors, so that the CPIS does not necessarily capture the true portfolio exposures of local households. Second, the CPIS cannot disentangle the impact of offshore financial centers on ultimate portfolio allocations. That is, the CPIS reports the level of holdings by a given reporting country in a given offshore financial center. However, the offshore center is not the final destination, since the fund in the offshore center in turn will allocate the investment to its final destinations. Third, the quality of the CPIS data surely varies across reporting countries, in line with the level of technical expertise and the degree of compliance with the CPIS manual. For instance, holdings are surely under-reported by some countries due to incomplete coverage or the complexities of tax-driven asset management structures.

Because the CPIS does not report the domestic holdings of investors, it does not provide a complete profile of the composition of portfolios, but only details the geographical breakdown of the cross-border component of investment positions. Moreover, the CPIS reports only aggregate holdings; it does not provide the decomposition in terms of whether securities are issued (or held) by public or private institutions and/or the relative holdings of individual investors versus financial intermediaries. For these reasons, the CPIS, while useful, by no means provides a complete profile of the investor base in international bond markets.
Table 4.1: Aggregate portfolio holdings

<table>
<thead>
<tr>
<th>Economy</th>
<th>2001</th>
<th>2007</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>EQ</td>
<td>LTD</td>
</tr>
<tr>
<td>Hong Kong, China</td>
<td>55.67</td>
<td>58.71</td>
</tr>
<tr>
<td>India</td>
<td>0.22</td>
<td>0.003</td>
</tr>
<tr>
<td>Indonesia</td>
<td>0.01</td>
<td>0.44</td>
</tr>
<tr>
<td>Japan</td>
<td>5.54</td>
<td>24.24</td>
</tr>
<tr>
<td>Korea, Republic of</td>
<td>0.25</td>
<td>1.29</td>
</tr>
<tr>
<td>Malaysia</td>
<td>1.44</td>
<td>1.02</td>
</tr>
<tr>
<td>Philippines</td>
<td>0.16</td>
<td>2.84</td>
</tr>
<tr>
<td>Singapore</td>
<td>34.95</td>
<td>84.26</td>
</tr>
<tr>
<td>Thailand</td>
<td>0.07</td>
<td>0.64</td>
</tr>
</tbody>
</table>

Source: International Monetary Fund, Coordinated Portfolio Investment Survey.

Notes: EQ = cross-border portfolio equity assets; LTD = cross-border long-term bond assets. Each is expressed as a ratio to gross domestic product.

4.3 Stylized facts

Table 4.1 shows the size of aggregate portfolio holdings in 2001 and 2007 for the main Asian economies that report asset holdings in the CPIS dataset. Clearly, there is considerable variation in terms of aggregate holdings, which is line with the differences across the economies in their liberalization of cross-border portfolio investment and level of domestic financial development. Table 4.1 also shows significant growth in cross-border portfolio holdings for most economies during 2001–7.

Figure 4.1, which displays the share of intra-Asian holdings in total portfolio holdings, shows some striking patterns. First, the level of intra-Asian holdings is much larger for the portfolio equity category than for portfolio debt. Second, the share of intra-Asian equity holdings has grown strongly during 2001–7, but no such trend is evident for intra-Asian bondholdings. This chapter’s goal is to explain the time variation in the bilateral distribution of portfolio holdings.

4.4 Empirical setup

4.4.1 Specification

The baseline specification can be written as follows:

\[
\log(A_{ijt}) = \alpha_{it} + \alpha_{jt} + \gamma_{ij} + \beta X_{ijt} + \epsilon_{ijt},
\]

where \(A_{ijt}\) is the level of assets held by source country \(i\) in destination country \(j\) at time \(t\), \(\alpha_{it}\) is a time-varying country source dummy, \(\alpha_{jt}\) is a time-varying country host dummy, \(\gamma_{ij}\) is a country-pair fixed effect, \(X_{ijt}\) is a set of time-varying bilateral variables, and \(\epsilon_{ijt}\) is the residual. The time-varying source dummy captures the
fluctuations in the aggregate portfolio of country $i$: its level of investment in country $j$ is in part just driven by the size of its overall portfolio. The time-varying host dummy captures the general level of attractiveness of country $j$ as a destination: a high level of investment by country $i$ in country $j$ in year $t$ may just reflect a high level of investment by all countries in destination $j$ in year $t$.

The country-pair fixed effect captures fixed bilateral characteristics that help to explain average differences across country pairs in the level of bilateral holdings. The vector $X_{ijt}$ includes variables that may help to explain the time variation in the level of bilateral investment from country $i$ to country $j$.

In relation to the vector $X_{ijt}$, the main focus is on the potential roles played by trade integration and exchange rate stability in promoting bilateral portfolio investment. Accordingly, the level of imports by country $i$ from country $j$ is included to capture trade integration and the level of bilateral exchange rate volatility between countries $i$ and $j$. Both measures vary over time, so they could help to explain the time variation in the level of bilateral portfolio holdings.

The inclusion of the country-pair fixed effect means that it is redundant to include as regressors bilateral characteristics that do not vary over time, such as the level of bilateral distance between countries $i$ and $j$, a “common language” dummy that captures whether an country pair shares a common language, and a “common colony” dummy that captures whether a country pair shares a common colonial history. Such variables have been explored extensively in
empirical work and it is more efficient to just include a general country-pair fixed effect.\textsuperscript{5}

The $\alpha$ variables are interpreted as representing common factors that hold across all country pairs that include source country $i$ or host country $j$, and the $\gamma$ variable as capturing fixed country-pair characteristics. In contrast, the bilateral variables, $X_{ijt}$, can be informative about the current and future prospects for regional financial integration. In particular, if the baseline equation provides a good model of the drivers of portfolio holdings, the prognosis for regional financial integration can be analyzed in relation to the likely future evolution of the regressors in the vectors $X_{ijt}$. In turn, policy discussions concerning regional financial integration can be framed in terms of the potential impact of a given policy on these drivers of portfolio holdings.

The set of source countries is restricted to the Asian participants in the CPIS. The advantage of this approach is that it insulates the coefficient estimates from possible noise that may be induced by differential behavior on the part of non-Asian reporting countries. Among the Asian reporters, Kazakhstan, Pakistan, and Vanuatu are omitted from the regressions because the data coverage for them is quite limited.

Because there many zero observations for bilateral portfolio holdings (especially for bondholdings), the log specification effectively excludes these from the estimation process. However, this is the most conservative approach, in view of the difficulties in modeling zero-value holdings.\textsuperscript{6}

In addition to the baseline specification, an expanded specification that includes Asian regional dummies is examined:

$$\log(A_{ij}) = \alpha_{it} + \alpha_{jt} + \gamma_{ij} + \beta X_{ijt} + p_t\text{ASEAN3}_{ij} + \epsilon_{ijt},$$

where the impact of the regional dummies is allowed to vary over time. In this way, one can check whether the level of regional bilateral holdings is influenced by non-modeled regional factors in addition to the $X$ vector and whether the regional effect is declining or growing over time. The members of the Association of Southeast Asian Nations (ASEAN)\textsuperscript{7} plus the People’s Republic of China, the Republic of Korea, and Japan (ASEAN+3) group are considered to be the relevant regional entity, in view of the central role the group plays in developing regional institutional initiatives such as the Chiang Mai Initiative and the Asian Bond Markets Initiative.

Shifts in portfolio allocations are explored by estimating the differenced equations

$$\log(A_{ij2007}) - \log(A_{ij2001}) = \alpha_{it} + \alpha_{jt} + \gamma_{ij} + \beta (X_{ij2007} - X_{ij2001}) + \epsilon_{ijt},$$

$$\log(A_{ij2007}) - \log(A_{ij2001}) = \alpha_{it} + \alpha_{jt} + \gamma_{ij} + \beta (X_{ij2007} - X_{ij2001}) + p_t\text{ASEAN3}_{ij} + \epsilon_{ijt},$$

The differenced equations are not directly comparable to the levels equations, because the fixed effects are retained.
These equations are estimated using ordinary least squares, with robust standard errors. The source of the portfolio data is described in Section 4.2. In relation to the explanatory variables, the level of bilateral imports is calculated from the IMF’s Direction of Trade Statistics database. Bilateral exchange rate volatility is measured as the standard deviation of the growth rate of the monthly bilateral exchange rate over a 36-month moving window. In addition, a non-linear alternative is considered by constructing a dummy variable, $ERDUM_{ijt}$, that takes the value 1 if exchange rate volatility is less than 4% and 0 otherwise.

### 4.4.2 Empirical results

#### Baseline results

Table 4.2 shows the results for the baseline specifications that do not include a regional dummy indicator. The continuous measure of exchange rate volatility is employed in columns (1)–(3), with the alternative $ERDUM$ indicator used in columns (4)–(6). Portfolio equity holdings, long-term debt holdings, and short-term debt holdings are considered separately. The latter category has by far the fewest data points.

The results in Table 4.2 show that an increase in the level of bilateral trade is associated with an increase in the bilateral portfolio equity position. This is in line with the cross-sectional result that was established in the previous literature. However, no other independent variable is individually significant in Table 4.2.

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EQ</td>
<td>0.18</td>
<td>0.08</td>
<td>0.18</td>
<td>0.22</td>
<td>0.09</td>
<td>0.17</td>
</tr>
<tr>
<td>LTD</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>STD</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TRADE</td>
<td>0.18</td>
<td>0.08</td>
<td>0.18</td>
<td>0.22</td>
<td>0.09</td>
<td>0.17</td>
</tr>
<tr>
<td>ERVOL</td>
<td>−18.20</td>
<td>−6.20</td>
<td>22.40</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ERDUM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>2,404</td>
<td>2,500</td>
<td>1,168</td>
<td>2,548</td>
<td>2,648</td>
<td>1,260</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.94</td>
<td>0.94</td>
<td>0.91</td>
<td>0.95</td>
<td>0.95</td>
<td>0.92</td>
</tr>
</tbody>
</table>

**Source:** author.

**Notes:** EQ = cross-border portfolio equity assets; LTD = cross-border long-term bond assets; STD = cross-border short-term debt assets; TRADE = the ratio of bilateral imports to gross domestic product; ERVOL = the standard deviation of the monthly growth rate of the bilateral exchange rate over a 3-year window; ERDUM = a currency volatility dummy variable that scores 1 if the standard deviation is above 4% and 0 otherwise; $N$ = number of observations; and $R^2$ = the overall explanatory power. Robust standard errors are shown in parentheses. ***, **, * denote significance at 10%, 5%, and 1% confidence levels, respectively.
Regional and global drivers of the portfolio holdings of Asian investors

Table 4.3 Differenced results: no regional effects

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
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</tr>
</thead>
<tbody>
<tr>
<td>(\Delta \text{TRADE} )</td>
<td>0.22</td>
<td>0.19</td>
<td>-0.18</td>
<td>0.26</td>
<td>0.27</td>
<td>0.18</td>
</tr>
<tr>
<td></td>
<td>(0.09)**</td>
<td>(0.142)</td>
<td>(0.179)</td>
<td>(0.15)*</td>
<td>(0.135)**</td>
<td>(0.38)</td>
</tr>
<tr>
<td>(\Delta \text{ERVOL} )</td>
<td>0.38</td>
<td>-42.10</td>
<td>-5.30</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.32)</td>
<td>(33.50)</td>
<td>(102.40)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(\Delta \text{ERDUM} )</td>
<td></td>
<td>-0.32</td>
<td>0.74</td>
<td>0.24</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.57)</td>
<td>(0.55)</td>
<td>(1.00)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(N)</td>
<td>213</td>
<td>215</td>
<td>86</td>
<td>213</td>
<td>252</td>
<td>102</td>
</tr>
<tr>
<td>(R^2)</td>
<td>0.53</td>
<td>0.46</td>
<td>0.55</td>
<td>0.53</td>
<td>0.46</td>
<td>0.56</td>
</tr>
</tbody>
</table>

Source: author.

Notes: \(\text{EQ}\) = cross-border portfolio equity assets; \(\text{LTD}\) = cross-border long-term bond assets; \(\text{STD}\) = cross-border short-term debt assets; \(\text{TRADE}\) = the ratio of bilateral imports to gross domestic product; \(\text{ERVOL}\) = the standard deviation of the monthly growth rate of the bilateral exchange rate over a 3-year window; \(\text{ERDUM}\) = a currency volatility dummy variable that scores 1 if the standard deviation is above 4% and 0 otherwise; \(N\) = number of observations; and \(R^2\) = the overall explanatory power.

Robust standard errors in parentheses. ***, **, * denote significance at 10%, 5%, and 1% confidence levels, respectively.

Table 4.3 presents the differenced specification. Under this formulation, the trade result for portfolio equity is significant in both columns (1) and (4). In addition, the evidence in column (5) indicates a positive association between bilateral trade and the bilateral level of long-term portfolio debt.

Table 4.4 shows the panel results when the regional dummy is included in the specification. In relation to portfolio equity holdings, the main finding is a strongly positive covariation between bilateral trade and bilateral equity holdings: this is true regardless of whether the regional dummy is included. In addition, there is a clear regional effect in equity holdings: joint membership in the ASEAN+3 group elevates bilateral equity holdings. This effect appears to be stable over time: there is no clear trend in the regional coefficient.

Turning to the findings for long-term debt assets, exchange rate volatility is a significantly negative factor if the measure is the \(\text{ERDUM}\) indicator: a decline in exchange rate volatility to below 4% is associated with a significant increase in long-term debt holdings. However, the linear specification does not show a relationship between exchange rate volatility and bilateral long-term debt holding. For debt, there is no significant association between trade growth and growth in bilateral debt positions. As was the case for equity, there is a robustly significant regional effect from common membership in the ASEAN+3 group. As before, there is no clear trend in the size of the regional effect.

In relation to short-term debt positions, column (3) shows some evidence of a positive regional effect in the determination of holdings. However, neither trade linkages nor exchange rate volatility is individually significant in the case of short-term debt positions.
Table 4.4 Panel results: regional effects

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<th>(3) STD</th>
<th>(4) EQ</th>
<th>(5) LTD</th>
<th>(6) STD</th>
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<td>(0.154)</td>
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<td>2.80</td>
<td>−1.50</td>
</tr>
<tr>
<td></td>
<td>(1.20)***</td>
<td>(0.77)***</td>
<td>(1.46)***</td>
<td>(1.07)***</td>
<td>(0.92)***</td>
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<td>(0.70)***</td>
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<td>0.96</td>
<td>0.95</td>
<td>0.91</td>
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</table>

Source: author.

Notes: EQ = cross-border portfolio equity assets; LTD = cross-border long-term bond assets; STD = cross-border short-term debt assets; TRADE = the ratio of bilateral imports to gross domestic product; ERVOL = the standard deviation of the monthly growth rate of the bilateral exchange rate over a 3-year window; ERDUM = a currency volatility dummy variable that scores 1 if the standard deviation is above 4% and 0 otherwise; ASEAN+3 = a dummy variable that scores 1 if both economies are ASEAN+3 members and 0 otherwise. N = number of observations; and R² = the overall explanatory power. Robust standard errors in parentheses. ***, **, * denote significance at 10%, 5%, and 1% confidence levels, respectively.

Table 4.5 shows the results for the differenced equations that seek to explain the shifts in portfolio patterns between 2001 and 2007. In relation to portfolio equity, columns (1) and (4) show that country pairs that have experienced an increase in bilateral trade have also enjoyed an increase in bilateral portfolio equity positions. The evidence from column (5) is that the transition from high exchange rate volatility to low exchange rate volatility boosts bilateral long-term debt holdings. There are no individually significant results for the short-term debt category. Finally, consistent with the results in Table 4.3, there is no significant regional shift in portfolios during 2001–7.
Regional and global drivers of the portfolio holdings of Asian investors

Table 4.5  Differenced results: regional effects

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<th>(4) EQ</th>
<th>(5) LTD</th>
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<td>18.30</td>
<td>−5.30</td>
<td>18.30</td>
</tr>
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<td>(56.60)</td>
<td>(33.50)</td>
<td>(102.40)</td>
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<td>(0.53)**</td>
<td>(1.5)</td>
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<td>(0.42)</td>
<td>(1.27)</td>
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<td>213</td>
<td>215</td>
<td>86</td>
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<td>R²</td>
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<td>0.55</td>
<td>0.53</td>
<td>0.46</td>
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Source: author.

Notes: EQ = cross-border portfolio equity assets; LTD = cross-border long-term bond assets; STD = cross-border short-term debt assets; TRADE = the ratio of bilateral imports to gross domestic product; ERVOL = the standard deviation of the monthly growth rate of the bilateral exchange rate over a 3-year window; ERDUM = a currency volatility dummy variable that scores 1 if the standard deviation is above 4% and 0 otherwise; ASEAN+3 = a dummy variable that scores 1 if both economies are ASEAN+3 members and 0 otherwise; N = number of observations; and R² = the overall explanatory power. Robust standard errors in parentheses. ***, **, * denote significance at 10%, 5%, and 1% confidence levels, respectively.

Alternative estimates

As a supplement to the baseline estimates, some alternative specifications are now considered. In Tables 4.6 and 4.7, the definition of the regional dummy is expanded to include two further economies: Hong Kong, China and Macau, China. The broad pattern of results is quite similar to Tables 4.2 and 4.3. In relation to the key regressors, the main difference is that bilateral trade is now significant in the long-term debt equation in column (5) of Table 4.6.

Since Hong Kong, China; Macau, China; and Singapore are significant international financial centers, the drivers of international portfolio allocations for these economies may be quite different than for the other Asian reporters in the CPIS data set. Accordingly, these economies are not included in Tables 4.8 and 4.9.

The results for this narrower subsample are noticeably different relative to the baseline estimates. First, the importance of exchange rate volatility as a covariate of long-term portfolio debt is enhanced in columns (2) and (5) of Tables 4.8 and 4.9. This may reflect the greater importance of exchange rate stability in determining portfolio behavior for economies with less-developed domestic financial markets.

Second, in comparing the results in Tables 4.5 and 4.9, the regional dummy is important in the shift in long-term portfolio debt allocations between 2001 and 2007 only for the narrower subsample. Again, this makes sense to the extent that the
various integration initiatives associated with ASEAN+3 are more important for the member economies with a lower level of financial development. However, the regional dummy is not significant in the panel estimates for the level of long-term debt positions in Table 4.9.

Finally, the trade variable is not significant in the equation for portfolio equity positions in the case of the narrower subsample. Accordingly, the significance of trade in the baseline estimates seems to depend on the inclusion of the Asian international financial centers as source economies.\(^9\)
Table 4.7 Alternative regional definition: differenced results

<table>
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<tr>
<th></th>
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<td>EQ LTD</td>
<td>STD</td>
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<td>(0.19)</td>
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<tr>
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</tr>
<tr>
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<tr>
<td></td>
<td></td>
<td>(0.63)</td>
<td>(0.53)**</td>
<td>(1.70)</td>
<td></td>
<td></td>
</tr>
<tr>
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<td>-0.13</td>
<td>0.45</td>
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<td>(0.68)</td>
<td>(2.50)</td>
</tr>
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<td>0.52</td>
<td>0.48</td>
<td>0.55</td>
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Source: author.

Notes: EQ = cross-border portfolio equity assets; LTD = cross-border long-term bond assets; STD = cross-border short-term debt assets; TRADE = the ratio of bilateral imports to gross domestic product; ERVOL = the standard deviation of monthly growth rate of bilateral exchange rate over a 3-year window; ERDUM = a currency volatility dummy variable that scores 1 if the standard deviation is above 4% and 0 otherwise; ASEAN+3 = a dummy variable that scores 1 if both countries are members of the ASEAN+3 group and 0 otherwise; N = number of observations; and $R^2$ = the overall explanatory power. Robust standard errors in parentheses. ***, **, * denote significance at 10%, 5%, and 1% confidence levels, respectively.

4.4.3 Empirical summary

The econometric estimates in this section provide some useful insights into the evolution of portfolio holdings for the group of Asian investor nations. First, for both equities and long-term bonds, there is indeed a significant regional boost from common membership in the ASEAN+3 group. Second, at least in the baseline estimates, there is a significantly positive association between growth in bilateral trade and growth in portfolio equity holdings. Third, at least in the case of the non-linear specification, there is some evidence that an increase in exchange rate stability does increase the level of bilateral bondholdings. Moreover, exchange rate stability seems especially important for Asian economies with a lower level of financial development.

These findings suggest there may be important complementarities between different types of regional integration. In particular, policy actions that boost regional trade should also increase regional equity market integration, while the stabilization of intraregional exchange rates may also boost regional bond market integration. The significance of the regional ASEAN+3 indicator dummy suggests that unobserved regional characteristics may be at play. In the case of the ASEAN+3, these may include the group support for currency stability via the Chiang Mai Initiative and the establishment of a common bond market development framework under the Asian Bond Markets Initiative.
Finally, this study has focused on understanding the evolving bilateral distribution of international portfolio holdings. The study has not addressed the factors determining the aggregate level of external portfolio investment for each economy. Because most Asian economies are still in the process of developing their domestic financial systems and liberalizing access to international investment opportunities, the gross level of regional portfolio holdings will also be expected to grow over time in line with the expansion of cross-border portfolio asset positions. This chapter’s contribution is to emphasize that the relative importance of regional

**Table 4.8 Narrow sample: panel results**

<table>
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<td>(4.80)</td>
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<td>(3.20)</td>
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</table>

Source: author.

Notes: EQ = cross-border portfolio equity assets; LTD = cross-border long-term bond assets; STD = cross-border short-term debt assets; TRADE = the ratio of bilateral imports to gross domestic product; ERVOL = the standard deviation of the monthly growth rate of the bilateral exchange rate over a 3-year window; ERDUM = a currency volatility dummy variable that scores 1 if the standard deviation is above 4% and 0 otherwise; ASEAN+3 = a dummy variable that scores 1 if both countries are members of the ASEAN+3 group and 0 otherwise; N = number of observations; and R² = the overall explanatory power. Robust standard errors in parentheses. ***, **, * denote significance at 10%, 5%, and 1% confidence levels, respectively.
versus global factors will be driven by complementary regional initiatives along dimensions such as intraregional trade integration and intraregional currency stability.

### 4.5 Conclusions

The goal of this chapter has been to exploit the information embedded in a panel of bilateral portfolio positions during the 2001–7 period. In particular, the capability of some time-varying bilateral factors to explain intrapair portfolio shifts has been examined. The study finds that an increase in bilateral trade is associated with an increase in portfolio equity positions, while a reduction in exchange rate volatility is associated with an increase in long-term bondholdings. In addition, a significant regional effect is found in the level of portfolio holdings of the ASEAN+3 group.

Looking to the future, one may anticipate that progress in domestic financial development and further liberalization of international portfolio investment opportunities will increase the gross scale of outward portfolio holdings. In turn, the relative importance of global and regional factors in determining the geographical patterns in international portfolios will depend on the success of regional initiatives in boosting intraregional trade and intraregional currency stability, together with "softer" forms of regional integration that cannot be measured with precision but may be influential in determining portfolio allocations.

---

**Table 4.9** Narrow sample: differenced results

<table>
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<tr>
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<th>(3)</th>
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<th>(5)</th>
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<td><strong>Delta TRADE</strong></td>
<td>0.43</td>
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<td>−0.76</td>
<td>0.61</td>
<td>0.63</td>
<td>−0.50</td>
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<td></td>
<td>(0.78)</td>
<td>(0.70)</td>
<td>(3.70)</td>
<td>(0.76)</td>
<td>(0.61)</td>
<td>(3.20)</td>
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<td><strong>Delta ERVOL</strong></td>
<td>50.50</td>
<td>−80.00</td>
<td>−57.10</td>
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<td>(71.00)</td>
<td>(44.10)*</td>
<td>(157.00)</td>
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<tr>
<td><strong>Delta ERDUM</strong></td>
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<td></td>
<td></td>
<td>(0.71)*</td>
<td>(0.50)***</td>
<td>(2.30)</td>
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<tr>
<td><strong>ASEAN+3</strong></td>
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<td>1.90</td>
<td>−0.03</td>
<td>3.00</td>
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</tr>
<tr>
<td></td>
<td>(1.40)***</td>
<td>(0.90)***</td>
<td>(1.60)</td>
<td>(0.90)</td>
<td>(0.64)***</td>
<td>(1.40)</td>
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<tr>
<td><strong>N</strong></td>
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<td>141</td>
<td>38</td>
<td>141</td>
<td>148</td>
<td>44</td>
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<tr>
<td><strong>R²</strong></td>
<td>0.54</td>
<td>0.67</td>
<td>0.66</td>
<td>0.54</td>
<td>0.7</td>
<td>0.65</td>
</tr>
</tbody>
</table>

**Source:** author.

**Notes:** EQ = cross-border portfolio equity assets; LTD = cross-border long-term bond assets; STD = cross-border short-term debt assets; TRADE = the ratio of bilateral imports to gross domestic product; ERVOL = the standard deviation of the monthly growth rate of the bilateral exchange rate over a 3-year window; ERDUM = a currency volatility dummy variable that scores 1 if the standard deviation is above 4% and 0 otherwise; ASEAN+3 is a dummy variable that scores 1 if both countries are members of the ASEAN+3 group and 0 otherwise; N = number of observations; and R² = overall explanatory power. Robust standard errors in parentheses. ***, **, * denote significance at 10%, 5%, and 1% confidence levels, respectively.
In terms of the agenda for future research, it will be illuminating to re-examine these data when the observations for the crisis period have been added to the CPIS dataset. In particular, it will be interesting to establish whether intraregional positions are more or less stable than extraregional holdings in the event of a major global crisis.

Notes

1 This was accomplished by including regional dummies in the regression specification.
2 Garcia-Herrero, Woldridge, and Yang also highlighted that countries offering a high return-risk ratio (Sharpe ratio) receive a higher level of inward portfolio investment. Countries that impose a higher withholding tax on portfolio income and controls on capital outflows also receive lower portfolio investment.
3 A trial survey was conducted in 1997 with only a limited number of reporting economies.
4 The Asian reporters are Hong Kong, China; India; Indonesia; Japan; Kazakhstan; the Republic of Korea; Macau; Malaysia; Pakistan; the Philippines; Singapore; Thailand; and Vanuatu. Vanuatu does not report data for 2004.
5 For the present analysis, whether the contribution of these gravity-type factors might vary over time was explored. However, the hypothesis of fixed coefficients could not be rejected.
6 Offshore financial centers are also excluded from the set of destination countries, since the reported positions in these locations are most likely reinvested elsewhere. See also the discussion in Lane and Milesi-Ferretti (2008).
7 The ASEAN members are Brunei Darussalam, Cambodia, Indonesia, the Lao People’s Democratic Republic, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Viet Nam.
8 It is possible to argue that some of the regressors may be endogenous to the level of bilateral financial integration, so that an instrumental–variables estimation approach is to be preferred. That said, Aviat and Coeurdacier (2007) showed that there is no substantial feedback from financial integration to trade integration. In relation to the potential impact of financial integration on bilateral exchange rate volatility, Devereux and Lane (2003) showed that such a channel may exist, at least for lower-income countries. However, there is no obvious set of good instruments that allow for the control of this channel.
9 Empirical analysis was extended to drop Japan from the set of source economies, in view of Japan’s advanced-country status. In general, the exclusion of Japan weakens the significance of the regional dummy in the equity equation, which suggests that the regional effect is disproportionately due to the increasing regional bias in the Japanese foreign equity position.

References

Regional and global drivers of the portfolio holdings of Asian investors


5 Regional and global short-term financial market integration in Asia: evidence from the interbank markets under the crises

Shin-ichi Fukuda

Financial integration allows different economies to smooth local shocks by borrowing on the international interbank market. The degree of regional and global financial integration is thus important for stabilizing economies. In a well-integrated market, assets with the same risk characteristics would yield identical expected returns. Controlling regulatory treatments and time differences, the yield spreads among fixed-income assets denominated in the same currency should be equalized in normal times. However, reflecting risk characteristics, the spreads may show substantial differences in crisis periods. This chapter explores how the Asian money markets have been integrated with the London money market since the 1990s.

The Asian interbank money markets explored are in Hong Kong, China; Malaysia; Singapore; Thailand; and Tokyo. Using the daily data of various interbank offered rates in Asian markets, the chapter investigates how each rate correlates with the London Interbank Offered Rate (LIBOR). LIBOR, the world’s most widely used benchmark for short-term interest rates, is calculated for ten currencies, including the United States (US) dollar and the Japanese yen. To the extent that the Asian market segments are highly integrated with the world, the Asian interbank rates would show synchronization with LIBOR. However, as risk characteristics vary substantially, the interbank rates may not be synchronized with LIBOR. In particular, it is not clear how well the synchronization with LIBOR persists when economies are in financial crisis.

The following analysis investigates to what extent each Asian interbank offered rate has been synchronized with LIBOR since the 1990s. To calculate the synchronization, dollar-denominated rates are matched with the dollar-denominated LIBOR. Interbank rates denominated in local currencies are also matched with the corresponding LIBORs. The matches allow a comparison of their returns without exchange rate risk. Although, the yen is the only Asian currency in which a LIBOR rate is denominated, the covered interest parity (CIP) condition allows one to calculate LIBOR in each local currency using the spot and forward exchange rates.
The sample period of the analysis is noteworthy because it includes two crisis periods: the Asian financial crisis of 1997–8; and the global financial crisis of 2008–9. Hong Kong, China and Tokyo markets, as well as offshore markets in Malaysia and Singapore, are highly synchronized with the London market in non-crisis periods. This suggests that these four money markets bring together global lenders and borrowers of very short-term credit. However, onshore markets in Malaysia, Singapore, and Thailand are less well correlated with the London market and their interbank offered rates frequently deviate substantially from LIBOR. The deviations are particularly large in Malaysia and Thailand.

More interestingly, each Asian interbank rate shows substantially different degrees of integration with LIBOR during the two crisis periods. Among the three interbank rates, the Singapore Interbank Offered Rate (SIBOR) remains highly integrated with LIBOR even in the late 1990s, when the Asian currency crisis seriously damaged Asian financial sectors. In contrast, the other interbank rates show substantial upward deviations from LIBOR in the late 1990s, reflecting increased regional risk premiums. During the global financial crisis, Asian interbank rates show significant deviations from LIBOR. However, there are remarkable asymmetric responses in reflecting regional risk premiums. During the global financial crisis, the credit quality of European and US banks deteriorated substantially, but that of many of Asian banks did not, suggesting that the London market carried a larger counter-party credit risk than did the Asian markets. The current analysis finds supporting evidence that risk premiums raised LIBOR more than Asian interbank rates when denominated in local currencies, but increased the Asian interbank rates more than LIBOR in dollar-denominated markets. The asymmetric impacts in the dollar-denominated and local-currency-denominated markets had a “home bias” feature reflecting different liquidity premiums under the liquidity crisis.

Several studies have explored the degree of integration in world money markets during normal times and in crisis periods. Exploring the London and New York interbank markets, Bartolini, Hilton, and Prati (2008) showed that the two markets were highly integrated in the period 2002–4. McAndrews (2008), on the other hand, found that LIBOR was significantly higher than the US rates at times of market distress beginning in August 2007. Baba and Packer (2009a,b) investigated dislocations in the foreign exchange swap market between the US dollar and three major European currencies under the global financial crisis and found that deviations from CIP were negatively associated with the creditworthiness of European and US financial institutions. Michaud and Upper (2008) showed that the cross-sectional dispersion of the premiums was largely independent of banks’ credit risk and was mainly driven by factors related to the funding liquidity under the global crisis. Castiglionesi, Feriozzi, and Lorenzoni (2009) proposed that integration helps to reallocate liquidity when different countries are hit by uncorrelated shocks but leads to larger spikes in interest rates on the interbank market when an aggregate liquidity shock hits.

As for the integration between the London and Asian interbank markets, numerous studies investigated a source of upward deviations of the Tokyo

The following analysis confirms part of the findings in previous studies. However, unlike previous studies, this analysis explores the degree of integration by using a variety of interbank offered rates in Asia. Asian money markets remain generally underdeveloped in Asia, except those in Hong Kong, China; Singapore; and Tokyo (Asian Development Bank 2009: 111). One can thus see how different degrees of financial market development relate to money market integration in the region. The chapter also investigates how the global financial crisis affected the degree of integration in Asian money markets. The results show that, even in underdeveloped money markets, the global financial crisis had asymmetric impacts on risk premiums of the Asian interbank rates between the rates denominated by the dollar and those denominated by local currency. The outcome suggests the importance of distinguishing not only between credit risk and liquidity risk, but also between liquidity risks denominated in different currencies.

The rest of the chapter is organized as follows: Section 5.1 briefly describes the interbank offered rates used in this chapter; Sections 5.2–5.6 investigate the degree to which each Asian interbank market is integrated with the London market, using the 3-month interbank offered rates in those markets; and Section 5.7 provides a conclusion.

5.1 The interbank offered rates

This section briefly describes the daily data of interbank offered rates used in the analyses. Daily data for the Bangkok; Hong Kong, China; London; Malaysia; and Singapore analyses are downloaded from Datastream (Thomson Reuters). The Bank of Thailand started to officially announce the Bangkok Interbank Offered Rate (BIBOR) only after January 2005, but data before 2005 are available from Datastream. Data for Tokyo are downloaded from the Nikkei Financial QUEST database.

5.1.1. London

LIBOR is a daily reference rate based on the interest rates at which banks borrow unsecured funds from other banks in the London wholesale money market (or interbank market). As the world’s most widely used benchmark for short-term interest rates, LIBOR is the rate at which the world’s most preferred borrowers are able to borrow money. It is also the rate upon which rates for less preferred
Regional and global short-term financial market integration in Asia

borrowers are based. For example, a multinational corporation with a very good credit rating may be able to borrow money for 1 year at LIBOR plus four or five points.

LIBOR is calculated by Thomson Reuters and published by the British Bankers’ Association after 11.00 am each day (Greenwich mean time). It is a trimmed average of interbank deposit rates offered by designated contributor banks, for maturities ranging from overnight to 1 year. Each currency panel comprises 8, 12, or 16 contributor banks, and the reported interest is the mean of the middle values (the interquartile mean). The rates are a benchmark rather than a tradable rate; the actual rate at which banks lend to one another varies throughout the day.

LIBOR is calculated for ten currencies: the Australian dollar, Canadian dollar, Danish krone, euro, Japanese yen, New Zealand dollar, pound sterling, Swedish krona, Swiss franc, and US dollar. The following analysis uses LIBOR denominated either in the US dollar or the Japanese yen. Because the US dollar traded on the offshore market is referred to as the “eurodollar” and the Japanese yen traded on the offshore market is referred to as the “euroyen,” this chapter refers to LIBOR denominated in the US dollar as “eurodollar LIBOR” and LIBOR in the Japanese yen as “euroyen LIBOR.”

5.1.2. Tokyo

The Japan offshore market is a relatively unregulated market that was established in December 1986 to further liberalize and internationalize Japanese financial markets. The Tokyo market is Asia’s largest money center. TIBOR is a daily reference rate based on the interest rates at which banks offer to lend unsecured funds to other banks in the Japan offshore market. The daily TIBOR data are available denominated in the Japanese yen and in the US dollar.

The Japanese Bankers Association (JBA) has been publishing daily TIBOR rates denominated in the Japanese yen (“Japanese yen TIBOR”) since November 1995 and “euroyen TIBOR” rates since March 1998. The Japanese yen TIBOR rates reflect prevailing rates on the unsecured call market, while the euroyen TIBOR rates reflect prevailing rates on the Japan offshore market. JBA calculates euroyen TIBOR as a prevailing market rate based on quotes for 13 maturities (1 week, 1–12 months) provided by reference banks as of 11.00 am each business day (Tokyo time). Although there is a partial overlap of reference banks between LIBOR and TIBOR, the reference banks in TIBOR are dominated by Japanese banks. The JBA excludes the top two and the two bottom reference rates for each maturity and takes the average of the remaining rates. These averages are published as the TIBOR rates (13 rates each for the Japanese yen and euroyen) through information providers that have contracts with JBA. The JBA does not publish a TIBOR rate denominated in the US dollar, but Bloomberg and Nikkei Quick News Inc. collect the eurodollar TIBOR data. Bloomberg states that their eurodollar TIBOR data are taken at the Tokyo close.
5.1.3. Singapore

SIBOR is a daily reference rate based on the interest rates at which banks offer to lend unsecured funds to other banks in the Singapore wholesale money market. SIBOR is denominated in the US dollar. In Southeast Asia, SIBOR is more used than LIBOR. Floating interest rate issues settled during European trading hours use LIBOR as the pricing basis. But to avoid interest rate risk, issues settled during trading in Asia and the Pacific use SIBOR for pricing.

SIBOR is set daily by the Association of Banks in Singapore. More than anything else, SIBOR serves as a benchmark, or reference rate, for borrowers and lenders that are directly or indirectly involved in an Asian financial market. Commonly, very large loans to businesses in the area and interest rate swaps involving businesses participating in the Asian economy are quoted or denominated in SIBOR plus a number of basis points.

In contrast with SIBOR, the Singapore Overnight Rate Average (SORA) is a daily domestic interbank rate denominated in the Singapore dollar. SORA is an index that tracks actual Singapore dollar overnight funding rates transacted by market participants. It is the weighted average rate, to four decimal places, of all unsecured Singapore dollar overnight cash transactions brokered in Singapore between 9 am and 5.15 pm. Singapore time with all counterparties. There is no minimum deal size. The Monetary Authority of Singapore publishes its daily data.

5.1.4. Hong Kong, China

The Hong Kong Interbank Offered Rate (HIBOR) is an interest rate quoted in Hong Kong dollars on the lending and borrowing between banks in the Hong Kong interbank market. The terms of the deposits vary from overnight to 1 year. Unlike TIBOR and SIBOR, HIBOR is denominated only in the Hong Kong dollar. A bank that is nearing the point at which withdrawals are depleting short-term cash reserves will go into the Hong Kong interbank market and borrow money at HIBOR. It is also considered a key benchmark interest rate in the wider Asian economy. For example, an interest rate swap involving two counterparties with good credit ratings, both of which have bonds issued in Hong Kong dollars, will likely be quoted in HIBOR plus a given percentage.

5.1.5. Malaysia

The Kuala Lumpur Interbank Offered Rate (KLIBOR) is the rate quoted by banks in the Kuala Lumpur interbank money market, in which the participants are domestic banks and other domestic financial institutions. KLIBOR, which is quoted in the Malaysian ringgit, is the average interest rate at which term deposits are offered between prime banks in the Malaysian wholesale money market or interbank market. Most banks in Malaysia use KLIBOR as a benchmark for pricing loans to corporate bodies and for pricing other money market instruments.

Malaysia designated Labuan Island as its official offshore financial hub in 1990, operating as the Labuan International Offshore Financial Centre (Labuan IOFC)
Regional and global short-term financial market integration in Asia

until the end of 2007 and as the Labuan International Business and Financial Centre thereafter. The hub was set up to promote Malaysia as a regional financial center. Although the Labuan IOFC is regulated under the Labuan Financial Service Authority Act 1996, it is an integrated financial center that seeks to provide a wide range of offshore products and services to customers worldwide, particularly those in Asia. In contrast with KLIBOR, the Labuan Interbank Offered Rate (LABOR) is denominated in the US dollar. LABOR is a benchmark for pricing loan rates in the Labuan IOFC and reflects the cost of US dollar funds in the Labuan IOFC.

5.1.6. Thailand

The Bangkok Interbank Offered Rate, which is denominated in the Thai baht, is a reference rate for short-term interest rates, and was launched by the Bank of Thailand officially on 4 January 2005. BIBOR is the rate of interest at which banks can borrow funds from other banks in the Bangkok interbank market. BIBOR provides short-term rates without collateral, determined by averaging the rates offered by seven local and seven foreign banks for interbank loans without collateral, and then excluding the highest and lowest rates.

To ensure that BIBOR accurately reflects the Thai market conditions, the Bank of Thailand set criteria for selecting the contributor panel whereby the scale of activities in longer term interbank transactions and lending to the private sector as well as their continued commitment to promoting BIBOR as a recognized reference rate are taken into consideration. Reference rates for term loans among banks as well as their customers are similar to those used in other international reference rates, including LIBOR and HIBOR.

5.2 Integration between LIBOR and TIBOR

This section investigates the nature of the relationship between the daily offer rates for the 3-month TIBOR and the 3-month LIBOR. The sample period is 28 February 1991 to 17 August 2009.

5.2.1 Integration in the US dollar

This subsection explores the nature of the relationship between the daily offer rates for the 3-month eurodollar rates in the London and Tokyo markets: the US dollar-denominated TIBOR (eurodollar TIBOR) and LIBOR (eurodollar LIBOR). In the data set used, the different trading times could be a source of deviation between the two series. However, given similar risk characteristics and regulatory treatments, the arbitrage condition suggests that the two series will show similar dynamics because both are denominated in the same currency.

Table 5.1 summarizes annual average and annual standard deviations of eurodollar spreads (i.e., US-dollar-denominated TIBOR minus LIBOR) in each calendar year from 1991 to 2009. The annual average was positive throughout the sample period, but was below 0.1 points except for a few years and fell below
Table 5.1  Average LIBOR spreads with TIBOR, SIBOR, and HIBOR

<table>
<thead>
<tr>
<th>Year</th>
<th>TIBOR–LIBOR (in eurodollar)</th>
<th>TIBOR–LIBOR (in euroyen)</th>
<th>SIBOR–LIBOR</th>
<th>HIBOR–LIBOR</th>
</tr>
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<td>1989</td>
<td>—</td>
<td>—</td>
<td>0.039</td>
<td>—</td>
</tr>
<tr>
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<td></td>
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<td>0.091</td>
<td>—</td>
</tr>
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<td>1990</td>
<td>—</td>
<td>—</td>
<td>0.031</td>
<td>—</td>
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<td></td>
<td></td>
<td>0.090</td>
<td>—</td>
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<td>1991</td>
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<td>0.029</td>
<td>0.004</td>
<td>—0.164</td>
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<td>0.011</td>
<td>0.018</td>
<td>0.400</td>
</tr>
<tr>
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<td>0.034</td>
<td>—0.009</td>
<td>—1.158</td>
</tr>
<tr>
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<td>0.069</td>
<td>0.008</td>
<td>0.019</td>
<td>0.422</td>
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<tr>
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<td>0.032</td>
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<td>—0.486</td>
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<td>0.016</td>
<td>0.617</td>
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<td>0.008</td>
<td>0.000</td>
<td>—0.920</td>
</tr>
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<td>0.020</td>
<td>0.017</td>
<td>0.334</td>
</tr>
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<td>0.011</td>
<td>—0.961</td>
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<td>0.032</td>
<td>0.372</td>
</tr>
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<td>2008</td>
<td>0.090</td>
<td>—0.077</td>
<td>0.056</td>
<td>—0.566</td>
</tr>
<tr>
<td></td>
<td>0.117</td>
<td>0.040</td>
<td>0.157</td>
<td>0.290</td>
</tr>
<tr>
<td>2009</td>
<td>0.118</td>
<td>0.069</td>
<td>0.007</td>
<td>—0.299</td>
</tr>
<tr>
<td></td>
<td>0.028</td>
<td>0.045</td>
<td>0.087</td>
<td>0.083</td>
</tr>
</tbody>
</table>

Sources: Datastream (Thomson Reuters) and Financial QUEST database (Nikkei).

Notes: — = not available; HIBOR = Hong Kong Interbank Offered Rate; LIBOR = London Interbank Offered Rate; SIBOR = Singapore Interbank Offered Rate; TIBOR = Tokyo Interbank Offered Rate. Italicized numbers are standard deviations.
0.03 points from 2000 to 2007. The correlation between LIBOR and TIBOR from 2000 to 2007 exceeds 0.99, suggesting that, despite the time difference between London and Tokyo, LIBOR and TIBOR are normally highly integrated.

However, TIBOR became significantly higher than LIBOR during the period of the Japanese banking crisis. The annual average spread exceeded 0.1 points from 1996 to 1999. In particular, it exceeded 0.44 points in 1998, when the Japanese banking crisis became critical. The difference between LIBOR and TIBOR, which is often referred to as the “Japan premium” in the literature, can be interpreted as representing the credit risk of Japanese banks at that time.

That the annual average spread becomes close to 0.09 points in 2008 and exceeds 0.1 points in 2009 implies: (1) that TIBOR becomes significantly higher than LIBOR during the global financial crisis; and (2) that risk premiums in the eurodollar markets boost both LIBOR and TIBOR during the crisis, but the impacts are greater on TIBOR than on LIBOR. This result is paradoxical because the credit quality of European and US banks had been downgraded substantially while that of Japanese banks had not been downgraded under the global financial crisis. The result suggests that liquidity risk, rather than credit risk, was important under the crisis.

Figure 5.1 depicts the time series of the 3-month eurodollar LIBOR and TIBOR from January 2007 to December 2009. For comparison, the figure also depicts the 3-month overnight index swap (OIS) in the New York market as a proxy for the risk-free 3-month rate in the US dollar. The figure shows that the three series move very closely before August 2007, but, after August 2007, both LIBOR and TIBOR deviate substantially upward from the OIS. The upward deviations

Figure 5.1  TIBOR, LIBOR, and the overnight index swap, eurodollar (2007–9).
Sources: Datastream (Thomson Reuters) and Financial QUEST database (Nikkei).
Notes: LIBOR = London Interbank Offered Rate; TIBOR = Tokyo Interbank Offered Rate.
reflect risk premiums in the two interbank markets under the global crisis – after the failure of Lehman Brothers in September 2008, the deviations become much larger. At the same time, TIBOR starts to show modest upward deviations from LIBOR, which persist in 2009 even as the deviations from the OIS become smaller.

5.2.2 Integration in the Japanese yen

The last subsection investigated the relationship between the two daily offer rates for the 3-month eurodollar LIBOR and TIBOR. This subsection explores the same relationship by using the daily offer rates for the 3-month yen-denominated rate in London (euroyen LIBOR) and Tokyo (euroyen TIBOR). Except for the denomination currency, these rates are traded in the same manner as those used in the last subsection. To the extent that the choice of currency denomination does not change the risk characteristics and regulatory treatments, one can expect the two series to show similar dynamics as those observed in the last section.

Table 5.1 summarizes annual average and standard deviations of the yen-denominated spreads (yen-denominated TIBOR minus yen-denominated LIBOR). As in the eurodollar markets, the annual average becomes large during 1995–9, especially in 1998, when the credit quality of Japanese banks deteriorated substantially, but the deviations are smaller than those in the eurodollar markets. This suggests that the credit risk during the Japanese banking crisis is reflected less in the euroyen TIBOR than in the eurodollar TIBOR in the period of the Japanese banking crisis. In general, Japanese banks can access various alternative sources for their yen-denominated borrowings but may not do so for their dollar-denominated borrowings. During the crisis, the asymmetry might have increased the observed credit risk of Japanese banks in the US dollar vis-à-vis in the Japanese yen.

Table 5.1 shows that the annual average, when positive, is very small in non-financial crisis periods, but it becomes significantly different from zero during 2003–5, when the Bank of Japan intensified its quantitative easing policy. The unconventional monetary policy distorted yen-denominated money markets but not dollar-denominated ones. The asymmetry made the TIBOR–LIBOR spreads significantly different from zero only in yen-denominated transactions in the first half of the 2000s.

A noteworthy result in Table 5.1 is that the annual average euroyen TIBOR–LIBOR spreads become negative in 2007 and 2008. This implies that, unlike in the eurodollar markets, risk premiums raised LIBOR more than TIBOR in the euroyen markets during the global financial crisis. Given that the credit quality of European and US banks declined substantially during the crisis but not that of Japanese banks, this is a natural consequence. However, as shown in Table 5.1, the risk premiums raise TIBOR more than LIBOR in the eurodollar markets at the same time. This indicates that, during the global financial crisis, the choice of the denomination currency dramatically changed how risk premiums were reflected.
in each interbank market. The result suggests the importance of distinguishing not only between credit risk and liquidity risk, but also between liquidity risks denominated in different currencies.

Figure 5.2 depicts the TIBOR–LIBOR spreads in both the eurodollar and the euroyen markets in the two crisis periods: that of the Japanese banking crisis (4 January 1995 to 30 December 1999) and that of the global financial crisis (1 January 2007 to 17 August 2009). During the Japanese banking crisis, the TIBOR–LIBOR spreads start to take positive values in the summer of 1995 in both the eurodollar and the euroyen markets. The spreads become temporarily small from April 1996 to October 1997, then become very large after the collapse of major Japanese financial institutions in November 1997. The spreads remain large through March 1999. A key feature in this period is that the TIBOR–LIBOR spreads have very large positive values in both markets, and are larger in the eurodollar than in the euroyen market. However, there is strong comovement of the spreads between the two markets.

In contrast, during the global financial crisis, the TIBOR–LIBOR spreads start to take opposite signs in the two markets. Before August 2007, the spreads are close to zero in both markets. But after August 2007, the spreads start to take positive values in the eurodollar market and negative values in the euroyen market. Before the summer of 2008, the absolute value of the deviations is slightly larger in the euroyen than in the eurodollar market. Then, after September 2008, it becomes larger in the eurodollar than in the euroyen market. The asymmetric impacts in the two markets are in marked contrast with what is observed during the Japanese banking crisis. The asymmetric deviations continue into the beginning of 2009. After January 2009, the TIBOR–LIBOR spreads start to take positive values in both markets.

5.3 Integration between London and Singapore

5.3.1 Integration between LIBOR and SIBOR

The last section explored how LIBOR and TIBOR denominated in two currencies are related both during normal times and in crisis periods. This section investigates the same issue by examining the relationship between the interbank rates in London and Singapore, Southeast Asia’s largest financial center. In Southeast Asia, SIBOR, which is denominated in the US dollar, is used more commonly than LIBOR. This subsection explores the integration between LIBOR and SIBOR. The following analysis uses the daily data of 3-month LIBOR and SIBOR rates from 17 August 1989 to 18 December 2009.

Table 5.1 summarizes the annual average and annual standard deviation of the spreads (SIBOR minus LIBOR). The table has three noteworthy features. First, the SIBOR–LIBOR spreads are on average much smaller than the TIBOR–LIBOR spreads for most years. The annual average spread never exceeds 0.1 points and is below 0.05 points except in 2008. This implies that SIBOR was more integrated with LIBOR than was TIBOR.
Figure 5.2 Crisis period LIBOR–TIBOR spreads, eurodollar and euroyen. (A) Japanese banking crisis period (1995–9). (B) Global financial crisis period (2007–9).

Sources: Datastream (Thomson Reuters) and Financial QUEST database (Nikkei).

Notes: LIBOR = London Interbank Offered Rate, TIBOR = Tokyo Interbank Offered Rate.
Second, the annual average SIBOR–LIBOR spread becomes negative in 1994, 1996, 1997, 1999, 2000, 2004, and 2005, although it never becomes significantly different from zero. This is in marked contrast with what is observed for TIBOR because the annual average TIBOR–LIBOR spread remained positive throughout the sample period. Government regulations in Singapore likely kept SIBOR lower than LIBOR in the 1990s, but the negative SIBOR–LIBOR spreads in 2004 and 2005 suggest that smaller risk premiums were reflected in the interbank market in Singapore.

Third, the annual average SIBOR–LIBOR spread shows no substantial rise during the two crisis periods. The annual average rises modestly in 2008 during the global financial crisis, but remains low during the Asian currency crisis and becomes negative in 1997 and 1999. The Asian crisis caused financial sectors in East Asia to deteriorate. While Singapore was not spared from the effects of the crisis, the impacts there were less serious than in the other East Asian countries. The Singapore dollar depreciated substantially after the Thai baht collapsed in July 1997, but the risk premiums were not reflected in SIBOR – government regulations might have suppressed potential risk premiums in the market. It is also likely that risk characteristics of the offshore market participants were different from those of local market participants in Singapore.

5.3.2 Integration between LIBOR and SORA

In contrast with SIBOR, SORA provides domestic interbank rates denominated in the Singapore dollar. Because there is no LIBOR denominated in the Singapore dollar, SORA is thus not a perfect substitute for LIBOR even if there is no risk premium. However, using the spot and forward exchange rates, the CIP condition allows one to calculate the LIBOR effectively denominated in Singapore dollar as

\[(SD_t / (SD_{t+1}) (1 + LIBOR_t) - 1,\]

where \(t\) is time, \(SD_t\) is the Singapore dollar spot rate at time \(t\), \(SD_{t+1}\) is the Singapore dollar 3-month forward rate in terms of the US dollar at time \(t\), and \(LIBOR_t\) is the 3-month LIBOR at time \(t\).

Using the converted LIBOR, this subsection explores the relationship between the Singapore dollar-denominated interbank offered rates in London and Singapore from 2 January 1990 to 18 December 2009. To the extent that the choice of currency denomination does not change their risk characteristics and regulatory treatments, one can expect the series to show similar features as those observed in the last subsection.

Figure 5.3 depicts SORA and converted LIBOR. All of the rates are denominated in the Singapore dollar. Owing to the time difference between London and Singapore, the converted LIBOR is more volatile than SORA, especially before 2000. However, deviations of the converted LIBOR from the SORA do not persist: other than infrequent temporal deviations, the two series move very closely throughout the period.
Before 2000, SORA tends to be lower than the converted LIBOR. This implies that SORA might have been set artificially low before 2000. During the Asian crisis, SORA rises, reflecting increased risk premiums as well as temporary monetary tightening, but the converted LIBOR also rises at the same time. Consequently, the spreads between the two rates become highly volatile during the period of the Asian crisis. Unlike the case of TIBOR, SORA shows no persistent upward deviations from the converted LIBOR. During the Asian crisis, neither SIBOR nor SORA reflect the regional risk premiums, implying that even the local interbank market in Singapore was isolated from the increased regional risk during the Asian crisis. Government regulations might have suppressed potential risk premiums.

From 2000 until September 2008, the spreads between SORA and the converted LIBOR are small, implying that a CIP condition held until the Lehman shocks. However, SORA has downward deviations from the converted LIBOR from September 2008 to the summer of 2009. This may reflect the deterioration of European and US banks’ credit during the global financial crisis, compared with that of many Asian banks. But it contrasts with the observations for SIBOR, which again suggests the importance of distinguishing between credit risk and liquidity risk as well as between liquidity risks denominated in different currencies.

Figure 5.4 depicts the SIBOR–LIBOR spreads and the SORA–converted LIBOR spreads from January 2007 to December 2009. Both spreads are small before the failure of Lehman Brothers in September 2008. But, after September 2008, the SIBOR–LIBOR spreads take significant positive values, while the

Figure 5.3 SORA–converted LIBOR spreads, Singapore dollar (1990–2009).
Source: Datastream (Thomson Reuters).
Notes: LIBOR = London Interbank Offered Rate; SORA = Singapore Overnight Rate Average.
Figure 5.4 SIBOR–LIBOR and SORA–converted LIBOR spreads (2007–9).
Source: Datastream (Thomson Reuters).
Notes: LIBOR = London Interbank Offered Rate; SIBOR = Singapore Interbank Offered Rate; SORA = Singapore Overnight Rate Average.

SORA–converted LIBOR spreads become significantly negative. The asymmetric impacts are similar to what is observed for the TIBOR–LIBOR spreads in the eurodollar and in the euroyen. However, the SIBOR–LIBOR spreads take positive values only temporarily, while the positive TIBOR–LIBOR spreads in the US dollar persist for several months. From September to December 2008, the SORA–converted LIBOR spreads are very similar to the TIBOR–LIBOR spreads in the Japanese yen. But, while the TIBOR–LIBOR spreads in the Japanese yen turn negative after the summer of 2007, the SORA–converted LIBOR spreads do not. While the TIBOR–LIBOR spreads in the Japanese yen are positive in 2009, the SORA–converted LIBOR spreads do not.

5.4 Integration between HIBOR and LIBOR

This section investigates the nature of the relationship between HIBOR and LIBOR. Unlike SIBOR and TIBOR, HIBOR is denominated only in the Hong Kong dollar. Thus, like SORA, it is not a perfect substitute for the US-dollar denominated LIBOR. However, since 17 October 1983, the government of Hong Kong, China has maintained a linked exchange rate system backed by a currency board in which the value of the US dollar was fixed at HK$7.8. HIBOR might have been a close substitute for the eurodollar LIBOR without a risk premium.
5.4.1 Integration without exchange rate adjustment

This subsection compares the daily data of the 3-month interbank offer rates of HIBOR and the eurodollar LIBOR without exchange rate adjustment. The sample period is from 1 January 1991 to 18 December 2009.

Table 5.1, which summarizes annual average and annual standard deviations of the HIBOR–LIBOR spreads in each calendar year from 1991 to 2009, shows two salient features of HIBOR. First, HIBOR has large deviations from LIBOR in most years. In particular, the annual average exceeds 1.5 points in 1997 and 1998, and drops below −0.9 points in 2004, 2006, and 2007. The large deviations support the proposition that the interest rate quoted in the Hong Kong dollar is far from a perfect substitute for that quoted in the US dollar.

Second, the annual average HIBOR–LIBOR spread, which is positive in the 1990s, becomes negative in most of the 2000s. In particular, it does not turn positive after 2003. Given that the deviations are also very large, this indicates that HIBOR has been set much lower than the eurodollar LIBOR since 2003.

Figure 5.5 depicts the daily data of HIBOR and the eurodollar LIBOR during 1991–2009. It shows relatively close comovements between HIBOR and LIBOR from January 2001 to September 2003, but the comovements diverge after October 2003. Except for a few months between June 2005 and November 2005, HIBOR then shows substantial downward deviations from LIBOR until July 2007. The downward deviations reflect Hong Kong, China’s monetary policy. The territory experienced substantial deflation in the early 2000s. To dampen the deflationary pressures, the monetary authority kept its target interest rates as low as possible under the fixed exchange rate system.

![Figure 5.5](HIBOR_LIBOR.png)

Figure 5.5 HIBOR and LIBOR, without exchange rate adjustment (1991–2009).

Source: Datastream (Thomson Reuters).

Notes: HIBOR = Hong Kong Interbank Offered Rate; LIBOR = London Interbank Offered Rate.
5.4.2 Integration with exchange rate adjustment

The last subsection shows that HIBOR has substantial downward deviations from LIBOR after October 2003, when the Hong Kong dollar carried a premium in the forward market. Despite the fixed exchange rate system backed by a currency board, the Hong Kong dollar strengthened more in the forward market than in the spot market in the 2000s. To exclude the effects of forward exchange rate premiums, this subsection investigates the integration between HIBOR and LIBOR using the CIP condition, employing the formula in the Singapore section, but substituting the Hong Kong dollar for the Singapore dollar.

Figure 5.6 depicts HIBOR and the converted LIBOR during 1991–2009. All the rates are denominated in the Hong Kong dollar. Despite the time difference between Hong Kong, China and London, HIBOR is very closely synchronized with the converted LIBOR throughout the period. In 1997 and 1998, HIBOR rises, reflecting increased risk premiums as well as temporary monetary tightening, but the converted LIBOR increases at the same time. Thus, unlike TIBOR, no additional risk premium is applied to HIBOR even during the Asian crisis. Despite the deterioration of Hong Kong, China’s financial sector during the Asian financial crisis, HIBOR does not reflect regional risk premiums, as is the case with SIBOR and SORA. Even after late 2003, HIBOR keeps closely synchronized with the converted LIBOR. This implies that the deviations of HIBOR from the eurodollar LIBOR are attributable to forward exchange rate premiums.

Figure 5.7 depicts the HIBOR–converted LIBOR spreads (i.e. HIBOR minus the converted LIBOR) from January 2007 to December 2009. The spreads are small.
throughout most of the period, but become significantly positive after March 2008 when the Bear Stearns Companies collapsed on Wall Street. The positive spreads continue to the beginning of October 2008, turn negative till April 2009, then become positive beginning May 2009.

During the global financial crisis, LIBOR carries higher risk premiums than the interbank rates in Singapore and Tokyo when denominated in local currencies, but this is not the case for the Hong Kong, China market. During the crisis, many Asian banks, including those in Hong Kong, China, did not suffer large losses. This implies that the London market might have larger counter-party risk than the Hong Kong market. But, except during the first quarter of 2009, the Hong Kong interbank rates had larger risk premiums than LIBOR denominated in the Hong Kong dollar. This is similar to what is observed in eurodollar interbank rates in Singapore and Tokyo. The results may have reflected that the Hong Kong dollar has been pegged to the US dollar for 25 years.

5.5 Integration of Malaysia’s rates with LIBOR

5.5.1 Integration in the offshore market

This subsection examines the integration of Malaysia’s offshore market with the London market. The analysis uses the daily data of 3-month rates of LABOR and the dollar-denominated LIBOR from 16 September 1996 to 18 December 2009.
Figure 5.8A depicts LABOR and LIBOR from September 1996 through December 2000. Before November 1997, LABOR is closely synchronized with LIBOR. From 16 September 1996 to 30 November 1997, the average spread between LABOR and LIBOR is below 0.0015 points. However, LABOR becomes significantly higher than LIBOR during December 1997. From January 1998 to August 1998, the average spread is close to 0.2 points, and from September 1998 to September 1999 it exceeds 0.5 points. The spreads remain generally positive until the end of 2000.

During the Asian crisis, the Malaysian ringgit depreciated substantially and the economy contracted in 1998. The upward deviations of LABOR from LIBOR may reflect the regional risk premiums under the Asian crisis. In common with TIBOR, LABOR carries the “Japan premium,” reflecting the credit risk of Japanese banks at that time.

However, Malaysia started capital control in September 1998. Although no explicit capital control was imposed for offshore trading in Labuan, foreign investors probably recognized the potential for capital control in the future. Consequently, the upward deviations of LABOR from LIBOR widen after September 1998. Although the Malaysian economy started to recover from the second quarter of 1999, the deviations remain high until the end of 2000, when capital control was no longer in effect.

Figure 5.8B depicts LABOR and LIBOR from January 2001 to December 2007. Although Malaysia had no conspicuous financial crisis during this period, LABOR shows some spikes, probably due to the limited transactions in the Labuan offshore market. Aside from the infrequent spikes, LABOR is closely synchronized with LIBOR throughout the period. The simple average of the LABOR–LIBOR spreads was about 0.036 points, which is larger than that of the TIBOR–LIBOR and SIBOR–LIBOR spreads during the same period. Even in normal times, Malaysia’s offshore market is not as integrated with the London market as are the Singapore and Tokyo markets. Lack of liquidity in Malaysia’s market is probably an important factor in the lower level of integration.

Figure 5.8C depicts LABOR and LIBOR from January 2008 to December 2009. Until mid-September 2008, LABOR is closely synchronized with LIBOR. From 1 January 2008 to 29 August 2008, the average spread between LABOR and LIBOR is about 0.035 points; almost the same as from January 2001 to December 2007. During the early stage of the global financial crisis, LABOR has no significant regional risk premium, but becomes significantly higher than LIBOR after September 2008. The spreads between the two rates exceed 2.0 points on 19 and 22 September 2008 and remain significantly positive even in 2009, with some stabilization.

The upward deviations of LABOR from LIBOR during the global financial crisis are similar to that which is observed for the eurodollar TIBOR. An interpretation is that the risk premium in the eurodollar markets boosted both TIBOR and LIBOR, but the impacts were larger on LABOR and TIBOR than on LIBOR at that time. The latter result is, however, paradoxical given the change in credit quality of European and US banks versus that of Asian banks. In terms of US
Figure 5.8 LABOR and LIBOR. (A) 1996–2000; (B) 2001–7; (C) 2008–9.
Source: Datastream (Thomson Reuters).
Notes: LABOR = Labuan Interbank Offered Rate; LIBOR = London Interbank Offered Rate.
Regional and global short-term financial market integration in Asia

Because there is no LIBOR denominated in the Malaysian ringgit, KLIBOR is not a perfect substitute for LIBOR. However, using the spot and forward exchange rates, the CIP condition allows one to calculate effectively Malaysian ringgit-denominated LIBOR, employing the formula in the Singapore section, but substituting the ringgit for the Singapore dollar.

Using the converted LIBOR, this subsection explores the relationship between the ringgit-denominated 3-month interbank offered rates in Malaysia and London, from 3 July 2006 to 18 December 2009. Owing to data availability, the sample period is short, but it includes the periods before and after the global financial crisis.

Figure 5.9 depicts KLIBOR and the converted LIBOR in the sample period and has three noteworthy features. First, KLIBOR is very “sticky” and remains constant for a long time, irrespective of the global financial crisis. Second, the converted LIBOR is highly volatile and has large temporary deviations from KLIBOR. Third, KLIBOR is generally higher than the converted LIBOR except from October 2008 to April 2009. The three features imply that KLIBOR has been a regulated interest rate, so that the CIP condition has not held in the Malaysian domestic interbank rate. The result is in marked contrast to the observations for

![Figure 5.9 KLIBOR and converted LIBOR (2006–9).](image)

Source: Datastream (Thomson Reuters).

Notes: KLIBOR = Kuala Lumpur Interbank Offered Rate; LIBOR = London Interbank Offered Rate.
the markets in Hong Kong, China; Singapore; and Tokyo, where interbank rates have been highly integrated with LIBOR especially in normal times, even when denominated in the local currency. Compared with money centers in Asia, the Kuala Lumpur interbank market is far less developed.

KLIBOR shows large deviations from the converted LIBOR even in normal times. KLIBOR is far from integrated with LIBOR even if the exchange rate risk is adjusted for. However, the deviations increase during the global financial crisis. After the summer of 2007, the converted LIBOR starts to show larger downward deviations from KLIBOR. During the early stage of the crisis, the ringgit-denominated interbank trade, which is less liquid, was regarded as risky in the international money market. In contrast, from October 2008 to April 2009, the converted LIBOR started to show larger upward deviations from KLIBOR. Deterioration in the credit quality of European and US banks after the Lehman shocks increases the risk premium in LIBOR. When the global financial turbulence stabilizes, the converted LIBOR starts to show larger downward deviations from KLIBOR again.

Figure 5.10 depicts the eurodollar LABOR–LIBOR spreads (i.e. LABOR minus LIBOR) and the ringgit-denominated KLIBOR–converted LIBOR spreads (KLIBOR minus the converted LIBOR) from August 2006 to December 2009. The two spreads show very different features. First, the LABOR–LIBOR spreads are small before the Lehman shocks in September 2008, while KLIBOR–converted LIBOR spreads remain positive. This might reflect a different degree of integration between the dollar-denominated and the ringgit-denominated interbank rates in normal times. But after September 2008, the LABOR–LIBOR spreads take large positive values, while the KLIBOR–converted LIBOR spreads

![Figure 5.10 LABOR–LIBOR and KLIBOR–converted LIBOR spreads (2006–9).](image-url)

Source: Datastream (Thomson Reuters).

Notes: LABOR = Labuan Interbank Offered Rate; KLIBOR = Kuala Lumpur Interbank Offered Rate; LIBOR = London Interbank Offered Rate.
become significantly negative. The asymmetric impacts after the Lehman shocks are similar to what is observed in the Tokyo and Singapore markets. The large LABOR–LIBOR spreads stabilize towards the end of December 2008 but remain positive even in 2009. KLIBOR–converted LIBOR spreads, in contrast, take large negative values until the end of March 2009, but become positive after 13 April 2009.

5.6 Integration of BIBOR with LIBOR

The Bangkok Interbank Offered Rate is the rate of interest at which not only Thai but also international banks can borrow funds from other banks in the Bangkok interbank market. Because BIBOR is denominated in the Thai baht, it is not a perfect substitute for LIBOR. However, a baht-denominated LIBOR can be effectively calculated as was done for the Singapore dollar. The sample period is 17 March 1995 to 18 December 2009, which includes the Asian crisis, the global financial crisis, and normal times.

Figure 5.11A, which depicts BIBOR and the converted LIBOR from 17 March 1995 to 18 December 2004, has two noteworthy features. First, BIBOR changes frequently even in normal times in the 1990s. Except during the Asian crisis, BIBOR is almost as volatile as the converted LIBOR. This is in marked contrast with KLIBOR, which remained constant for a long time. Domestic interbank markets are less developed in both Malaysia and Thailand, but Bangkok has more flexible interbank rates denominated in local currency than does Kuala Lumpur.

Second, the CIP condition does not hold between BIBOR and LIBOR. This is especially true during the Asian currency crisis, but even in normal times, BIBOR has significant deviations from the converted LIBOR. Before the Asian crisis, BIBOR has upward deviations from the converted LIBOR. The upward deviations accelerate during the Asian crisis, but after the crisis, BIBOR has downward deviations from the converted LIBOR. Significant downward deviations continue until 2002. In 2003 and 2004, the deviations become smaller and are infrequent.

Figure 5.11B depicts BIBOR and the converted LIBOR from January 2005 to December 2009. Even in 2005 and 2006, BIBOR has some downward deviations from the converted LIBOR, but they increase after 2007. The result is similar to that observed for KLIBOR, SORA, and TIBOR, all of which have downward deviations from LIBOR during the global financial crisis, when denominated in their local currencies. However, BIBOR has large downward deviations even before the summer of 2007 and the global financial crisis.

The BIBOR–LIBOR spreads indicate that BIBOR is far from integrated with LIBOR even if the exchange rate risk is adjusted and even during normal times. This is in marked contrast within the Hong Kong, China; Singapore; and Tokyo markets. As noted, BIBOR’s deviations from the CIP condition are very large until the end of 2001. Starting from 2003, the spreads narrow. In 2006, BIBOR’s deviations are smaller than KLIBOR’s; however, during the global financial crisis, BIBOR’s downward deviations are larger than those of any other Asia interbank rate. Even though the Bangkok market is far from developed, risk premiums raised LIBOR more than BIBOR during the global financial crisis.
5.7 Concluding remarks

Regional and global financial integration may help the region promote the development of national and regional financial markets. This chapter explores the degree of short-term financial market integration in East Asia. Unlike medium- or long-term financial markets such as bond markets and stock markets, short-term financial markets play an important role in providing liquidity. Their regional and global financial integration therefore helps to prevent regional and global
liquidity crises. Thus, this chapter investigates how the Asian money markets have been integrated with the London money market since the 1990s.

The Asian money markets explored are those in Hong Kong, China; Malaysia; Singapore; Thailand; and Tokyo. After matching the currency denomination, how each Asian interbank rate has been synchronized with LIBOR is investigated. Money markets in Asia remain generally underdeveloped, except for Hong Kong, China; Singapore; and Tokyo. Nevertheless, those three markets and the offshore markets in Malaysia and Singapore, are highly synchronized with the London market in non-crisis periods. In contrast, onshore markets in Malaysia, Singapore, and Thailand are less well correlated with the London market and their interbank offered rates frequently show substantial deviations from LIBOR. More interesting are the remarkably asymmetric responses in how Asian markets reflect regional risk premiums during the global financial crisis. The asymmetric impacts in the dollar-denominated and local currency-denominated markets have a “home bias,” reflecting different liquidity premiums during the financial crisis.

The results suggest the importance of US dollar liquidity provisions during the global financial crisis. During the crisis, risk premiums are mainly driven by factors related to funding liquidity. In particular, pressure in the interbank market made it critical for non-US banks to retain access to other sources of dollar funding. In developed economies, coordinated central bank liquidity provisions would be useful in reducing the risk premiums. But in Asia, promoting regional money markets could also be important. Regional arrangements to provide substantial liquidity could be indispensable during a financial crisis. The Chiang Mai Initiative is a promising arrangement in East Asia to handle regional liquidity issues. But the initiative may need to be developed further to manage regional short-term liquidity problems.

Notes

1 For example, Gyntelberg and Wooldridge (2008) provided some comparisons of interbank offered rates.

2 In 2009, reference banks for the US dollar were Bank of America, Bank of Tokyo-Mitsubishi UFJ Ltd, Barclays Bank, Citibank NA, Credit Suisse, Deutsche Bank AG, HSBC, JP Morgan Chase, Lloyds Banking Group, Mizuho Corporate Bank, Norinchukin Bank, Rabobank, Royal Bank of Canada, Royal Bank of Scotland Group, Société Générale, UBS AG, and WestLB AG. Those in the Japanese yen are almost the same. But they include Mizuho Corporate Bank and Sumitomo Mitsui instead of Credit Suisse and Royal Bank of Canada.

3 Reference banks in 2009 were Bank of Tokyo-Mitsubishi UFJ, Bank of Yokohama, Chuo Mitsui Trust and Banking Co., Deutsche Bank AG, JPMorgan Chase Bank, Mitsubishi UFJ Trust and Banking Corporation, Mizuho Bank, Mizuho Corporate Bank, Mizuho Trust and Banking Co., National Association, Norinchukin Bank, Resona Bank, Shinkin Central Bank, Shinsei Bank, Shoko Chukin Bank, Sumitomo Mitsui Banking Corporation, Sumitomo Trust and Banking Co., and UBS AG.

4 In 2009, the seven local banks were Bangkok Bank Public Company, Bank of Ayudhya Public Company, Kasikornbank Public Company, Krung Thai Bank Public Company, Siam City Bank Public Company, Siam Commercial Bank Public Company, and Thai Military Bank Public Company. The seven foreign banks were ABN-Amro Bank
Shin-ichi Fukuda


5 Since the KLIBOR–converted LIBOR spreads are highly volatile, for this analysis they were smoothed out by taking an 11-day average in Figure 5.10.

6 The Chiang Mai Initiative is a multilateral currency swap arrangement among the ten members of the Association of Southeast Asian Nations (ASEAN) plus the People’s Republic of China, Japan, and the Republic of Korea. The ASEAN members are Brunei Darussalam, Cambodia, Indonesia, the Lao People’s Democratic Republic, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Viet Nam.

References

6 Stock market integration and financial contagion

Kee-Hong Bae

It is generally agreed that national capital markets have become more integrated in recent years, in large part as a consequence of the trend toward financial deregulation coupled with technological developments that have greatly reduced transaction and information costs. Many studies have documented the benefits of improved sharing of risks, which is a decrease in cost of capital (Bekaert and Harvey 2000, Henry 2000a) and an increase in real investment (Henry 2000b, Mitton 2006, Chari and Henry 2008, Bae and Goyal 2009). Recent literature has focused on economic growth benefits associated with financial market integration (Bekaert, Harvey, and Lundblad 2001, 2005, 2009).

While the benefits of stock market integration are well documented both theoretically and empirically, a quantitative measure of integration that allows for cross-sectional and time-series comparison across countries is hard to obtain. This chapter provides a quantitative measure of stock market integration and examines how the measure evolves. Specifically, the chapter poses the following questions: How has the degree of global and regional integration in Asian economies changed over time? Does a regional factor, beyond a global factor, affect the economies in the region? How does the degree of integration in Asia compare with that in Latin America or Europe?

The market integration measure used is the proportion of national stock index returns explained by global factors. Using global factors extracted from major developed stock market index returns by principal component analysis, Pukthuanthong and Roll (2009) showed that \( R^2 \)s of national stock index returns explained by global factors capture the degree of global integration for each national stock market. This concept of market integration is rather a broad one and is not based on any asset-pricing theory. Nevertheless, it is intuitively a sensible measure of integration. If the proportion of global shock explaining the national market index returns is small, the local influence would dominate return movements. If many countries are susceptible to the same global shocks, then their markets are likely to be integrated. There are several advantages to using the \( R^2 \)'s from the multifactor regression as a measure of global integration. First, the computation of this measure requires only national stock market indexes, which can be easily obtained. Thus, this measure can be computed for a large number of countries and across time, making the investigation of cross-sectional
and time-series variations of global integration possible for a large number of countries. Another advantage is that this measure of integration can be easily extended to capture regional integration.

Global and regional integration measures are computed for ten Asian economies, 14 European countries that adopt the common currency (the “euro countries”), and seven Latin American countries. Empirical analyses of global and regional integration measures can be summarized as follows:

- The degree of global and regional integration has improved over the years for most countries. In Asia, the mainland People’s Republic of China (PRC) market is least integrated. Malaysia shows a decreasing trend. The biggest improvement in integration is by the Republic of Korea.
- The degree of global and regional integration is much higher in the euro countries than in Asia and Latin America. The degree of global and regional integration in Asia is similar to that in Latin America.
- The extent of regional integration due to purely regional factors has decreased in both Asia and Latin America, with the magnitude of decrease more pronounced in Latin America. About the time the euro was introduced in 1999, the degree of pure regional integration among euro countries increased.

Episodes of financial crisis have prompted many policy makers to question the benefits of integrating their financial markets with global markets. Emerging market economic crises have led to massive bailouts to quell contagion and have reduced support for free capital mobility. Bhagwati (1998: 8) argued that “Capital flows are characterized by panics and manias.” In contrast, Choe, Kho, and Stulz (1999) argued that there is little evidence that trades by foreign investors had a destabilizing effect on the Republic of Korea’s stock market during the crisis period in 1997. Given the ongoing debate regarding the cost and benefit of financial market globalization, this chapter investigates whether stock market integration has any impact on the degree of financial contagion.

The contagion measure this chapter uses is from Bae, Karolyi, and Stulz (2003). They proposed a measure of contagion defined as a joint occurrence of extreme return shocks across countries within a region on a particular trading day, or co-exceedances. For instance, when an extreme return is defined as the one below the fifth quantile of the marginal return distribution in each country, there is one trading day when all ten Asian economies realize extreme returns, which means that the number of co-exceedances is ten on that trading day. First, the number of co-exceedances is computed in each region – Asia, Europe, and Latin America. The frequency of co-exceedances is higher in Latin America and Europe than in Asia. Next, the chapter investigates how this co-exceedance measure is related to the degree of integration. Using multinomial logit regression, the probability of co-exceedances in each region is regressed on conditional volatility, average interest rate, average exchange rate changes, and average global and regional integration in each region. The results suggest that, when countries
are more integrated, they are more likely to experience co-exceedances. This positive relation is strongest in Latin America. However, the marginal effects of integration measures are mostly statistically insignificant and economically small in magnitude. For example, in Asia, when the global integration measure increases by 1%, the probability of experiencing six or more co-exceedances on a given day increases only by 1.52 basis points. The corresponding figure associated with a 1% increase in the regional integration is 2.24 basis points. The impact of integration on the extent of contagion appears negligible, if there is any.

The rest of the chapter is organized as follows: the next section describes the data and presents the empirical results; Section 6.2 examines the relation between stock market integration and financial contagion; and Section 6.3 concludes.

6.1 Measuring stock market integration

6.1.1 Data

Daily national stock indexes converted into United States (US) dollars are used as the basis of empirical analyses for this chapter. Three regions are studied: Asia, Europe, and Latin America. For Europe, the countries select are those that use the euro for their currency – the euro countries. Each national stock market’s stock index is selected from Datastream (Thomson Reuters). Following Pukthuanthong and Roll (2009), when there are multiple stock indexes, the selected index is that with the broadest coverage of stocks within the country and the longest period of availability. Applying some filtering rules for each national market index returns results in the selection of ten Asian, 14 European, and seven Latin American economies into the sample.2

Table 6.1 lists the sample economies selected in each of the three regions, the number of daily observations, the sample period, and summary statistics on daily return data. For Asia, the analysis period begins in January 1985, even though index data are available well before that for Hong Kong, China; Japan; and Singapore. The reason for this choice is that in much of Asia, the liberalization process was not initiated until the late 1980s (Bae and Goyal 2009, Bekaert and Harvey 2000). Cyprus and Greece are excluded from the euro region sample because they did not have enough usable return data. Most of the euro countries have index data available as early as 1975, while emerging markets, such as Malta, Slovakia, and Slovenia, that recently joined the eurozone have index data available starting from the early 1990s. In Latin America, seven countries are selected and index data for them are available starting from the late 1980s or early 1990s when these markets started their liberalization programs. The last row of the table presents the global portfolio. The global portfolio is computed as an equal-weighted return of the 16 countries employed to extract global factors.

The last five columns of Table 6.1 present summary statistics on daily index returns. The best performer among the sample countries is Brazil, realizing daily mean a return of 0.13%. It is also the most volatile market, with a daily standard
### Table 6.1 Summary statistics

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<th>SD</th>
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<th>Maximum</th>
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<td></td>
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<td>0.74</td>
<td>−8.67</td>
<td>0.07</td>
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</table>

Source: Data from Datastream (Thomson Reuters).

Notes: N = number of observations; SD = standard deviation. The table lists the sample economies selected in each region (Asia, Europe, and Latin America); number of daily observations; sample period; and summary statistics on daily return data. Daily national stock indexes converted into United States dollars are used to compute daily dollar returns and these are employed as the basis of empirical analyses. Global portfolio is the equal-weighted portfolio of 16 developed countries.
deviation of 3.73%, which translates into an annual standard deviation of almost 60%. In fact, Latin American countries have the most volatile markets, with a daily average standard deviation of 2.21%, followed by Asian and euro economies with an average standard deviation of 1.88% and 1.30%, respectively. It is a well-known fact that emerging markets tend to be more volatile (Bekaert and Harvey 1997).

Table 6.2 presents correlations among the sample economies. While correlation may be a poor measure of integration, Bekaert, Hodrick, and Zhang (2009: 2612) noted that “correlations are an important ingredient in the analysis of international diversification benefits and international financial market integration,” suggesting that cross-market correlations provide meaningful information to the study of market integration. Table 6.2A presents correlations among sample economies in Asia, and correlations with contemporaneous and lagged returns on the global portfolio. The correlation with the lagged return of the global portfolio is to capture the effect of non-synchronous trading on cross-market correlations. Not surprisingly, two international financial centers in Asia (Hong Kong, China and Singapore), display the highest correlation with the global market portfolio. The sum of contemporaneous and lagged return correlations is 0.76 for Hong Kong, China and 0.78 for Singapore. The corresponding magnitude for Japan is 0.68, followed by Thailand with 0.63. The least correlated market with the global portfolio is the PRC, with the magnitude of 0.23. The average pair-wise correlation among Asian economies is 0.23. The magnitude of correlation of one economy with other Asian economies ranges from 0.08 (the PRC) to 0.37 (Singapore). Again, Hong Kong, China and Singapore are most highly correlated with other economies in the region, while the PRC is least correlated.

Table 6.2B presents correlations among the 14 euro countries. Most developed euro countries exhibit high correlations with the global portfolio. The sum of contemporaneous and lagged return correlations with the global portfolio is mostly over 0.70, while a less developed euro country such as Slovakia has correlation of 0.22. The average pair-wise correlation among the euro countries is 0.40. This magnitude is 1.7 times that of Asia. If Malta, Slovakia, and Slovenia are excluded, the figure increases to 0.52, which is 2.3 times that in Asia.

Finally, Table 6.2C presents correlations among the seven countries in Latin America. Countries in Latin America are quite highly correlated with the global market portfolio. The magnitude of 2-day correlations with the global market portfolio ranges from 0.46 for Brazil to 0.61 for Peru. However, Ecuador has practically no relation with the global market and the magnitude of correlation for Venezuela is a modest 0.23. The average pair-wise correlation among Latin American countries is 0.20, a magnitude similar to Asian economies. If Ecuador and Venezuela are excluded, the figure doubles to 0.40.

6.1.2 Empirical method to measure stock market integration

The empirical method used by Pukthuanthong and Roll (2009) is employed to measure the degree of stock market integration. Their measure of integration is intuitively appealing and is less subject to estimation problems than are other
Table 6.2 Correlations

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<tr>
<th>Economy</th>
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<th>Hong Kong, China</th>
<th>India</th>
<th>Japan, Republic of</th>
<th>Malaysia</th>
<th>Philippines</th>
<th>Singapore</th>
<th>Taipei, China</th>
<th>Thailand</th>
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<tr>
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<td>1.00</td>
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<td>0.26</td>
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Cont’d
Table 6.2 Cont’d

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Source: Data from Datastream (Thomson Reuters).

Notes: The table presents cross-market correlations among the sample within in each region (Asia, Europe, and Latin America). Daily national stock indexes converted into United States dollars are used to compute daily dollar returns. Global portfolio is the equal-weighted portfolio of 16 developed countries.
methodologies in the sense that their empirical model is less sensitive to the choice of sample and model specification. More importantly, their empirical model can be easily extended to measure the degree of both global and regional integration.

Suppose each country’s stock market return is driven by global factors:

\[ r_{i,t} = \alpha_i + \beta_{i,g} f_{g,t} + e_{i,t}, \]  

(6.1)

where \( r_{i,t} \) is the market index return of a national stock market \( i \) at time \( t \), \( \beta s \) are vectors of sensitivity coefficients, \( f s \) are vectors of global factors at time \( t \), and \( g \) refers to global.

Global factors are estimated using the principal component method and 16 major developed markets. These countries (the “cohort countries”) are Australia, Austria, Belgium, Canada, Denmark, France, Germany, Ireland, Italy, Japan, the Netherlands, Singapore, South Africa, Switzerland, the United Kingdom, and the US. There are a few reasons for this choice. First, index data for these countries are available as early as 1975. Second, they are the largest economies and have the largest stock markets, with a few exceptions. They also have a long tradition of free capital mobility and are likely to be most integrated globally. An alternative choice, excluding the small economies (such as Austria, Belgium, Denmark, Ireland, Singapore, and South Africa), does not change the results. Global factors estimated using all sample countries give similar results.

One could employ principal factor analysis to extract global factors instead of principal component analysis. The characteristic that distinguishes between the two factor analysis models is that, in principal component analysis, one assumes that all variability in a country’s index returns should be used in the analysis, while in principal factor analysis one only uses the variability in a country’s index returns that the economy has in common with other countries’ index returns. By using principal component analysis to extract global factors, one implicitly assumes that the variability in the 16 countries’ index returns is global in nature. The current analysis also experimented with principal factor analysis and obtained similar results. Regional factors are estimated using market index returns of sample countries in each of the three regions.

The analysis included applying principal component analysis to daily dollar returns of the 16 cohort countries in each year and using the estimated components as proxies for global factors. The number of principal components selected account for more than 90% of the total volatility in the covariance matrix. Therefore, the resulting number of global factors changes from year to year, ranging from 10 to 14. The number of regional factors extracted ranges from 5 to 10 for Asian and euro economies, and 3 to 5 for Latin America.

Once regional and global factors are estimated, then each country’s national market index returns are regressed on global (regional) factors in each year. The explained proportion of a country’s return variation due to global (regional) factors is the measure of global (regional) integration.
6.1.3 Degree of global and regional integration in the Asian, European, and Latin American regions

Asia

Table 6.3 presents summary statistics on the extent of global and regional integration by economy. The first column lists the sample economies by region and the second column indicates the number of years used to compute statistics. The next two columns, under the heading "global integration," show the mean and median of adjusted $R^2$s of daily national market index returns explained by global factors. Similarly, columns five and six show the mean and median of adjusted $R^2$s of daily national market index returns explained by regional factors. Columns seven and eight show the mean and median of adjusted $R^2$s of daily national market index returns explained by both global and regional factors. The last two columns show summary statistics of incremental adjusted $R^2$s when regional factors are added in addition to global factors in explanatory variables. This measure captures the degree of regional integration not ascribed to global factors. In the following discussion, adjusted $R^2$s are used as a quantitative measure of integration.

The average global integration for all Asian sample economies is 23%. It is above 30% for Hong Kong, China; Malaysia; and Singapore, while it is below 11% for the PRC and India. Hong Kong, China is most highly integrated to global markets, with the degree of integration being 45%, while the PRC is least integrated, with only 2% of global integration.

The average regional integration is 34%, 11 percentage points higher than the average global integration. This result is not surprising, because regional factors are partly driven by global factors and partly by purely regional ones. If regional factors are completely explained by global factors, the extent of regional integration will be exactly the same as that of global integration. The regional integration shows a pattern similar to that of the global integration. Hong Kong, China and Singapore show the highest degree of integration, with the adjusted $R^2$s being 60% and 72%, respectively. In contrast, the PRC and India have only 5% and 14% of regional integration, respectively.

To measure the extent of regional integration solely due to regional factors not driven by global factors, the difference between the adjusted $R^2$ explained by global and regional factors combined together and the adjusted $R^2$ explained by global factors is computed. This difference is termed "pure regional integration." A larger difference suggests a higher degree of pure regional integration. The degree of pure regional integration is highest for Singapore at 42%. Interestingly, the degree of pure regional integration is lowest for Thailand at 3%, suggesting that Thailand's market is mostly driven by global factors.

To assess the evolution of market integration through time, the average level of global, regional, and pure regional integration is plotted by year from 1987 to 2009. Figure 6.1A presents the result. The degree of regional integration remains stable at about 30% until late the 1990s. Then it continues to increase to more than 50% by 2009. Global integration shows a similar pattern. The degree of pure regional integration is quite stable at about 15%.
Table 6.3 Summary statistics of stock market integration measures

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Cont’d
Table 6.3 Cont’d

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</table>

Source: Data from Datastream (Thomson Reuters).

Notes: The table presents summary statistics on the estimated measures of global and regional integration. Global factors are estimated with the principal component method using 16 major developed markets. Principal component analysis is applied to daily dollar returns of the 16 cohort countries in each year and the estimated components are used as proxies for global factors. Regional factors in each of the three regions are estimated using market index returns of sample economies in each region. Once regional and global factors are estimated, then each economy’s national market index returns are regressed on global (regional) factors in each year. The explained proportion of a country’s return variation due to global (regional) factors is the measure of global (regional) integration. Pure regional integration refers to the difference between the adjusted $R^2$ explained by global and regional factors combined together and the adjusted $R^2$ explained by global factors, measuring the extent of regional integration solely due to regional factors not driven by global factors.
Figure 6.1  The degree of global and regional integration by region: (A) Asia; (B) Europe; and (C) Latin America. Source: author.
Figure 6.2A shows the degree of global and regional integration by year for each economy in Asia. The PRC’s integration remains low and shows a gradual upward trend in recent years. Malaysia shows a big drop in the integration level at about the time of the 1997 Asian currency crisis. Surprisingly, Singapore shows little increase in integration, but this might be because it has been highly integrated with global and regional markets since the beginning of the sample period. All other economies show an increasing trend. The biggest increase observed is for the Republic of Korea. In 1997, both its regional and global integration are close to zero, which is perhaps due to the Asian currency crisis; but by 2008, its regional integration level exceeds 80%.

To examine whether the upward trend in the degree of integration is statistically significant, the adjusted $R^2$’s obtained in each year for each country are regressed on a linear time trend during the years data are available. The results are presented in Table 6.4. Consistent with Figure 6.2, all Asian economies have significantly positive $t$-statistics except the PRC, Malaysia, and Singapore. Malaysia has significantly negative $t$-statistics in both global and regional integration.

**Europe**

Table 6.3B presents summary statistics of integration for the euro countries. The average global integration is 48%, which is 25 percentage points higher than that of global integration in Asia. The variation is large among the euro countries. The highest degree of integration comes from the Netherlands, at 76%, while the lowest is from Slovakia, at only 5%. In general, less developed euro countries such as Malta, Slovakia, and Slovenia have low global integration. Most euro countries’ pure regional integration is much lower than that of Asian economies. In the eurozone, the mean and median of pure regional integration are only 8% and 3%, respectively.

Figure 6.1B shows the average global, regional, and pure regional integration by year from 1976 to 2009. Both regional and global integration continue to increase, with global integration reaching a high at over 70% in 1991. Then, the levels decrease to 32% in 1996, and rise again, reaching 80%. Interestingly, pure regional integration remains very low until 1996. It starts to go up in 1997, 2 years before the introduction of euro, and reaches 23% by 2003. After that, it descends to only 3% in 2008.

Figure 6.2B shows the degree of global and regional integration by year for each euro country. By 2008, most euro countries show a very high degree of integration, with adjusted $R^2$’s reaching over 80%. Exceptions are Ireland, Malta, Slovakia, and Slovenia. Even for these countries, the level of regional integration in 2008 is close to 50%, a magnitude similar to that in Asia. The highest degree of integration is observed in countries such as France, Germany, Italy, the Netherlands, and Spain, whose regional integration is over 90%. All euro countries show an upward trend. This result is confirmed in Table 6.4B. All euro countries have significantly positive $t$-statistics.
Figure 6.2A The degree of global and regional integration by economy: (A) Asia.

Source: author.
Figure 6.2A  The degree of global and regional integration by economy: (A) Asia—Cont’d
Figure 6.2A The degree of global and regional integration by economy: (A) Asia—Cont’d
### Table 6.4 Regression of stock market integration measures over time

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<td>p-value</td>
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<tr>
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<td>7.09 (0.00)</td>
</tr>
<tr>
<td>Japan</td>
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<td>3.52 (0.00)</td>
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<td>−3.11 (0.01)</td>
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</tr>
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<td>Thailand</td>
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<tr>
<td>(B) Europe</td>
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<td>3.53 (0.00)</td>
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</tr>
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<td>Spain</td>
<td>34 11.57 (0.00)</td>
<td>12.64 (0.00)</td>
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<tr>
<td>(C) Latin America</td>
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<tr>
<td>Argentina</td>
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<td>−1.14 (0.27)</td>
</tr>
<tr>
<td>Brazil</td>
<td>15 4.63 (0.00)</td>
<td>3.52 (0.00)</td>
</tr>
<tr>
<td>Chile</td>
<td>15 4.41 (0.00)</td>
<td>3.44 (0.00)</td>
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<td>2.08 (0.06)</td>
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<td>15 3.53 (0.00)</td>
<td>1.46 (0.17)</td>
</tr>
<tr>
<td>Venezuela</td>
<td>15 −1.88 (0.08)</td>
<td>−2.22 (0.04)</td>
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</tbody>
</table>

Source: Data from Datastream (Thomson Reuters).

Notes: N = number of years; t-statistic = the time trend slope coefficient; p-value = the associated p-values. This table presents the results of regression in which the estimated global (regional) integration measure in Table 6.3 is regressed on a linear time trend. The number of available years, the t-statistics for the time trend slope coefficient, and the associated p-values are presented for each sample economy.
Figure 6.2B  The degree of global and regional integration by economy: (B) Europe.
Source: author.
Figure 6.2B  The degree of global and regional integration by economy: (B) Europe—Cont’d
**Figure 6.2B** The degree of global and regional integration by economy: (B) Europe—Cont’d
Figure 6.2B The degree of global and regional integration by economy: (B) Europe—Cont'd
Stock market integration and financial contagion

Latin America

Table 6.3C presents summary statistics of integration for the Latin American countries. The level of integration is surprisingly similar to that of Asia. The mean and median of global integration are 23% and 18%, respectively; the corresponding numbers in Asia are 23% and 19%. Mexico and Brazil have the highest degree of global and regional integration, which is not surprising given the size and importance of these economies in Latin America. Ecuador and Venezuela have little relation to either global or regional markets.

Figure 6.1C presents the time trend in the degree of integration. From 1995 to 2008, global integration rises from 4% to 45%, an impressive increase of 41 percentage points. In contrast, the increase in regional integration is rather modest: it rises to 53% in 2008 from 39% in 1995, an increase of 14 percentage points. In fact, the degree of pure regional integration decreases to 9% in 2008 from 35% in 1995. Latin American countries appear to have become more globally integrated than regionally, as the magnitude of pure regional integration solely due to regional factors has decreased.

Figure 6.2C shows the average global and regional integration by year for each country. With the exception of Ecuador and Venezuela, all show an improvement in the degree of global integration. Table 6.4C confirms this result. Except Ecuador and Venezuela, all countries have significantly positive t-statistics when the degree of global integration is regressed on a linear time trend. However, for regional integration, the evidence is mixed. Only Brazil, Chile, and Mexico have significantly positive t-statistics. Venezuela has significantly negative t-statistics for both global and regional integration. Interestingly, Argentina has a high degree of regional integration in the early sample period and its level of regional and global integration drop sharply in 2001, probably because of Argentina’s peso crisis. After 2003, the extent of Argentina’s integration is restored and reaches 64% for global and 73% for regional integration.

6.2 Stock market integration and financial contagion

6.2.1 Measuring financial contagion

The empirical approach used in Bae, Karolyi, and Stulz (2003) is applied here to measure contagion. The data for the analysis are the daily US dollar market index returns used in Section 6.1. For Asia, the sample period is 4 April 1991 to 31 August 2009, as all Asian economies have data available during this period. Malta, Slovakia, and Slovenia are excluded from the analysis for Europe because they do not have a long enough time series of data. The sample period for the euro countries is 3 January 1992 to 31 August 2009. The euro sample starts on 3 January 1992 because data for Luxembourg are only available starting on that date. For Latin America, the sample period is 2 January 1996 to 31 August 2009.
Figure 6.2C The degree of global and regional integration by economy: (C) Latin America.

Source: author.
Figure 6.2C The degree of global and regional integration by economy: (C) Latin America—Cont’d
Kee-Hong Bae

Joint occurrences of extreme returns are computed for each region: Asia, the eurozone, and Latin America. First, an extreme negative return, or exceedance, is arbitrarily defined as one that lies below the fifth quantile of the marginal return distribution in each country. Because a joint occurrence of extreme return could simply be a result of high volatility, negative exceedances are defined as negative returns that are below $-1.65$ times the conditional volatility, where conditional volatility is estimated from an exponential GARCH model. When negative extreme returns are identified in each country, the number of joint occurrences of extreme returns, or co-exceedances, are counted within a region on a particular day. A co-exceedance count of $i$ units for negative returns is defined as the joint occurrence of $i$ exceedances of negative returns on a particular day.

The left side of Table 6.5 presents the frequency distribution of co-exceedances within a region. Table 6.5A presents the distribution for Asia. The sample period has 4,483 trading days. They are divided into days in which there are no exceedances in any country (3,321 such days), exceedance by only one country (792 such days), and multi-economy co-exceedances. The table provides information on the total number of days with co-exceedances of a given count, and on which countries participate in those events and how often. In Asia, on 36 out of 4,483 days (0.81%), more than six Asian economies are in the bottom of the marginal return distribution at the same time, with three (Hong Kong, China; the Republic of Korea; and Singapore) being the most frequent participants. On one occurrence, all ten Asian economies experience negative exceedances. In sharp contrast to Asia, among euro countries, on 104 of 4,505 days (2.31%), more than six countries are in the bottom of the marginal return distribution at the same time (Table 6.5B). On 16 days (0.36%), ten or all 11 euro countries experience negative exceedances. In Latin America, on five occurrences (0.18%), six countries realize negative exceedances at the same time, although there are only seven countries. To the extent that one accepts the idea that co-exceedances of six and more countries indicate contagion, euro and Latin American countries appear to be more “contagious” than Asian economies.

The right side of Table 6.5 also reports the mean return for each country for the days when it participates in co-exceedances of various counts. The average daily return when more than six countries realize exceedances is $-5.21\%$ in Asia. The corresponding figure for Latin American countries is $-7.54\%$. The euro countries experience less negative returns during the days of co-exceedances. The average return, when six or more countries experience exceedances, is $-3.26\%$, which is only half of that for Asia or Latin America.

### 6.2.2 Are integrated markets more susceptible to financial contagion?

To validate or invalidate the claim that capital market openness leads to vulnerability to financial panic and contagion, whether the degree of contagion is related to the degree of financial integration is examined. One would expect a positive relation if integrated markets are more vulnerable to global economic crises.
Table 6.5 Frequency distribution of co-exceedances

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<tr>
<th>Economy</th>
<th>Number of negative (co-)exceedances</th>
<th>Total</th>
<th>Mean return when (%)</th>
</tr>
</thead>
<tbody>
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<td></td>
<td>0 1 2 3 4 5 6 7 8 9 ≥10 ≥6 ≥7 ≥8 ≥9 ≥10</td>
<td></td>
<td></td>
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<td>(A) Asia</td>
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</tr>
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<td>Japan</td>
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<td>4,483</td>
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<tr>
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<td>4,483</td>
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<tr>
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<td>4,483</td>
<td>−3.63 −3.50 −3.70 −3.47 −2.34</td>
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<tr>
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<td>4,483</td>
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<tr>
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<td>−5.21 −5.19 −5.05 −4.47 −3.74</td>
</tr>
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<th>Total</th>
<th>Mean return when (%)</th>
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</thead>
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<td>Brazil</td>
<td>2,766</td>
<td>12</td>
<td>9</td>
</tr>
<tr>
<td>Chile</td>
<td>2,702</td>
<td>47</td>
<td>29</td>
</tr>
<tr>
<td>Ecuador</td>
<td>2,721</td>
<td>75</td>
<td>13</td>
</tr>
<tr>
<td>Mexico</td>
<td>2,685</td>
<td>61</td>
<td>33</td>
</tr>
<tr>
<td>Peru</td>
<td>2,706</td>
<td>63</td>
<td>16</td>
</tr>
<tr>
<td>Venezuela</td>
<td>2,744</td>
<td>39</td>
<td>14</td>
</tr>
<tr>
<td>Pooled</td>
<td>2,326</td>
<td>369</td>
<td>74</td>
</tr>
<tr>
<td>In %</td>
<td>82.75</td>
<td>13.13</td>
<td>2.63</td>
</tr>
</tbody>
</table>

Source: Data from Datastream (Thomson Reuters).

Notes: The table presents the frequency distribution of co-exceedances in each region of Asia, Europe, and Latin America. The co-exceedances are computed using the approach of Bae, Karolyi, and Stulz (2003). First, an extreme negative return, or exceedance, is defined as one that lies below the fifth quantile of the marginal return distribution. Once negative extreme returns are identified in each country, then the number of joint occurrences of extreme returns, or co-exceedances, is counted within a region on a particular day. A co-exceedance count of \( i \) units for negative returns is defined as the joint occurrence of \( i \) exceedances of negative returns on a particular day. The data for the analysis are daily United States dollar market index returns. The sample period is from 4 April 1991 to 31 August 2009 for Asia; 3 January 1992 to 31 August 2009 for the euro countries; and 2 January 1996 to 31 August 2009 for Latin America.
A multinomial logit regression model is employed. In particular, if \( P_i \) is the probability associated with a category \( i \) of \( m \) possible categories, then a multinomial distribution may be given by

\[
P_i = \frac{\exp(\beta_i x)}{1 + \sum_{j=1}^{m} \exp(\beta_j x)},
\]

(6.2)

where \( x \) is the vector of covariates and \( \beta \) the vector of coefficients associated with the covariates. To balance the need to have a model that is parsimonious and yet richly captures the range of possible outcomes, the number of categories is restricted to 7 (0, 1, 2, 3, 4, 5, and 6 or more co-exceedances) for Asian and euro countries, and 5 (0, 1, 2, 3, and 4 or more co-exceedances) for Latin America.

Table 6.6A provides estimates of the multinomial logistic regressions for Asia. Marginal effects estimated at the unconditional mean of each variable are reported alongside the corresponding coefficient estimates. Marginal effects are small and thus are reported in percentages (i.e. multiplied by 100). Column (1) reports estimates of regressions with conditional volatility, average interest rate, and average change in exchange rate in each region as the explanatory variables. Consistent with Bae, Karolyi, and Stulz (2003), the occurrences of more co-exceedances are largely immune from the impact of interest rates. But, when exchange rates increase (local currencies depreciate), the occurrences of co-exceedances increase significantly. However, this result is likely to be due to the use of US dollar-denominated returns. When local currencies depreciate, extreme negative returns are more likely to be observed when US-dollar-denominated returns are used.\(^7\) Conditional volatility mostly has no effect on the frequency of joint occurrences. This is because negative exceedances are defined as negative returns that are below \(-1.65\) times the conditional volatility, and thus the effect of conditional volatility on co-exceedances is already taken into account.

In column (2), the global integration measure estimated from Section 6.1 is added to the explanatory variables. Note that the integration measure is computed at the yearly frequency, while the dependent variable is computed at the daily frequency. The direction of bias is not clear. Since the integration measure is included in the explanatory variable as it provides new information in each trading day, the standard error may be understated. However, the integration variable measured at the yearly frequency will have much smaller variation than that measured at the daily frequency, which will understate the effect of integration.

The coefficient estimates and the marginal effects of the global integration measure are mostly negative for lower degrees of co-exceedances but positive for higher degrees. These results seem to suggest that, when countries are more integrated, they are more likely to experience co-exceedances than single-country exceedances. However, the marginal effects of these integration measures are mostly statistically insignificant and economically small in magnitude. For example, when the global integration measure increases by 1%, the probability
Table 6.6 Multinomial logit regression of daily return co-exceedances on stock market integration measures

<table>
<thead>
<tr>
<th>(A) Asia</th>
<th>(I)</th>
<th>(2)</th>
<th>(3)</th>
</tr>
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<tbody>
<tr>
<td>Coefficient</td>
<td>Δp</td>
<td>Coefficient</td>
<td>Δp</td>
</tr>
<tr>
<td>β₃₁ (constant)</td>
<td>−1.71ᵃ</td>
<td>−1.53ᵃ</td>
<td>−1.30ᵃ</td>
</tr>
<tr>
<td>β₃₂</td>
<td>−2.80ᵃ</td>
<td>−2.77ᵃ</td>
<td>−2.75ᵃ</td>
</tr>
<tr>
<td>β₃₃</td>
<td>−3.61ᵃ</td>
<td>−3.39ᵃ</td>
<td>−3.25ᵃ</td>
</tr>
<tr>
<td>β₃₄</td>
<td>−4.29ᵃ</td>
<td>−4.45ᵃ</td>
<td>−4.51ᵃ</td>
</tr>
<tr>
<td>β₃₅</td>
<td>−5.48ᵃ</td>
<td>−7.00ᵃ</td>
<td>−8.57ᵃ</td>
</tr>
<tr>
<td>β₃₆</td>
<td>−4.80ᵃ</td>
<td>−5.75ᵇ</td>
<td>−6.80ᵃ</td>
</tr>
<tr>
<td>β₃₇ (Global_Integₐ)</td>
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<td>−1.54</td>
<td>−0.06</td>
</tr>
<tr>
<td>β₃₈</td>
<td>−0.19</td>
<td>−0.68</td>
<td>−0.18</td>
</tr>
<tr>
<td>β₃₉</td>
<td>−0.05</td>
<td>−0.05</td>
<td>0.01</td>
</tr>
<tr>
<td>β₄₀</td>
<td>−0.01</td>
<td>0.01</td>
<td>−0.05</td>
</tr>
<tr>
<td>β₄₁</td>
<td>0.79ᵇ</td>
<td>0.22ᵇ</td>
<td>0.43</td>
</tr>
<tr>
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<td>0.42ᵃ</td>
<td>0.57ᶜ</td>
</tr>
<tr>
<td>β₄₃ (Reginal_Integₐ)</td>
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<td>0.88ᵃ</td>
<td>0.05ᵃ</td>
</tr>
<tr>
<td>β₄₄</td>
<td>0.01</td>
<td>−0.01</td>
<td>0.00</td>
</tr>
<tr>
<td>β₄₅</td>
<td>−0.03</td>
<td>−0.06</td>
<td>−0.04</td>
</tr>
<tr>
<td>β₄₆</td>
<td>−0.10</td>
<td>−0.06</td>
<td>−0.08</td>
</tr>
<tr>
<td>β₄₇</td>
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<td>−0.04</td>
<td>−0.02</td>
</tr>
<tr>
<td>β₄₈</td>
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<td>−0.09ᵇ</td>
<td>−0.08</td>
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<tr>
<td>β₄₉ (Fiat)</td>
<td>−0.18ᵃ</td>
<td>23.35ᵃ</td>
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<tr>
<td>β₅₀</td>
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<td>9.58ᵃ</td>
<td>2.92ᵃ</td>
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<tr>
<td>β₅₁</td>
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<td>4.23ᵃ</td>
<td>3.05ᵃ</td>
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<tr>
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<td>1.89ᵃ</td>
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<td>3.8₅ᵃ</td>
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<tr>
<td>β₅₅ (Global_Integₐ)</td>
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<td>−11.₈₉ᶜ</td>
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<td>0.02</td>
<td></td>
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<tr>
<td>β₅₇</td>
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<td>−1.₂₈</td>
<td></td>
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<tr>
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<td>0.4₀</td>
<td></td>
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<tr>
<td>β₅₉</td>
<td>4.₅₉ᶜ</td>
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</tr>
<tr>
<td>β₆₀</td>
<td>2.₉₂</td>
<td>1.₅₂</td>
<td></td>
</tr>
<tr>
<td>β₅₁ (Regional_Integₐ)</td>
<td>−1.₁₀ᶜ</td>
<td>−16.₁₅ᵇ</td>
<td></td>
</tr>
<tr>
<td>β₅₂</td>
<td>−0.₁₂</td>
<td>0.₂₀</td>
<td></td>
</tr>
<tr>
<td>β₅₃</td>
<td>−0.₉₅</td>
<td>−1.₃₂</td>
<td></td>
</tr>
<tr>
<td>β₅₄</td>
<td>0.₅₀</td>
<td>0.₄₀</td>
<td></td>
</tr>
<tr>
<td>β₅₅</td>
<td>6.₇₆ᵇ</td>
<td>1.₆₉ᵇ</td>
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<tr>
<td>β₅₆</td>
<td>4.₄₁ᶜ</td>
<td>2.₂₄ᵇ</td>
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<td>Log likelihood</td>
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<td>−3,6₀₆.₃₅</td>
<td>−3,6₀₄.₉₉</td>
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<tr>
<td>Pseudo R²</td>
<td>0.₀₄</td>
<td>0.₀₄</td>
<td>0.₀₄</td>
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Cont’d
Table 6.6 Cont’d

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<thead>
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<th>(J)</th>
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<th>(3)</th>
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<td><strong>Coefficient Δp</strong></td>
<td><strong>Coefficient Δp</strong></td>
</tr>
<tr>
<td><strong>(B) Europe</strong></td>
<td><strong>(B) Europe</strong></td>
<td><strong>(B) Europe</strong></td>
</tr>
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<td>$-1.92^a$</td>
</tr>
<tr>
<td>$\beta_{02}$</td>
<td>$-3.80^a$</td>
<td>$-3.45^a$</td>
</tr>
<tr>
<td>$\beta_{03}$</td>
<td>$-4.21^a$</td>
<td>$-3.50^a$</td>
</tr>
<tr>
<td>$\beta_{04}$</td>
<td>$-5.34^a$</td>
<td>$-5.44^a$</td>
</tr>
<tr>
<td>$\beta_{05}$</td>
<td>$-4.69^a$</td>
<td>$-4.16^a$</td>
</tr>
<tr>
<td>$\beta_{06}$</td>
<td>$-4.23^a$</td>
<td>$-5.06^a$</td>
</tr>
<tr>
<td>$\beta_{11}$ ($\Delta_t$)</td>
<td>$-0.30^b$</td>
<td>$-2.88^b$</td>
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<td>$\beta_{12}$</td>
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<td>0.82</td>
</tr>
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<td>0.03</td>
<td>0.05</td>
</tr>
<tr>
<td>$\beta_{14}$</td>
<td>0.45</td>
<td>0.33</td>
</tr>
<tr>
<td>$\beta_{15}$</td>
<td>0.46</td>
<td>0.36</td>
</tr>
<tr>
<td>$\beta_{16}$</td>
<td>0.79</td>
<td>1.09</td>
</tr>
<tr>
<td>$\beta_{21}$ ($\Delta_{it}$)</td>
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<td>0.53</td>
</tr>
<tr>
<td>$\beta_{22}$</td>
<td>0.06</td>
<td>0.15</td>
</tr>
<tr>
<td>$\beta_{23}$</td>
<td>0.07</td>
<td>0.12</td>
</tr>
<tr>
<td>$\beta_{24}$</td>
<td>0.04</td>
<td>0.03</td>
</tr>
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<td>$\beta_{25}$</td>
<td>-0.08</td>
<td>-0.07</td>
</tr>
<tr>
<td>$\beta_{26}$</td>
<td>$-0.12^b$</td>
<td>$-0.17^b$</td>
</tr>
<tr>
<td>$\beta_{31}$ ($\Delta_{it}$)</td>
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<td>6.59</td>
</tr>
<tr>
<td>$\beta_{32}$</td>
<td>1.29</td>
<td>3.43</td>
</tr>
<tr>
<td>$\beta_{33}$</td>
<td>0.90</td>
<td>1.29</td>
</tr>
<tr>
<td>$\beta_{34}$</td>
<td>1.52</td>
<td>0.99</td>
</tr>
<tr>
<td>$\beta_{35}$</td>
<td>1.44</td>
<td>0.99</td>
</tr>
<tr>
<td>$\beta_{36}$</td>
<td>2.06</td>
<td>2.58</td>
</tr>
<tr>
<td>$\beta_{41}$ (Global_Integ$_{it}$)</td>
<td>-0.62</td>
<td>-5.05</td>
</tr>
<tr>
<td>$\beta_{42}$</td>
<td>-0.85</td>
<td>-2.34</td>
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<td>$\beta_{43}$</td>
<td>-1.77</td>
<td>-2.99</td>
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<td>$\beta_{44}$</td>
<td>0.28</td>
<td>0.28</td>
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<tr>
<td>$\beta_{45}$</td>
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<td>-0.77</td>
</tr>
<tr>
<td>$\beta_{46}$</td>
<td>1.75</td>
<td>2.51</td>
</tr>
<tr>
<td>$\beta_{51}$ (Regional_Integ$_{it}$)</td>
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<td>Pseudo $R^2$</td>
<td>0.05</td>
<td>0.05</td>
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</table>

Cont’d
covariates and $\beta$ measures. A multinomial distribution is given by 1%, 5%, and 10%, confidence levels, respectively. The table presents the result of multinomial logit exchange rate; $\beta$

Notes

Sources: Data from Datastream (Thomson Reuters).

Table 6.6 Cont’d

(C) Latin America

<table>
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<tr>
<th></th>
<th>Coefficient</th>
<th>$\Delta p$</th>
<th>Coefficient</th>
<th>$\Delta p$</th>
<th>Coefficient</th>
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<td>$-4.66^a$</td>
<td>$-4.62^a$</td>
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<td>$-7.51^a$</td>
<td>$-8.12^a$</td>
</tr>
<tr>
<td>$\beta_{03}$</td>
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<td>$-12.33^a$</td>
<td>$-13.77^a$</td>
<td>$-12.56^a$</td>
<td>$-12.77^a$</td>
<td>$-12.70^a$</td>
</tr>
<tr>
<td>$\beta_{11}(h_{it})$</td>
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<td>$10.81^a$</td>
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<td>$10.54^b$</td>
<td>$1.09^a$</td>
<td>$10.61^a$</td>
</tr>
<tr>
<td>$\beta_{12}$</td>
<td>$1.77^a$</td>
<td>$3.80^a$</td>
<td>$1.10$</td>
<td>$1.97$</td>
<td>$1.17$</td>
<td>$2.08$</td>
</tr>
<tr>
<td>$\beta_{13}$</td>
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<td>$1.62^a$</td>
<td>$1.28$</td>
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<td>$0.65$</td>
</tr>
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<tr>
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<td>$0.00$</td>
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<td>$-0.38^b$</td>
<td>$-0.04^b$</td>
<td>$-0.41^b$</td>
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<td>$0.00$</td>
<td>$0.02$</td>
<td>$0.06$</td>
<td>$0.00$</td>
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</tr>
<tr>
<td>$\beta_{23}$</td>
<td>$0.03$</td>
<td>$0.00$</td>
<td>$0.12^b$</td>
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<td>$1.88^a$</td>
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<td>$4.43^c$</td>
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<tr>
<td>$\beta_{43}$</td>
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<td>$6.00^c$</td>
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<td>$2.16$</td>
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<td>$0.07$</td>
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<td>$0.07$</td>
<td>$0.07$</td>
<td>$0.04$</td>
<td>$0.07$</td>
<td>$0.07$</td>
</tr>
</tbody>
</table>

Sources: Data from Datastream (Thomson Reuters).

Notes: $\beta_m$: constant; $\beta_{l2} = (h_{it})$: conditional volatility; $\beta_{l3} = (i_{it})$: inflation rate; $\beta_{l4} = (e_{it})$: exchange rate; $\beta_{l5} = (o_{it})$: global integration; $\beta_{l6} = (G_{it})$: regional integration. a, b, c denotes significance at the 1%, 5%, and 10%, confidence levels, respectively. The table presents the result of multinomial logit regression model where the category variable that proxy for co-exceedances is regressed on integration measures. A multinomial distribution is given by

$$P_i = \frac{\exp(\beta_i x)}{\sum_{t=1}^{m} \exp(\beta_i x)}$$

where $P_i$ is the probability associated with a category $i$ of $m$ possible categories, $x$ is the vector of covariates and $\beta$ the vector of coefficients associated with the covariates. The number of categories is chosen as 7 (0, 1, 2, 3, 4, 5, and 6 or more co-exceedances) for Asia and Europe, and 5 (0, 1, 2, 3, and 4 or more co-exceedances) for Latin America.

Marginal effects estimated at the unconditional mean of each variable are reported alongside the corresponding coefficient estimates. Marginal effects are small and thus reported in percentages (i.e. multiplied by 100). Explanatory variables include conditional volatility, average interest rate, average change in exchange rate, and average global (regional) integration measure in each region.
of experiencing six or more co-exceedances on a given day increases only by 1.52 basis points. Furthermore, the estimate is not statistically significant. The impact of regional integration on co-exceedances seems stronger than that of global integration. The result is presented in column (3). When the regional integration increases by 1%, the probability of five co-exceedances on a given day increases by 1.69 basis points, while the probability of six or more co-exceedances increases by 2.24 basis points. Taken together, the probability increases by 3.93 basis points. Even when one assumes that the co-exceedances of five or more are a result of contagion, the impact of integration on the extent of contagion appears negligible. Notice also that pseudo $R^2$ does not increase when integration measures are added, suggesting that integration measures do not add to the explanatory power of the model.

Figure 6.3A illustrates the co-exceedance response curve of Asia associated with the models in columns (2) and (3) of Table 6.6A. The response curves are important for understanding the impact of global and regional integration on the probability of exceedances. The marginal effects in the tables are estimates of the partial derivatives of the exceedance probabilities with respect to the regressors evaluating the partial derivatives at the means of the regressors. However, these partial derivatives give an incomplete picture of the impact of changes in the regressors because the probabilities are not linear functions of the regressors. Plotting the probability of exceedances as a function of a regressor over the whole relevant range of the regressor allows us to better assess how changes in the regressor affect the probability of exceedances. Figure 6.3 presents the sensitivity of implied conditional probabilities of different numbers of co-exceedances to the degree of global and regional integration. The different areas of the plot correspond to different co-exceedance events. The figure shows that the probability of a co-exceedance of six or more increases only by 0.76% even when one moves the degree of global integration in Asia from the lowest 8.7% to the highest 47.6%. The corresponding increase for the regional integration is 0.96%.

Table 6.6B presents the results for the euro countries. Similar to the results in Asia, the coefficient estimates and the marginal effects of the global integration measure are mostly negative for lower degrees of co-exceedances but positive for higher degrees. These estimates are again all insignificant and small in magnitude. The exception is the occurrence of six or more co-exceedances associated with the global integration measure. The estimate is significant at the 10% level but the magnitude is small.

Table 6.6C presents the results of Latin American countries. Unlike the results in Asia and Europe, the effect of conditional volatility appears strong. Comparing columns (1) and (2), the global integration measure increases the pseudo $R^2$’s from 4% to 7%. The probability of co-exceedances also significantly increases. While the economic magnitude is statistically significant, it is small. For example, even when global integration increases by 40 percentage points, from the lowest level in 1995 to the highest level in 2008, the probability of four or more co-exceedances increases only by 1.34 percentage points.
Figure 6.3 Co-exceedance response curves: (A) Asia.
Source: author.
Notes: $P =$ probability. The number after “$P =$” is the probability that number of co-exceedances (except $P = 6$ where “$6$” refers to 6 or more) occurs within a region on a particular day.
Figure 6.3 Co-exceedance response curves: (B) Europe—Cont’d
Figure 6.3 Co-exceedance response curves: (C) Latin America—Cont'd
Overall, the empirical results presented in this section provide little evidence that capital market openness leads to vulnerability to financial panic and contagion. Little evidence supports an economically significant positive relation between integration and financial contagion, even within the most integrated markets in the eurozone. This result might be due to the fact that annual data of integration measures, which are relatively stale, are matched with daily data of co-exceedances. Alternatively, there might indeed be no link between integration and contagion.

6.3 Summary and conclusions

Using return variation in national stock market indexes explained by global and regional factors as a proxy for the degree of global and regional integration, the chapter examines the cross-sectional and time-series variation in the degree of integration in 31 countries in Asia, Europe, and Latin America. Most countries show a marked increase in the extent of integration, with a few exceptions. Not surprisingly, the level of regional integration is highest in Europe. However, the degree of regional integration that is not ascribed to global factors but is solely due to regional factors is low. Regional integration also appears to have decreased in both Asia and Latin America, suggesting that global factors have become increasingly important in affecting national stock markets.

Episodes of financial crises have prompted many policy makers to question the benefits of integrating their financial markets with global markets. Thus, the chapter also examines whether market integration is associated with stock market contagion as measured by co-exceedance, a joint occurrence of extreme negative returns across countries within a region on a particular trading day. When one assumes that co-exceedances of six or more are a result of financial contagion, the impact of market integration on financial contagion appears quite small.

Notes

1 “Financial integration” is a broad term that could refer to integration of international stock markets, bond markets, money markets, etc. In this study, financial integration refers to the integration of stock markets.
2 The same filtering rules applied by Pukthuanthong and Roll (2009) are applied here. See the section on data on p. 14 of their paper for details of filtering the data.
3 One concern with the integration measure used here is that what was captured may be a set of industry factors that are common to developed countries such as in the eurozone. However, if the principal components capture well the underlying global factors, the measure should contain factors related to different industries too. The argument for using the $R^2$ measure does not rely on whether the underlying global factors are industry related. Further, Heston and Rouwenhorst (1994) showed that, even among the European countries, stock market variations due to economy factors are much greater than those due to industry factors.
4 GARCH = generalized autoregressive conditional heteroskedasticity.
5 When cross-listed firms or global deposit receipts become an important part of national market indexes, this could mechanically induce joint occurrences of extreme returns.
To address this concern, the PRC and Malaysia are dropped from the Asian sample and the analyses are repeated, as many PRC firms are cross-listed in Hong Kong, China and Malaysian firms in Singapore. Similar results are found whether or not the PRC and Malaysia are included.

6 The distribution of co-exceedances will depend on the returns-generating process of national stock index returns in each region. The returns-generating process in the eurozone might generate more occurrences of co-exceedances than is the case in Asia. In this case, a high frequency of co-exceedances in the eurozone does not suggest contagion, but is simply a result of stock market return dynamics in the euro countries. Using the Monte-Carlo simulation, Bae, Karolyi, and Stulz (2003) showed that occurrences of co-exceedances can be generated by making a somewhat strong assumption about excess co-kurtosis in the Student’s $t$-distribution, but not with the assumption of unconditional or conditional multivariate normal distribution.

7 Using US dollar returns, an exceedance could be a result of stock return decrease or local currency depreciation. To address the concern that the co-exceedance could be driven by exchange rate changes, co-exceedances are examined using local currency returns, and similar results are found.

References


7 Stock market integration:
emerging East Asia’s experience

Marthe Hinojales and Cyn-Young Park

Emerging Asia’s\(^1\) equity markets plunged to their lowest levels in 10 years in the wake of the global financial crisis, losing 66.4% in United States (US) dollar terms from their October 2007 peak to a market trough 1 year later (Figure 7.1). The global financial crisis, which deepened dramatically in September 2008 following the failure of Lehman Brothers (and other institutions), and growing evidence of economic slowdown in industrial countries exacted a heavy toll on emerging Asian equities. Indeed, in terms of the speed and magnitude of equity price declines, the impact of the global financial crisis exceeds that of the two previous crises that affected the region: the 1997–8 Asian financial crisis and the bursting of the global information technology bubble in 2001–2. Although Asian stock markets have rebounded strongly on early hopes of economic recovery since their troughs in November through February, clear signs of a turnaround for the global and regional economy remain elusive, contributing to continued market volatility.

The global financial crisis illustrates the role of increasingly integrated global and regional financial markets in propagating shocks, with evidence of spillovers through equity market channels. Abrupt swings in global investor sentiment affected the performance of the region’s equity markets. Continued deleveraging and the persistence of significant risk aversion likewise emphasize the vulnerability of emerging East Asian equity markets to sharp reversals of foreign portfolio investment flows, particularly in markets with high levels of foreign participation.

Assessing and monitoring the progress of financial market integration is important, as the degree of financial integration has implications for financial stability and an economy’s capacity to absorb shocks (Fung, Tam, and Yu 2008). Financial integration, in theory, offers many important benefits, such as better consumption smoothing through international risk-sharing, more efficient allocation of capital for investment, and enhanced macroeconomic and financial discipline. However, tighter financial links also generate a higher risk of cross-border financial contagion in practice.

This chapter aims to contribute to the growing literature on financial integration in emerging East Asia. Literature in this area appears to generally support the idea of increasing financial integration in Asia, although the degree and breadth of
Financial integration appears to be a point of discussion. Nevertheless, empirical evidence remains limited and inconclusive given the absence of a clear understanding of the determinants and established measurements of financial integration (Kim and Lee 2008).

The chapter will address several issues in this regard. First, it aims to empirically investigate how the degrees of regional and global integration have evolved over time for emerging East Asian equity markets. The chapter examines the dynamic comovements of emerging East Asia’s domestic equity markets with other markets in the region (regional markets) and with the rest of the world (global markets). Second, with the slowdown led by the US exacting a heavy toll on emerging East Asian equities, the transmission channels of the global financial crisis are investigated by looking at the financial spillovers in subsectors of equity markets. This provides more detailed analysis of the region’s financial linkages with the US equity market and identifies the particular subsectors of emerging East Asian equities that are more vulnerable to volatility spillovers. Third, this chapter attempts to address the relative influence of regional versus global factors in emerging East Asia’s equity returns, offering comparative analysis of the degrees of regional and global financial integration.

In terms of methodology, the analysis follows the previous literature and uses the comovement of stock prices as a measure of financial integration. Synchronized
stock market movements between two economies can signal that these markets are closely integrated. To measure cross-market correlations and allow for time-varying characteristics as well as relative volatilities, a simple model of dynamic conditional correlation (DCC) – a class of multivariate GARCH\(^2\) models proposed by Engle (2002) – is used. While the DCC–GARCH model takes into account each variable’s volatilities, the model also allows for time-varying characteristics, assigning lower weights to observations occurring in the more distant past, which is one of the model’s advantages over the simple rolling correlation analysis. For the analysis, weekly return data of domestic equity indexes in emerging East Asia, Japan, and the US from 1993 to 2009 are used.

Although the forementioned correlation analysis yields interesting results, correlation per se cannot prove or disprove market integration. The high pairwise correlation among emerging East Asian stock prices could simply be a result of spurious factors, although it may well reflect increased market integration in which a regional and global common factor exerts influence on both stock markets (Kim and Lee 2008). Moreover, the 2008 global financial crisis highlights increased financial linkages and spillovers across borders, but the correlation analysis cannot identify the source of shocks, including domestic, regional, and global factors. With domestic stock markets becoming increasingly integrated with other markets within the region and beyond, regional and global common factors play an important role in the pricing of domestic stock returns. Taking this into consideration, the DCC–GARCH model is supplemented with factor analysis. Factor analysis allows identification of uncorrelated factors (e.g. global and purely regional) that will be subjected to a battery of regressions to determine each factor’s relative influence in emerging East Asia’s integration experience. For factor analysis, the panel data set is expanded to include equity indexes of the eurozone and Latin America in an attempt to capture the global factor.

The rest of the chapter is organized as follows: Section 7.1 briefly reviews related literature in measuring and assessing financial integration, particularly in emerging Asia; Section 7.2 presents the empirical analysis using the DCC–GARCH model and the factor analysis, together with their results; and Section 7.3 concludes and provides policy implications and recommendations for future research.

### 7.1 Survey of the literature on emerging East Asian financial integration

There is no unambiguous and universal definition of financial integration. Financial integration, however, has been closely associated with financial openness and the free movement of capital. The opening of an economy’s financial markets allows investors to identify and select the most efficient source of capital and to achieve the optimal structure of their asset holdings. With the free movement of capital, one can expect integration of financial services between economies, thus improving market efficiencies, ideally leading to higher productivity and economic growth. Indeed, Cavoli, Rajan, and Siregar (2004) noted in their survey of East
Asian financial integration that there seems to be a close correlation between measures of financial integration and the extent of the development of financial markets in general.

Empirical analyses to measure the extent and depth of Asian financial integration in the literature can be broadly classified in two categories: (1) asset price and return-based measures, which focus on price convergence and evidence in support of the law of one price in asset markets; and (2) quantity-based measures, which use the correlations between savings and investment, consumption correlations, and capital flows (e.g. cross-border financial transactions) as measures of financial integration (Cavoli, Rajan, and Siregar 2004). Some studies also suggest the use of regulatory and institutional measures, usually aggregated into a capital control “index” or used as dummy variables.

For equity markets, the empirical analysis for measuring integration typically involves examining stock price comovements and volatility spillovers. Bekaert, Hodrick, and Zhang (2008), in their study of international stock return comovements, noted that the correlation, though not a perfect measure, is an important element in the analysis of market integration. Further, they argued that “it is generally believed that increased capital market integration should go hand in hand with increased cross-country correlations.” Many studies have also focused on the trend of international stock market comovements using various subperiods or employing econometric techniques for time-varying data. Indeed, a substantial body of literature has documented that correlations among international stock returns are time varying, with evidence pointing to an increase in correlations across international stock markets at times of stress and market downturns (King and Wadhwan 1990, Longin and Solnik 1995, Karolyi and Stulz 1996, and Forbes and Rigobon 2002). While there is no definitive proof that the correlations of international stock markets have trended upward over time, evidence for it is building.

Two strands of empirical literature attempted to measure the degree of stock market integration with methodological applications ranging from correlation and covariance analyses to the use of vector autoregression (VAR) techniques. The first strand involved testing the hypothesis of market integration within the capital asset pricing model (CAPM) framework. The extant literature is too extensive to survey here, but Errunza and Losq (1985), De Santis and Imrohoroglu (1997), and Bekaert, Harvey, and Ng (2005) provide some details. Within the CAPM framework, the authors analyzed the effects of global and local risk factors on returns. If the markets were perfectly integrated, only global factors would be priced. In instances of complete market segmentation, only local factors would be priced. The markets were partially integrated if both global and local risk factors are priced. The second line of empirical exercises took a VAR approach to test evidence of cointegration among international stock markets in the long run. In this framework, stock markets were said to be perfectly integrated if their movements shared a common stochastic trend over long-term horizons. The absence of cointegration implies financial segmentation. Another related variant of the literature employing VAR techniques includes Granger causality, impulse
responses, and forecast error variance decomposition to examine dynamic causal linkages in the short run.

The integration of emerging East Asia’s stock markets has received much attention in recent years given the relatively progressive phase of market developments and ongoing financial liberalization in the region. Nevertheless, empirical evidence in this area remains limited. Various studies have examined both long-run and short-run interdependencies among Asian financial markets and major developed markets. In general, such studies have supported the observation that Asian stock market integration has gradually increased over time, in particular, during and after crisis periods (see Hashmi and Liu 2001, Ratanapakon and Sharma 2002, and Yang, Kolari, and Min 2003).

Asian stock market integration with the US has often been investigated. For example, Lee and Park (2009) estimated increasing US shock spillover intensity in Asian equity markets over the period 2001–7 and concluded that a US shock is an important force behind domestic equity volatility movements. Other studies emphasizing the importance of the US market in Asian equity prices include Moon (2001) and Chai and Rhee (2005).

A significant focus of recent empirical literature on Asian stock market integration is the relative importance of intraregional versus interregional linkages in Asia’s overall integration experience. However, studies of Asian equity markets explicitly indicating one’s influence over the other remain limited. Results of the limited studies tend to show that Asian financial markets are more integrated with the global market than among themselves. One such study is by Chai and Rhee (2005) who, using the VAR approach to show variance decomposition, found that the global market (using the US market as a proxy) exerted a stronger influence on individual East Asian markets than did any regional market. Similarly, in a CAPM framework, Jeon, Oh, and Yang (2005) concluded that Asian stock markets moved more tightly with the US, and less so with each other, after the 1997–8 Asian financial crisis, implying that the region’s markets had become more globalized.

### 7.2 Empirical analysis

The empirical analysis is carried out using US dollar returns of emerging East Asia’s domestic equity market indexes, either individually or collectively, plus indexes of two advanced economies: Japan and the US (Table 7.1). Specifically, total return indexes in US dollar terms (i.e. returns including reinvested dividends) are used to calculate the returns. If the total return index is not available, the price index is used. This is the case for the People’s Republic of China (PRC); the Republic of Korea; the Philippines, and Taipei, China.

The sample period is from January 1993 to May 2009. Weekly returns for the empirical analysis are calculated from each economy’s equity closing price indexes or return indexes by taking their weekly log first differences. The data was sourced from Datastream (Thomson Reuters).

The extent of market integration can be seen in comovements of equity prices across borders. Table 7.2A reports simple cross-market correlation analysis.
Table 7.1: Selected stock market indexes

<table>
<thead>
<tr>
<th>Economy</th>
<th>Index</th>
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<tr>
<td>People’s Republic of China</td>
<td>Shanghai A Share Index</td>
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<tr>
<td>Hong Kong, China</td>
<td>Hang Seng Index</td>
</tr>
<tr>
<td>Indonesia</td>
<td>Indonesia DS Market Index</td>
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<tr>
<td>Japan</td>
<td>Tokyo SE Weighted Index</td>
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<td>Thailand</td>
<td>Thailand DS Market Index</td>
</tr>
<tr>
<td>United States</td>
<td>Dow Jones Industrial Average</td>
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</table>

Sources: Authors.

Interestingly, bilateral correlations among emerging East Asian equity markets appear to be generally higher than the correlations between the region’s individual markets and the US market. In general, stock markets in more open economies (such as Hong Kong, China; the Republic of Korea; and Singapore) seem to be more correlated with the rest of the equity markets in the sample than are the other emerging East Asian markets. The results also show that the market in the PRC is by far the least correlated with other markets in the sample, although it is more correlated with the region’s market than with the US market.

As noted extensively in the previous literature, equity market correlations are time varying. Indeed, as the correlation analysis is divided into two periods, one sees a substantial increase in individual economies’ correlations among themselves and with the US in the second period (Table 7.2B). The newly industrialized economies (NIEs) maintain the higher correlations (region-wise and with the US) than do their counterparts in the Association of Southeast Asian Nations (ASEAN). The PRC remains the least correlated with other markets, but it is interesting to see how much its correlation with the rest of emerging East Asia’s economies has increased since 2000.

Pukthuantong and Roll (2009) showed how simple correlations between two stock markets are poor indicators of financial integration because two markets can be perfectly integrated and yet still be imperfectly correlated. Even the ever-popular rolling correlation estimator gives equal weights to all observations less than $n$ periods in the past and zero weight to older observations. Comparison between simple correlations over time could also lead to spurious results.4

The rest of the section presents two models to address the usual shortcomings of simple correlations and provides more rigorous empirical measures of financial integration. First, the DCC model is employed to take into account time-varying characteristics of financial integration by incorporating time-varying volatilities in the correlation measures. Second, the degrees of regional and global integration of emerging East Asian equity markets are examined by measuring the influence of regional and global factors in the pricing of the region’s equity returns.
### Table 7.2
Average simple correlations of equity markets

**A) 1993–2009**

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**B) 1993–2000 versus 2001–9**

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</table>

Source: authors.

Notes: HKG = Hong Kong, China; INO = Indonesia; JPN = Japan; KOR = the Republic of Korea; MAL = Malaysia; PRC = the People’s Republic of China; PHI = Philippines; SIN = Singapore; TAP = Taipei, China; THA = Thailand; and US = United States. The correlations are until May 2009. “Region” refers to simple average of estimates for individual economies. Numbers in italics correspond to 2001–9 period; other numbers correspond to 1993–2000 period.
7.2.1 The dynamic conditional correlation model

Data

For the DCC model, weekly returns are used for individual equity markets of emerging East Asia, together with their respective aggregates, as well as those of Japan and the US. Sectoral indexes (e.g. the financial and technology sectors) are also employed to analyze equity market correlations on a per sector basis. The sectoral data were sourced from indexes generated by Datastream.

Table 7.3 presents the descriptive statistics on the data series, as well as stationarity and serial correlation tests. Unit root tests show that all return series are stationary in their differences; however, there is evidence of serial correlation for each series.

Theoretical framework

Price volatilities of several emerging Asian equity markets reached highs in the months following the Lehman Brothers’ bankruptcy (Figure 7.2). Examining time-varying correlations of equity markets, while taking into account their volatilities, allows for a more rigorous view of markets’ integration, particularly during a crisis, than does simple correlation analysis.

The DCC model proposed by Engle (2002) can be used for this purpose as it calculates correlations between two variables of interest while also incorporating valuable information from their historical volatilities. In addition, this approach allows periods of correlation between the two to be positive, negative, or zero. A higher time-varying correlation implies larger comovement between markets (Fung, Tam, and Yu 2008).

The conditional correlations are estimated by using the GARCH(1,1)–DCC model following a two-step estimation procedure, as adopted by Fung, Tam, and Yu (2008). In the first stage, univariate GARCH models are estimated for each of the equity return series. The standardized residuals from the first stage are used as inputs to estimate a time-varying correlation matrix. The correlation estimator is defined as

$$\rho_{i,j,t} = \frac{q_{i,j,t}}{\sqrt{(q_{ii,t} q_{jj,t})}},$$  (7.1)

where $\rho_{i,j,t}$ is the conditional correlation between the equity asset returns of countries $i$ and $j$ at time $t$, and $q_{i,j,t}$ is the off-diagonal elements of the variance–covariance matrix. The GARCH(1,1) process followed by the $q$s is as follows:

$$q_{i,j,t} = \overline{\rho_{i,j}} + \alpha(\varepsilon_{i,t-1}\varepsilon_{j,t-1} - \overline{\rho_{i,j}}) + \beta(q_{i,j,t-1} - \overline{\rho_{i,j}}),$$  (7.2)

where $\overline{\rho_{i,j}}$ is the unconditional expectation of the cross product, $\varepsilon_{i,t-1}\varepsilon_{j,t-1}$.
### Table 7.3 Descriptive statistics and tests for the weekly data

<table>
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<th>Economy</th>
<th>Descriptive statistics</th>
<th>Tests</th>
</tr>
</thead>
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<td>United States</td>
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<td>0.019172</td>
</tr>
</tbody>
</table>

*Source:* authors’ estimates.

*Notes:* SD = Standard deviation; Min. = minimum; Max. = maximum.

<sup>a</sup> Uses the Phillips–Perron (PP) test to determine stationarity (* denotes significance at the 10% confidence level).

<sup>b</sup> Uses the Portmanteau (Q) test for white noise. Figures are Portmanteau statistics up to the fifth order.
Defining the conditional covariance matrix as $H_t$, then

$$H_t = D_t R_t D_t,$$

(7.3)

where $R_t$ is the $k \times k$ time-varying correlation matrix, and $D_t$ is a $k \times k$ diagonal matrix of conditional standardized residuals, $\varepsilon_t$, obtained from the univariate GARCH model. Further specification is as follows:

$$R_t = \text{diag} \{ Q_t \}^{-1} Q_t \text{diag} \{ Q_t \}^{-1},$$

$$Q_t = S \circ (u' - A - B) + A \circ \varepsilon_{i,t-1} \varepsilon_{j,t-1} + B \circ Q_{t-1}. \quad (7.4)$$

A sample bivariate case for equation 7.4 is as follows:

$$\begin{bmatrix} q_{ii,t} & q_{ij,t} \\ q_{ij,t} & q_{jj,t} \end{bmatrix} = (1 - a - b) \begin{bmatrix} 1 \\ 1 \end{bmatrix} + a \begin{bmatrix} \varepsilon_{i,t-1}^2 & \varepsilon_{i,t-1} \varepsilon_{j,t-1} \\ \varepsilon_{i,t-1} \varepsilon_{j,t-1} & \varepsilon_{j,t-1}^2 \end{bmatrix} + b \begin{bmatrix} q_{ii,t-1} & q_{ij,t-1} \\ q_{ij,t-1} & q_{jj,t-1} \end{bmatrix}.$$
Results from the DCC–GARCH model

In general, the conditional correlations among emerging East Asian equity markets and the equity markets of the US, the region, and other regional economies have increased over time, reflecting the growing internationalization of the region’s equity markets. The results also help illustrate the differences in equity price comovements between normal times and during periods of financial stress. Conditional correlations rose sharply around September of 2008, reflecting the spillover effects of the global financial crisis. Nevertheless, there are important variations in the cross-market correlations across groups and individual countries. Key findings of the correlation analysis are listed in the following paragraphs.

Emerging East Asia with the US

First, there is a noticeable upward trend in the emerging East Asia–US correlation, with the correlation parameter picking up sharply in the second half of 2008 and peaking during the last week of October 2008 (Figure 7.3). Interestingly, in recent years the emerging East Asia–US correlation has progressed at a slower pace than the average cross-correlation among the region’s equity markets. Although the PRC market has the lowest level of correlation with the US market.
among its regional peers, the PRC’s correlations with the US have also increased substantially over time. The same is true for Japan–US correlations, which are shown here for comparison (Figure 7.4).

Second, the correlation with the US market is higher among the NIEs than among the four middle-income ASEAN economies (ASEAN-4, comprising Indonesia, Malaysia, the Philippines, and Thailand). However, the stock market comovements of these two economy groups with the US are generally synchronized. Among the NIEs, the Republic of Korea and Taipei,China have seen a visible increase in their correlations with the US, while Singapore’s and Hong Kong, China’s correlations have been largely stable at high levels over the same period. Prior to 2004, the Republic of Korea and Taipei,China were moving less in sync with the US than either Hong Kong, China or Singapore (Figure 7.5). For the ASEAN-4, stock market correlations with the US move in a generally synchronized manner, gradually increasing over time (Figure 7.6).

**Emerging East Asia with the PRC and Japan**

Emerging East Asia’s major stock markets, including that in the PRC, are increasingly integrated with the other markets in the region. The PRC market has the lowest level of correlation with the region, although it has risen significantly. Individual emerging East Asian equity markets also show high correlations with Japan. The average correlation between emerging East Asian equity markets and Japan is higher than emerging East Asia’s correlation with the US in most periods (Figure 7.7).
Figure 7.5 Conditional correlations of equity markets: newly industrialized economies with the United States (US).

Source: authors.

Figure 7.6 Conditional correlations of equity markets: ASEAN-4 with the United States (US).

Source: authors.

Note: ASEAN-4 = Indonesia, Malaysia, the Philippines, and Thailand.
Conditional correlations of equity markets: the People’s Republic of China (PRC), Japan, and the United States (US) with emerging East Asia.

Source: authors.

Notes: Emerging East Asia refers to the mainland PRC; Hong Kong, China; Indonesia; the Republic of Korea; Malaysia; the Philippines; Singapore; Taipei, China; and Thailand. Correlations are computed as the simple average of bilateral correlations between the specified economy and the rest of the economies in emerging East Asia.

Emerging East Asia’s intraregional correlations

In general, intraregional correlations have been increasing over time. Correlations between individual emerging East Asian equity markets have risen even more than those with the US (Figure 7.3). The two are relatively similar in terms of progress until 2005, when intraregional correlation among emerging East Asia’s equity markets gains pace.

Intraregional correlations have increased significantly within ASEAN-4 and the NIEs. The average of cross-market correlations has generally been higher among the NIEs, but stock market comovement among ASEAN-4 has been catching up fast, particularly since 2006 (Figure 7.8).

Conditional correlations of equity subsectors

Similar exercises are carried out for the financial, industrial, and telecom, media, and information technology sectors to shed light on the impact of the global financial crisis on different industries in emerging East Asia, through analysis of different sectoral patterns in the emerging East Asian equity markets.

• The conditional correlation between emerging East Asia’s financial shares and US financials is much lower than the correlation for broad market
indexes (Figure 7.9). The result might be surprising given that the financial sector was the origin of the global crisis; however, the result may reflect the difference in financial sector fundamentals, which appears in the relatively low correlations between emerging East Asian and US financial shares. Although the origin of the crisis can be traced to the US subprime mortgage market, which spread rapidly to the global banking and financial markets, emerging East Asian banks were relatively shielded from immediate financial losses due to US subprime mortgages and related credit derivatives markets.

- The average correlation among emerging East Asian financial shares is higher than the average correlation with US financials (Figure 7.10). Although the region’s banking and financial sectors were relatively more resilient to the initial shock than their US counterparts, the subsequent retrenchment in bank funding, credit markets, and investors’ risk appetite was felt region-wide. This may also reflect the fact that the region’s financial sectors share common characteristics and, therefore, respond to the shocks in a similar way.

- As the global financial crisis intensifies with considerable knock-on effects on the real economy, the spillover to the region’s equity markets is mostly through the real sectors, including the industrial and telecoms, media, and information technology sectors (Figure 7.11).
Figure 7.9 Conditional correlations of equity markets: emerging East Asia with the United States (US).

Source: authors.

Notes: Emerging East Asia includes the People’s Republic of China; Hong Kong, China; Indonesia; the Republic of Korea; Malaysia; the Philippines; Singapore; Taipei, China; and Thailand. Correlations are computed as the simple average of bilateral correlations between the US and individual economies in emerging East Asia (i.e. the average of correlations between the US and each other economy).

Figure 7.10 Intra- and interregional conditional correlations of financial stocks: emerging East Asia.

Source: authors.

Notes: US = United States. Emerging East Asia includes the People’s Republic of China; Hong Kong, China; Indonesia; the Republic of Korea; Malaysia; the Philippines; Singapore; Taipei, China; and Thailand.
• For emerging East Asia, the impact through the industrial sector appears to be very substantial, given the region’s high dependence on manufacturing and electronics exports. Again, the spillover was felt across the region. The average correlation among emerging East Asian industrials has been rising (Figure 7.12), reflecting the region-wide impact of a global recession on industry.

The DCC model provides more substantial information for time-varying comovements of equity market returns than simple correlation analysis. Yet, the model insufficiently shows what drives the synchronicity of equity price movements. As mentioned earlier, correlation alone neither proves nor disproves market integration, and a high pair-wise correlation between any two variables may be a result of a common factor driving both.

However, it is reasonable to believe that the effect of the common factors on domestic asset pricing will likely increase over time, if emerging East Asian equity markets continue to become more integrated both regionally and globally. The global crisis and the associated spillovers through real and financial channels all throughout the world economy attest to this fact. Identifying and examining such factors may allow one to disentangle the recent trend in emerging East Asian financial integration by factor, depending on the influence each has on the pricing of domestic assets.
Figure 7.12 Intraregional conditional correlations of selected equity subsectors: emerging East Asia.

Source: authors.
Notes: IT = information technology. Emerging East Asia includes the People’s Republic of China; Hong Kong, China; Indonesia; the Republic of Korea; Malaysia; the Philippines; Singapore; Taipei, China; and Thailand.

7.2.2 The factor analysis model

Data

The monthly averages of weekly return series from January 1993 until May 2009 are used for the factor analysis. Factor analysis assumes that the variables have no serial correlations. This assumption is often violated by financial data taken with a frequency of less than or equal to 1 week. However, the assumption appears to be reasonable for the monthly average of weekly returns.

To identify regional and global common factors, the geographical coverage of the data set is expanded to include representative Datastream indexes from Latin America and the eurozone. Table 7.4 provides descriptive statistics for this data set. Indeed, serial correlation for most of the series has disappeared (except for Indonesia; Malaysia; and Taipei, China).

Theoretical framework

The basic premise of financial market integration is that assets of similar risks should be priced similarly anywhere they are traded. In an equity market that is increasingly integrated with other regional and global markets, regional and global factors should play a greater role in the pricing of a domestic market. If one estimates regional and global factors, one can also use these factors to measure
### Table 7.4 Descriptive statistics and tests for the monthly data

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**Source:** authors’ estimates.

**Notes:** SD = standard deviation; Min. = minimum; Max. = maximum.

\(^a\)Uses the Phillips–Perron (PP) test to determine stationarity.

\(^b\)Uses the Portmanteau (Q) test for white noise. Figures are Portmanteau statistics up to the fifth order.

\(^*\) Denotes significance at the 10% confidence level.
the degree of regional and global financial market integration by assessing how much regional and global factors influence the pricing of domestic asset returns. For this reason, a simple factor analysis model is proposed for this analysis to:

(1) identify factors that explain the common variability in equity prices; and

(2) assess the effect of each of these common factors in individual equity markets.

Factor analysis helps address the “curse of multidimensionality,” as it allows for the simplification of a large set of data by describing variability among observed variables in terms of fewer unobserved variables called “factors.” The observed variables are modeled as linear, uncorrelated combinations of the factors plus “error” terms that account for each variable’s unique variability. The aim of factor analysis is to identify a few factors that can account for most of the variations in the covariance or correlation matrix of the data (Tsay 2005).

The general factor model can be specified as follows:

\[ X_j = l_1 F_1 + l_2 F_2 + l_3 F_3 + l_4 F_4 + \ldots + l_k F_k + e_j, \] (7.5)

where \( X_j \) is the \( j \)th variable (\( j = 1, 2, 3 \ldots p \), number of variables), \( l_k \) is the factor loading of the \( k \)th common factor, \( F_k \) is the \( k \)th common factor, \( k \) is the number of common factors, and \( e_j \) is the unique variance of the \( j \)th variable.

An assessment of factor loadings allows one to attribute a “name” to a factor (i.e. variables that load heavily on a particular factor must have a common characteristic that can be used to approximate the nature of that factor). In addition to determining the loadings, factor analysis will also generate data for each factor to arrive at an approximation of its value. These derived values for each case are called “factor scores.” By multiplying the original data by the factor loadings of the retained dimensions, one obtains such scores. This is illustrated in equation (7.6):

\[ Z_{ik} = w_1 X_{1i} + w_2 X_{2i} + w_3 X_{3i} + w_4 X_{4i} + \ldots + w_p X_{pi}, \] (7.6)

where \( Z_{ik} \) is the factor score of the \( i \)th subject for the \( k \)th common factor retained, \( w_j \) is the factor loading of variable \( j \), \( X_{ji} \) is the observation of the \( i \)th subject on the \( j \)th variable, and \( i \) is the number of observations for \( p \) number of variables.

The scores can then be used in further regression analysis in place of the original variables, while preserving the underlying variation in the original data.

An important question in factor analysis is the number of factors to extract. By its nature this is quite an arbitrary decision, but a number of guidelines have been developed for this purpose. Most statistical software also has various methods for determining how many factors to extract. In general, however, the decision basically depends on how much random variability is left. In this chapter, the number of factors chosen accounts for 100% of the variance. The procedures for extracting the factors, an assessment of the loadings, and an attempt to identify (or “name”) the factors are found in the Appendix.

As mentioned earlier, the factor analysis model allows one to derive factor scores that can be used in further regression analysis. As these factors are linear combinations of the observed variables, one can employ simple regression analysis.
on each return series with the factor scores as independent and uncorrelated variables. A simple linear model, assuming two identified factors – global factor \((g)\) and regional factor \((r)\) – is as follows:

\[
Y = \alpha + \beta_1 \text{factor}_g + \beta_2 \text{factor}_r + \epsilon, \quad (7.7)
\]

where \(Y\) is the monthly return of each economy’s equity index.\(^7\)

Rolling regressions with 18-month windows are used to capture the time-varying \(\beta\)s. That is, the first \(\beta\) is estimated using the monthly returns for the first 18 months in the data set, after which the data window is moved 1 month ahead. The time-varying \(\beta\)s will allow one to examine which factor has a stronger effect on each return series in emerging East Asia [i.e. the higher the responsiveness of an individual equity market return to the regional (or global) factor, the more integrated that market is to the regional (or global) market]. Further, it will help identify whether the increasing integration as described in related literature is due to regionalization or globalization.

This framework can be compared to the model used by Pukthuanthong and Roll (2009), which included a multifactor, \(R^2\) measure of integration. Using daily equity indexes of 82 economies from 1974 to 2006 (adjusted for valid returns), they estimated global factors through principal component analysis. The first ten (out-of-sample) principal components were used as proxies for the global factors and served as the explanatory variable in a battery of regressions for each year. The adjusted \(R^2\) from these regressions is their suggested measure of market integration. In the current chapter, however, factor analysis is employed to identify an underlying common structure in the data. Further, the current analysis is concerned with the \(\beta\)s of each factor, rather than the \(R^2\)s of each regression.

**Results of the factor analysis**

In line with the findings of the DCC–GARCH model, results of the factor analysis show distinct progress in emerging East Asia’s integration with the rest of the global economy over time. Purely regional integration, however, remains stable during the review period (Figure 7.13). Further, the time-varying \(\beta\)s from the rolling regressions attest to the general observation that emerging East Asian stock markets are more interlinked with the global markets than they are linked intraregionally, as shown by the responsiveness of the equity market returns (i.e. higher unweighted average \(\beta\)s of the global factor for selected economy groupings). Table 7.5 summarizes the global and regional \(\beta\)s of each economy.

Although the ASEAN-4 economies and the NIEs are both becoming more integrated globally, there is still a noticeable difference between their integration experience. As the more open economies, in terms of real and financial trade, responsiveness of the NIEs’ equity markets to the global factor remains higher (vis-à-vis the regional factor), and relatively stable since 2000. However, the ASEAN-4 show considerable progress in their integration with the rest of the
global economy over time, particularly since 2004. Such responsiveness to the
global factor $\beta$ remains stable thereafter (Figures 7.14 and 7.15).

An extended analysis is done by covering years prior to 2000 in order to examine
the development and the effects of the two factors during the 1997–8 Asian
financial crisis. During the 1997–8 crisis, both the regional and global factor $\beta$'s
rise relatively sharply. This observation is not surprising. As the crisis originated
from within the region, Asian equity markets’ vulnerability to the regional factor
increased sharply. Similarly, their responsiveness to the global factor behaves
similarly due to the heightened risk aversion of foreign investors and the capital
outflows that ensued. Subsequent post-crisis years show the regional factor $\beta$
settling into a stable level, and moving nearly in sync with the global factor $\beta$
(Figure 7.16).

For the global financial crisis, however, the global factor $\beta$ is increasing, while
the regional factor $\beta$ moves in the opposite direction. Movements in emerging East
Asian equity returns are most likely driven by developments in the global economy
since the financial crisis unfolded, with investors consistently restructuring their
portfolios away from risky assets. The increase in the global factor’s influence is
mostly apparent when comparing the ASEAN-4 vis-à-vis the NIEs. This attests to
the fact that the NIEs are more vulnerable during the global financial crisis than
the ASEAN-4 economies due to the NIEs’ financial and economic openness.

It is difficult at this point to ascertain whether the responsiveness of emerging
East Asian equity markets to regional factors will increase in the future.
Table 7.5 Global and regional factor betas of emerging East Asian equity markets

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<th>Economy</th>
<th>Global $\beta$</th>
<th>Regional $\beta$</th>
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<td>Hong Kong, China</td>
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<td>1.108</td>
<td>0.080</td>
</tr>
<tr>
<td>Philippines</td>
<td>1.336</td>
<td>0.292</td>
</tr>
<tr>
<td>13.58*</td>
<td>5.73*</td>
<td></td>
</tr>
<tr>
<td>Singapore</td>
<td>1.392</td>
<td>0.572</td>
</tr>
<tr>
<td>26.64*</td>
<td>16.24*</td>
<td></td>
</tr>
<tr>
<td>Taipei, China</td>
<td>1.067</td>
<td>0.118</td>
</tr>
<tr>
<td>9.77*</td>
<td>1.80**</td>
<td></td>
</tr>
<tr>
<td>Thailand</td>
<td>1.812</td>
<td>0.309</td>
</tr>
<tr>
<td>19.08*</td>
<td>6.66*</td>
<td></td>
</tr>
</tbody>
</table>

Source: authors.

Notes: Italics indicate $t$-statistics; * denotes significance at the 5% confidence level; ** denotes significance at the 10% confidence level; $\beta = $ beta.

Figure 7.14 Global versus regional factor: newly industrialized economies (NIEs).
Source: authors.
Note: In this case, the four NIEs are Hong Kong, China; the Republic of Korea, Singapore; and Taipei, China.
Figure 7.15 Global versus regional factor: ASEAN-4.
Source: authors.
Notes: ASEAN-4 = Indonesia, Malaysia, the Philippines, and Thailand. The sharp rise in the global factor beta ($\beta$) appears to suggest a “structural break” in the data. It is reasonable to believe that this is due to the sudden rise in the global factor $\beta$s for the Philippines starting in August 2004, during which time its economy was under threat of fiscal crisis. Since the $\beta$s are simply unweighted averages of the $\beta$s of the four countries, the increase in the Philippine $\beta$ pulled up the overall $\beta$ average of the ASEAN grouping.

Figure 7.16 Global versus regional factor during crisis periods: emerging East Asia.
Source: authors.
Note: Emerging East Asia includes the People’s Republic of China; Hong Kong, China; Indonesia; the Republic of Korea; Malaysia; the Philippines; Singapore; Taipei, China; and Thailand.
With equity markets still in the process of regaining their precrisis levels, investor perception and risk appetite, which appear to have improved since the months immediately following September 2008, could tip the scale in either direction.

7.3 Conclusions and policy implications

The size of stock market correlations and the degree of integration are important issues for both policy makers and market participants. For policy makers, these are important elements in assessing the potential costs from financial contagion and policy coordination. For market participants, these elements may imply reductions in the benefits of portfolio diversification.

This chapter contributes to the existing literature on stock market integration in emerging East Asia by: (1) empirically investigating how the degree of integration has evolved over time in emerging East Asian equity markets; (2) examining the region’s financial linkages with the US market and identifying possible transmission channels of the global financial crisis; and (3) assessing the influence of regional factors relative to that of global factors in emerging East Asia’s equity markets.

In general, the chapter’s empirical results suggest that emerging East Asian equity markets are increasingly integrated both regionally and globally. First, the conditional correlations of domestic equity markets in emerging East Asia, both with other markets in the region and with the US market, have increased over time, potentially reflecting the growing regional and global integration of the region’s equity markets. Consistent with earlier literature on stock market comovements, the correlations are also higher during times of market distress.

Given the heightened linkages of emerging East Asian economies with the US, the authors also try to illustrate the channels through which the global crisis was transmitted to East Asian financial markets. It appears that the knock-on effects in emerging East Asia were mostly experienced through the real sector (vis-à-vis banks), given that growth of most Asian economies is export-led. Indeed, Asian banking systems have been relatively shielded from the immediate losses arising from the global financial crisis as a result of Asian banks’ limited direct exposure to the US subprime mortgages. Meanwhile, the trade sector proved to be a potent channel of transmission. The impact through the industrial sector appears to be the most substantial, given the region’s high dependence on manufacturing and electronics exports.

Second, the influence of both regional and global factors in emerging East Asian equity markets as measured by time-varying betas ($\beta$s) suggests that emerging East Asian equity markets are more integrated globally than regionally. The higher $\beta$s of the global factor point to the greater international integration of the region’s financial markets. In particular, the noticeable increase in the $\beta$ of the global factor during the global financial crisis highlights the importance of the global factor in emerging East Asia’s equity markets in times of financial turmoil and the effects of financial spillovers. Overall, the extent to which the regional factor is priced as a risk is more limited than that of the global factor. Also, the factor analysis does
not paint a clear picture for the time trend in purely regional integration, compared to the results of the DCC–GARCH analysis.

Much remains to be done in understanding the degree and dynamics of financial integration in emerging East Asia, particularly of the role it plays in cross-border financial contagion and volatility spillovers. Although factor analysis allows one to identify the latent variables that are contributing to the common variance in the data, the very nature of such factors is still subject to interpretation and cannot be regularly monitored. Apart from their trend over time, the $\beta$s by themselves cannot be interpreted completely without specific identification of the factor. In this light, an interesting area for further research is the development of a single measure that can take advantage of the multifaceted dimensions of financial integration, as well as an approach to combine price-based and quantity-based measures into a “financial integration index,” although data availability in emerging market economies may be a constraint.

Emerging East Asia’s domestic equity price movements are increasingly driven by global and regional factors, reflecting the growing degree of financial integration. As markets become increasingly integrated regionally and globally, any convulsion in global financial markets and significant developments in major industrial economies will likely influence the region’s equity prices. The results also suggest that the degree of stock market comovements increases during stressful times. As such, the extent of integration within a particular region has important implications, particularly from a risk-sharing perspective. Tighter regional linkages may reduce the impact of economic and financial shocks from outside the region, to the extent that these two forms of integration could be substitutable. Further, regional integration could also push institutional upgrades within the region, thus improving market efficiency and welfare (Garcia-Herrero and Wooldridge 2007).

Emerging East Asian equity markets, particularly those with tight financial linkages to the global market, have demonstrated vulnerabilities to an abrupt swing in global investor sentiment and a reversal in foreign portfolio investment flows. To maintain investor confidence, sound macroeconomic management is necessary. Despite the visible improvements in depth and breadth across emerging East Asian equity markets, the persistence of major vulnerabilities also suggests that further actions are needed to enhance market resilience. This requires active steps to foster deeper and more liquid domestic capital markets including: broadening the investor base; encouraging development of more diverse local financial products; improving legal, regulatory, and institutional frameworks; upgrading governance and transparency; and establishing more sound market infrastructure and institutions.

Appendix: Details of factor analysis

Choosing the number of factors

Traditional factor analysis assumes no serial correlation in the data. To adjust for autocorrelation in the data set prior to running factor analysis, the analysis fits a
simple ARIMA\(^{(1,1)}\) model on each return series to remove dependence on past values. Indeed, residuals from the ARIMA\(^{(1,1)}\) estimation show the absence of serial correlation at the 10% confidence level.

The residuals can be considered as the unexplained behavior of returns unaccounted for by the ARIMA process. Factor analysis is then used on these residuals to explore their common structure.

In estimating the common factors, the principal factor method is used and the number of factors that account for 100% of the common variance is chosen. For most stock markets, two are sufficient to explain 100% of the common variance, which are classified either as global or purely regional. (The exceptions are the stock markets of the People’s Republic of China and Malaysia, where three factors account for 100% of the common variance.)

Separate factor analyses are estimated for each market after it has been excluded in the data set. For example, when the subject market is the mainland People’s Republic of China, common factors are extracted from the returns of the remaining eight markets. This is to avoid any suspicion that a market’s return being regressed on the common factors, classified as regional or global factors, is biased by that same market being heavily weighted in the computed factor scores; see equation (7.7) of the main text (Pukthuanthong and Roll 2009).

Scores are then generated for each market’s two extracted factors.

“Naming” the factors

To “name” the identified factors, the authors propose that the factor scores be used subsequently as inputs in a second round of factor analysis.

The factor scores are rerun together with the returns of the G-3 [the euro area (EUR), Japan (JPN), and the United States (USA)] and with Latin America (LAM). The rationale for this exercise is only to classify the two factors. In particular, the factor that exhibits the highest communality (or the lowest uniqueness) with the G-3 and Latin American markets is assumed to be the global factor. On the other hand, the factor that exhibits the lowest communality (or the highest uniqueness) with the G-3 is assumed to be the regional factor.\(^{10}\)

The Republic of Korea’s case provides an example. First-round factor analysis extracts two common factors. Their scores are analyzed with the G-3 economies and Latin America in a second-round factor analysis (Table 7.A1).

The first factor, kor\(_1\), exhibits the highest communality with the other economies. The opposite is true for kor\(_2\), which means that a large portion of its variance is not explained by the same factors that explain a large share of the common variance of the other items (except Japan, in this case). For this reason, kor\(_1\) is identified as the global factor, and kor\(_2\) as a purely regional factor.

The same exercise is done for all nine markets. After identifying the regional and global factor, scores (of the factors extracted during the first round of factor analysis) are used as independent variables in the rolling regressions as specified in equation (7.7) of the main text.
Stock market integration

Table 7.A1 Factor identification (Republic of Korea)

<table>
<thead>
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<th>Uniqueness</th>
<th>Communality</th>
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<tr>
<td>kor1</td>
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</tr>
<tr>
<td>kor2</td>
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</tr>
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<td>0.71</td>
</tr>
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<td>EUR</td>
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</tr>
<tr>
<td>LAM</td>
<td>0.32</td>
<td>0.68</td>
</tr>
<tr>
<td>JPN</td>
<td>0.61</td>
<td>0.39</td>
</tr>
</tbody>
</table>

Source: authors.

Notes: kor1 and kor2 = variables 1 and 2 for Republic of Korea; EUR = euro area; JPN = Japan; US = United States. Communality = 1−uniqueness.

Notes
1 “Emerging Asia” refers to the People’s Republic of China; Hong Kong, China; India; Indonesia; the Republic of Korea; Malaysia; the Philippines; Singapore; Taipei, China; Thailand; and Viet Nam.
2 GARCH = general autoregressive conditional heteroskedasticity.
3 The use of weekly data is an attempt to avoid the confounding effects of non-synchronous data in measuring integration through correlations that arise from national holidays as well as different trading hours, particularly true in the case of the US for Asian economies.
4 For further discussion, see Cappiello et al. (2006).
5 The Datastream mnemonics are TOTMKER and TOTMKLA, respectively.
6 A priori, authors expect, at the very least, two common factors.
7 A potentially simple approach would be to run a regression of an individual country’s index return on the world market return and the regional one:
\[ r_{i,t} = \alpha + \beta_g r_m + \beta_r r_{rt} + \epsilon_{i,t}. \]

However, it is likely that both global and regional factors influence these market returns and global and regional market returns are significantly correlated. Alternatively, one can assume that the return on the regional index has an expected and an unexpected component, \( \epsilon_{r,t} \). This unexpected component is then decomposed into a purely regional influence (the intercept) and a global influence, \( \epsilon_{g,t} \) (proxied by an unexpected component of US market returns), such that
\[ \epsilon_{r,t} = \alpha_{r,t} + \beta_{g,r} \epsilon_{g,t}. \]

If the regional market is more integrated globally, the global factor will dominate in explaining the unexpected component of the regional market return (i.e. the responsiveness of the regional market to the global factor will increase). (For further details of this methodology, see Lee and Park 2009.)

The estimated \( \beta \)'s using this model are broadly consistent with the results from the proposed factor analysis method used in this chapter. That is, emerging East Asian equity markets are more closely tied to the global markets than among themselves.
8 Eviews 6 and Stata 10 are used in this chapter.
9 The autoregressive integrated moving average (ARIMA) model combines the ideas of the autoregressive, or AR(p), and moving average, or MA(q), models. For further discussion, see Tsay (2005).
10 Perhaps a simpler exercise for identification is a correlation analysis of the factor scores with the G-3 markets (the euro area, Japan, and the US) and Latin America. This generates the same result, for the purpose of classifying the factor, as the method described above.

References


Bloomberg L.P. Bloomberg Electronic Database. Available at: http://about.bloomberg.com/product.html


Stock market integration


This chapter constructs a dynamic general equilibrium, sticky-price model of a small open economy to study the impact of international financial integration on business cycle volatility. Though the integration of financial markets may affect business cycle stability in many ways, this chapter will focus on the financial accelerator channel (Bernanke 2007). In the financial accelerator framework, the health of the balance sheets of corporate firms and financial intermediaries is an important determinant of investment expenditure. In line with Carlstrom and Fuerst (1997) and Bernanke, Gertler, and Gilchrist (1999), financial accelerator mechanisms have been incorporated into dynamic stochastic general equilibrium models to study the business cycle characteristics of investment.1

Recent decades have seen a rapid increase in cross-border financial flows (Lane and Milesi-Ferretti 2003). Although the evidence suggests relatively little cross-border holdings of debt within Asia (Kim, Lee, and Shin 2008; Lee, 2008), regional cross-border holdings of equity have been increasing rapidly (Lane 2010). Increasing degrees of foreign direct investment are likely to intertwine the balance sheets of firms, leading to an integration of the financial accelerator process. Foreign investment occurs within East Asia (Hattari and Rajan 2009) and large-scale foreign direct inflows come from outside the region (Wei 2010).

Substantial empirical evidence suggested that financially integrated economies display relatively stronger business cycle comovement (Imbs 2004, 2006; Morgan, Rime, and Strahan 2004). Faia (2007) found that countries with similar types of financial accelerator tend to have greater business cycle comovement in a sticky-price model. Gilchrist (2003) and Gilchrist, Hairault, and Kempf (2002) constructed models in which shocks in one country affect asset prices, which spills over to balance sheets in other economies, leading to greater comovement. Some recent papers, including Devereux and Yetman (2009, 2010) and Dedola and Lombardo (2009), suggested that internationally linked balance sheets enhance international comovement.2 A shock to one economy will affect the balance sheets of multinational firms, impacting investment demand across borders. Choi and Cook (2009) emphasized the stabilization benefits of international financial accelerator integration, which helps diversify the effects of shocks across countries.
This chapter examines a small open economy with some features based on the environment faced by newly industrialized countries in Asia. The economy is quite open to foreign trade and competes with other countries in the region to export goods. The countries in the model face sticky prices and both their exports and imports are priced in a foreign currency from outside the region. Cook and Devereux (2006) and McKinnon and Schnabl (2004) reported evidence that a large fraction of Asian trade is invoiced in United States (US) dollars. The economy can borrow and lend at an external interest rate in bond markets. Given the evidence on a lack of cross-regional bondholding, the study assumes that a single bond denominated in a non-regional currency is available for international lending. Finally, with credit market imperfections, domestic investment is subject to a financial accelerator effect.

Given the trend toward financial integration, business cycle dynamics in a financial autarky model, where domestic capitalists are limited to investment in domestic capital, are compared with those in a financial integration model, where international capitalists can acquire international assets. Two paths for international integration are studied: balance sheets are either integrated with regional economies or integrated into the broader global economy. In doing this, the extreme case is examined, where the cross-border exposure of corporate balance sheets is so large that the risk premium on financing domestic investment is determined externally.

The finding is that external financial integration ameliorates the balance sheet effects of domestic shocks, which is particularly important when the economy faces liability dollarization. Integration of balance sheets can also propagate the effects of external shocks on the domestic economy. One interesting reminder is that the balance sheet channel can propagate external shocks even when there is no direct financial integration. The equilibrium effects of negative external shocks will typically have negative impacts on domestic balance sheets. In the current model, a non-integrated economy performs no better in the face of external shocks than do economies with internationally integrated balance sheets. Thus, either regional or global balance sheet integration offers some clear stabilization benefits.

However, the benefits of global versus regional integration differ in the current financial and policy environment. A negative shock to the global economy damages the balance sheets of domestic capitalists integrated with the global economy just as a negative shock to the regional economy damages regionally integrated capitalists. Nonetheless, the risk-free interest rate at which capitalists borrow and lend is set in the global economy, and may be expected to fall when there is a negative shock to the global economy. Hence, damage to the balance sheets of globally integrated capitalists (and the consequent rise in the risk premium in their costs of financing) is offset by a decline in base interest rates. In contrast, the regional economy is modeled as not impacting global interest rates. Damage to balance sheets of regionally integrated capitalists from negative regional shocks is not offset by cushioning interest rate movements.
Given these disparate impacts of different types of financial integration on business cycle stability, it is not surprising that there are implications for monetary policy. In the model presented, an interest rate rule that focuses on consumer price index (CPI) inflation will put some emphasis on stabilizing exchange rates with the global currency that dominates external debt and trade. A CPI inflation target will tend to ameliorate the effects of shocks from extraregional sources as domestic currency interest rates fall in tandem with the global currency rates. Conversely, a CPI inflation target forces domestic interest rates to rise in the face of negative regional and domestic shocks that depreciate the domestic currency, exacerbating their effects. Given the extreme exposure of a regionally integrated financial system to regional shocks, a regionally integrated economy might have the most to gain from targeting domestic producer prices.

8.1 The model

The model considers a small open economy that, along with some regional competitors, is part of an international trading and financial system. The small open economy is small in two ways. The domestic economy is small relative to regional economies, and the regional economy is also small relative to the global economy. A currency, called the “dollar,” dominates the global trading system. The small open economy trades goods (priced in dollars) with the global economy, as do all regional economies. The representative agent in the domestic economy has access to a global financial market with a single risk-free dollar bond. The small open economy has an imperfection in the financial market: a set of credit-constrained capitalists must hold physical capital through time. Credit constraints imply that the risk premium on borrowing is determined by the capitalists’ leverage. Depending on circumstances, intermediaries may or may not be integrated with the international financial system.

8.1.1 Global demand

The global economy has a demand for goods exported from the region, $IM^G_{t}$, a constant elasticity of substitution combination of exports from the small open economy, $EX^H_{t}$, and from the rest of the region, $EX^R_{t}$:

$$IM^G_{t} = \left[ b^{1-\psi} \left( EX^H_{t} \right)^{\psi} + (1-b)^{1-\psi} \left( EX^R_{t} \right)^{\psi} \right]^{1/\psi}.$$  \hfill (8.1)

The global dollar price of domestic exports is $XP_{t}^H$; the dollar price of other regional exports is $XP_{t}^R$. Cost-minimizing demand for each of the goods is

$$EX^H_{t} = b \left( \frac{XP_{t}^H}{MIP_{t}^G} \right)^{1/\psi} IM^G_{t}, \quad EX^R_{t} = (1-b) \left( \frac{XP_{t}^R}{MIP_{t}^G} \right)^{1/\psi} IM^G_{t}.$$  \hfill (8.2)
The implied import price for the global customer, $\text{MPI}_t^{\text{GBL}}$, is

$$\text{MPI}_t^{\text{GBL}} = \left[ b \left( \text{XPI}_t^{\text{HM}} \right)^{\psi} + (1 - b) \left( \text{XPI}_t^{\text{RG}} \right)^{\psi} \right]^{\psi - 1}. \quad (8.3)$$

The regional economy is treated as much larger, so that $b$ is approaching zero; $\text{MPI}_t^{\text{GBL}}$ is treated as determined exogenously in the regional economy. This is clearly an approximation, but, given a sufficiently small domestic economy, the endogenous effect of domestic prices on regional prices will be negligible.

### 8.1.2 Local absorption

The absorption of the home country, $A_t$, is a constant elasticity of substitution (CES) combination of $A_t^{\text{HM}}$ (absorption of home goods) and $A_t^{\text{GBL}}$ (imported goods from the global market):3

$$C_t + CK_t + I_t + G_t = A_t = \left[ a^{1-\psi} \left( A_t^{\text{HM}} \right)^{\psi} + (1 - a)^{1-\psi} \left( A_t^{\text{GBL}} \right)^{\psi} \right]^{1/\psi}. \quad (8.4)$$

Absorption is used for $C_t$, consumption; $CK_t$, capitalists’ consumption; $I_t$, investment; and $G_t$, government spending. The choice between home and imported goods minimizes the cost of absorption given domestic producer prices, $\text{PPI}_t$; foreign producer prices, $\text{PPI}_t^{\text{GBL}}$; and the spot exchange rate with the global dollar, $S_t$:

$$A_t^{\text{HM}} = a \left( \frac{\text{PPI}_t}{\text{CPI}_t} \right)^{\psi / \psi - 1} A_t, \quad A_t^{\text{GBL}} = (1 - a) \left( S_t \text{PPI}_t^{\text{GBL}} / \text{CPI}_t \right)^{\psi / \psi - 1} A_t. \quad (8.5)$$

The implicit price of absorption goods, $\text{CPI}_t$, is given by

$$\text{CPI}_t = \left[ a (\text{PPI}_t)^{\psi / \psi - 1} + (1 - a) \left( S_t \text{PPI}_t^{\text{GBL}} \right)^{\psi / \psi - 1} \right]^{\psi - 1 / \psi}. \quad (8.6)$$

### 8.1.3 Representative agent

The representative agent is a worker, consumer, and/or saver maximizing the discounted sum of expected future felicity:

$$E_t \left[ \sum_{t=0}^\infty \beta^t \left[ \ln(C_t) + h(T - L_t) \right] \right]. \quad (8.7)$$
The budget constraint for the representative worker is:

\[ S_t B_t = (1 + \iota_{t-1}^{GBL}) S_{t-1} B_{t-1} + \Pi_t + W_t L_t - CPI_t C_t, \]  

(8.8)

where \( L_t \) is labor, \( W_t \) is nominal wages, \( \iota_t^{GBL} \) is the interest rate in global currency, \( B_t \) is the domestic holdings of global bonds, and \( \Pi_t \) is all lump-sum profits. The first-order conditions are given by

\[ \frac{1}{C_t} = CPI_t \Omega_t, \quad \Omega_t W_t = h'(T - L_t) \]  

(8.9)

\[ 1 = E_t \left[ \frac{\beta (1 + i_{t}^{GBL}) S_{t+1} \Omega_{t+1}}{\Omega_t} \right]. \]  

(8.10)

### 8.1.4 Production

The economy has a standard Cobb–Douglas production function:

\[ Y_t = K_t^{\alpha} L_t^{1-\alpha}, \]  

(8.11)

where \( Y_t \) is output and \( K_t \) is the capital stock. Price-taking producers sell at a competitive price, \( MC_t \), to wholesale distributors and rent capital at rate \( R_t \) and labor at wage rate \( W_t \). Profit maximization suggests

\[ W_t = MC_t (1 - \alpha) \frac{Y_t}{H_t}, \quad R_t = MC_t \alpha \frac{Y_t}{K_t}. \]  

(8.12)

### 8.1.5 Investment

Capital is installed for future use by competitive firms with a production function:

\[ K_{t+1} = (1 - \delta) K_t + I_t - \frac{1}{2} (I_t/K_t - \delta)^2 K_t. \]  

(8.13)

Old capital \( K_t \) is purchased from capitalists who held the capital through time to period \( t \) at price \( Q_t \). New investment is acquired at price \( CPI_t \). New capital, \( K_{t+1} \), is sold to capitalists at price, \( P^K_t \). Cost minimization suggests:

\[ 1 - \left( \frac{CPI_t}{P^K_t} \right) = e \left( \frac{I_t}{K_t} - \delta \right), \quad Q_t = P^K_t \left[ (1 - \delta) + \frac{I_t}{K_t} e \left( \frac{I_t}{K_t} - \delta \right) \right]. \]  

(8.14)

### 8.1.6 Retail pricing

A competitive domestic retail sector distributes a combination of a unit range of differentiated wholesale goods. The production function of the retail good is

\[ A_t^{HM} = \left( \int \left| d_t \right| \phi dt \right)^{\frac{1}{\varphi}}. \]  

(8.15)
Cost minimization implies:
\[
\left( \frac{a_{i}^{t}}{A_{i}^{HM}} \right)^{\phi^{-1}} = \frac{ppi_{i}^{t}}{PPI_{i}},
\]
(8.16)
where the price of each retail good, \( l_{i} \), is \( ppi_{i}^{t} \), and the price index is
\[
PPI_{i} = \left( \int \left\{ ppi_{i}^{t} \right\}^{\frac{\phi}{\phi - 1}} dt \right)^{\frac{\phi - 1}{\phi}}.
\]
(8.17)

The wholesaler of differentiated good \( l_{i} \) produces it with a one-for-one transformation of the production good, so marginal cost is \( MC_{i} \). Before time \( t \) information is revealed, a fraction of firms \( (1 - \kappa) \) receive the opportunity to change their nominal price as in Rotemberg and Woodford (1997). The wholesalers maximize the discounted sum of profits:
\[
\max_{ppi_{i}} E_{t-1} \left[ \sum_{j=t}^{\infty} (\kappa \beta)^{j-t} \Omega_{j} \left\{ ppi_{i}^{t} a_{j}^{t} - MC_{j} a_{j}^{t} \right\} \right].
\]
(8.18)

Given demand for each good, equation (8.16), equation (8.18) is written as
\[
\max_{ppi_{i}} E_{t-1} \left[ \sum_{j=t}^{\infty} (\kappa \beta)^{j-t} \Omega_{j} A_{j}^{HM} PPI_{j}^{\frac{1}{\phi}} \left\{ ppi_{i}^{t} \left\{ \frac{\phi}{\phi - 1} \right\} - MC_{j} \left\{ ppi_{i}^{t} \right\}^{\frac{1}{\phi}} \right\} \right].
\]
(8.19)

Following Calvo (1983) and Yun (1996), the optimal price is
\[
ppi_{i} = \frac{1}{E_{t-1}} \left[ \frac{\sum_{j=t}^{\infty} (\kappa \beta)^{j-t} \Omega_{j} A_{j}^{HM} PPI_{j}^{\frac{1}{\phi}} \left\{ ppi_{i}^{t} \left\{ \frac{\phi}{\phi - 1} \right\} - MC_{j} \left\{ ppi_{i}^{t} \right\}^{\frac{1}{\phi}} \right\} }{\sum_{j=t}^{\infty} (\kappa \beta)^{j-t} \Omega_{j} A_{j}^{HM} PPI_{j}^{\frac{1}{\phi}}} \right].
\]
(8.20)

The price level evolves according to
\[
PPI_{j}^{\frac{\phi}{\phi - 1}} = \kappa PPI_{j-1}^{\frac{\phi}{\phi - 1}} + (1 - \kappa) ppi_{i}^{t-1}. \quad (8.21)
\]

### 8.1.7 Export Pricing

A competitive export sector distributes a combination, \( EX_{j}^{HM} \), of a unit range of differentiated wholesale goods, \( ex_{i}^{l} \). The production function of the retail good is
\[
EX_{i}^{HM} = \left( \int \left\{ ex_{i}^{l} \right\}^{\phi} dt \right)^{\frac{1}{\phi}}.
\]
(8.22)
Cost minimization implies:

\[
\left( \frac{e_{lt}^l}{EX_{l,t}^{HM}} \right)^{\phi-1} = \frac{x_{pi,t}^l}{XP_{i,t}^{HM}}, \tag{8.23}
\]

where the global dollar price of each wholesale good, \( l \), is \( x_{pi,t}^l \), and the price index is also in global dollars:

\[
X_{Pi,t} = \left( \int \left[ x_{pi,t}^l \right]^{\phi \phi} \, dl \right)^{\phi-1}. \tag{8.24}
\]

The wholesaler of differentiated good \( l \) produces goods with a one-for-one transformation of the production good; the global dollar marginal cost of production is \( MC_j/S_j \).

In each period, a fraction of firms \((1 - \kappa)\) receive the opportunity to change their nominal price. The wholesalers with the opportunity to change price will maximize:

\[
\max_{p_{it}} E_{t-1} \left[ \sum_{j=t}^{\infty} (\kappa \beta)^{j-t} \Omega_j S_j \left\{ x_{pi,j}^l e_{x_j}^l - \frac{MC_j}{S_j} e_{x_j}^l \right\} \right]. \tag{8.25}
\]

Given the demand for each good, equation (8.23), equation (8.25) may be written as

\[
E_{t-1} \left[ \sum_{j=t}^{\infty} (\kappa \beta)^{j-t} \Omega_j EX_{j,t}^{HM} XP_{j,t}^{HM} \frac{1}{1-\phi} \left\{ x_{pi,j}^l \right\}^{\frac{\phi}{\phi-1}} - \frac{MC_j}{S_j} \left\{ x_{pi,j}^l \right\}^{\frac{1}{1-\phi}} \right]. \tag{8.26}
\]

Following Betts and Devereux (2000), the optimal price is

\[
x_{pi,t} = \frac{1}{\phi} E_{t-1} \left[ \sum_{j=t}^{\infty} (\kappa \beta)^{j-t} \Omega_j EX_{j,t}^{HM} XP_{j,t}^{HM} \frac{1}{1-\phi} \cdot MC_j/S_j \right]. \tag{8.27}
\]

The price level evolves according to:

\[
XP_{i,t}^{HM} = \kappa XP_{i,t-1}^{HM} + (1 - \kappa) x_{pi,t}^{\frac{\phi}{\phi-1}}. \tag{8.28}
\]
8.1.8 Monetary policy

The central bank sets domestic interest rates to target inflation:

\[ i_t = i + \phi \pi_t (CPI_t / CPI_{t-1} - 1 - \eta) , \]  
(8.29)

where \( \eta \) is the steady-state inflation rate and

\[ i = \frac{1 - \beta}{\beta} + \eta. \]

The domestic interest rate is linked to the global interest rate adjusted by exchange rate growth, as implied by an uncovered interest parity condition:

\[ 1 + i_t = E_t \left[ (1 + i_{GBL}^{t+1}) \frac{S_{t+1}}{S_t} \right]. \]
(8.30)

8.1.9 Capitalists

Capital is held across periods by a set of agents referred to as capitalists. Owing to asymmetric information, capitalists finance the ownership of capital through a combination of debt and equity at borrowing costs that depend on the debt–equity ratio. Two basic scenarios are considered: (1) capitalists are restricted to investment in domestic capital; and (2) capitalists can hold foreign assets and are well diversified in the international economy.

**Domestic capitalists**

The financing problem of domestic capitalists follows Carlstrom and Fuerst (1997) and Bernanke, Gertler, and Gilchrist (1999), building on Gale and Hellwig (1985); Bernanke and Gertler (1989, 1990); and Williamson (1987). The cases examined are domestic capitalists financed with: (1) domestic currency debt; and (2) foreign currency debt.

**Domestic currency debt**

The financial intermediaries, indexed by \( l \), are endowed with a stochastic technology that allows them to own assets across time. If \( k^l_t \) is purchased at time \( t \), the intermediary will have \( \omega^l_t k^l_t \) at time \( t + 1 \). Stochastic technology, \( \omega^l \), is independently distributed (across intermediaries and time) with a log normal cumulative distribution function, \( \Phi(\omega) \), and a mean of 1.

In each country, the capitalists begin with net worth, \( n w^l \), and borrow, \( deb^l_t + 1 \), to finance the purchase of capital:

\[ deb^l_{t+1} = P_t^k \cdot k^l_{t+1} - n w^l. \]
(8.31)

Capitalists earn a payoff, \( PAY_t \), by renting the capital to the final goods producing firm at \( R_t \) and selling the capital at price \( Q_t \): \( PAY_t = Q_t + R_t \). The financial contract
Woon Gyu Choi and David Cook requires the capitalists to pay interest rate, \(1 + \rho\); if they are unable to pay, they turn over all capital to the creditor. The minimum level of idiosyncratic technology that will allow them to pay off their debt is

\[
\sigma_{t+1}^I = \frac{(1 + \rho)\text{debt}_{t+1}^I}{\text{PAY}_{t+1} k_{t+1}^I}.
\]  

(8.32)

If the capitalist has a technology outcome less than \(\sigma_{t+1}^I\), the creditor forecloses, destroying a fraction of income \(\nu\).

Assume that the financial contract chooses \(\sigma_{t+1}^I\) and \(k_{t+1}^I\) to maximize the expected payoff to the capitalists, subject to bondholders receiving the risk-free interest rate. The capitalists earn zero if they default, so their expected payoff, \(f(\sigma_{t+1}^I)\text{PAY}_{t+1} k_{t+1}^I\), is the product of the probability of no default and the conditional expected revenue upon no default less the interest paid to creditors. The payoff to the creditors, \(g(\sigma_{t+1}^I)\text{PAY}_{t+1} k_{t+1}^I\), is the interest earned in case of no default plus the recovery in the case of default. The debt contract maximizes the payoff to the entrepreneurs, subject to the expected creditor payoff equaling the risk-free interest rate:

\[
f(\sigma_{t+1}^I)\text{PAY}_{t+1} k_{t+1}^I = 1 + \rho(\sigma_{t+1}^I)\text{PAY}_{t+1} k_{t+1}^I = (1 + \rho)\text{PAY}_{t+1} k_{t+1}^I - \rho \phi(\sigma_{t+1}^I)\text{PAY}_{t+1} k_{t+1}^I - \rho \phi(\sigma_{t+1}^I)\text{PAY}_{t+1} k_{t+1}^I\].
\]  

(8.33)

The first-order condition of equation (8.33) implies a degree of leverage common across firms generating a common risk premium of the gross return on capital over the interest rate:

\[
E_t \left[ \frac{\text{PAY}_{t+1}}{p^k_r}, \rho(\sigma_{t+1}^I) \right] = 1 + \rho(\sigma_{t+1}^I).
\]  

(8.34)

The risk premium, \(\rho(g)\), is of the form:

\[
\rho(\sigma_{t+1}^I) = \left[ g(\sigma_{t+1}^I) f(\sigma_{t+1}^I) - f'(\sigma_{t+1}^I) \right]^{-1}.
\]  

(8.35)

Equation (8.35) shows that the risk premium depends on the technology level that avoids default. The constraint in equation (8.33) can be inverted to show this can
be solved as a function of the asset to debt ratio:

\[
\varpi_{t+1}' = h^{-1}\left(\frac{PAY_{t+1}k_{t+1}'}{(1+i)^{\delta t}}\right), \quad h\left(\varpi_{t+1}'\right) \equiv \frac{1}{g\left(\varpi_{t+1}'\right)}.
\]

(8.36)

Some fraction of capitalists, \(\lambda\), will die in every period and consume their net worth. The next period’s net worth will be

\[
nw_{t+1}' = f\left(\varpi_{t+1}'\right)PAY_{t+1}k_{t+1}'.
\]

(8.37)

The first-order conditions are aggregated, using capitals to represent aggregates:

\[
DEBT_{t+1} = PK_t K_t - NW_t
\]

(8.38)

\[
g\left(\varpi_t\right)PAY_t K_t = (1+i_{t-1})DEBT_t
\]

(8.39)

\[
NW_t = (1-\lambda)f\left(\varpi_t\right)PAY_t K_t
\]

(8.40)

\[
CPI_t CK_t = \lambda f\left(\varpi_t\right)PAY_t K_t.
\]

(8.41)

These four equations will describe the dynamics of capitalists’ net worth and consumption, \(CK_t\). Equation (8.38) indicates the amount of borrowing needed to acquire capital. Equation (8.39) defines the minimum technology needed to avoid default. Equations (8.40) and (8.41) show how the capitalists’ returns are divided between consumption and retained earnings.

**Foreign currency debt**

The additional case considered is where the domestic financial intermediaries are financed by issuing liabilities raised in the foreign currency.\(^4\) In this case, the first-order conditions are written:

\[
E_t \left[\frac{PAY_{t+1}}{P^X_t \rho\left(\varpi_{t+1}'\right)}\right] = E_t \left[\left(1+i_{t-1}^{GBL}\right)\frac{S_{t+1}}{S_t}\right]
\]

(8.42)

\[
S_t DEBT^S_{t+1} = PK_t K_{t+1} - NW_t
\]

(8.43)

\[
g\left(\varpi_t\right)PAY_t^S K_t = S_t(1+i_{t-1}^{GBL})DEBT^S_t
\]

(8.44)

where \(DEBT^S_t\) is the amount of global dollar-denominated debt of domestic capitalists.

**International capitalists**

When capitalists can freely acquire international assets, risk-neutral capitalists will be indifferent between investing in projects with equal expected returns. Given free capital flows, the allocation of the portfolios of capitalists is indeterminate.
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(Appendix). International capitalists are assumed to be symmetric and, thus, each will have a diversified portfolio. Given complete diversification and the small nature of the domestic economy, the state of balance sheets is treated as determined completely offshore and unaffected by domestic events. The markup of capital returns over the interest rate will be determined exogenously:

\[ E_t \left[ \frac{PAY_{t+1,i}}{PK_t \rho_t} \right] = 1 + i_t. \]  

(8.45)

Capitalists will be integrated with either the regional economy or a broader global economy. If capitalists are integrated into the regional economy, the risk premium is negatively associated with regional gross domestic product (GDP):

\[ \rho_t = \rho(\text{Y}_{RG}^t), \quad \rho' < 0. \]  

(8.46)

If capitalists are integrated into the global economy, the risk premium is negatively associated with global GDP:

\[ \rho_t = \rho(\text{Y}_{GBL}^t), \quad \rho' < 0. \]  

(8.47)

In either case, the consumption of the entrepreneurs is assumed to be constant, \( CK_t = CK_{SS} \).

8.1.10 Shocks

Three exogenous shocks are considered, each of which follows a first-order autoregressive (AR[1]) process. The first is a domestic shock to government spending. External shocks to both global and regional GDP are also considered.

**Domestic demand shocks**

Domestic government spending directly impacts the demand for absorption goods, equation (8.4). The log of government spending, \( g_t \equiv \ln G_t \), follows:

\[ g_t = (1 - \mu_g)g_{SS} + \mu_g g_{t-1} + \varepsilon^g_t. \]  

(8.48)

**Global shocks**

Logged global output, \( y_{GBL}^t \equiv \ln Y_{GBL}^t \), follows:

\[ y_{GBL}^t = \mu_y y_{GBL}^{t-1} + \varepsilon_{GBL}^t. \]  

(8.49)

Income elasticity of global exports is \( \zeta: im_{GBL}^t = \zeta y_{GBL}^t \). Global interest rates are set according to economic conditions in the global economy. Assuming a simple
sort of New Keynesian Philips curve

\[
\pi_t^{GBL} = \partial y_t^{GBL} + \beta E_t \left[ \pi_{t+1}^{GBL} \right] = \frac{\alpha}{\beta} \sum_{j=0}^{\infty} \beta^j E_t \left[ y_{t+j}^{GBL} \right].
\]  

(8.50)

Assuming an inflation targeting rule for international interest rates

\[
i_t^{GBL} = \tau \pi_t^{GBL} = \tau \frac{\partial}{\beta} \frac{1}{1 - \beta \mu_y} y_t^{GBL}.\]

(8.51)

That global capitalists are exposed to global business cycles is also assumed. If the domestic economy is integrated into the global financial accelerator

\[\rho(y_t^{GBL}) = \rho - \rho_3 y_t^{GBL}.\]

(8.52)

**Regional shocks**

Regional business cycles, \(y_t^{RG} = \ln Y_t^{RG}\), also follow an AR(1) process:

\[y_t^{RG} = \mu_y y_{t-1}^{RG} + \varepsilon_t^{RG}.\]

(8.53)

Negative shocks to the regional economy are assumed to lead to proportional real depreciations of \(M_{PL_t}^{GBL}\) against the global economy: \(m_{PL_t}^{GBL} = (1 - \psi) \xi y_t^{RG}\). The factor of proportion is set so that a shock to either regional or global GDP has equivalent direct impacts on the demand for domestic goods.

The regional shock will have parallel impacts on the risk premium of regionally integrated capitalists:

\[\rho(y_t^{RG}) = \rho - \rho_3 y_t^{RG}.\]

(8.54)

**8.2 Calibration**

Most parameters can be drawn from previous work in international macroeconomics. The subjective discount factor is set at \(\beta = 0.99\), consistent with a 1% real interest rate. The parameters relating to capital are set as in Baxter and Crucini (1993): the depreciation rate of capital is set at \(\delta = 0.025\); the elasticity of investment with respect to Tobin’s \(q\) is set at 15; the capital elasticity of output is \(\alpha = 0.42\). Preference parameters are set in function \(b(\cdot)\) in equation (8.7) so steady-state \(L = 1/3\) and the Frisch elasticity of labor is set at 1/0.455, following Mendoza (1991). Following Backus, Kehoe, and Kydland (1992), the elasticity of substitution between domestic and regional goods and between domestic goods and foreign imports is set at 1/1 - \(\psi = 1.5\).

The three microparameters of the capitalists’ problem are: (1) the fraction of capital lost through liquidation, \(\nu\); (2) the fraction of funds consumed by
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capitalists, λ; and (3) the standard deviation of the idiosyncratic shock, σ. Following Bernanke, Gertler, and Gilchrist (1999), these parameters are set so that the steady-state risk premium is ρ = 1.005 (200 basis points per annum); the fraction of firms that fail every period is 0.75% (3% per annum); and the leverage ratio is 50%.

The model is linearized around a steady-state equivalent to perfect competition in the goods market with φ → 1 as in Galí and Monacelli (2005). Price stickiness is assumed at the standard level, κ = 0.75. The coefficient of the interest rate rule is set at φπ = 1.5, as in the Taylor rule.

Irwin (2002) found the global income elasticity of trade had increased in the recent decades. The global economy’s income elasticity of imports is set, for the current chapter, at a level of ζ = 3.7, following the estimate of Freund (2009) for recent periods. The short-term response of global inflation to global GDP, ϑ = 0.016, is set to match the estimates in Roberts (2001) using one lead and lag of CPI inflation. The persistence of shocks is set as in Hansen (1985), μy = 0.95.

A regression, ρUS t = 0.003 (0.000) − 0.031 yUS t (standard errors in parentheses), is set using quarterly data from the second quarter of 1970 to the fourth quarter of 2004, where ρUS t is the spread between BAA and AAA corporate bonds (from the St Louis FRED database, Federal Reserve Bank of St Louis) on a quarterly basis and yUS t is the output gap measured in the natural log of the ratio of US real GDP (from the FRED database) to potential output (from the US Congressional Budget Office). Based on this result: ρY = −0.031.

The parameter of home bias in goods is set at α = 0.66 to match Korean exports as a share of GDP for the period of 1980–2008 (from the CEIC database). The steady-state government spending is set to match the 12% share of Korean GDP devoted to government consumption. The economy is evaluated near a steady state, where the level of bonds, B, is equal to the debt of intermediaries, DEBT, so that at a national level the current account is in balance. A steady-state technology is assumed, so the relative price of domestic and foreign goods is normalized to one. The steady-state inflation is normalized to zero: η = 0.

### 8.3 Domestic shocks

The effect of a 1% GDP increase in government spending in period 1 is examined. The size of the domestic demand shock (with a log-linear approximation) is set at

$$ε_1^G = \frac{Y}{G} \times 0.01. \quad (8.55)$$

where Y/G is the inverse of the steady state government consumption to output ratio.

Three scenarios are compared: (1) when the financial accelerator is strictly domestic and liabilities are in domestic currency; (2) when the financial accelerator is strictly domestic and the liabilities are dollarized; and (3) when the balance sheets are integrated with the global or regional economy. As the financial accelerator is
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offshore, in the final case, whether the integration is with the regional or global economy is irrelevant when domestic shocks are considered.

Figure 8.1 shows the response of four variables (output, $Y_t$, investment, $I_t$, the domestic interest rate, $i_t$, and the exchange rate, $S_t$) to the fiscal policy shock. Sticky prices serve as a propagation channel for the demand shock. A persistent increase in government spending induces an increase in aggregate demand concentrated (due to home bias) on domestic goods. This induces an appreciation of the exchange rate (see Figure 8.1D). Given sticky domestic prices, the appreciation will manifest itself as a decline in domestic CPI inflation. Given the monetary rule, the central bank will cut interest rates in the period of the shock (see Figure 8.1C).

In addition to the direct effects of government spending on output, the shock will also stimulate investment indirectly in a number of ways. The persistently higher level of output will raise the marginal product of capital, increasing Tobin’s $q$.

![Figure 8.1 Domestic demand shocks: (A) output; (B) investment; (C) domestic interest rate; (D) exchange rates.](image)

Source: authors.

Notes: The graphs show the response to a positive shock by government spending equal to 1% of gross domestic product at period 1. The figure illustrates the results under three structures of the financial system: (1) domestic – when domestic capitalists finance investment with domestic currency debt; (2) regional/global – when capitalists’ balance sheets are offshore; and (3) dollarized – when domestic capitalists finance investment with foreign currency debt.
The demand shock will be inflationary with a lag, but will lead to a cut in nominal rates and an initial decline in the real interest rate. Finally, the shock will have balance sheet effects that will impact the risk premium if capitalists are domestically oriented, but not if capitalists’ balance sheets are internationally integrated.

Compared to the model with domestic balance sheets, the model with regional/global balance sheets entails the amelioration of balance sheet effects. The demand shock will lead to an increase in the ex post return to the capital on the capitalists’ balance sheets. This improvement in balance sheets will reduce the risk premium and increase investment demand. In the model with domestic balance sheets, investment increases by 4.5% in the period of the shock while in the model with regional/global balance sheets investment increases by 2.5%. With sticky prices, output increases by 1.5% in the domestic model compared to an output increase of about 1% in the regional/global model. The increase in demand leads to an exchange rate appreciation. In the dollarization case, appreciation reduces the cost of repaying foreign currency debt. This magnifies the financial accelerator effect as the resulting improvement in balance sheets will further reduce the risk premium on borrowing. This results in an increase in investment of more than 8% and an output increase of 2% in the period of the shock.

8.4 Foreign shocks

Figures 8.2 and 8.3 show the responses to external demand shocks under (1) the domestic model with strictly domestic capitalists, financed with domestic currency loans; (2) the regional model, with regional capitalists; and (3) the global model, with global capitalists. Global shocks are assumed to be the same size as the regional shocks:

$\varepsilon^G_e = \varepsilon^R_e = -0.01$  \hspace{1cm} (8.56)

8.4.1 Regional shock

Figure 8.2 depicts the impact of a negative shock to output in the regional economy. This leads to a real depreciation of the price of goods of regional competitors in global dollar terms, which will directly reduce foreign demand for domestic exports. The decline in demand for domestic goods results in an equilibrium depreciation. The resulting exchange rate depreciation increases CPI inflation and the domestic interest rate.

The decline in demand for exports (a substantial fraction of domestic production) has a negative impact on the overall demand for goods. Owing to sticky prices, this translates into a decline in demand for labor and capital. This decline in the demand for capital translates into a persistently lower equilibrium capital rental rate, which has two effects. First, optimal investment will be reduced. Second, payoffs on physical capital will be lower than expected. The effect of lower payoffs on capitalists’ balance sheets depends on the integration of the financial
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Figure 8.2 Regional demand shocks: (A) output; (B) investment; (C) domestic interest rate; (D) exchange rate.

Source: authors.

Notes: The graphs show the response of regional gross domestic product at period 1 to a −1% output shock. The figure illustrates the results under three structures of the financial system: (1) domestic – when domestic capitalists finance investment with domestic currency debt; (2) regional – when capitalists’ balance sheets are integrated with the regional economy; and (3) global – when capitalists’ balance sheets are integrated with the global economy.

The rise in the risk premium has a negative impact on investment demand in the domestic and regional models. In the domestic model, this creates a multiplier effect with a decline in investment demand reducing the capital rental rate and payoffs to capital, damaging balance sheets of capitalists, raising the risk premium, further reducing investment demand, and so on. The relative decline in investment demand in the non-integrated economy is large. Investment declines by about

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Figure 8.3 Shock to the global economy: (A) output; (B) investment; (C) domestic interest rate; (D) exchange rate.

Source: authors.

Notes: The graphs show the response of global gross domestic product at period 1 to a −1% output shock. The figure illustrates the results under three structures of the financial system: (1) domestic — when domestic capitalists finance investment with domestic currency debt; (2) regional — when capitalists’ balance sheets are integrated with the regional economy; and (3) global — when capitalists’ balance sheets are integrated with the global economy.

4.5% in the global model in which the risk premium is stable, and by nearly 9% in the regional model in which the risk premium is directly affected. The decline in investment (nearly 10%) in the domestic model is even larger. Sharper declines in investment result in sharper declines in output. Output falls by 2.1% in the global model, by 2.6% in the regional model, and by about 3% in the domestic model.

8.4.2 Global shock

Figure 8.3 shows the responses of the economy to a global shock under the three models of financial intermediary integration. A decline in global GDP directly reduces the demand for domestic exports. This has contractionary effects on the
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However, the global economy shock will result in a decline in the external interest rate (unlike the strictly regional shock). A persistent decline in the foreign interest rate will result in an appreciation of the domestic currency (Figure 8.3C). This will slow CPI inflation and lead to a cut in domestic nominal interest rates (Figure 8.3D) and, given sticky prices, real interest rates. A persistent cut in real interest rates stimulates demand for investment and consumption, which will have expansionary effects offsetting the export decline.

Figure 8.3A shows that domestic output decreases in each of the models in response to a negative shock to the global economy, though Figure 8.3B shows domestic investment increases because of reduced interest rates. In the regional case, capitalists’ balances sheets are assumed to be independent of the global economy, so the financial accelerator would be unaffected by the shock. In this case, low interest rates spur investment to rise by 4%, and output declines only by 0.5%. In the global case where balance sheets are integrated with the global source of the shock, the risk premium on borrowing for capitalists rises. Since higher risk premiums on borrowing offset lower interest rates, investment increases only by a small 1% and GDP falls by almost 1%. The negative global shock and its deflationary impact also damage capitalists’ balance sheets in the domestic model. In the domestic case, the risk premium on borrowing rises endogenously, attenuating the impact on low interest rates. Investment rises by only 2%, barely more than when capitalists’ balance sheets are directly exposed to the global economy. Output falls by 0.7%, which is again almost as much as in the global case.

8.5 Monetary policy

In the benchmark model, the domestic central bank focuses on stabilizing the consumer price inflation. Indeed, this corresponds with the stated inflation target of the Bank of Korea (2009) along with targets of some other Asian central banks, (e.g. Bank of Thailand 2010). The CPI reflects a mix of domestic producer prices and import prices. Given the openness of the economy, the imported component is large. Short-term fluctuations in import prices will be driven by fluctuations in the exchange rate with the global economy because of the dominance of the global dollar in external trade. Given that domestic prices are quasi-fixed, the immediate response of the CPI to shocks will be driven by fluctuations in the exchange rate. Therefore, CPI targeting has the quality of putting some weight on short-term exchange rate stabilization. This focus on exchange rates has destabilizing effects when the economy faces shocks that require a domestic depreciation (e.g. a negative regional GDP shock). A central bank that stabilizes the exchange rate will raise interest rates in the face of a negative shock.

For comparison, outcomes are studied in an economy that focuses on targeting domestic producer price inflation (PPI). In this economy, the following equation is substituted:

$$i_t = i + \phi \left[ \frac{PPI_t}{PPI_{t-1}} - 1 - \eta \right]$$ (8.57)

for the CPI inflation target observed in equation (8.29).
Figure 8.4 Regional demand shocks with producer price targeting: (A) output; (B) investment; (C) domestic interest rate; (D) exchange rate.

Source: authors.

Notes: The graphs show the response of regional gross domestic product at period 1 to a −1% output shock. The figure illustrates the results under three structures of the financial system: (1) domestic – when domestic capitalists finance investment with domestic currency debt; (2) regional – when capitalists’ balance sheets are integrated with the regional economy; and (3) global – when capitalists’ balance sheets are integrated with the global economy.

Figure 8.4 shows the responses to a negative 1% regional shock under three models of the financial system when the central bank targets PPI inflation. Figure 8.4D shows that the exposure of the domestic economy to the regional economy will cause the domestic currency exchange rate to depreciate against the global dollar. However, the CPI inflation generated by that depreciation does not affect the central bank’s policy rule. The PPI is quasi-fixed, so, in the initial period of the shock, the nominal interest rate is fixed. Thereafter, the deflationary effects of the shock will result in falling interest rates (Figure 8.4C). Figure 8.4 can be compared with Figure 8.2, which shows the responses when the central bank targets CPI inflation and, thus, raises the nominal interest rate immediately upon the shock.

Monetary policy choice contributes to a large fraction of real instability when there is a negative shock to the regional economy. This is true for all degrees
of financial integration, but the study now concentrates on the regional model. Under the model with PPI targeting, investment declines in the period of the shock, but to a much smaller extent and less persistently than in the model with CPI targeting. In the regional model, investment declines in the period of the shock by about 4% under PPI targeting (Figure 8.4B) and by about 8% under CPI targeting (Figure 8.2B). This translates into a much smaller decline in output, which drops by 1.7% under PPI targeting (Figure 8.4A) compared to a decline of 2.7% under CPI targeting (Figure 8.2A).

Figure 8.5 shows the responses to a negative 1% global shock in three models of the financial system when the central bank targets the PPI. In the period of the shock, real output is actually slightly more unstable when the central bank has a PPI target than when it has a CPI target (compare Figures 8.5 and 8.3). The negative shock in the global economy and the accompanying decline in

![Figure 8.5](image_url)

*Figure 8.5 Global demand shocks with producer price targeting: (A) output; (B) investment; (C) domestic interest rate; (D) exchange rate.

Source: authors.

Notes: The graphs show the response of global gross domestic product at period 1 to a −1% output shock. The figure illustrates the results under three structures of the financial system: (1) domestic – when domestic capitalists finance investment with domestic currency debt; (2) regional – when capitalists’ balance sheets are integrated with the regional economy; and (3) global – when capitalists’ balance sheets are integrated with the global economy.
external interest rates cause the domestic currency to appreciate against the
global currency. Under CPI targeting, this will lead to an immediate cut in interest
rates. The persistent decline in interest rates leads to a persistent rise in investment
following a negative global demand shock. However, this is attenuated in the
period of the shock under PPI targeting, where the interest rate will decline
with a lag. As a result, the decline in output is more severe in the period
of the shock under PPI targeting for all three degrees of financial integration.
Quantitatively, for example, the trough decline in output in the global capitalist
model is about 0.9% under CPI targeting (Figure 8.3A) and 1.1% under PPI
targeting (Figure 8.5A).

8.6 Conclusion

The overall results suggest that both regional and global integration stabilize
the economy in the face of domestic shocks relative to a strictly domestically
oriented financial system. Integration with all or part of the international economy
might introduce external risk premium shocks as an additional exposure of
the domestic economy to foreign shocks. However, this analysis finds that the
endogenous response to foreign shocks of the credit risk premium in an imperfect
domestically oriented system may be just as destabilizing as risk premium shocks
originating in an internationally oriented system. This will be especially true if
the domestic financial system faces foreign exchange rate risk due to liability
dollarization.

The type of international integration may matter as well. All else equal, shocks
from within the region may be more destabilizing for the domestic economy simply
because external debt markets are dominated by extraregional currencies. As the
interest rate on extraregional currencies is likely to be cyclical, a negative shock
to extraregional demand is likely to be accompanied by an easing of external
borrowing costs. This will tend to cushion the domestic economy from global
shocks; for strictly regional shocks, no such cushion exists.

The study finds that CPI targeting may better stabilize the economy in the face
of global demand shocks (i.e. shocks in the economies that provide the globally
dominant currencies) while PPI targeting may better stabilize the economy in
the face of regional demand shocks. All else being equal, regional demand
shocks are much more destabilizing to the domestic economy because they do
not coincide with declines in the external interest rates. This is especially true
when the capitalists financing domestic investment are not diversified with the
global economy. Moreover, the stabilization benefits obtained by PPI targeting
in the face of regional shocks are quantitatively much larger than the benefits
obtained by CPI targeting in the face of global shocks. Therefore, the chapter
finds a strong case favoring PPI targeting for an economy with regional financial
integration to ameliorate the impact of shocks that stem from the regional
business cycle itself. In the case of global financial integration, where global
shocks are most severe, the favorable aspects of CPI targeting might be more
relevant.
Appendix: Multilocation entrepreneurs

Assume that a single set of entrepreneurs indexed by \( l \) over the unit interval can invest in capital in \( N \) different countries. They finance the intertemporal holdings of capital by issuing debt in the global dollar. Debt financing is issued with a financial contract of the sort that maximizes the surplus to the financiers subject to creditors receiving the risk free-return:

\[
\begin{align*}
  f \left( \sigma_{t+1} \right) & \sum_{n=1}^{N} \left[ PAY_{t+1,n}k_{t+1,n} \right] \\
  \text{s.t. } g \left( \sigma_{t+1} \right) & \sum_{n=1}^{N} \left[ PAY_{t+1,n}k_{t+1,n} \right] \\
  & = \left( 1 + i^{GBL}_{t} \right) \left[ \left( \sum_{n=1}^{N} \left[ p_{t,n}k_{t+1,n} \right] \right) - n \sigma_{t+1} \right] = \left( 1 + i^{GBL}_{t} \right) \text{debt}_{t}^{l} \quad \text{(8.A1)}
\end{align*}
\]

The demand for capital of type \( n \) is set to equalize returns on capital. The first-order condition is:

\[
E_{t} \left[ \frac{PAY_{t+1,n}}{p_{t,n} \cdot \rho \left( \sigma_{t+1} \right)} \right] = 1 + i^{GBL}_{t}. \quad \text{(8.A2)}
\]

Two points are noteworthy. First, the contract for all capitalists will specify the same \( \sigma_{t+1} \) regardless of initial net worth. Second, the portfolio allocation of any capitalist \( l \) is indeterminate. Owing to risk neutrality, the capitalists will be indifferent between assets with the same return. Dedola and Lombardo (2009) solve for endogenous portfolio allocations by assuming risk aversion. Unfortunately, the risk neutrality of capitalists embedded in the microfoundations of the current chapter’s model does not allow use of this approach. Given the symmetry of the capitalists’ problem, a symmetric equilibrium is studied, in which all capitalists hold the same portfolio. Thus, if the group of countries \( N \) includes the regional economy, the capitalists investing in the domestic economy will be perfectly diversified across the regional economy. If the group of \( N \) includes the global economy, the capitalists will be perfectly diversified across the global economy. It should be possible to assume a kind of \textit{ad hoc} home bias in which there was partial financial integration. However, intuition suggests that the outcomes would be midway between the outcomes in the fully segregated model and the fully integrated model. This is left for future research.

\[\text{Notes}\]

1 Tovar (2009) discussed issues concerning the incorporation of financial accelerator affects into central bank policy models.
3 The source of the imported good makes no difference. The key point is that the imported goods are priced exogenously in global dollars.

References

CEIC Database. Available: www.ceicdata.com


9 Financial contagion and vulnerability of Asian financial markets

Michael B. Devereux and James Yetman

Standard economic theory predicts that international financial integration is a good thing. Financial markets allow for cross-country risk-sharing, increased investment, and a more efficient allocation of resources across countries. Extending financial market integration from a region comprising a small group of economies to a global arena encompassing all economies should offer welfare benefits to all countries and regions. Indeed, the rapid increase in capital flows across advanced and emerging economies in the last decade, often described as “the process of financial globalization,” has been associated with substantially higher economic growth rates, as well as large increases in the volume of international trade. Going beyond anecdotal evidence of the benefits of liberalized financial markets to establish clear empirical evidence on the growth of risk-sharing gains from financial integration has been more difficult, however. Kose et al. (2009) provide an extensive review of the empirical evidence on the effects of financial integration, and conclude that there is no clear-cut evidence that financial integration is beneficial.

One message that comes from this literature is that, when predicting the impact of financial integration, the type of integration is just as important as the presence or absence of integration itself. For example, in the Asian region, the 1990s was a time of rapid growth combined with substantial financial integration through external capital inflows. The subsequent Asian crisis in 1997–8 was judged to have been magnified partly because of the nature of financial imbalances built up during the early 1990s growth boom (East Asian economies found themselves with large outstanding liabilities in short-term non-contingent bank loans denominated in foreign currency) exactly the configuration likely to precipitate a panic-driven sudden stop in capital flows, and to exacerbate the effects of such an event.

The post-2000 experience of financial openness in East Asia has been much more successful. While in the 1990s, Asian economies had large capital inflows of short-maturity bank lending denominated in the United States (US) dollar, from 2000 on, most of these economies ran current account surpluses, building up stocks of international reserves while at the same time receiving inflows in the form of equity investment and foreign direct investment. In most circumstances,
this pattern of growth financing is likely to prove much more resilient than the previous episodes of capital inflows and debt financing (Devereux and Sutherland 2009). Indeed, even during the global financial crisis beginning in 2008, Asian financial markets had relatively little exposure to derivative products associated with the US subprime mortgage industry, so their banks and financial institutions suffered less than many of their counterparts in Europe.

Nevertheless, Asian financial markets and real economies have been deeply affected by the global financial crisis emanating from Europe and the US. Despite not being directly linked to toxic US assets that lay at the heart of the financial meltdown, Asian stock markets fell precipitously in late 2008, and Asian banks and corporations experienced large withdrawals of funds by foreign banks and investors. This coincided with a rapid drop in investment spending, a drying up of trade financing, and a subsequent collapse of exports from many Asian economies. Thus, while East Asian economies were well diversified according to the principles of portfolio diversification, there is a sense in which portfolio linkages themselves may lead to negative business cycle transmission during a crisis. That is, financial market interactions, through interdependent banks and financial institutions in many different economies, were associated with contagion effects among economies. Rather than acting in the traditional manner as a stabilizing mechanism for sharing risk across regions and countries, the interdependence of financial institutions appears to have acted as an international propagation mechanism for the financial crisis.

Motivated by the experience of Asian financial markets and economies, this chapter explores the role of financial markets as propagators of international macro shocks. The hypothesis explored is that there is a fundamental trade-off between the efficiency benefits of international financial integration on the one hand and the contagion effects of international financial market interdependence on the other hand. In an environment without financial market frictions, the international financial system would be fully efficient and would act to provide the maximum possible risk-sharing and the best allocation of resources. But the presence of informational frictions and a lack of contract enforcement lead to substantial constraints on the operation of financial markets. A key friction, highlighted by many economists during the past decade, is the different nature of internal and external financing of investment. Because of informational and enforcement failures, many borrowers are constrained in the degree of borrowing and the maximum leverage of investment financing they can undertake. This means that movements in asset prices, by affecting borrowers’ net worth, can have substantial effects on access to capital markets. Negative returns shocks, causing asset prices to fall, lead to a tightening of collateral constraints and result in a drying up of access to credit. This forces a process of deleveraging, in which investors need to sell assets after a negative returns shock in order to satisfy capital or leverage constraints. In the international context, with interconnected balance sheets among financial institutions across countries, shocks that cause a fall in asset prices in one country may precipitate deleveraging effects that spill over into the balance sheets of institutions in other countries.
The chapter first presents evidence on the extent of deleveraging among US financial institutions' Asian portfolios during the global financial crisis. As is clear from the data, foreign banks reduced their exposure to Asia in order to shore up their balance sheets in their home jurisdictions. Next, the chapter provides evidence that this financial deleveraging may have acted as a powerful propagation mechanism in itself (Devereux and Yetman 2010). Two types of evidence are brought to bear on this. First, during the crisis period, negative shocks to asset prices in the US are associated with increased correlation of asset prices across countries. Daily stock price data show that, in response to negative movements in the US stock market after the beginning of the financial crisis, Asian markets' movements were significantly greater (and were negative) than before the crisis. This is implied by the model of international portfolio integration with leverage constraints. The second piece of empirical evidence discussed concerns the importance of financial linkages to the real economy. One of the basic hypotheses of the model is that during crises the importance of financial linkages among countries may be equal to or greater than that of traditional trade linkages in generating business cycle comovement. The chapter shows that, empirically, the propagation of the recent global downturn has been more important for countries with financial linkages than for those with trade linkages. This holds especially for countries that are financially vulnerable in the sense that their sovereign bond ratings are low.

The chapter then constructs a theoretical model of international financial linkages in the presence of leverage constraints. The model emphasizes how a process of balance sheet contractions, generated by a downturn in one country, is spread around the globe through interconnected portfolios. In the presence of leverage constraints, this gives rise to a separate financial transmission mechanism of business cycle shocks that is completely independent of trade linkages. In fact, the chapter works with a highly stripped down “one world good” model in which, in steady state, there are no trade linkages across countries at all.

The theoretical model illustrates the chapter’s key message, which is that the combination of two features (financial market constraints and international financial linkages) gives rise to the possibility for very strong positive macroeconomic comovement. In the absence of leverage constraints, standard theory suggests that financial market integration has relatively slight implications for business cycle comovements across countries (except for the degree of consumption comovement). The chapter shows that, when leverage constraints are present and binding, but financial markets are nationally segmented, international macro comovement is actually negative. Shocks that reduce domestic consumption and investment will lead to increasing foreign consumption and investment. But the combination of binding leverage constraints and integrated international equity markets generates very high positive cross-country comovements in macroeconomic variables. The key reason is that financial integration leads to interdependence of portfolios across countries, and with binding leverage constraints the returns on portfolios, by affecting net worth, have independent effects on the degree of access to capital markets.
When leverage constraints are binding, and financial markets (in equity) are integrated, the channel of business cycle transmission takes place through movements in asset prices. A fall in asset prices in one country forces an immediate and large process of balance sheet contractions in that country’s financial institutions. But the fall in asset prices leads to balance sheet deterioration in other countries that have internationally diversified asset portfolios, causing a sell-off in assets and a forced reduction in borrowing around the globe. This, in turn, drives a further sell-off in the first country, establishing a feedback loop. The end result is a large magnification of the initial shock, a large fall in investment, and highly correlated business cycles across countries during the resulting downturn.

The chapter does not attempt to provide an integrated explanation of the global financial crisis, but instead highlights how the joint process of balance sheet constraints and portfolio interdependence generates an important cross-country propagation effect. This is done within the context of a two-country model in which investors borrow from savers in each country, and invest in fixed assets. Investors also diversify their portfolios across countries and hold equity positions in the assets of the other country as well as in their own. Investors cannot commit to repay savers, however, and, to enforce payment, may face limits on the maximum amount of leverage on their balance sheets.

In standard finance models, portfolio diversification is always beneficial. It allows for a diversification of consumption risk without affecting the nature of the risk itself. The portfolio diversification itself does not have any significant impact on cross-country comovements of real variables. But, in the presence of leverage constraints, this principle does not apply. When leverage constraints bind, moving from an environment without portfolio diversification to one where agents hold interdependent portfolios has a first-order implication for real cross-country comovements, because movements in portfolio valuations affect leverage constraints and, by doing so, tend to propagate shocks across countries.

This perspective on the effects of financial market integration raises a number of general issues regarding the benefits of financial integration. First, regional financial integration is compared relative to global integration. Increasing the extent of financial integration (going from regional to global) should bring clear welfare benefits in terms of enhanced risk-sharing and greater allocative efficiency. But increasing portfolio linkages in the face of balance sheet constraints may expose regions in which financial institutions are fundamentally sound to the dangers of contagion from crises generated in other regions. If financial markets operated freely in an environment where portfolios were unconstrained, this would not matter, since the basic gains from trade theorems would operate. But, in the presence of leverage constraints, there may be a genuine trade-off between regional and global financial integration. In the Asian context, as previously mentioned, countries receiving substantial capital inflows from US banks were subject to rapid outflows during the crisis. The asset price ramifications of this (in the presence of financial frictions) may generate real effects of deleveraging. This suggests that a cautious approach to global financial integration is advisable.
A second implication of the model is that, as suggested by the theoretical literature, different types of financial integration may have major implications for macroeconomic outcomes. As will be shown, in the presence of leverage constraints, the transmission of shocks across economies with bond markets will be both qualitatively and quantitatively fundamentally different from that experienced with equity market integration. The key point is that different types of financial market linkages may have substantial effects for real economic outcomes.

The model draws heavily on the literature. First, and most importantly, the model follows Kiyotaki and Moore (1997) and much subsequent literature in imposing leverage limits on investors. This leads to a wedge between the effective returns faced by investors and savers, and can act as an amplification mechanism for business cycle shocks. Second, the model emphasizes the linkages among countries through the presence of interconnected portfolios. Portfolio linkages, in a somewhat different context, have for some time been seen as important in the contagion effects of financial shocks (e.g. Rigobon 2003, Pavlova and Rigobon 2008). Finally, endogenous portfolio interdependence is introduced through the recently developed techniques of Devereux and Sutherland (2009).

The chapter is organized as follows: the next section provides evidence of the importance of a financial channel in the recent business cycle downturn; Section 9.2 develops the basic two-country model in which investors and savers interact, but investors may be limited by leverage constraints; Section 9.3 explores the effects of a negative productivity shock in one country and demonstrates the role of balance sheet adjustments in propagating business cycle shocks across countries; and Section 9.4 concludes.

9.1 Empirical evidence on financial linkages and leverage constraints

This section presents some evidence supporting the view that financial linkages were a key part of the transmission of the global financial crisis. First, Figure 9.1 documents the global nature of the economic crisis. Figure 9.1A, for Organisation for Economic Co-operation and Development (OECD) countries, and Figure 9.1B, for economies in the Asia and Pacific region, show a remarkably synchronous collapse in economic growth rates. It is unlikely that trade linkages alone could account for the simultaneous downturns in all regions. The countries in the graphs are very heterogeneous in their trade linkages and, in particular, their sensitivity to trade with the US varies greatly. This makes it reasonable to look for other areas of macroeconomic interdependence and, especially, the degree of financial linkages.

Table 9.1 presents more direct evidence on the process of deleveraging that took place during the financial crisis of 2008. It illustrates the growth rate of total short-term exposures of US banks to major Asian economies. This is the total stock of all loans to the destination economy with less than 1 year remaining until maturity, among US banks reporting to the Bank for International Settlements. A rapid decline in this stock in less than 1 year [e.g. to Taipei, China between...
Figure 9.1 Real growth in gross domestic product (GDP; per cent): (A) OECD countries; (B) Asia and the Pacific region.

Sources: Data from Oxford Economics, except for New Zealand data which was downloaded from Statistics New Zealand.

Notes: AUS = Australia; CAN = Canada; FRA = France; GDP = gross domestic product; GER = Germany; HKG = Hong Kong, China; IND = India; INO = Indonesia; ITA = Italy; JPN = Japan; KOR = Republic of Korea; MAL = Malaysia; MEX = Mexico; NET = Netherlands; NZL = New Zealand; OECD = Organisation for Economic Co-operation and Development; PHI = Philippines; POL = Poland; PRC = People’s Republic of China; SIN = Singapore; SPA = Spain; SWI = Switzerland; THA = Thailand; TUR = Turkey; UKG = United Kingdom; and USA = United States. The graphs show year-over-year changes in real GDP.
Financial contagion and vulnerability of Asian financial markets

Table 9.1  Short-term claims of United States banks on Asian economies ($ million)

<table>
<thead>
<tr>
<th>Destination of funds</th>
<th>2007Q4</th>
<th>2008Q1</th>
<th>2008Q2</th>
<th>2008Q3</th>
<th>2008Q4</th>
</tr>
</thead>
<tbody>
<tr>
<td>China, People’s Republic of</td>
<td>13,192</td>
<td>11,635</td>
<td>14,795</td>
<td>12,693</td>
<td>6,498</td>
</tr>
<tr>
<td>Hong Kong, China</td>
<td>10,079</td>
<td>10,066</td>
<td>12,900</td>
<td>11,366</td>
<td>8,837</td>
</tr>
<tr>
<td>India</td>
<td>25,722</td>
<td>20,779</td>
<td>16,582</td>
<td>17,093</td>
<td>13,801</td>
</tr>
<tr>
<td>Indonesia</td>
<td>6,007</td>
<td>5,902</td>
<td>5,286</td>
<td>6,782</td>
<td>5,313</td>
</tr>
<tr>
<td>Korea, Republic of</td>
<td>26,254</td>
<td>27,435</td>
<td>28,027</td>
<td>29,873</td>
<td>21,518</td>
</tr>
<tr>
<td>Malaysia</td>
<td>3,345</td>
<td>3,431</td>
<td>4,054</td>
<td>2,201</td>
<td>1,997</td>
</tr>
<tr>
<td>Philippines</td>
<td>1,370</td>
<td>2,060</td>
<td>1,923</td>
<td>1,579</td>
<td>1,547</td>
</tr>
<tr>
<td>Singapore</td>
<td>17,007</td>
<td>16,966</td>
<td>15,196</td>
<td>11,778</td>
<td>10,188</td>
</tr>
<tr>
<td>Taipei, China</td>
<td>7,845</td>
<td>9,689</td>
<td>8,929</td>
<td>7,155</td>
<td>3,795</td>
</tr>
<tr>
<td>Thailand</td>
<td>794</td>
<td>860</td>
<td>534</td>
<td>692</td>
<td>869</td>
</tr>
</tbody>
</table>

Source: Bank for International Settlements.

the second quarter of 2008 (2008Q2) and 2008Q4] implies little new issuance and few loans being rolled over. Indeed, the average decline between 2008Q3 and 2008Q4 represents a 26% fall in total claims on Asia, demonstrating that US banks substantially deleveraged their balance sheets with respect to Asia during the run-up of the economic crisis.

9.1.1 Deleveraging and asset price correlation

One feature of the deleveraging process is that asset prices become more correlated during crises. As negative shocks in one country lead to a deterioration of balance sheets through interconnected portfolios, a deleveraging process takes place in other countries; as a result, asset prices fall in a highly correlated manner across countries.

The evidence strongly supports the view that asset prices became more highly correlated during the crisis. This can be illustrated by focusing on equity markets as a proxy for asset markets more generally. Then the links between equity prices in the US and major Asian and Pacific economies are seen to have strengthened during the crisis.

The following equation illustrates this:

\[ \Delta e_i^s_t = \beta_0^i + \beta_1^i D_t \Delta e_{US}^s_t + \beta_2^i (1 - D_t) \Delta e_{US}^s_t + \epsilon_t, \]  

(9.1)

where \( \Delta e_i^s = \ln (e_i^s) - \ln (e_{i,-s}) \) is the change in the log of the level of the equity price index for economy \( i \) over interval \( s \), and \( D_t \) is a dummy variable that takes on a value of 1 before the financial crisis and zero thereafter.

Consider two possible dates as representing the onset of the global financial crisis. The first is 9 August 2007, which coincides with the BNP Paribas announcement that it could not fairly value the underlying assets in three funds as a result of exposure to US subprime mortgage lending markets. As a robustness check, 15 September 2008, when Lehman Brothers entered bankruptcy,
is also considered. Three time intervals are considered ($s \in \{1, 4, 13\}$ in weeks), approximately corresponding to weekly, monthly, and quarterly frequencies.\(^3\)

Table 9.2 outlines the estimation results for a break date of 9 August 2007. The results clearly show strong evidence consistent with a structural break in the relationship between US equity prices and those in the Asia and Pacific region. The coefficient of the importance of US equity prices as a driver of Asian and Pacific equity prices increases significantly in 30 of 36 cases examined, increases insignificantly in a further three cases, and declines insignificantly in each case involving Malaysia.

If equity price shocks generate comovement due to deleveraging during a crisis, this is more likely to occur for negative than for positive price shocks, because negative price shocks will tend to force collateral constraints to bind with greater frequency, as suggested by the model presented below.

To that end, the model’s following variant is estimated:

$$
\Delta e_i^t = \gamma_i^0 + \gamma_i^1 D_i \Delta e_i^{US} + \gamma_i^2 D_i (1 - P_t) \Delta e_i^{US} + \gamma_i^3 (1 - D_i) P_t \Delta e_i^{US} + \gamma_i^4 (1 - D_i)(1 - P_t) \Delta e_i^{US} + u_i^t,
$$

(9.2)

where $P_t$ takes on the value 1 when US equity prices are rising ($\Delta e_i^{US} > 0$), and zero otherwise. The form $H_0: \hat{\gamma}_i^4 - \hat{\gamma}_i^2 = 0$ tests if declines in US equity prices have a larger effect on equity prices in Asia and the Pacific since the beginning of the crisis. Table 9.3 presents the results.

As with the previous results, there is clear evidence that declines in US equity prices have a larger negative effect on equity prices in the Asia and Pacific region after the beginning of the crisis. In 22 of 36 cases examined, the coefficient of US equity prices increases significantly after the onset of the crisis. In a further 11 cases it increases insignificantly, while it declines insignificantly in each case involving Malaysia. As above, these results are robust.

In contrast, there is less evidence that an increase in US equity prices drives a larger positive change in Asian and Pacific equity prices since the beginning of the crisis. Examining the same 36 cases presented in Table 9.3, and testing $H_0: \hat{\gamma}_i^3 - \hat{\gamma}_i^1 = 0$, there are 11 statistically significant increases, 17 statistically insignificant increases, five statistically insignificant decreases, and three statistically significant decreases.

### 9.1.2 Financial versus trade linkages

The effects of global deleveraging shocks should be expected to vary by country. Countries are integrated both in trade and financial markets, and if the portfolio interconnectedness represents an important channel, then it should help to explain some of the comovement among real activity, independent of direct trade linkages.

To compare the importance of balance sheet contractions spread through portfolio interdependence as a propagation mechanism for the crisis versus direct
Table 9.2 Estimation results, equation 9.1

<table>
<thead>
<tr>
<th>Economy</th>
<th>Weekly data (s = 1)</th>
<th>Monthly data (s = 4)</th>
<th>Quarterly data (s = 13)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\hat{\beta}_1$</td>
<td>$\hat{\beta}_2$</td>
<td>p value</td>
</tr>
<tr>
<td>Australia</td>
<td>0.47</td>
<td>0.73</td>
<td>0.14</td>
</tr>
<tr>
<td>China, People’s Republic of</td>
<td>$-0.02$</td>
<td>0.15</td>
<td>0.41</td>
</tr>
<tr>
<td>Hong Kong, China</td>
<td>0.76</td>
<td>1.20</td>
<td>0.00</td>
</tr>
<tr>
<td>India</td>
<td>0.10</td>
<td>1.21</td>
<td>0.00</td>
</tr>
<tr>
<td>Indonesia</td>
<td>0.02</td>
<td>0.90</td>
<td>0.00</td>
</tr>
<tr>
<td>Japan</td>
<td>0.41</td>
<td>1.08</td>
<td>0.00</td>
</tr>
<tr>
<td>Korea, Republic of Malaysia</td>
<td>0.48</td>
<td>0.79</td>
<td>0.03</td>
</tr>
<tr>
<td>New Zealand</td>
<td>0.22</td>
<td>0.40</td>
<td>0.07</td>
</tr>
<tr>
<td>Philippines</td>
<td>0.28</td>
<td>1.01</td>
<td>0.00</td>
</tr>
<tr>
<td>Singapore</td>
<td>0.61</td>
<td>0.87</td>
<td>0.05</td>
</tr>
<tr>
<td>Thailand</td>
<td>0.40</td>
<td>0.69</td>
<td>0.08</td>
</tr>
</tbody>
</table>

Source: authors.

Notes: Reported p values are for a test of $H_0: \hat{\beta}_2 - \hat{\beta}_1 = 0$. Italics indicate $\hat{\beta}_2$ is significantly greater than $\hat{\beta}_1$ at the 10% confidence level.

Table 9.3 Estimation results, equation 9.2

<table>
<thead>
<tr>
<th>Economy</th>
<th>Weekly data (s = 1)</th>
<th>Monthly data (s = 4)</th>
<th>Quarterly data (s = 13)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\hat{\gamma}_2$</td>
<td>$\hat{\gamma}_4$</td>
<td>p value</td>
</tr>
<tr>
<td>Australia</td>
<td>0.65</td>
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<td>0.69</td>
</tr>
<tr>
<td>China, People’s Republic of</td>
<td>0.05</td>
<td>0.20</td>
<td>0.54</td>
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<tr>
<td>Hong Kong, China</td>
<td>0.85</td>
<td>1.16</td>
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<tr>
<td>India</td>
<td>0.24</td>
<td>1.18</td>
<td>0.00</td>
</tr>
<tr>
<td>Indonesia</td>
<td>$-0.01$</td>
<td>0.90</td>
<td>0.00</td>
</tr>
<tr>
<td>Japan</td>
<td>0.50</td>
<td>1.20</td>
<td>0.00</td>
</tr>
<tr>
<td>Korea, Republic of Malaysia</td>
<td>0.48</td>
<td>0.75</td>
<td>0.15</td>
</tr>
<tr>
<td>New Zealand</td>
<td>0.34</td>
<td>0.53</td>
<td>0.14</td>
</tr>
<tr>
<td>Philippines</td>
<td>0.39</td>
<td>1.12</td>
<td>0.00</td>
</tr>
<tr>
<td>Singapore</td>
<td>0.78</td>
<td>0.88</td>
<td>0.51</td>
</tr>
<tr>
<td>Thailand</td>
<td>0.62</td>
<td>0.79</td>
<td>0.59</td>
</tr>
</tbody>
</table>

Source: authors.

Notes: Reported p values are for a test of $H_0: \hat{\gamma}_4 - \hat{\gamma}_2 = 0$. Italics indicate $\hat{\gamma}_4$ is significantly greater than $\hat{\gamma}_2$ at the 10% confidence level.
trade linkages, the following regression analysis is employed. As a rough measure of the international effect of the crisis, the model uses the change in the growth rate of real gross domestic product (GDP) between the years ended in December 2007 and December 2008. To measure financial linkages, the total capital inflows from the US are employed, as a per cent of 2007 GDP, using US Treasury International Capital (TIC) data. The sample includes all OECD members for which TIC data are available. Trade linkages are measured by using exports to the US in 2007 as a per cent of GDP ($X$). Finally, each variable is interacted with the sovereign credit rating of the economy ($CR$) to capture the idea that capital withdrawals are likely to affect lower rated economies more heavily than higher rated ones. Again, motivated by the model presented below, lower rated economies are more likely to be constrained in financial markets, so that balance sheet or leverage constraints are more likely to act as a propagation mechanism for macro shocks for these economies. Sovereign credit ratings are based on Standard and Poor’s sovereign foreign currency credit rating in December 2007.

These regressions are run for two separate samples. Table 9.4A reports the results for a group of two OECD countries and Table 9.4B uses 12 Asia and Pacific economies. For the OECD sample, the results provide good support for the argument that financial flows were a strong causal factor in the propagation of the crisis, while trade channels appear less important. First the export variables ($X$ and $CRX$) are never economically or statistically significant, and sometimes enter with the wrong sign. Second, the measure of capital flows ($TIC$) is statistically significant in all cases. Third, an interactive term included between the credit rating and the size of capital inflows from the US not only enters significantly, consistent with flight to quality, but also strengthens the statistical support for TIC. Finally, the size of the adjusted $R^2$ statistics is supportive of capital inflows playing an important role in explaining the downturn, while trade channels are less important.

In contrast, for the Asian and Pacific economies, trade channels are more important in accounting for the size of the slowdown. When the trade variable alone is included, it is highly statistically significant, and the size of the coefficient is of economic significance. When the capital flows variable is included on its own, it is significant at the 10% level, but it loses significance when both trade and capital flows are included. The interactive variable is never significant.

These results suggest that the impact of shocks that originate in the US and affect other countries depends on the way in which these countries interact with the US. If these countries have significant capital flows from the US, and there exists financial fragility (defined as in the regressions), then capital flow linkages represent the primary channel of business cycle transmission. But if the countries have more robust financial sectors, then trade linkages represent the predominant channel of transmission. In a rough sense, this is consistent with anecdotal evidence that Asian economies had little direct financial exposure to the type of structured financial products that lay at the heart of the global financial crisis.
Financial contagion and vulnerability of Asian financial markets

Table 9.4 Explaining the slowdown

<table>
<thead>
<tr>
<th></th>
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<th>(2)</th>
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<td></td>
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<tr>
<td>$X$</td>
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<td>(0.844)</td>
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<td>CRX</td>
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<td></td>
<td>(0.775)</td>
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<td>TIC</td>
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<tr>
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<td>(0.035)</td>
<td>(0.006)</td>
<td>(0.005)</td>
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<tr>
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<td>(0.009)</td>
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<tr>
<td>Adj. $R^2$</td>
<td>$-0.036$</td>
<td>$-0.072$</td>
<td>$0.133$</td>
<td>$0.278$</td>
<td>$0.294$</td>
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<tr>
<td><strong>(B) Asia and the Pacific</strong></td>
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<tr>
<td>$X$</td>
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<tr>
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<td>$0.137$</td>
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<td>(0.483)</td>
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<td>(0.188)</td>
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<tr>
<td>TIC</td>
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<td>$-0.103$</td>
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<tr>
<td></td>
<td>(0.088)</td>
<td>(0.221)</td>
<td>(0.224)</td>
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<tr>
<td>CRTIC</td>
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<td>(0.751)</td>
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<td>(0.322)</td>
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<tr>
<td>Adj. $R^2$</td>
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<td>$-0.348$</td>
<td>$0.190$</td>
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<td>12</td>
<td>12</td>
<td>12</td>
<td>12</td>
</tr>
</tbody>
</table>

Source: authors.

Notes: GDP = gross domestic product. OECD = Organisation for Economic Co-operation and Development, US = United States. Dependent variable: real GDP growth rate in the year to 2008Q4, less the growth rate in the previous year. P-values are in parentheses. Italics indicate significance at the 5% confidence level. $X$ equals exports to the US. TIC is from US Treasury International Capital data, using gross capital inflows from the US, each as a percentage of GDP, in 2007. CRX and CRTIC are interactive terms, where CR is Standard and Poor’s sovereign foreign currency credit rating in 2007. CR = 0 corresponds to an AAA-rating, 1 for AA+, and so on, to 12 for BB-. $N$ = number of observations.

9.2 A model of leverage constraints and portfolio interdependence

A very stripped down model illustrates the two main elements discussed in the introduction: the role of leverage or financial constraints in international transmission, and the trade-off between the risk-sharing effects of financial integration and the contagion effects of integrated financial markets. The two-country model used features financial markets both within and between countries. Within countries there are borrowers (investors) and lenders (savers). Across countries, there is trade in risk-free bonds and (possibly) in equities. The countries are called “home” and “foreign.” Within each country the investors and savers both use the same fixed asset and have infinite horizons. Investors purchase the fixed
asset and rent it to production firms, receiving a risky return in exchange. One may think of this investment as the purchase of an equity claim on the production firm. Savers also use the fixed asset in home production. Savers therefore choose a portfolio in which they hold the debt of investors and the fixed asset. By assumption, savers do not hold domestic or foreign equity, but they may engage in lending or borrowing from foreign countries.

Investors in either country, however, may trade claims with investors in the other country, to diversify their portfolio of equity holdings. Thus, investors in each country hold leveraged investments, but may also have equity portfolios that are interconnected across countries. The impacts of a financial integration will be investigated as a move from an equilibrium where there is a unified world market for non-contingent debt, but equity markets are segmented, to an equilibrium with integrated world equity markets. Finally, both investors and savers in each country supply a fixed quantity of labor to production firms.

9.2.1 Investors

The population of each country is normalized to unity, with a measure \( n \) of investors and \( 1 - n \) savers. The representative investor in the home country maximizes:

\[
E_t \sum_{s=1}^{\infty} \theta_s^t U(C_s^t),
\]

where \( C_s^t \) is consumption of the final good. To keep the analysis solely focused on financial interlinkages between countries, it is assumed that there is just one world good. Adding endogenous terms of trade to the analysis would enrich the response, but would not fundamentally alter the cross-country transmission of balance sheet adjustments modeled here, so long as the elasticity of substitution across home and foreign goods is not close to unity.

The discount factor for investors is defined so that

\[
\theta_{s+1}^t = \beta^t(C_s^t) \theta_s^t, \quad \beta^t(C_s^t) \leq 0,
\]

where \( \beta^t(C_s^t) \leq 0 \), where \( C_s^t \) is the economy-wide average consumption of investors. Thus, the investor’s time preference is increasing in consumption, but the rate of time preference is taken as given by the individual investor. The assumption of endogenous time preference for investors plays the usual role of ensuring a stationary wealth distribution among groups, both within and across countries.

Investors receive income from their current holdings of domestic equity and, if they have access to international financial markets, from foreign equity also. In addition, they receive labor income from working in the domestic production firm. They must repay their debts to savers and issue new debt, purchase equity claims on home (and foreign, if financial markets are open) investments, and consume.
The home country investor’s budget constraint in the case without international equity market integration is written as

\[ C^I_t + q_{1t}k^I_{1t} = W^I_t + (q_{1t} + R_{1K_t})k^I_{1t-1} + B^I_t - R_{t-1}B^I_{t-1}. \]  

(9.4)

If there are integrated cross-country equity markets, then the budget constraint is

\[ C^I_t + q_{1t}k^I_{1t} + q_{2t}k^I_{2t} = W^I_t + (q_{1t} + R_{1K_t})k^I_{1t-1} + (q_{2t} + R_{2K_t})k^I_{2t-1} + B^I_t - R_{t-1}B^I_{t-1}. \]  

(9.4')

where \( q_{1t} \) and \( q_{2t} \) represent the price of the fixed asset (or equity) in the home and foreign country, respectively, and \( k^I_{1t} \) and \( k^I_{2t} \) are the portfolio holdings of the fixed assets in each country held by the home investor. The fixed asset of the home (foreign) country earns a return \( R_{1K_t} \) (\( R_{2K_t} \)). \( W^I_t \) is wage income for the investor, who supplies one unit of labor. Finally, \( B^I_t \) is the debt issued to domestic or foreign savers, and \( R_{t-1}B^I_{t-1} \) is payment for previously incurred debt.

To generate heterogeneity in financial markets and the need for debt, the assumption is that only investors can purchase the fixed asset representing a claim on the output of final goods. As in Bernanke, Gertler, and Gilchrist (1999), one could assume that investors (or entrepreneurs, in their model) have some special capability for transforming a unit of the fixed asset into a usable factor of production that is rented to production firms. Lenders cannot do this, and so can gain from the investment only indirectly by lending to the investors.

In addition to constraint (9.4), the model assumes that investors face a constraint on total leverage due to an inability to commit to repayment. Total debt is assumed to be restricted to no greater than \( \kappa \) times the market value of equity assets: \( \kappa < 1 \). Thus, home investors’ choices are constrained by the presence or absence of equity market integration. Without integration, the constraint is described as

\[ B^I_t \leq \kappa q_{2t}k^I_{2t}. \]  

(9.5)

When equity markets are integrated, investors in each economy choose a portfolio comprising equity of home and foreign firms. In this case the leverage constraint is described as

\[ B^I_t \leq \kappa (q_{1t}k^I_{1t} + q_{2t}k^I_{2t}). \]  

(9.5')

The full leverage rate (the value of assets to capital) for investors is then \( 1/1 - \kappa \), in the case where the leverage constraint (9.5) – or (9.5') – is binding.

### 9.2.2 Savers

Savers have preferences given by

\[ E_t \sum_{s=1}^\infty \theta_s^S U(C_s^S). \]  

(9.6)
Again, the discount factor is defined so that
\[ \theta_s^{S+1} = \beta_s(C_x^S) \theta_s^S, \]
with \( \beta_s(C_x^S) \leq 0, \) where \( C_x^S \) is the economy-wide aggregate consumption of savers. The assumption is that savers are inherently more patient than investors, in the sense that
\[ \beta_s(x) > \beta_I(x), \] (9.7)
for all feasible values of \( x. \) Assumption (9.7) ensures that savers will lend to investors and that investors will not have an incentive to build up enough wealth to be debt free.5

Savers purchase the fixed asset and lend to investors. They receive wage income from working in the final goods sector and returns from their lending to investors. Thus, an individual saver owning \( k_{1t}^S \) of the home fixed asset produces \( G(k_{1t}^S) \) in terms of home production, with \( G'(k_{1t}^S) < 0. \) For simplicity, one assumes that home production is perfectly substitutable by the final good in savers preferences. With this assumption, one may write the savers’ budget constraint as
\[ C_t^S + q_{1t}^1 k_{1t}^S = W_t^S + q_{1t}^1 k_{1t-1}^S + G(k_{1t-1}^S) + B_{t-1}^S - R_{t-1} B_{t-1}^S. \] (9.8)

Savers purchase only the domestic fixed asset. They do not have access to the same investment opportunity that investors have; therefore, they have use only for the domestic fixed asset that is useful for their home production. However, savers’ purchase of debt from either home or foreign investors is unconstrained.

### 9.2.3 Optimality conditions

Investors in the home country choose investment in equity and borrowing to maximize utility. In the case without international financial markets, the first-order conditions for investors are
\[ U'(C_t^I) = E_t \beta_I(C_{t+1}^I) U'(C_{t+1}^I) \frac{(q_{1t+1} R_{1t+1})}{q_{1t}} + \kappa \mu_t \] (9.9)
\[ U'(C_t^I) = E_t \beta_I(C_{t+1}^I) U'(C_{t+1}^I) R_t + \mu_t. \] (9.10)

Equation (9.9) is the optimal condition for choice of debt with a binding leverage constraint. The variable \( \mu \) represents the shadow value of relaxing the leverage constraint by one unit. If this is positive, it means that the investor would like to borrow more, but is constrained by (9.5). Therefore, current marginal utility is greater than expected future marginal utility times the return on investing in either the home or foreign country. Thus, \( \mu \) is a measure of the value of the opportunity to make a leveraged investment. To show this, put (9.5), (9.9) and (9.10) together to obtain
\[ \mu_t = E_t \beta_I(C_{t+1}^I) U'(C_{t+1}^I) \left( \frac{r_{1t+1} - R_t}{1 - \kappa} \right), \] (9.11)
where \( r_{1,t+1} = (q_{1,t+1} + R_{1K,t+1})/q_{1,t} \) is the return on the home equity. Equation (9.9) shows that, for a given distribution of excess returns and consumption, \( \mu \) increases as the leverage rate goes up. It also implies that, when \( \mu > 0 \), the expected return on the portfolio, up to the first order, exceeds the cost of borrowing.

When investors have access to international financial markets, choosing a portfolio of both home and foreign equity, one has the following conditions:

\[
U'(C_t^I) = E_t \beta^I(C_t^I) U'(C_{t+1}^I) \frac{(q_{1t+1} + R_{1Kt+1})}{q_{1t}} + \kappa \mu_t, \tag{9.12}
\]

\[
U'(C_t^F) = E_t \beta^I(C_t^F) U'(C_{t+1}^F) \frac{(q_{2t+1} + R_{2Kt+1})}{q_{2t}} + \kappa \mu_t, \tag{9.13}
\]

\[
U'(C_t^S) = E_t \beta^S(C_t^S) U'(C_{t+1}^S) R_t + \mu_t. \tag{9.14}
\]

Although the leverage constraint may bind, with open international financial markets, investors have an incentive to diversify their equity holdings across countries. In fact, (9.12) and (9.13) may be put together to get the standard portfolio selection condition:

\[
E_t U'(C_{t+1}^I) \left[ \frac{(q_{1t+1} + R_{1Kt+1})}{q_{1t}} - \frac{(q_{2t+1} + R_{2Kt+1})}{q_{2t}} \right] = 0. \tag{9.15}
\]

Given that the portfolio choice may be written in the form (9.15) allows one to use standard methods to derive the optimal equity portfolio of each country’s investors.

For savers, the first-order conditions for the optimal choice of \( k_S^i_t \) and \( B_t^S \) are simply

\[
U'(C_t^I) = E_t \beta^S(C_t^I) U'(C_{t+1}^I) \frac{q_{1t+1} + R_{1Kt+1}}{q_{1t}} + G'(k_{1,t+1}') \tag{9.16}
\]

\[
U'(C_t^S) = E_t \beta^S(C_t^S) U'(C_{t+1}^S) R_t. \tag{9.17}
\]

The return on the fixed asset for savers is determined by the asset’s marginal value in home production. Being unconstrained, savers will, up to a first order, choose a portfolio so as to equalize the return on debt and the total return on the fixed asset.

### 9.2.4 Production firms

Production firms in each country hire capital and fixed assets in order to produce. Firms are competitive, and maximize profits given the production function

\[
Y_t = A_t F(L_t, K_t). \tag{9.18}
\]
where \( L_t \) is effective employment and \( K_t \) is the firm’s use of the fixed asset. Profit maximization then implies that

\[
W^1_t = A_t F_1(L_t, K_t),
\]

(9.19)

\[
W^S_t = A_t F_1(L_t, K_t),
\]

(9.20)

\[
R_{1K,t} = A_t F_2(L_t, K_t).
\]

(9.21)

### 9.2.5 Equilibrium

An equilibrium of the two-country world economy must satisfy market clearing for the fixed asset, as well as debt market clearing. Without international equity markets, one has the following condition for equity market clearing in the home economy:

\[
nk^I_{1,t} + (1 - n)k^S_{1,t} = 1.
\]

(9.22)

In addition, one has the world bond market clearing condition

\[
nB^I_t + nk^I_{1,t} + (1 - n)B^S_t + (1 - n)B^*_t = 0,
\]

(9.23)

where the asterisk represents the values of foreign variables.

In the case of open international equity markets, one replaces (9.22) with the condition

\[
nk^I_{1,t} + nk^I_{1,t} + (1 - n)k^S_{1,t} = 1,
\]

(9.24)

where \( k^I_{1,t} \) represents the foreign country investor’s real holdings of the home asset at the beginning of time \( t + 1 \). In addition, the world market clearing condition must be satisfied:

\[
n(C^I_t + C^S_t) + (1 - n)(C^I_t + C^S_t) = A_t F\left[1, n \left(k^I_{1,t} + k^S_{1,t}\right)\right] + A^*_t F\left[1, n \left(k^I_{2,t} + k^S_{2,t}\right)\right] + (1 - n)\left[G\left(k^I_{1,t}\right) + G\left(k^S_{1,t}\right)\right].
\]

(9.25)

This condition incorporates the fact that the total labor supply of investors and savers is \( n \) and \( 1 - n \), respectively, and the total use of the fixed factor by final goods firms is equal to the total holdings by domestic and foreign investors.

Without international equity markets, the equilibrium is described by conditions (9.4), (9.5), (9.8)–(9.10), (9.16), (9.17), and (9.19)–(9.22) for the home country, and the analogous conditions for the foreign economy, as well as conditions (9.23) and (9.25). This gives 24 equations in the 23 variables:

\[
C^I_t, C^S_t, C^I_t, C^S_t, k^I_{1,t}, k^I_{2,t}, k^S_{1,t}, k^S_{2,t}, B^I_t, B^S_t, B^*_t, B^*_t, q^I_{1,t}, q^I_{2,t},
\]

\[
R_t, \mu^I_t, \mu^*_t, W^I_t, W^S_t, W^*_t, W^*_t, R_{1K,t}, \text{ and } R_{2K,t},
\]

with one equation being redundant by Walras’ law.
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With international equity markets, the equilibrium is described by conditions (9.4′), (9.5′), (9.8), (9.12), (9.13), (9.14), (9.16), (9.17), and (9.19)–(9.22) for the home economy, and the analogous conditions for the foreign economy, as well as conditions (9.24) and (9.25). This gives 26 equations in the 25 variables:

\[
\begin{align*}
C_i^t, C_s^t, C_t^t, C_i^{s,t}, k_{1,i,t}, k_{2,i,t}, k_{1,s,t}, k_{2,s,t}, B_i^t, B_s^t, B_t^t, B_i^{e,t}, B_s^{e,t},
q_{1,t}, q_{2,t}, R_t, \mu_t, \mu_t^*, W_i^t, W_s^t, W_t^t, W_i^{e,t}, W_s^{e,t}, B_{1K,t}, B_{2K,t},
\end{align*}
\]

with one redundant equation.

9.2.6 Portfolio choice

It is useful to provide a little more insight into the solution of the portfolio choice problem in this model. When investors can hold both domestic and foreign equity, they determine the optimal portfolio share using condition (9.15). But, up to a first order, this condition just says that the return on the two equities must be equal. Thus, up to a first order, they would be indifferent between the two assets. To solve for the share of the portfolio in each equity, therefore, one must approximate (9.15) up to a second order. This is done following the method of Devereux and Sutherland (2009).

To illustrate the application of this method to the present model, take equation (8.4′), the budget constraint for home country investors with integrated equity markets. This may be rewritten as

\[
C_i^t + NFA_t = W_i^t + R_{1K,t} \hat{k}_{i,t-1} - q_{1,t}(\hat{k}_{i,t} - \hat{k}_{i,t-1}) + r_{2,t} NFA_{t-1} + r_{st} \left[q_{1,t-1}(\hat{k}_{i,t-1} - \hat{k}_{i,t-1})\right] + B_t - R_{t-1} B_{t-1},
\]

(9.26)

where \(\hat{k}_{i,t} = k_{i,t} + k_{i,t}^{el}\) represents the total stock of fixed capital in home production, \(NFA_t\) denotes net foreign assets and is defined as \(NFA_t = q_{2,t} k_{2,t} - q_{1,t} (k_{1,t} - k_{1,t}^{el})\), and \(r_{st}\) is defined as the excess return on the portfolio:

\[
r_{st} = r_{1t} - r_{2t} = \left(\frac{q_{1,t} + R_{1K,t}}{q_{1,t-1}}\right) - \left(\frac{q_{2,t} + R_{2K,t}}{q_{2,t-1}}\right).
\]

For, given \(NFA_t\), the portfolio choice may be described as the choice of \(\alpha_t = q_{1,t}(k_{1,t} - \hat{k}_{i,t})\), which is the net holding of home country equity by home agents. It is easy to show that the first-order condition that maximizes utility with respect to \(\alpha_t\) gives equation (9.15). If \(\alpha_t < 0\), the investors diversify in the sense that less than 100% of all home equity is owned by home investors. Equivalently, it says that, from (9.26) when \(r_{st} > 0\), due to a favorable return on the home equity, the investor in the home country receives a negative valuation effect on his portfolio. This makes sense, because it implies that the investor is engaging in risk-sharing with investors from the foreign country.
Note that, given the revised definition of net foreign assets, the leverage constraint for home country investors becomes

\[ B_t \leq \kappa (NFA_t + q_1 \hat{k}_t^I). \] (9.27)

Thus, holding the home asset price constant, an increase in net foreign assets generated by either a current account surplus or a capital gain on the external portfolio will loosen the leverage constraint. But, because \( NFA_t + NFA^*_t = 0 \), this will simultaneously tighten the leverage constraint facing foreign investors. Therefore, the degree to which leverage linkages govern the transmission of shocks across countries depends on the dynamics of net foreign assets, and these in turn are linked to portfolio choices made by home and foreign investors.

### 9.2.7 Calibration

Next, the implications of the model for a number of alternative scenarios with respect to financial market integration, and the effect of leverage constraints, are explored. Clearly, the model is a substantial simplification of reality. Dynamic stochastic general equilibrium models have a number of standard features that are not included in the exercise. For example, there is no endogenous capital accumulation, and no variable for labor supply. But the aim of the exercise is solely to explore the way in which financial leverage constraints affect the cross-country dynamics of asset prices, asset allocations, and leveraged investments, and to investigate the effect of financial market integration within this environment. To do this, however, one needs to choose parameter values for preferences, production technologies, and the leverage-constraint itself. Table 9.5 gives the set of parameter values used in the baseline model.

<table>
<thead>
<tr>
<th>Table 9.5 Calibration</th>
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<tr>
<td><strong>Parameter</strong></td>
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<tr>
<td>( \omega )</td>
</tr>
<tr>
<td>( \sigma )</td>
</tr>
<tr>
<td>( \rho )</td>
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</table>

*Source: authors.*

*Notes: *\( n \) = labor supply of investors, \( \eta \) = margin constraint, \( \zeta \) = discount factor, \( \kappa \) = net worth-capital ratio, \( \varepsilon \) = labor output elasticity, \( \omega \) = share of saver’s capital used in home production, \( \sigma \) = elasticity of substitution, \( \rho \) = the autoregressive (AR[1]) coefficient on the productivity shock.*
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The measure of investors and savers is assumed to be equal, so that \( n = 0.5 \). In the leverage-constrained economy, this accords with the estimates of Campbell and Mankiw (1990) regarding the share of households that are subject to credit constraints in the US economy.

In the model with binding leverage constraints, total leverage (investment relative to capital) is equal to \( 1/(1 - \kappa) \). The leverage ratio has a significant effect on the quantitative dynamics. Two alternatives are examined. First, a relatively low ratio of 2 (\( \kappa = 0.50 \)) is chosen, as in Bernanke and Gertler (2000). But, given the high rates of leverage seen in the financial system in recent years, the implications of a higher value of \( \kappa = 0.75 \), corresponding to a total leverage of 4, are also explored. While the impact of shocks is greater for higher leverage, when the leverage constraint is binding, qualitatively, the results are similar for both leverage ratios.

An assumed discount factor is defined as

\[
\beta^i(C) = \xi^i(1 + C)^{-\eta}, \quad i = I, S.
\]

Following Mendoza and Smith (2006), \( \eta = 0.022 \). The chapter chooses \( \xi \) for lenders to match an annual interest rate of 4%, and the value of \( \xi \) for investors is chosen so that, in a steady state without binding leverage constraints, borrowing by investors is such that the leverage ratio matches that of the economy with binding leverage constraints. In the case of \( \kappa = 0.75 \), this requires that \( \xi^H = 0.985 \) and \( \xi^I = 0.9735 \). When \( \kappa = 0.50 \), one obtains \( \xi^H = 0.9825 \) and \( \xi^I = 0.975 \).

The model assumes a Cobb–Douglas final goods production technology, and lets \( F(L, K) = L^{\varepsilon}K^{1-\varepsilon} \). To have substantial propagation effects from leverage constraints, Kiyotaki and Moore (1997) required production in the borrowing sector to be linear in the fixed asset. Kocherlakota (2000) showed that, with a more conventional calibration allowing for decreasing returns, credit constraints have much less impact. The current chapter sets \( \varepsilon = 0.45 \). The choice of \( \varepsilon \) implies that fixed assets are slightly more important than conventional measures of capital’s share in calibrations of the US economy.\(^6\) Regarding the home production sector, one assumes that \( G = Z(k_S^{1/\omega})^\omega \) and \( \omega = 0.25 \), implying that the fixed asset is less important in this sector.\(^7\) The chapter sets \( A = Z = 1 \) in steady state. These assumptions, combined with the other calibrated parameters, imply that, in a steady state, 80% of the fixed asset is employed in final goods production.\(^8\)

The chapter follows the standard business cycle literature in setting an elasticity of intertemporal substitution equal to 0.5, so that \( \sigma = 2.00 \) in \( U(C) = (C^{1-\sigma}/(1 - \sigma)) \). Alternative values of \( \sigma \) change the volatility of asset prices, but have little qualitative effect on the results otherwise.

What are the appropriate shocks to focus on? While the global financial crisis has raised the awareness of shocks to the financial system, the model lacks detailed financial structure. It is not easy to pinpoint any key crisis-generating shock within the model. Instead, the standard macro real business cycle literature is followed and the international propagation of productivity shocks in the final goods sector
is explored. The stochastic process for final goods productivity is modeled as
\[
\log(A_t) = \rho \log(A_{t-1}) + \nu_t, \tag{9.28}
\]
where \(\rho = 0.90, E_{t-1} \nu_t = 0, \) and \(\sigma^2 = 0.02^2.\) The model assumes that foreign productivity is driven by the same process, and foreign and domestic productivity shocks are uncorrelated.

### 9.3 Effects of productivity shocks

This section investigates how the joint process of balance sheet constraints with portfolio interdependence affects the international propagation of shocks. The key aspect of the model is to show that the two features of portfolio interdependence and leverage constraints introduce a substantial process of macroeconomic comovement that is absent when these features are not present.

#### 9.3.1 Portfolio autarky with leverage constraints

First, the effects of a 1% negative shock to the productivity of the fixed asset in final goods are compared in the home country when leverage constraints are binding but without international equity portfolio diversification. Figure 9.2 describes the impact, in the environment where there is no portfolio diversification, of the shock on: (1) total consumption of final goods, aggregated across both savers and investors, in each country; (2) asset prices; (3) borrowing by investors; (4) asset allocation; (5) the home country trade balance; and (6) the world lending rate. The figure incorporates a high leverage rate, as described in the calibration section.

The fall in the return on the productivity of final goods production has two immediate effects. It (temporarily) reduces wages for both investors and savers, and (since the fall is persistent), it reduces the return on investment in the fixed asset for investors. With temporarily lower income, all else being equal, both investors and savers would like to smooth out the impacts on consumption by borrowing more or saving less (note that because there is no aggregate investment, there is no tendency for reduced overall spending on capital, as in the standard real business cycle model). At the same time, the fall in the return on the fixed asset will reduce the demand for investment funds by investors in the home economy. In a closed economy, these two effects would lead to a fall in the price of the fixed asset and reduced investment in the fixed asset in final goods. The impact on the real interest rate depends on the degree to which the leverage constraint plays an important role. If there were no binding leverage constraint, the impact of the fall in \(A_t\) would lead real interest rates to rise, because both savers and investors have temporarily lower consumption, and the real interest rate should rise to eliminate the aggregate desire to smooth this consumption fall over time. But when the leverage constraint is binding, the fall in the asset price precipitated by the fall in the future return on investment in fixed assets causes a tightening
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Figure 9.2 The impact of a home country productivity shock with segmented financial markets and high leverage: (A) consumption; (B) asset prices; (C) investors borrowing; (D) asset holdings; (E) home country trade account; (F) world lending rate.

Source: authors.

Notes: \( C \) = home country consumption of final goods; \( C^* \) = foreign country consumption of final goods; \( q_1 \) = home country price of fixed assets; \( q_2 \) = foreign country price of fixed assets; \( B \) = borrowing by home investors; \( B^* \) = borrowing by foreign investors; \( k_1 \) = portfolio holdings of fixed assets held by the home investor; \( k_2 \) = portfolio holdings of fixed assets held by the foreign investor.
of the constraint, reducing the amount that investors can borrow to invest. This leads to an amplification of the impact of the productivity shock on investment in the fixed asset. If the amplification is great enough, then the fall in the demand for borrowing leads to a fall in the real interest rate rather than a rise.

With this explanation in mind, one may focus on the impact of the home country shock in Figure 9.2, where there is a unified world debt market (but no cross-country equity holdings). The figure is based on a high leverage rate. As a result, the amplification effect of asset prices is significant. Thus, the fall in the productivity of the fixed asset in final goods leads to significant tightening of the leverage constraint, and a large forced reduction in home country investors’ borrowing to finance investment. This fall in borrowing is great enough that world real interest rates fall.

What does this imply for the international macroeconomic transmission of shocks? Figure 9.2 shows that, in this case, the comovement of international macroeconomic aggregates is negative. The decline in home country productivity reduces aggregate home country consumption of final goods and reduces investment in the final goods sector, reducing the price of the fixed asset in the home country. But because the world real interest rate is lower, due to the amplified effect of the collateral reduction in the home country, the cost of investment in fixed assets in the foreign country is reduced. Because equity markets are segmented across countries, there is no balance sheet interconnection across them, so that the fall in the home asset price has no direct effect on the foreign investors’ leverage constraint. But, because the cost of borrowing is lower, foreign investors increase their borrowing and investment in the fixed asset. Foreign total consumption rises, as the fall in interest rates encourages an increase in spending, and the rise in foreign investment increases production of final goods in the foreign country.

The different response of home and foreign investment leads asset prices to move in opposite directions in the two countries. There is an asset price decline in the home country, for reasons explained above. In the foreign country, by contrast, the increase in demand for the fixed asset raises the price of that asset.

Note also that the negative comovement in asset prices is associated with pathological movements in the trade balance. The home country has a temporarily lower output and, by standard reasoning, one would anticipate that it runs a trade deficit. But the large collateral-related fall in wealth leads to a fall in aggregate consumption of final goods that is greater than the immediate fall in output, leading to a trade surplus. The foreign country, by contrast, experiences a collateral-related expansion in wealth, and runs a trade deficit, even though it experiences (through an increase in investment in final goods) a temporarily higher level of output.

Thus, the end result is that consumption, investment, and asset prices move in opposite directions in the two countries when there is an integrated world bond market, but no equity market integration. Without equity market integration, the two countries interact in capital markets only through the world bond market. But in the presence of binding leverage constraints and a high level of leverage, productivity shocks drive real interest rates to move in a perverse direction, leading bond markets to transmit shocks in a negative direction.
Figure 9.3 looks at the case with low leverage constraints, but again segmented financial markets. When leverage is set at 2 rather than 4, the impact of a home country productivity shock on the real interest rate is initially slightly negative, but then quickly turns positive, because the collateral-related fall in borrowing is not large enough to overturn the home agents’ initial desire to smooth consumption. Thus, following the logic of the previous paragraphs, the increase in the world interest rate leads to a reduction in the demand for borrowing in the foreign country, a fall in fixed investment, and a fall in foreign consumption and asset prices. The home country then experiences a trade deficit rather than a surplus. So in this case of lower leverage, the cross-country comovement is positive. But as shown in the following section, the extent of comovement is substantially less than is seen in the case of integrated international equity markets.

9.3.2 Equity market integration: risk-sharing versus contagion

The international macro transmission mechanism in Figure 9.2 strongly suggests the possibility of gains from international financial market integration. Productivity shocks in one country cause large collateral amplification effects, but have the opposite impact on the rest of the world. Because all equity has to be held in domestic portfolios, there is no possibility of financial risk-sharing to smooth the impact of macro shocks across countries. This section illustrates the effects of equity market integration and shows the same shock as before, but now extended to allow for equity market integration.

Figure 9.4 (which illustrates the high leverage case) shows that when equity markets are integrated, there is a clear positive comovement across the two countries in response to the home country productivity shock. Clearly, one would anticipate that, due to the improved risk-sharing possibilities from equity trade, consumption movements would be more aligned across countries. But Figure 9.4 shows that the positive comovement extends beyond consumption risk-sharing to the real economy. In contrast to Figure 9.2, the integration of equity markets leads asset prices and investment to become highly synchronized across countries.

The explanation for this positive comovement is critically tied to the presence of binding leverage constraints in both the home and foreign countries. The home country productivity shock leads to a fall in the price of the home asset, as before, and from the arbitrage condition (9.15), the foreign asset price also falls. Now, however, the home investor is hedged against the fall in the value of home equity. The optimal portfolio holding for the home investor is to have a negative net position in home equity (i.e. it divests some home equity in return for foreign equity), so that \( \alpha_t < 0 \). This, in conjunction with the fact that the home country productivity fall results in a negative \emph{ex post} return on home equity (so that \( r_{xt} < 0 \)), leads to a positive portfolio gain for the home country following the shock. This facilitates an increase in home net foreign assets, through valuation effects. For the foreign country, these valuation effects are negative, leading to a tightening of the leverage constraint on foreign investors. This forces foreign investors to reduce borrowing and investment in the fixed asset in the foreign country.
Figure 9.3 The impact of a home country productivity shock with segmented financial markets and low leverage: (A) consumption; (B) asset prices; (C) investors borrowing; (D) asset holdings; (E) home country trade account; (F) world lending rate.

Source: authors.

Notes: $C$ = home country consumption of final goods; $C^*$ = foreign country consumption of final goods; $q_1$ = home country price of fixed assets; $q_2$ = foreign country price of fixed assets; $B$ = borrowing by home investors; $B^*$ = borrowing by foreign investors; $k_1$ = portfolio holdings of fixed assets held by the home investor; $k_2$ = portfolio holdings of fixed assets held by the foreign investor.
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Figure 9.4 The impact of a home country productivity shock with integrated financial markets and high leverage: (A) consumption; (B) asset prices; (C) investors borrowing; (D) asset holdings; (E) home country trade account; (F) world lending rate.

Source: authors.

Notes: $C =$ home country consumption of final goods; $C^* =$ foreign country consumption of final goods; $q1 =$ home country price of fixed assets; $q2 =$ foreign country price of fixed assets; $B =$ borrowing by home investors; $B^* =$ borrowing by foreign investors; $k1 =$ portfolio holdings of fixed assets held by the home investor; $k2 =$ portfolio holdings of fixed assets held by the foreign investor.
As before, the world interest rate on debt falls. But, in contrast to the case without an integrated equity market, foreign investors cannot take advantage of lower world interest rates to increase their investment, because they find themselves less creditworthy due to tightened leverage constraints. The negative collateral impact of falling asset prices forces them to reduce their investment in fixed assets. Moreover, because equity markets immediately transmit wealth effects across countries, consumption falls in both the home and foreign countries.

A comparison of Figures 9.2 and 9.4 shows that, conditional on leverage-constrained investment, portfolio integration itself causes a dramatic qualitative shift in the international transmission process of productivity shocks. In the absence of equity market integration, shocks are transmitted negatively to consumption, asset prices, and investment. There would thus be a clear incentive to diversify country-specific risk through equity market diversification. But integrating equity markets in the presence of binding leverage constraints causes a sharp change in the nature of international transmission itself. Without leverage constraints, there would be no such effects; real investment is entirely independent across countries in this basic model, and opening up financial markets in equity trade would have no effect on this comovement whatsoever. But, with these binding constraints, portfolio diversification leads to large shifts in net worth across countries in the face of country-specific shocks. These net worth changes interact with leverage constraints to cause highly synchronized movements in investment demand across countries. Thus, the gains to diversification after financial integration are less than the gains perceived before equity market liberalization.

Equivalently, one can observe that, while financial integration through equity markets allows for a gain from cross-country risk-sharing, it also generates a contagion effect in the presence of leverage constraints on investment. This contagion effect works through cross-country changes in net worth, impacting investment, and increases the degree of macroeconomic comovement relative to an absence of portfolio integration. As in standard models, portfolio diversification enhances risk-sharing. But it does so at the cost of simultaneously increasing business cycle comovement, because it generates interdependent movements in balance sheet positions and balance sheet constraints affect the propagation of macro shocks. Thus, portfolio diversification increases comovement of business cycles. This is in stark contrast to the standard business cycle model, where increased risk-sharing usually leads to a reduced comovement in business cycles (by reducing the income effect of shocks and enhancing the allocation of resources to their location of greatest returns, portfolio diversification will normally reduce the cross-country comovement of output in the standard business cycle model).

Finally, Figure 9.5 shows the case of the same shock, with equity market integration, but with lower leverage. Qualitatively, the effects are very similar to Figure 9.4. The main difference is that the amplitude of the effects of the shock is diminished because, in the case of lower leverage, the impact of asset price declines through the leverage mechanism is lessened.
Figure 9.5 The impact of a home country productivity shock with integrated financial markets and low leverage: (A) consumption; (B) asset prices; (C) investors borrowing; (D) asset holdings; (E) home country trade account; (F) world lending rate.

Source: authors.

Notes: $C =$ home country consumption of final goods; $C^*$ = foreign country consumption of final goods; $q1 =$ home country price of fixed assets; $q2 =$ foreign country price of fixed assets; $B =$ borrowing by home investors; $B^*$ = borrowing by foreign investors; $k1 =$ portfolio holdings of fixed assets held by the home investor; $k2 =$ portfolio holdings of fixed assets held by the foreign investor.
9.4 Conclusions

This analysis raises fundamental questions about the nature of the gains from financial market integration and how financial and regulatory policy should be designed in the light of these market failures. With interdependence among financial market distortions across countries, full financial liberalization may not be a “first-best” policy. There may be an optimal sequencing of financial market opening that minimizes the risk of financial contagion. In broad terms, it is necessary to identify the financial structure that most efficiently exploits the trade-off between the gains from international portfolio diversification and the costs of financial contagion.

One may go beyond the narrow confines of the model and draw some more general implications for monetary and financial policy. First, insofar as the contagion effect of financial markets is linked to excessive leverage within the financial system, the model suggests that financial regulatory policy that limits leverage may offer both domestic and international benefits. Consequently, the model implies a clear case for international coordination on financial regulatory policy. This is at odds with views suggesting that regulation is best left to individual national policy makers (e.g. Taylor 2008).

A further implication follows regarding regional versus global financial integration. As suggested above, a cautious approach to global financial integration may be desirable when integration involves exposing domestic financial markets to foreign jurisdictions with excessive leverage and/or financial fragilities. By exposing domestic balance sheets to the risk of foreign asset price shocks, countries may find that business cycle risk is magnified by international financial integration. Moreover, this process is likely to be asymmetric. Negative shocks may have a greater effect than positive shocks, because they are more likely to push asset values down to the point where leverage constraints bind.

Finally, the model may have some implications for monetary policy coordination across countries. While the model has no explicit monetary policy dimension (indeed, the authors maintain the assumption of fully flexible prices throughout), monetary policy has a potential role in providing liquidity to avoid hitting the lower bound on leverage constraints. In this situation again, much as was the case for regulatory policy, there is a clear case for international coordination in the form of foreign exchange swaps and other liquidity-enhancing reciprocal arrangements between central banks.

Notes

1 An alternative mechanism where balance sheets play a key role in business cycles is the financial accelerator model of Bernanke, Gertler, and Gilchrist (1999). Gilchrist (2004) extended this to a multi-economy setting.

2 Dedola and Lombardo (2009) developed an interesting model similar to that in the present chapter based on the financial accelerator model, incorporating endogenous portfolios as is done here. They emphasized a somewhat different type of transmission effect, unique to the financial accelerator model, coming from the direct connection between risk premiums across countries.
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3 The base data are weekly, taken from the close of business on Tuesday for the US series, and the close of business on Wednesday for Asian and Pacific economies.

4 The chapter does not explicitly decompose financial integration into regional relative to global. As discussed in the Introduction and Conclusions, however, regional Asian financial integration may be thought of as corresponding to integration between financial systems that are not directly subject to leverage constraints (at least insofar as the global financial crisis is concerned). Global financial integration, then, increases the exposure to financial systems in which leverage constraints magnify shocks.

5 An alternative, but considerably more difficult, approach to achieving an equilibrium with leveraged investment is to assume that investors are less risk-averse than savers. Solving a model with leverage based on risk preferences would be substantially harder than the approach followed here, because one would need to solve the full stochastic model to a higher order of approximation. Adding habit persistence to the model could allow for some time variation in risk aversion in a relatively simple way. This is deferred for future work, however, to keep the analysis as simple as possible.

6 For many emerging markets, however, estimates of capital share equal to 50% are quite common.

7 Benhabib, Rogerson, and Wright (1991) calibrated the share of capital in home production equal to 0.08, but they did not include residential structures as capital.

8 The equity portfolio positions taken in an equilibrium with integrated equity markets are not reported directly in Table 9.5, because they are endogenous to the particular case focused on. In general, there is more diversification of equities in the model than seen empirically: the model does not explain the puzzle of “home equity bias.” Devereux and Yetman (2010) introduced transaction frictions in financial markets that can generate home bias in equities. The results here would be qualitatively unchanged if such frictions were incorporated.

References


Michael B. Devereux and James Yetman


10 Not all financial integration is created equal: the composition matters

Shang-Jin Wei

This chapter aims to examine the notion that the composition of capital flows matters for a typical developing economy’s experience with (global or regional) financial integration, and to investigate some underlying institutional determinants of the composition. The 2008–9 global financial crisis presents the latest reminder that financial integration is a two-edged sword, especially for developing countries. In good times, financial integration may help a developing country by augmenting domestic savings for local investment, improving sharing of consumption risks, and disciplining national governments into pursuing better policies in macroeconomic and other areas. However, in bad times, a financially integrated economy is less able to remain unaffected. While the global financial crisis started as a subprime mortgage crisis in the United States (US) in late 2007, it spread quickly to the rest of the world, especially to countries with close ties to the world’s capital and goods markets.

Even before the 2008–9 crisis, the theoretical benefits of financial integration were not convincingly supported by empirical evidence. Surveys of then existing empirical literature by Eichengreen (2001) and Kose et al. (2003) suggested that, despite many possible beneficial channels in theory, it is not easy to find a strong and robust causal effect from financial globalization to economic growth, especially for developing economies. However, some economies with an equally high level of financial integration appear to suffer from a crisis more easily than others. Why? One hypothesis is that the composition of an economy’s inflows affects the risks and benefits associated with financial integration. In other words, not all capital flows are equal. International direct investment, and perhaps international portfolio flows, appears to be robustly associated with a positive effect on economic growth (Bekaert, Harvey, and Lundblad 2005). In contrast, there is no strong evidence that private foreign debt, including international lending, has robustly promoted economic growth. Indeed, one sometimes finds evidence that international lending is negatively associated with economic growth (Reisen and Soto 2001). Official aid does not robustly support growth either (Rajan and Subramanian 2005).

The composition of capital flows has also been related to a country’s propensity to experience a currency crisis. Frankel and Rose (1996), in their study of all episodes of currency crises in emerging markets during 1971–92, reported that,
while virtually no variable has a strong predictive power for subsequent currency crashes, the composition of capital inflows is one of the very few variables that are robustly related to the probability of a currency crisis. In particular, the share of foreign direct investment (FDI) in an economy’s total capital inflows is negatively associated with the probability of a currency crisis. This is confirmed in several subsequent studies including Frankel and Wei (2005).

A liquidity crunch experienced by non-financial firms (a reduced supply of external funds normally used to support a firm’s working capital or long-term investment needs) is an important feature of the 2008–9 crisis. Does the composition of an economy’s capital flows affect the severity of financial crunch faced by its non-financial firms? The chapter’s first objective is to address this question.

The literature has also proposed a threshold effect as a way to understand the empirical findings. The threshold effect states that certain minimum conditions have to be met before an economy can be expected to benefit from financial globalization. Otherwise, the economy may experience more crises and lower growth. The threshold effect comes in various versions. Only economies with reasonably good public institutions (e.g. a minimum level of rule of law, and reasonable control of corruption) and a minimum level of human capital seem to be able to translate exposure to financial globalization into stimulus to investment and growth on a sustained basis (see the surveys by Kose et al. 2003, 2009, 2010).

It is not difficult to imagine why economies with bad institutions may not benefit from financial globalization. In a highly corrupt economy, more capital inflows could lead to more bribery and rent seeking but not much productive investment. So more capital flows may not result in higher growth rates. What is the connection between the composition and the threshold effects? The chapter’s second objective is to examine this question.

While the two effects are often presented as rival explanations, earlier work (Wei 2000a, 2000b, 2001; Wei and Wu 2002) suggested that a concrete connection between the two – economies with better public institutions (i.e. above an institutional threshold) – is likely to attract more international direct investment relative to international bank loans. Evidence is derived using data on bilateral FDI reported by source countries of the Organisation for Economic Co-operation and Development (OECD), and bilateral international lending reported by member economies of the Bank for International Settlements. The author’s earlier work measured the quality of public institutions by the perception of corruption reported in surveys of firms, such as those conducted by the World Economic Forum for its Global Competitiveness Report or by the World Bank for its World Development Report. Recent evidence on investment by international mutual funds suggested that better institutions, measured by a high degree of government and corporate transparency, help to attract more international equity investment (Gelos and Wei 2005). So, the composition effect and the threshold effect are perhaps just two sides of the same coin.

The idea that the composition effect and the threshold effect are linked this way has its detractors. Hausmann and Fernandez-Arias (2000) found no relationship
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between the share of FDI in total capital inflows and good institutions. In a panel of advanced and developing countries, Albuquerque (2003) found the share of FDI in total inflows to be negatively related with good credit rating. As will be argued later, while their measures are labeled as institutions, they are in fact about financial development. Conceptually, financial development and other public institutions could have different effects on the composition of capital flows (Ju and Wei 2007, 2008). Furthermore, none of these studies employed instrumental variables to correct for possible measurement errors and endogeneity of the corruption or other institutional measures.

In any case, more recent papers with an instrumental variable (IV) approach and arguably better data again affirmed the earlier conclusion that there may be an intimate relationship between the institutional threshold and the composition effect. Using International Monetary Fund (IMF) data on balance of payments, Alfaro, Kalemli-Ozcan, and Lolosovych (2003) found that good institutional quality is a key determinant of total capital inflows. Papaioannou (2005) reported that foreign asset holdings by banks that are members of the Bank for International Settlements, including their portfolio assets and direct investments, tend to be higher in destinations with better institutions. Using recent IMF data on member countries’ international investment position, Faria and Mauro (2009) showed evidence that countries with good institutions are likely to attract more equity-like capital flows (FDI and portfolio equity flows) relative to other types of capital. Their measure of institutional quality is the average of six indicators: voice and accountability, political stability and absence of violence, government effectiveness, regulatory quality, rule of law, and control of corruption, as computed and reported by Kaufmann, Kraay, and Mastruzzi (2003). An important feature of the study is that the authors explicitly addressed the possibility that the composite institutional index may be measured with errors and/or may be endogenous. As IVs, they employed mortality of European settlers during the early colonial period, as proposed by Acemoglu, Johnson, and Robinson (2001), and ethnolinguistic fragmentation, first used by Mauro (1995). The IV approach reaffirms their basic conclusion.

The cumulative evidence points to the strong possibility that, for countries with bad public institutions, the composition of capital flows tilts away from FDI and portfolio equity flows and toward debt, including bank loans, making the economy more vulnerable to currency crisis and liquidity crunch, and less able to translate a given amount of capital inflow into stimulus for economic growth. If an institutionally deficient country wants to reap the benefit of financial globalization, it needs to work on improving its institutions to reach a minimum level of acceptance.

The rest of the chapter is organized as follows: Section 10.1 compares the statistical properties of different types of capital flows; Section 10.2 reviews some recent evidence on whether the composition of capital flows played a role in the spread of a liquidity crunch among emerging market economies during 2008–9; Section 10.3 provides some updated evidence on the institutional determination of the composition of capital flows and clarifies the relationship
10.1 Not all capital flows are created equal: a look at the relative volatility

One reason that the composition of capital flows makes a difference for a country’s experience with financial integration is that some types of capital may be more volatile than others. The discussion is organized in two steps. First, using data for 1980–2006 (i.e. before the global financial crisis), the relative volatility of different types of capital flows is examined using information on all IMF member countries for which relevant data are available (Table 10.1). Second, based on data from the global financial crisis, recent evidence on a connection between the composition of capital flows and the severity of an economy’s credit crunch is reviewed.

10.1.1 Relative volatility

First, volatility is measured by the standard deviations of FDI/gross domestic product (GDP), portfolio inflows/GDP, and debt/GDP for each of the 175 economies during 1980–2006. The results are reported in the upper half of Table 10.2 and presented in Figure 10.1. Across all countries in the sample, on average, the ratio of portfolio/GDP is volatile (with an average standard deviation across countries of 0.211), followed by the ratio of loans/GDP (with a standard deviation of 0.065). FDI/GDP is the most stable of the three measures (with a standard deviation of 0.038). If one looks at the median values across the countries, then the loans/GDP ratio is more volatile (with a standard deviation of 0.037) than either FDI/GDP (with a standard deviation of 0.021) or portfolio flows/GDP (with a standard deviation of 0.014). If one restricts the sample to emerging markets and developing economies, then the contrast becomes somewhat larger. The loans/GDP ratio tends to be twice as volatile as FDI/GDP, but the relative ranking of the portfolio flows/GDP ratios depends on whether one looks at the mean or median values of the volatility series. The emerging markets and developing countries in Asia behave very much the same way as their counterparts in other regions.

As an alternative measure of relative volatility, the coefficients of variations (COV) are computed. While the COV measure helps to purge the impact of the scale of the series on the measured volatility, it has limitations. In particular, if a series has a mean very close to zero, its COV can take on an enormous value; if a series has a negative mean, its COV is also negative. In these cases, a higher COV value does not necessarily correspond to higher volatility in the economic sense. For this reason, the COVs are reported for the three types of capital inflows as a complement to (rather than as a substitute for) the standard deviation measure. The results are reported in the lower half of Table 10.2 and presented in Figure 10.2. Across all samples, the loans/GDP ratio is always more volatile than FDI/GDP. For the the emerging markets subsample, the portfolio flows/GDP ratio is clearly
Table 10.1 Economies in the analysis

<table>
<thead>
<tr>
<th>Type of economy and area</th>
<th>Country/economy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emerging markets and developing countries/economies</td>
<td>Afghanistan; Bangladesh; Brunei Darussalam; Cambodia; China, People’s Republic of; Hong Kong, China; India; Indonesia; Korea, Republic of; Lao People’s Democratic Republic; Macao, China; Malaysia; Maldives; Mongolia; Myanmar; Nepal; Pakistan; Philippines; Singapore; Sri Lanka; Thailand; Viet Nam.</td>
</tr>
<tr>
<td>Middle East and North Africa</td>
<td>Algeria; Bahrain; Egypt; Iran; Iraq; Israel; Jordan; Kuwait; Lebanon; Morocco; Oman; Saudi Arabia; Syria; Tunisia; Turkey; Yemen</td>
</tr>
<tr>
<td>Latin America</td>
<td>Antigua and Barbuda; Argentina; Aruba; Bahamas; Barbados; Belize; Bolivia; Brazil; Chile; Colombia; Costa Rica; Dominica; Dominican Republic; Ecuador; El Salvador; Grenada; Guatemala; Guyana; Haiti; Honduras; Jamaica; Mexico; Nicaragua; Panama; Paraguay; Peru; St. Kitts and Nevis; Saint Lucia; Saint Vincent and the Grenadines; Suriname; Trinidad and Tobago; Uruguay; Venezuela.</td>
</tr>
<tr>
<td>Central and Eastern Europe and the Former Soviet Republics</td>
<td>Albania; Armenia; Azerbaijan; Belarus; Bosnia and Herzegovina; Bulgaria; Croatia; Czechoslovakia; Estonia; Georgia; Hungary; Kazakhstan; Kyrgyz Republic; Latvia; Lithuania; Macedonia; Moldova; Poland; Romania; Russian Federation; Serbia; Tajikistan; Turkmenistan; Ukraine; Yugoslavia, Socialist Federal Republic of.</td>
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<tr>
<td>Developed Countries</td>
<td>Australia, Austria, Belgium, Belgium-Luxembourg, Canada, Cyprus, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Israel, Italy, Japan, Luxembourg, Malta, Netherlands, New Zealand, Norway, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland, United Kingdom, United States.</td>
</tr>
</tbody>
</table>

Source: author.
Figure 10.1 Volatility of foreign direct investment (FDI)/gross domestic product (GDP) and loans/GDP, measured by standard deviation (1980–2006).

Source: author’s calculations.

Notes: Excludes outside values.

Table 10.2 Volatility of foreign direct investment (FDI)/gross domestic product (GDP), bank loans/GDP, and portfolio flows/GDP as measured by standard deviation or coefficient of variation (Asia versus the rest of the world, 1980–2006)

<table>
<thead>
<tr>
<th>Measure</th>
<th>FDI/GDP</th>
<th>Loans/GDP</th>
<th>Portfolio flows/GDP</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Standard deviations</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whole sample</td>
<td>175 economies</td>
<td>168 economies</td>
<td>124 economies</td>
</tr>
<tr>
<td>Mean</td>
<td>0.038</td>
<td>0.065</td>
<td>0.211</td>
</tr>
<tr>
<td>Median</td>
<td>0.021</td>
<td>0.037</td>
<td>0.014</td>
</tr>
<tr>
<td>Emerging markets</td>
<td>143 economies</td>
<td>136 economies</td>
<td>96 economies</td>
</tr>
<tr>
<td>Mean</td>
<td>0.033</td>
<td>0.055</td>
<td>0.241</td>
</tr>
<tr>
<td>Median</td>
<td>0.020</td>
<td>0.040</td>
<td>0.010</td>
</tr>
<tr>
<td>Asian emerging markets</td>
<td>20 economies</td>
<td>20 economies</td>
<td>15 economies</td>
</tr>
<tr>
<td>Mean</td>
<td>0.021</td>
<td>0.045</td>
<td>0.111</td>
</tr>
<tr>
<td>Median</td>
<td>0.015</td>
<td>0.028</td>
<td>0.010</td>
</tr>
<tr>
<td><strong>Coefficients of variation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whole sample</td>
<td>175 economies</td>
<td>168 economies</td>
<td>124 economies</td>
</tr>
<tr>
<td>Mean</td>
<td>1.366</td>
<td>16.280</td>
<td>0.010</td>
</tr>
<tr>
<td>Median</td>
<td>0.881</td>
<td>1.231</td>
<td>0.007</td>
</tr>
<tr>
<td>Emerging markets</td>
<td>143 economies</td>
<td>136 economies</td>
<td>96 economies</td>
</tr>
<tr>
<td>Mean</td>
<td>1.430</td>
<td>20.041</td>
<td>2.252</td>
</tr>
<tr>
<td>Median</td>
<td>0.876</td>
<td>1.228</td>
<td>1.594</td>
</tr>
<tr>
<td>Asian emerging markets</td>
<td>20 economies</td>
<td>20 economies</td>
<td>15 economies</td>
</tr>
<tr>
<td>Mean</td>
<td>0.726</td>
<td>0.698</td>
<td>3.690</td>
</tr>
<tr>
<td>Median</td>
<td>0.674</td>
<td>1.221</td>
<td>1.495</td>
</tr>
</tbody>
</table>

Source: author’s calculations based on the data on FDI, loan, and portfolio liabilities from the International Monetary Fund’s Balance of Payments Statistics, Standard Presentation.

Notes: Asian emerging markets refer to all economies in Asia except Japan.
3.00  2.00  2.50  1.50  1.00  0.00  0.50

Figure 10.2 Volatility of foreign direct investment (FDI)/gross domestic product (GDP) and loans/GDP, measured by coefficient of variation (1980–2006).

Source: author’s calculations.
Notes: Excludes outside values.

more volatile than FDI/GDP, though the reverse appears to be true for developed economies.

To summarize, the evidence suggests that the conclusion in Wei (2001) with regard to the relative volatility of various types of capital inflows is still true with 10 more years of data. This lends support to the composition hypothesis.

To see the relative reliance on various types of capital flows, the mean and median values of FDI/GDP, foreign loans/GDP, and portfolio inflows/GDP are tabulated by country groups for three periods: 1980–9, 1990–9, and 2000–6 (Table 10.3). For emerging markets in Asia, both FDI/GDP and portfolio/GDP have increased dramatically from the 1980s to the first decade of the twenty-first century. Conversely, the ratio of foreign loans/GDP has declined. Somewhat surprisingly, the same time series pattern holds for Latin American countries. The main difference is that countries in Latin America tend to rely more on foreign borrowing. Central and Eastern Europe and the former Soviet Union also tend to rely more on foreign borrowing than do Asian economies.

10.1.2 Relative reversibility of capital flows by type since 1990

The relative stability of capital flows can also be seen from a simple time-series plot. In Figure 10.3, components of international capital inflows are traced from 1990 to 2009 for 24 emerging economies: Argentina; Brazil; Chile; the People’s Republic of China; Colombia; the Czech Republic; Egypt; Hong Kong, China; Hungary; India; Indonesia; Israel; the Republic of Korea; Malaysia; Mexico; Pakistan; Peru; the Philippines; Poland; the Russian Federation; Singapore;
Table 10.3  Relative reliance on foreign direct investment (FDI), foreign loans, and portfolio debts and equities by region

<table>
<thead>
<tr>
<th>Country group</th>
<th>FDI/GDP</th>
<th>Loans/GDP</th>
<th>Portfolio/GDP</th>
<th>FDI/(loans + portfolio)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asia (excluding Japan)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1980–9</td>
<td>Mean 0.013</td>
<td>0.033</td>
<td>0.005</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>Median 0.006</td>
<td>0.031</td>
<td>0.002</td>
<td>0.208</td>
</tr>
<tr>
<td>1990–9</td>
<td>Mean 0.031</td>
<td>0.025</td>
<td>0.007</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>Median 0.018</td>
<td>0.019</td>
<td>0.006</td>
<td>0.498</td>
</tr>
<tr>
<td>2000–6</td>
<td>Mean 0.028</td>
<td>0.009</td>
<td>0.014</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>Median 0.016</td>
<td>0.004</td>
<td>0.014</td>
<td>0.513</td>
</tr>
<tr>
<td>Latin America</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1980–9</td>
<td>Mean 0.010</td>
<td>0.039</td>
<td>0.003</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>Median 0.010</td>
<td>0.031</td>
<td>0.001</td>
<td>0.140</td>
</tr>
<tr>
<td>1990–9</td>
<td>Mean 0.024</td>
<td>0.016</td>
<td>0.010</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>Median 0.026</td>
<td>0.014</td>
<td>0.009</td>
<td>0.812</td>
</tr>
<tr>
<td>2000–6</td>
<td>Mean 0.036</td>
<td>0.013</td>
<td>0.010</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>Median 0.032</td>
<td>0.010</td>
<td>0.009</td>
<td>0.399</td>
</tr>
<tr>
<td>Central and Eastern Europe and former Soviet Republics</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1980–9</td>
<td>Mean 0.000</td>
<td>0.022</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>Median 0.000</td>
<td>0.019</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>1990–9</td>
<td>Mean 0.030</td>
<td>0.042</td>
<td>0.009</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>Median 0.027</td>
<td>0.038</td>
<td>0.007</td>
<td>0.576</td>
</tr>
<tr>
<td>2000–6</td>
<td>Mean 0.043</td>
<td>0.028</td>
<td>0.011</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>Median 0.043</td>
<td>0.030</td>
<td>0.008</td>
<td>1.234</td>
</tr>
<tr>
<td>All emerging markets</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1980–9</td>
<td>Mean 0.012</td>
<td>0.041</td>
<td>0.003</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>Median 0.008</td>
<td>0.036</td>
<td>0.001</td>
<td>0.125</td>
</tr>
<tr>
<td>1990–9</td>
<td>Mean 0.023</td>
<td>0.032</td>
<td>0.007</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>Median 0.019</td>
<td>0.031</td>
<td>0.004</td>
<td>0.538</td>
</tr>
<tr>
<td>2000–6</td>
<td>Mean 0.032</td>
<td>0.018</td>
<td>0.009</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>Median 0.031</td>
<td>0.015</td>
<td>0.006</td>
<td>0.410</td>
</tr>
</tbody>
</table>

Cont’d
Table 10.3 Cont’d

<table>
<thead>
<tr>
<th>Country group</th>
<th>FDI/GDP</th>
<th>Loans/GDP</th>
<th>Portfolio/GDP</th>
<th>FDI/(loans + portfolio)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All countries</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1980–9</td>
<td>Mean</td>
<td>0.011</td>
<td>0.036</td>
<td>0.008</td>
</tr>
<tr>
<td></td>
<td>Median</td>
<td>0.007</td>
<td>0.031</td>
<td>0.003</td>
</tr>
<tr>
<td>1990–9</td>
<td>Mean</td>
<td>0.022</td>
<td>0.029</td>
<td>0.012</td>
</tr>
<tr>
<td></td>
<td>Median</td>
<td>0.019</td>
<td>0.027</td>
<td>0.008</td>
</tr>
<tr>
<td>2000–6</td>
<td>Mean</td>
<td>0.032</td>
<td>0.019</td>
<td>0.015</td>
</tr>
<tr>
<td></td>
<td>Median</td>
<td>0.031</td>
<td>0.016</td>
<td>0.010</td>
</tr>
</tbody>
</table>

Source: author’s calculations based on data from the International Monetary Fund’s Balance of Payments, standard presentations.

Notes: — = not applicable; GDP = gross domestic product. To reduce noise, economies with less than 1 million population and Luxembourg and Belgium (tax havens) are excluded. Furthermore, FDI/GDP, portfolio/GDP, and loans/GDP are trimmed by excluding observations with values smaller than the fifth percentile or greater than the 95th percentile.

Figure 10.3 Capital flows to emerging market economies ($ billion).
Source: International Monetary Fund World Economic Outlook Database.

South Africa; Thailand; and Turkey (used in Tong and Wei 2009), with the data collected from the World Economic Outlook database (IMF). While all three components rose in the years leading up to the crisis and exhibited a reversal during the crisis, there are still visible differences among them. In particular, both the rise and the fall are sharpest for international bank loans. In contrast, FDI is
comparatively stable. While the precrisis rise of FDI was more gradual than that of international bank loans, the FDI reversal started only in 2008 and has been milder. In short, the time-series patterns of the capital flows in the latest episode of financial globalization still conform to the notion that international bank loans are more volatile than FDI, especially during a crisis.

10.2 Evidence on the composition effect during the global financial crisis

The global financial crisis provides an opportunity to re-examine the validity of the composition effect. Tong and Wei (2009) is likely the only publication that has done so. Some key evidence presented in that paper is reviewed in the following paragraphs.

10.2.1 Basic specification

The basic empirical strategy is to check whether an ex ante classification of firms by their characteristics in terms of degree of liquidity constraint helps to predict the ex post magnitude of their stock price changes from the start of the global crisis (taken as 31 July 2007) to 31 December 2008. To be precise, the specification is given by the following equation:

\[
StockReturn_{i,k,j} = \text{Economy fixed effects} + \beta \cdot \text{FinancialDependence}_k + \text{Control}_{i,k,j} + \epsilon_{i,k,j},
\]  

(10.1)

where \(i\) stands for company, \(k\) for sector, and \(j\) for country. Note that this is a purely cross-sectional regression and the key regressors are predetermined (in 2006). As a start, the same \(\beta_j\) is assumed for all countries in order to estimate an average effect.

To see how a pattern of precrisis exposure to capital flows affects the extent of a liquidity crunch, a country’s pattern of financial integration and its manufacturing firms’ dependence on external finance are interacted. In other words,

\[
\beta_j = \beta_1 + \beta_2 Pattern_{of\_Capital\_Flow}_j,
\]  

(10.2)

where the \(Pattern_{of\_Capital\_Flow}\) experienced in country \(j\) is measured by either the total volume of precrisis capital inflows or the composition of capital inflows (FDI versus non-FDI). The slope coefficient, \(\beta_2\), then captures the degree to which the extent of a credit crunch depends on patterns of capital inflows.

Asset pricing models provide guidance for control variables. Three factors from Fama and French (1992) are included: firm size (log assets), the ratio of the market to book value, and the beta (the correlation between the firm stock return and the market return). In addition, sector-level intrinsic sensitivity to a demand contraction, as in Tong and Wei (2008), and a momentum factor from Lakonishok, Shleifer, and Vishy (1994) are included.
10.2.2 Measures of sector-level dependence on external finance

Two separate measures of intrinsic dependence for external finance are included. The first aims to capture intrinsic dependence on external finance for investment ($\text{DEF}_{\text{INV}}$). This follows a methodology in Rajan and Zingales (1998):

$$
\text{DEF}_{\text{INV}} = \frac{\text{capital expenditures} - \text{cash flow}}{\text{capital expenditures}},
$$

(10.3)

where $\text{cash flow} = \text{cash flow from operations} + \text{decreases in inventories} + \text{decreases in receivables} + \text{increases in payables}$. All the numbers are based on US firms, which are judged to be least likely to suffer from financing constraints (during a normal time) relative to firms in other economies. While the original Rajan and Zingales (1998) paper covers only 40 (mainly SIC two-digit) sectors, here the coverage is expanded to about 250 SIC three-digit sectors.

The second variable aims to measure the intrinsic dependence on external finance for working capital ($\text{DEF}_{\text{WK}}$). In addition to the need for capital for investment, a firm requires working capital to operate and to satisfy both short-term debt payment and ongoing operational expenses. Firms may use lines of credit, term loans, or commercial paper to cover such needs. In an unexpected liquidity crunch for working capital, industries that depend intrinsically more on external finance for working capital should experience a larger decline of stock prices than do other firms. A sector-level measure of intrinsic need for external finance for working capital is constructed following Raddatz (2006) and Kroszner, Laeven, and Klingebiel (2007). The cycle measures the time elapsed from the moment a firm pays for its inputs to the moment it receives payment for the goods it sells. The key assumption is that dependence on external finance for working capital is due to pure technological reasons, such as the length of time in the production process and the mode of operation. For US firms during a non-crisis period, when the supply of finance is as abundant as in any country, the relative values of the cash conversion cycle across sectors reflect relative true needs for external finance for working capital. Specifically,

$$
\text{Cash conversion cycle} = \frac{\text{365} \left( \frac{\text{inventories} - \text{account payables}}{\text{cost of goods sold}} + \frac{\text{account receivables}}{\text{total sales}} \right)}{\text{365}}
$$

The sector-level proxy is constructed as follows. First, for each US firm from 1990 to 2006, the cash conversion cycle is calculated based on annual data from Standard and Poor’s Compustat Industrial Annual. Then the median within each US SIC three-digit sector is calculated and applied as the sector’s intrinsic dependence on external finance for working capital. The index for the US firms is then extrapolated to other countries. The measurement assumes that the supply of liquid funds is reasonably elastic in the US (in a non-crisis period); hence, observed differences in relative working capital levels across industries are mainly demand driven.
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The median and mean values of this index are both 71 days, and the standard deviation is 41 days.

10.2.3 Evidence

Table 10.4 examines the volume effect of precrisis capital flows. The dependent variable is stock returns from 31 July 2007 to 31 December 2008. The sample consists of listed manufacturing companies in 24 emerging markets (listed on pp. 282, 285). In column (1) of Table 10.4, the interactions between the volume of capital inflows and the two measures of financial dependence are included. Neither interaction term is significant. On average, the extent of the liquidity crunch does not appear to be linked to a country’s precrisis volume of capital inflows. In columns (2) and (3), firm-level factor and sector fixed effects are added sequentially. In these two specifications, the volume of capital flow multiplied by DEF_INV is not significant, while capital flow multiplied by DEF_WK is significant at the 10% level. Hence, there are some indications that the volume of

| Table 10.4 The role of precrisis exposure to capital inflows in emerging economies (volume effect) |
|---------------------------------|--------|--------|--------|
|                                | (1)    | (2)    | (3)    |
| DEF_INV                        | −4.414 | −2.488 |          |
|                                | (10.21)| (9.098)|          |
| DEF_INV · Inflow               | 0.329  | 0.442  | 0.576   |
|                                | (0.492)| (0.455)| (0.424) |
| DEF_WK                         | −0.108 | −0.050 |          |
|                                | (0.077)| (0.071)|          |
| DEF_WK · Inflow                | −0.005 | −0.0078*| −0.0085*|
|                                | (0.005)| (0.0047)| (0.0048)|
| Beta · Market Index            | 0.312***| 0.285***|          |
|                                | (0.044)| (0.043)|          |
| Firm Size                      | 1.281  | 1.317  |          |
|                                | (1.072)| (1.136)|          |
| Market/Book Value              | −1.285*| −1.404**|          |
|                                | (0.669)| (0.680)|          |
| Momentum                       | −0.145***| −0.144***|          |
|                                | (0.040)| (0.042)|          |
| Demand Sensitivity             | −9.425***|          |          |
|                                | (2.070)|          |          |
| Sector Fixed Effects           | No     | No     | Yes     |
| N                              | 3,796  | 3,747  | 3,747   |
| $R^2$                          | 0.145  | 0.185  | 0.239   |

Source: Tong and Wei (2009).

Notes: The dependent variable is the change in log stock prices from 31 July 2007 to 31 December 2008. DEF_INV is an index for external financial dependence for investment; and DEF_WK is an index for external financial dependence for working capital. Standard errors, clustered at the sector level, are in parentheses.

***, **, and * denote significance at 1%, 5%, and 10% confidence levels, respectively.
precrisis capital flows may have affected the degree of a liquidity crunch during the global financial crisis, but the evidence is not overwhelming.

However, it may be misleading to conclude that a country’s exposure to financial globalization does not matter. The literature suggests that the composition of capital flows matters in currency and balance-of-payments crises (Wei 2001, 2006; Kim and Wei 2002). For example, the volume of international bank lending (scaled by a recipient country’s GDP) is generally more volatile than international direct investment as measured either by standard deviation or COV.

To examine formally whether the degree of financial constraint during the 2007–9 crisis is related to the components of precrisis capital flows, each component is multiplied by the financial dependence indicators for long-term investment ($DEF_{INV}$) and short-term working capital ($DEF_{WK}$). The results are shown in Table 10.5. In column (1), the multiplication of $DEF_{INV}$ with foreign portfolio investment ($FPI$) is significantly negative. That is, firms with needs for external finance for long-term investment suffer more from a liquidity crunch in economies with a large exposure to foreign portfolio investment. Meanwhile, foreign loans generate a negative coefficient and FDI generates a positive coefficient, although statistically insignificant in both cases. In column (2), $DEF_{WK}$ and the interaction terms are added, and similar sign patterns are found. While $DEF_{WK}$ has a positive coefficient that is significant at the 5% level, both $DEF_{WK} \cdot FPI$ and $DEF_{WK} \cdot Foreign Loans$ have negative coefficients. These are significant at the 1% confidence level. Moreover, $DEF_{WK} \cdot Foreign Loans$ generates a coefficient more than twice that of $DEF_{WK} \cdot FPI$, consistent with the story that international loans are reversed (not renewed) more quickly in a crisis, which triggers domestic banks to decrease their loans to firms even for working capital needs. In addition, even though the interaction term between FDI and $DEF_{WK}$ is significantly positive, if each flow component is multiplied by its coefficient in column (2), and they are added with the coefficient of $DEF_{WK}$ (i.e. $-0.153$), this verifies that a higher $DEF_{WK}$ is on average associated a greater decline in stock prices.

In column (3) of Table 10.5, sector fixed effects are added to control for potentially omitted sector-level variables that are correlated with financial dependence indexes. This drops financial dependence indexes and the demand sensitivity index from the regression, as they are part of the sector-specific fixed effects. However, the interaction terms between financial dependence and capital flow components are preserved. This addition generally shows a sharpened asymmetric impact of different capital flow components on the severity of a financial shock. In column (4), firm-level measures of risks as captured by the Fama-French factors are added, but the basic conclusion stays the same.

It is important to note that, for capital flows to affect a liquidity crunch, it is not necessary for manufacturing firms to borrow directly from international banks or to raise funds directly from the international capital market. In a study of the effect of capital controls on liquidity constraints in Chile, Forbes (2007) noted that borrowing by domestic banks from international banks and capital markets is enough to forge a connection between liquidity constraints on domestic
Table 10.5 The composition effect

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEF_INV</td>
<td>-4.585</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(12.49)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DEF_INV*FDI</td>
<td>2.859</td>
<td></td>
<td>3.375**</td>
<td>3.240*</td>
</tr>
<tr>
<td></td>
<td>(1.870)</td>
<td></td>
<td>(1.627)</td>
<td>(1.661)</td>
</tr>
<tr>
<td>DEF_INV*FPI</td>
<td>-1.626*</td>
<td>-1.503*</td>
<td>-1.387*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.909)</td>
<td>(0.789)</td>
<td>(0.799)</td>
<td></td>
</tr>
<tr>
<td>DEF_INV*Foreign Loans</td>
<td>-2.531</td>
<td>-2.491</td>
<td>-2.076</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.651)</td>
<td>(1.670)</td>
<td>(1.798)</td>
<td></td>
</tr>
<tr>
<td>DEF_WK</td>
<td>-0.153*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.082)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DEF_WK*FDI</td>
<td>0.044**</td>
<td>0.041*</td>
<td>0.031</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.022)</td>
<td>(0.023)</td>
<td>(0.022)</td>
<td></td>
</tr>
<tr>
<td>DEF_WK*FPI</td>
<td>-0.022***</td>
<td>-0.022**</td>
<td>-0.020**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.008)</td>
<td>(0.009)</td>
<td>(0.008)</td>
<td></td>
</tr>
<tr>
<td>DEF_WK*Foreign Loans</td>
<td>-0.055***</td>
<td>-0.059***</td>
<td>-0.051***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.017)</td>
<td>(0.020)</td>
<td>(0.019)</td>
<td></td>
</tr>
<tr>
<td>Beta*Market Index</td>
<td></td>
<td>0.280***</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.043)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Firm Size</td>
<td></td>
<td>1.260</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(1.153)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Market/Book Value</td>
<td></td>
<td>-1.357**</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.682)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Momentum</td>
<td></td>
<td>-0.148***</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.042)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: author.

Notes: FDI = foreign direct investment; FPI = foreign portfolio investment. The dependent variable is the change in log stock prices from 31 July 2007 to 31 December 2008. DEF_INV is an index for external financial dependence for investment; and DEF_WK is an index for external financial dependence for working capital. Standard errors, clustered at the sector level, are in parentheses. ***, **, and * denote significance at 1%, 5%, and 10% confidence values, respectively.

manufacturing firms and a country’s exposure to international capital flows. In particular, firm-level financial constraints could be affected by the global financial market, “whether the small firms received capital inflows directly, or whether they borrowed from banks (which experienced a lengthening of their maturities and attempted to match the maturities of their assets and liabilities)” (Forbes 2007: 3).

The effect of precrisis exposure to FDI on the financial constraint is worth noting. In normal times, having an internal capital market is considered a strength of multinational firms. This is shown by Aguiar and Gopinath (2005) and Desai, Foley, and Forbes (2008). Multinational firms use their relatively strong financial positions to alleviate financial constraints in their foreign subsidiaries. Whether this holds in a time of financial crisis is an open question because the
multinational firms could themselves be in financial difficulties. Indeed, the news about the financial difficulties faced by Chrysler and General Motors points to this possibility. However, since many manufacturing firms in the US had a high level of cash reserves just before the crisis (Bates, Kahle, and Stulz 2009), such firms that engage in FDI, which tend to be larger than average, may still be in a better position to weather a financial shock than other firms, especially firms in developing countries. The evidence in the current chapter suggests that the internal capital market of multinational firms may very well be tapped in places where foreign subsidiaries experience financial difficulties and cannot obtain financing from the host economy financial system.

The estimated effect of precrisis exposure to foreign portfolio inflows on the financial constraint is also intuitive. The withdrawal of international portfolio capital makes it more costly for firms to roll over their debt. For firms that wish to use seasonal stock offerings to raise new capital, the cost of capital also increases when less international capital is available to support the market. In either case, when international portfolio flows retreat, the financial constraints experienced by firms in the recipient countries tighten.

10.3 Corruption versus financial development: which matters for the composition of capital flows and how?

The chapter now turns to statistical evidence on whether and how the institutional variables affect the composition of total foreign liabilities. This updates the results in Wei (2000b, 2001) with more recent data on the composition of capital inflows (the average over 2004–6) and attempts to use economic history to instrument modern-day property rights institutions and financial development.

Let $\text{Composition}_j$ be a measure of country $j$’s composition (e.g. the share of the stock of FDI in total foreign liabilities, or the share of the stock of bank loans in total foreign liabilities). The two key regressors are the quality of public institutions in country $j$, or $\text{Institutions}_j$, and the level of financial development in country $j$, or $\text{FinDev}_j$.

The institutional quality measure is derived by averaging the six governance indicators (voice and accountability, political stability and absence of violence, government effectiveness, regulatory quality, rule of law, and control of corruption) developed by Kaufmann, Kraay, and Mastruzzi (2003), a team of World Bank researchers. The index is scaled so that almost all values are between $-2.5$ and $2.5$. A higher value means a higher quality of public institutions.

The basic specification used in this chapter is

$$\text{Composition}_j = \beta_1 \text{Institutions}_j + \beta_2 \text{FinDev}_j + Z_j \Gamma + e_j,$$

where $Z_j$ is a vector of control variables; $\beta_1$, $\beta_2$, and $\Gamma$ are parameters (of appropriate dimensions) to be estimated; and $e_j$ is a random error.

One could estimate equation (10.1) by ordinary least squares (OLS). But there are two problems. First, both institutional quality and financial development are
difficult to measure precisely. The measurement errors are likely to cause a bias toward zero (an attenuation bias). Second, both variables are likely to be endogenous. For example, greater presence of foreign multinational corporations could lead to an increased lobbying by these firms for the local government to reduce corruption and to improve the financial market. In this case, one might find a positive correlation between better institutional quality and more foreign investment, or between more financial development and more foreign investment, even though more foreign investment is not caused by either better institutions or high financial development (an endogeneity bias).

If one can find good instrumental variables, then one can simultaneously address the endogeneity and the measurement error problems. What are the appropriate instruments in this context? Here, the chapter uses of the work by La Porta et al. (1998), Acemoglu, Johnson, and Robinson (2001), and Acemoglu and Johnson (2005).

### 10.3.1 How informative are the instrumental variables?

Table 10.6 reports a set of “first-stage” regressions that relate either institutional quality or financial development to the proposed instruments. Column (1) regresses financial development on a set of legal origin dummies (the left-out group is English, or common-law, origins). Evidently, French and socialist legal origins are associated with a lower level of financial development than is English origin.

<table>
<thead>
<tr>
<th></th>
<th>Financial development</th>
<th>Institutional quality</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
</tr>
<tr>
<td>Log (settler mortality)</td>
<td>$-0.44^{**}$</td>
<td>$-0.43^{**}$</td>
</tr>
<tr>
<td></td>
<td>(0.08)</td>
<td>(0.09)</td>
</tr>
<tr>
<td>Legal Origin (French)</td>
<td>$-0.61^{**}$</td>
<td>$-0.55^{**}$</td>
</tr>
<tr>
<td></td>
<td>(0.17)</td>
<td>(0.20)</td>
</tr>
<tr>
<td>Legal Origin (German)</td>
<td>$1.13^{**}$</td>
<td>$1.00$</td>
</tr>
<tr>
<td></td>
<td>(0.42)</td>
<td>(0.00)</td>
</tr>
<tr>
<td>Legal Origin (Scandinavian)</td>
<td>$1.04^{**}$</td>
<td>$0.00$</td>
</tr>
<tr>
<td></td>
<td>(0.42)</td>
<td>(0.00)</td>
</tr>
<tr>
<td>Legal Origin (Socialist)</td>
<td>$-0.74^{**}$</td>
<td>$-0.69$</td>
</tr>
<tr>
<td></td>
<td>(0.21)</td>
<td>(0.71)</td>
</tr>
<tr>
<td>Trade Openness</td>
<td>$0.58^{**}$</td>
<td>$0.60^{**}$</td>
</tr>
<tr>
<td></td>
<td>(0.13)</td>
<td>(0.14)</td>
</tr>
<tr>
<td>Resource Exporter</td>
<td>$0.07$</td>
<td>$0.07$</td>
</tr>
<tr>
<td></td>
<td>(0.39)</td>
<td>(0.39)</td>
</tr>
</tbody>
</table>

**Source:** author.

**Notes:** Standard errors in parentheses.

* and ** denote significance at 10% and 5% confidence levels, respectively.
On the other hand, German and Scandinavian origins are associated with higher levels of financial development than is English origin. When legal origins are included in the same regression with settler mortality [column (2)], the sample shrinks considerably. In any case, legal origins retain some explanatory power for today’s financial development. In particular, countries with a French legal origin appear to suffer more in financial development than their peers with an English legal origin. Higher settler mortality rates or higher population densities several centuries ago also help predict lower levels of financial development. In column (3), trade openness and a dummy for when the country is a major resource exporter are added. Greater trade openness is found to be positively associated with a higher level of financial development, whereas resource exporters do not matter in this context.

Column (4) of Table 10.6 indicates that settler mortality in the eighteenth to nineteenth centuries is a good predictor of a country’s level of institutional quality today: the higher the mortality, the lower the level of institutional quality on average. When settler mortality is put to compete with legal origins [column (5)], it comes out as a significant predictor. When trade openness and a dummy for major resource exporters are added [column (6)], greater trade openness is associated with better institutions. While the coefficient of the resource exporter dummy is negative, consistent with the “resource curse” hypothesis, it is not statistically significant.

To summarize, the data reveal that economic history influences institutional development. At the same time, different aspects of the history appear to have differential impacts on financial development and bureaucratic corruption. Legal origins have a discernible influence on a country’s level of financial development today, but do not appear to affect a country’s bureaucratic quality significantly, once the impact of the historic pattern of settler mortality is accounted for. However, settler mortality affects both bureaucratic corruption and financial development. These variations in the type of institutions today that can be explained by different historic experiences are crucial to identifying the effects of corruption and financial development in the subsequent analyses.

10.3.2 Benchmark results

Do institutional variables affect a country’s composition of foreign liabilities? Before continuing to the statistical results, a few features of the basic specification are listed here. First, one has to decide whether to focus on flows or on stocks of FDI, portfolio investment, and bank loans. As argued in Wei (2000a, 2000b, and 2001), stock levels are more appropriate than flow levels. For example, when a multinational firm solves a profit maximization problem to decide on an optimal level of FDI, it decides on an optimal stock of FDI. If the current stock is different from the optimal stock, the firm would use the current flow as an adjustment until the stock reaches the desired level. As a corroboration, Faria and Mauro (2009) also determined that cumulative liabilities, or the stocks of capital inflows, are the appropriate variables to be used to examine composition of capital flows.
Second, the current chapter focuses on a cross-section of countries rather than trying to develop panel data. One reason is that both corruption and financial development evolve relatively slowly. A more important reason has to do with the instrumental variable strategy here. Since both legal origin and settler mortality are part of a country’s history, they are essentially fixed in the modern times. This dictates the focus on cross-country comparisons.

Third, because the settler mortality (of the European colonizers), by definition, is only available for countries that once were colonized by Europeans, the sample of countries that can take advantage of this instrument is limited (up to 70 countries, and is even less when missing values of other variables in a regression further shrink the sample size). This limitation on the sample size also implies that only a relatively parsimonious list of determinants of the composition of foreign liabilities can be examined.

While both the second and third features illustrate the limitations of the IV approach, it is worth bearing in mind that the gains associated with the IV approach are also considerable. Most importantly, the history-based IVs can be said to be truly exogenous to modern-day levels of corruption and financial development.

Table 10.7 presents a series of regressions of the determinants of the shares of FDI, portfolio inflows, and foreign borrowing in total foreign liabilities. For each dependent variable, the table reports both an OLS regression and an IV regression. Because the OLS regressions suffer from the attenuation bias due to measurement errors and potential reverse causality due to endogeneity

| Table 10.7 Two-stage least squares estimation: determinants of the composition of capital inflows |
|-----------------------------------|--------|--------|--------|--------|
|                                   | FDI/total foreign liability | Portfolio/total foreign liability | Loans/total foreign liability |
|                                   | (1) OLS | (2) IV | (3) OLS | (4) IV | (5) OLS | (6) IV |
| **Institutional Quality**         | –0.11  | 7.10** | 0.15*  | 1.85   | –0.04  | –8.94** |
|                                  | (0.11) | (1.71) | (0.08) | (1.58) | (0.13) | (2.17) |
| **Financial Development**         | –0.15* | –5.22**| 0.04   | –1.15  | 0.10   | 6.37** |
|                                  | (0.09) | (1.19) | (0.06) | (1.10) | (0.11) | (1.51) |
| **Resource Exporter**            | –0.25  | 1.94   | –0.10  | –0.11  | 0.35   | –1.83 |
|                                  | (0.38) | (1.22) | (0.26) | (1.13) | (0.46) | (1.55) |
| **Trade Openness**               | 0.05   | 1.58** | –0.16**| 0.21   | 0.11   | –1.79**|
|                                  | (0.11) | (0.41) | (0.08) | (0.38) | (0.14) | (0.52) |
| **N**                            | 70     | 21     | 70     | 21     | 70     | 21     |
| **R²**                           | 0.14   | 0.57   | 0.17   | 0.14   | 0.04   | 0.55   |

Source: author.

Notes: IV = instrumental variable; OLS = ordinary least squares. The IVs are all regressors in Table 10.5, except that the legal origins are excluded from the set of IVs for institutional quality. Standard errors in parentheses.

* and ** denote significance at 10% and 5% confidence levels, respectively.

a Indicates that all coefficients and standard errors are multiplied by 100.
Not all financial integration is created equal

of the institutions and financial development, the chapter goes straight to the IV results. The specification follows the convention in Acemoglu and Johnson (2005), and imposes the constraint that the legal origins do not directly enter the determination of institutional quality. Individually, both institutional quality and financial development are significant [column (2)]: countries with better institutions tend to receive relatively more FDI [consistent with results shown in Hines (1995) and Wei (2000a)].

Interestingly, more financial development is associated with less inward FDI. This pattern was first reported in Wei (2000b, 2001) but with a different sample and without the use of historical instrumental variables. Wei (2001) explained this as a possible substitution effect. For a given amount of capital inflows, if corruption discourages FDI (and other equity-like investment), then it may indirectly encourage bank loans to take their place. Thus, a higher level of corruption could tilt the composition of a country’s capital inflows away from FDI and toward foreign bank loans. The current result shows that the early result (in Wei 2001) was not an idiosyncratic consequence of a special sample and survives an endogeneity correction. However, more financial development leads to more foreign loans once corruption is accounted for. This further corroborates the possibility that FDI and loans are substitutes.

Nonetheless, the negative coefficient of financial development may appear unintuitive, and deserves more discussion. Indeed, this may underlie why Hausmann and Fernandez-Arias (2000) and Albuquerque (2003) reported the seemingly contradictory results from the earlier work of Wei. In fact, the negative sign on financial development makes sense. Using different models, both Caballero, Farhi, and Gourinchas (2008) and Ju and Wei (2007) showed that FDI may go to countries with both low capital–labor ratios and low financial efficiency. The intuition for the Ju–Wei model is that a low capital–labor ratio implies that the return to physical capital is high, hence attracting foreign (and domestic) investment. However, low financial efficiency implies that domestic households find it difficult to reap the benefits of high domestic marginal returns to physical capital through the domestic financial system, and so are eager to send the money abroad. This raises the return to FDIs that do not rely on the domestic financial system. Hence, a low level of financial development and high volume of FDI can go hand in hand. FDI effectively works as a substitute for a domestic financial system. Conversely, higher levels of financial development, other things being equal, would translate into relatively less FDI. Since the return to physical capital determines total capital inflows, financial development may affect the attractiveness of FDI compared to other forms of capital inflows.

Column (4) of Table 10.7 reports a similar regression for portfolio inflows as a share of total foreign liabilities. Somewhat disappointingly, neither institutional quality nor financial development has a significant coefficient. In the last column, both institutional quality and financial development matter, but the signs are opposite from those in the FDI regression. In particular, better institutions are associated with less reliance on foreign loans, but better domestic financial
development is associated with more foreign loans. This pattern is again consistent with the model in Ju and Wei (2007).

The results so far can be summarized in the following way: institutional quality affects the composition of a country’s capital inflows significantly. As FDI is strongly discouraged by poor institutions, foreign loans are encouraged to take its place. To the extent that a higher loans/FDI ratio increases a country’s vulnerability to a currency and balance-of-payments crisis, corruption alters a country’s composition of capital inflows in an unfavorable direction.

10.3.3 Robustness checks and extensions

The IV regressions reported previously take the estimates in the first stage (in Table 10.6) very literally, and impose the constraint that the legal origins do not enter the determination of institutional quality. This constraint is now relaxed, and institutional quality and financial development are included by a common set of instruments (all regressors in Table 10.6). The two-stage least squares (2SLS) estimation results are reported in Table 10.8 (in the three columns labeled as IVs). For comparison, the OLS regressions are also performed, for which the sample is restricted to be the same as the IV regressions. While the coefficients fluctuate a bit, the results are qualitatively the same as with the previous IV regressions.

Some authors have suggested that the effect of institutional quality on the degree of risk sharing may be non-linear, depending on an economy’s degree

<table>
<thead>
<tr>
<th>Table 10.8 Two-stage least squares estimation: determinants of the composition of capital inflows, with a common set of instrumental variables (IVs) for institutions and financial development</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Institutional Quality</td>
</tr>
<tr>
<td>Financial Development</td>
</tr>
<tr>
<td>Resource Exportera</td>
</tr>
<tr>
<td>Trade Opennessa</td>
</tr>
<tr>
<td>N</td>
</tr>
<tr>
<td>R²</td>
</tr>
</tbody>
</table>

Source: author.

Notes: OLS = ordinary least squares. The IVs are all regressors in Table 10.5, except that the legal origins are excluded from the set of IVs for institutional quality. Standard errors in parentheses.

* and ** denote significance at 10% and 5% confidence levels, respectively.
a Indicates that all coefficients and standard errors are multiplied by 100.
Not all financial integration is created equal (Fratzcher and Imbs 2007). In particular, poor institutions may be especially pernicious in a closed economy, but the effect is less significant once the economy is open to international trade. By similar logic, the effect of institutional quality (and, potentially, financial development) on the composition of capital flows may also be non-linear, depending on the country’s degree of trade openness. To investigate this, the regression specification is augmented by adding an interaction term between openness and institutional quality, and another interaction term between openness and financial development. The results are reported in Table 10.9. The interaction between trade openness and institutional quality is statistically significant in none of the regressions. In comparison, the interaction between openness and financial development is significant in the OLS regression for FDI/GDP. In particular, the negative effect of financial development on inward FDI becomes smaller in more open economies. However, this effect does not survive in the IV regression.

The exercise reported in this chapter has limitations. The use of the history-based instruments severely restricts the sample size, which reduces the set of control variables that could be included. This makes it infeasible to check whether and how bad institutions may affect the composition of capital inflows indirectly.

Table 10.9 Interacting trade openness with institutions and financial development
(instrumental variable regressions)

<table>
<thead>
<tr>
<th></th>
<th>(1) OLS</th>
<th>(2) IV</th>
<th>(3) OLS</th>
<th>(4) IV</th>
<th>(5) OLS</th>
<th>(6) IV</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Institutional Quality</strong></td>
<td>−0.03</td>
<td>8.35**</td>
<td>0.23</td>
<td>4.67</td>
<td>−0.20</td>
<td>13.02**</td>
</tr>
<tr>
<td></td>
<td>(0.22)</td>
<td>(3.58)</td>
<td>(0.16)</td>
<td>(3.23)</td>
<td>(0.27)</td>
<td>(4.59)</td>
</tr>
<tr>
<td><strong>Financial Development</strong></td>
<td>−0.37**</td>
<td>−6.52**</td>
<td>−0.02</td>
<td>−2.62</td>
<td>0.40**</td>
<td>9.14**</td>
</tr>
<tr>
<td></td>
<td>(0.14)</td>
<td>(2.13)</td>
<td>(0.10)</td>
<td>(1.92)</td>
<td>(0.18)</td>
<td>(2.73)</td>
</tr>
<tr>
<td><strong>ResourceExporter</strong>a</td>
<td>−0.22</td>
<td>2.59*</td>
<td>−0.11</td>
<td>0.47</td>
<td>0.33</td>
<td>−3.07</td>
</tr>
<tr>
<td></td>
<td>(0.37)</td>
<td>(1.46)</td>
<td>(0.26)</td>
<td>(1.32)</td>
<td>(0.45)</td>
<td>(1.88)</td>
</tr>
<tr>
<td><strong>Trade Openness</strong>a</td>
<td>−0.44*</td>
<td>2.57</td>
<td>−0.23</td>
<td>0.95</td>
<td>0.66**</td>
<td>−3.52*</td>
</tr>
<tr>
<td></td>
<td>(0.25)</td>
<td>(1.47)</td>
<td>(0.18)</td>
<td>(1.33)</td>
<td>(0.31)</td>
<td>(1.89)</td>
</tr>
<tr>
<td><strong>Institutional Quality</strong></td>
<td>0.00</td>
<td>1.66</td>
<td>−0.07</td>
<td>−1.24</td>
<td>0.07</td>
<td>−0.42</td>
</tr>
<tr>
<td></td>
<td>(0.20)</td>
<td>(2.33)</td>
<td>(0.15)</td>
<td>(2.10)</td>
<td>(0.25)</td>
<td>(2.98)</td>
</tr>
<tr>
<td><strong>Financial Development</strong></td>
<td>0.16*</td>
<td>−0.62</td>
<td>0.05</td>
<td>0.29</td>
<td>−0.20</td>
<td>0.33</td>
</tr>
<tr>
<td></td>
<td>(0.09)</td>
<td>(1.00)</td>
<td>(0.06)</td>
<td>(0.90)</td>
<td>(0.11)</td>
<td>(1.28)</td>
</tr>
<tr>
<td><strong>Trade Openness</strong>a</td>
<td>0.20</td>
<td>0.59</td>
<td>0.18</td>
<td>0.21</td>
<td>0.11</td>
<td>0.56</td>
</tr>
<tr>
<td></td>
<td>70</td>
<td>21</td>
<td>70</td>
<td>21</td>
<td>70</td>
<td>21</td>
</tr>
<tr>
<td>R²</td>
<td>0.20</td>
<td>0.59</td>
<td>0.18</td>
<td>0.21</td>
<td>0.11</td>
<td>0.56</td>
</tr>
</tbody>
</table>

Source: author.

Notes: IV = instrumental variable; OLS = ordinary least squares. The IVs are all regressors in Table 10.5, except that the legal origins are excluded from the set of IVs for institutional quality. Standard errors in parentheses.

* and ** denote significance at 10% and 5% confidence levels, respectively.

a Indicates that all coefficients and standard errors are multiplied by 100.
through some of these variables. Usefully, future work could tackle this problem in some creative way.

10.4 Conclusion

Not all types of capital flows are created equal. Non-FDI financial capital, especially international bank lending, appears to be more volatile than FDI. During the 2008–9 global financial crisis, the financial firms in countries with a greater reliance on non-FDI types of capital flows also faced a more severe liquidity crunch. Therefore, a country’s precrisis composition of capital flows affects the transmission of a crisis to the country.

While the threshold and composition effects are related, the two effects do not have to be identical. Nonetheless, recent evidence suggests that better institutional quality in a capital-importing country may lead to a more favorable composition of capital inflows for that country. The earlier literature did not disentangle possibly different effects of financial development and quality of bureaucratic institutions. Indeed, by not separating institutions by financial development and quality of bureaucracy, the earlier literature reported mixed evidence on the relationship between quality of institutions and the composition of capital inflows. This chapter furnishes evidence that these two institutional qualities can indeed have different effects on the structure of capital inflows. In particular, bad public institutions (reflected in e.g. a higher level of bureaucratic corruption) strongly discourage FDI in the shares of a country’s total foreign liabilities, but appear to encourage the relative prominence of borrowing from foreign banks. In comparison, low financial sector development discourages inward portfolio equity flows but encourages inward FDI. Therefore, views on the connection between domestic institutions and the structure of international capital flows have to be nuanced.

To gain confidence that the documented data patterns reflect causal relations, the chapter employs instrumental variables for the institutional measures based on the sample countries’ economic histories (in particular, the mortality rate of earlier European settlers and the origin of legal systems). The instrumental variable approach bolsters the case that bad institutions are a cause of unfavorable composition of capital inflows.

Note

1 SIC = standard industrial classification codes.

References


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Not all financial integration is created equal

11 What happened to the East Asian business cycle?

Jean Imbs

The onset of the subprime crisis has triggered what has been labeled the first global recession in decades. According to virtually any definition, most countries entered recession between the third quarter of 2008 (2008Q3) and 2009Q2. World trade has collapsed, though whether it happened as a cause or a consequence of the crisis is an open question. Far from dampening the effect on consumption of business cycle fluctuations, international financial linkages are often accused of having accelerated the international diffusion of the shock. International capital is being withdrawn as financial intermediaries deleverage their balance sheets, which is often argued to have worsened the consequences of the crisis, especially in the developing world.

This chapter examines these claims rigorously with a focus on East Asia. The cross-sectional distribution of bilateral cycle correlations for East Asian economies is computed using data available at the time of writing. The time change in distributions estimates is considered, with focus on subperiods of interest for East Asia. Changes in the distribution around 1997Q2 capture the impact of the Asian crisis on cycle correlations. They are contrasted with changes during the late 2000s.

The chapter also investigates the specificities of the East Asian business cycle by comparing the time properties of international cycle correlations in the region with what happened in two alternative samples. Comparisons are first drawn with a sample of 33 developed economies for which recent data are available, and second with a small sample of Latin American countries. Correlations are estimated over the same subperiods as those considered for East Asia. By definition, the Asian crisis of 1997 presumably had special consequences in East Asia. Whether the same can be said of the 2008 global financial crisis is an open question. It is also one that potentially informs the mechanics of the international diffusion of the ongoing shock.

The chapter proposes to examine the joint dynamics of bilateral cycle correlations in various geographic samples and the observed changes in goods trade and financial linkages. Importantly, no causal inferences are drawn, because both trade and financial linkages have undoubtedly responded to the onset of the crisis. And time-varying instruments for goods and asset trade are simply not available. The approach is therefore akin to an analysis of variance. The dynamics
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The results are as follows. There is overwhelming evidence that East Asian, Latin American, and world cycles have all become more synchronized since the 1980s. However, the bulk of the increase in East Asia corresponds to the 1997 Asian crisis. Cross-sections that exclude dates after 1997Q2 do not display a significant shift relative to the early 1990s. In contrast, the rest of the world or Latin America do not become more correlated in the late 1990s. In fact, the most significant shift in world business cycles corresponds to the inclusion of the global crisis, from 2008Q3. This brings the focus onto a specificity of East Asia. While 2008Q3 sees a sizeable upward shift in business cycle correlations in the developed world, such is not the case for East Asia. First, the shock is smaller in relative magnitude, as cycles were already highly correlated prior to the 2000s. Second, and perhaps most interestingly, the shock from the global crisis appears to have had differentiated effects on East Asian economies. The cross-sectional distribution of business cycles in East Asia has shifted upward with the inclusion of the post 2008Q3 period, but only partly. In the most recent period, the distribution has become bimodal, with one mode at high correlation levels (above 0.75), and another insignificantly different from zero. In other words, some East Asian business cycles are left relatively unaffected by the global crisis shock.

The last section seeks to account for this heterogeneous response. Two conventional determinants of business cycle correlations are considered that are of particular relevance in the current discussion. The intensity of bilateral trade and a measure of mutual openness to financial flows are computed. Both are time-varying measures and their patterns over time are related to the changes in the cross-sectional distribution of cycle synchronization. The results confirm the specificity of East Asia as compared with the rest of the world. In the 2000s, but prior to the global crisis, the determinants of business cycle correlations are entirely conventional, both in East Asia and in the rest of the world. Countries that engage in goods and financial trade tend to be more correlated in cross-section. With the onset of the global crisis, however, a striking difference arises. In East Asia, the determinants of cycle correlations remain largely unchanged. But in the rest of the world, financial trade falls and the correlation between financial trade and cycle correlation becomes negative. In this cross-section, countries with lower financial openness tend to be more correlated.

The results are diametrically opposed in East Asia and in the developed world when it comes to accounting for the change in business cycle correlations around the global crisis. In East Asia, a fall in goods trade seems to be significantly associated with the (heterogeneous) increase in bilateral correlations. In developed countries, it is mostly a fall in financial openness that correlates with cycle synchronization. These correlations should not be interpreted causally, for both kinds of trade are eminently endogenous to the cycle and cannot be instrumented in this panel framework. That said, the results suggest a fundamentally different
margin of adjustment in East Asia in response to an exogenous shock. Perhaps because the region is less financially integrated to start with, a global recession translates mostly into a fall in goods trade. In the rest of the world, the global recession is associated with falling asset trade, perhaps because the role for multinational banks is more advanced there and deleveraging is more prevalent. Thus, East Asian economies that have relatively less pronounced trade linkages with the developed world, such as Indonesia, the Philippines, or Viet Nam, have remained relatively insulated from the real effects of the crisis.

The rest of the chapter is structured as follows: Section 11.1 discusses the measurement of the variables of interest (i.e. the cross-section of cycle correlation, bilateral trade, and openness to capital flows). The section also describes the data used in computing all variables. Section 11.2 presents the time pattern in bilateral cycle correlations for East Asian economies and the rest of the world, Section 11.3 investigates the trade and financial determinants in a panel framework, and Section 11.4 provides a conclusion.

11.1 Measurement strategy

First, the the procedure used to track the distribution of cycle correlations over time is described, and the data constraints, given the need to have observations around the time of the global crisis. Next is a description of how measures of bilateral trade intensity and financial openness are computed. Both approaches have become quite standard in the literature.

11.1.1 The distribution of bilateral correlations

The current chapter takes inspiration from the seminal approach in Frankel and Rose (1998), followed by a vast literature interested in the determinants of the international synchronization of business cycles. The analysis considers windows of arbitrary lengths over which the lower triangular matrix of the Pearson correlation coefficients between all pairs of countries in a given sample is computed. The window is rolled forward in time, the computations repeated, and the cross-sectional matrix saved. The result is a panel formed by repeated cross-sections of cycle synchronization. The approach entails several choices of a relatively arbitrary nature, which are discussed in the following paragraphs.

First and foremost, the length of each window determines the significance of the coefficients that form each cross-section. It is well known that, for a conventional Pearson correlation coefficient $\rho$ computed on $N$ observations,

$$t = \frac{\rho}{\sqrt{(1 - \rho^2)(N - 2)}},$$

approximately follows a $t$-distribution with $N - 2$ degrees of freedom. This provides a convenient rule of thumb when assessing the significance of bilateral correlation coefficients. In most of the quarterly data used here, correlation
coefficients are computed on a minimum of 25 quarters. For results based on quarterly data, therefore, correlations above 0.34 are significant at the 10% confidence level. Some results are also presented using yearly data, for which 15 years are used, and coefficients above 0.45 can be considered significant at the 10% confidence level.

The window length is dictated by data availability. The longest available series on quarterly real gross domestic product (GDP) for East Asia is released by the World Economic Outlook. At the time of writing, data are available from 1984Q1 until 2009Q2. For East Asia, however, no data are available prior to 1991Q1. The window length is also conditioned by the subperiods that are relevant for economic reasons. In Asia, the date 1997Q2 is pivotal, and correlations must be computed before and after it. For simplicity and convenience, this analysis focuses on up to three 25-quarter subperiods: 1991Q1–1997Q2 (precrisis), 1997Q3–2003Q2 (Asian crisis), and 2003Q3–2009Q2 (global crisis). The sample of economies covered is not identical in all periods.

For each available cross-section of countries, results that pertain to the three subperiods under consideration are presented. For example, the distribution of bilateral correlations is computed for 11 countries in the Asian crisis and global crisis subperiods (because this cross-section is available from 1999Q1). By the same token, the distribution for ten countries is estimated in the pre-, Asian, and global crisis subperiods, bearing in mind the first subperiod’s distribution is only computed for 1995Q1–1997Q2. This ensures robustness in terms of the representativity of the cross-section of economies, and gives rise to four sets of figures, corresponding to the distributions between 7, 9, 10, and 11 East Asian economies. Indeed, for the earliest period, only seven economies are available: the People’s Republic of China (PRC); Hong Kong, China; Japan; Malaysia; the Philippines; Singapore; and Taipei, China. Indonesia and Thailand have data from 1993Q1, and the Republic of Korea from 1995Q1. The most complete economy coverage is available from 1999Q1, with the addition of Viet Nam.

The same exercise is performed on a sample of 33 developed countries. There, data from the World Economic Outlook are available from 1984Q1, and make it possible to estimate the distribution of cross-correlations for four periods of 25 quarters: 1984Q1–1990Q2, 1991Q1–1997Q2, 1997Q3–2003Q2, and 2003Q3–2009Q2. [The sample is a heterogeneous set of countries, including not only advanced economies such as the United Kingdom and the United States (US), but also transition economies, such as the Czech Republic, Slovakia, and Slovenia.] Comparison with the Association of Southeast Asian Nations (ASEAN) sample is focused on the last three subperiods. Nine economies are available from 1984Q1, 17 from 1988Q1, 27 from 1995Q1, and all 33 from 1998Q1. Analogously, this gives rise to four sets of figures.

For the sake of comparison, a Latin American sample of seven developing economies is also considered: Argentina, Chile, Colombia, the Dominican Republic, Mexico, Peru, and Venezuela. Data are available for all seven starting in 1997Q1.
Data from the World Economic Outlook are measured both in local currency and in US dollars. The results correspond to local currency GDP numbers, but the same conclusions are obtained with US dollar data. By the same token, the correlation coefficients are computed between GDP (logarithm) fourth differences, simply because growth rates are the most widely used numbers in reference to the onset of or the exit from a recession. Taking fourth differences also accounts for the fact that the data are not seasonally adjusted, to maximize coverage. An alternative is to detrend GDP using a conventional filter to isolate its business cycle component. The body of the chapter consists of results based on GDP growth rates, but similar conclusions are obtained when the filter introduced by Baxter and King (1999) is implemented on the data instead.

11.1.2 Trade and financial linkages

The analysis relates the cross-section of cycle correlations with two of its conventional determinants. Frankel and Rose (1998) forcefully established the relevance of trade intensity as a driver of the international business cycle. Cycles between trade partners are significantly more correlated, so much so that the estimated elasticity is in fact hard to reproduce in a general equilibrium model of the business cycle. This was labeled a “trade-comovement” puzzle by Kose and Yi (2006). The conventional approach implements data from the Direction of Trade data issued by the International Monetary Fund (IMF) to compute

\[ T_{i,j}^1 = \frac{X_{i,j} + X_{j,i}}{Y_i + Y_j}, \]

where \( X_{ij} \) denotes total merchandise exports from country \( i \) to \( j \) and \( Y_i \) denotes nominal GDP in country \( i \). Trade intensity is typically measured at the beginning of the period to assuage endogeneity concerns, and the same will be true here. Even so, external instruments are typically indispensable because trade patterns are persistent over time. Instruments for trade are based on gravity arguments, and include variables such as geographic proximity and the presence of a common border, a common colonial history, common languages, or shared access to an open body of water. Most of these instruments are constant over time, and thus cannot be used in this analysis, where the time dimension is of the essence. This conditions the interpretation of the results, which should not be taken in a causal sense, but rather in a purely descriptive one. The analysis seeks to evaluate whether the time pattern of international correlations correlates with changes in trade intensity, bearing in mind that the shock from the global crisis may have conjointly increased cycle correlations and decreased world trade.

The measure \( T_{i,j}^1 \) focuses on trade intensity relative to output. If, however, both output and trade fall simultaneously because of an exogenous shock, \( T_{i,j}^1 \) will show no response, as the measure captures only the scale of trade. But the allocation of trade across destinations may also have altered in response to the recent shock.
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$T_{i,j}^1$ will not capture such a reallocation effect. Therefore, an alternative measure that focuses on the allocation of trade across trade partners is defined as

$$T_{i,j}^2 = \frac{X_{i,j} + X_{j,i}}{X_i + X_j},$$

where $X_i$ denotes total exports from country $i$. $T_{i,j}^2$ will respond to changes in the allocation of goods trade between partners, rather than to a disproportionate change in trade relative to production.

A channel of shock diffusion that is especially relevant in the current context pertains to financial linkages. Unfortunately, bilateral data on financial flows do not yet cover the global crisis. When this chapter was written, data available from the Coordinated Portfolio Investment Survey (CPIS) supervised by the IMF and released on a yearly basis stopped in 2007. And the locational banking statistics of the Bank of International Settlements (BIS) are only available bilaterally for a reduced cross-section of lending economies, limited to countries of the Organisation for Economic Co-operation and Development (OECD). Therefore, an imperfect proxy is constructed for bilateral financial openness. Conventional measures of bank lending are considered, taking inspiration from Lane and Milesi-Ferretti (2001, 2007, 2008). The share of external lending by banks relative to the size of the lending economy is constructed. The data are available from the BIS’ locational banking statistics for all countries in both samples, at least until 2008Q4.

The locational banking statistics gather quarterly data on international financial claims and liabilities of bank offices in the reporting countries. Both domestically owned and foreign-owned banking offices in the reporting countries record their positions on a gross (unconsolidated) basis, including those vis-à-vis their own affiliates in other countries. This is consistent with the residency principle of national accounts, balance-of-payments, and external debt statistics. The variable brings the focus on the role of banks’ international linkages for the diffusion of the 2008 crisis. An “entrenchment” argument is often heard to account for the global nature of the 2008 crisis, and financial intermediaries are often accused of “deleveraging,” thus contributing to the international diffusion of an originally US-based shock. BIS data are therefore directly relevant to the question at hand. Data on capital accounts from the IMF’s International Financial Statistics imply similar conclusions.

The BIS data used here are not bilateral. This is a serious shortcoming, especially relative to information on goods trade. Thus, an approximating shortcut is proposed, and a bilateralized version of the BIS data is computed, given by

$$\Phi_{i,j} = \frac{A_i + L_i}{Y_i} + \frac{A_j + L_j}{Y_j},$$

where $A_i$ and $L_i$ are measures of banks’ claims and liabilities in country $i$. The contention implicit in the interpretation of $\Phi_{i,j}$ as a measure of bilateral financial linkage is that when both countries are open to capital flows, they will tend to be open to each other.
The analysis considers an instrumentation of $\Phi_{i,j}$ based on the corresponding variable implied by the CPIS data, computing

$$CPIS_{i,j} = \frac{A_{ij} + L_{ij}}{A_i + L_i + A_j + L_j},$$

where $A_{ij}$ and $L_{ij}$ denote bilateral asset holdings between countries $i$ and $j$ in 2007, $A_i = \sum_j A_{ij}$ and $L_i = \sum_j L_{ij}$. The variable is only available before 2007, and therefore can not inform the changes in business cycle correlations around the global crisis date. But it can serve several purposes. First, if such instrumentation confirms the cross-sectional results based on $\Phi_{i,j}$, it brings support to the assumption that financially open countries are open to each other. Then, using multilateral data is not what drives the conclusions. This is particularly important for Asian economies, which are often said to be more open financially to the rest of the world than to each other. Second, CPIS data are persistent. Thus, if the instrumentation is satisfactory before the crisis, but gives different results afterward, it indicates that the global crisis has altered the international allocation of asset holdings in an unprecedented manner.

11.2 What happened to the international business cycle?

This section discusses the patterns observed in the cross-section of bilateral cycle correlations within East Asia, and draws comparisons with what happened in an aggregate of the “rest of the world,” formed by 33 developed countries.

11.2.1 The East Asian business cycle

The first piece of evidence is based on yearly data covering several business cycles. Because the data extend to 1984, they provide 25 years of observations on which to evaluate the time pattern of (yearly) business cycles in East Asia. Unlike quarterly data, yearly GDP numbers are actually available for 15 economies.2 These effectively comprise the most representative cross-section available, as quarterly data are not available at all for four of the economies. To preserve significance, Figure 11.1 reports kernel estimates of the distribution of correlations for the periods 1984–99 and 1994–2009. Thus, each correlation coefficient is estimated on 15 observations. All estimates are based on the Epanechnikov kernel distribution.

As is patent, the cross-sectional distribution of business cycle correlation has shifted upward significantly. Between 1984 and 1999, correlation coefficients are roughly centered around zero, and take extreme values close to $-1$ and 1. The distribution is also virtually symmetric around zero. After 1994, however, the kernel shifts upward sizeably, with a mode around 0.7. Note this is significantly different from zero at the 1% confidence level. The distribution has also become asymmetric, with only positive values. The overall upward shift is significant at any conventional confidence level. It may reflect Asia-specific developments, such
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Source: author.

as the 1997 crisis, or, indeed, perhaps more recent developments resulting from the global crisis. The Asian crisis year effectively belongs to both samples, but represents only two observations in the earlier sample. Its effect may therefore be only muted in the first kernel estimate in the figure.

Figure 11.2 turns to quarterly data, and focuses on the cross-section formed by the seven economies with data from 1991Q1. The three kernel estimates correspond to three 25-quarter periods. The earlier, precrisis, subperiod is characterized by a distribution centered around zero, slightly skewed to the right. The mode is around zero, which suggests a period with only a few extreme economy pairs with large (and positive, in this instance) degrees of synchronization. The second, Asian crisis, subperiod corresponds to a shift upward of the distribution, which becomes heavily skewed to the right with few negative correlations. The mode continues to be barely significant, however, with values between 0.3 and 0.4, just at a significance level given the number of observations. Still, the mass of significantly positive correlations increases sizeably in the crisis subperiod. Interestingly, the global crisis period starting from 2003Q3 is characterized by a bimodal distribution of correlations. A first mode is indistinguishable from zero, but a second one takes high values around 0.8. This suggests a heterogeneous response of cycle correlations in East Asia to the global shock. While some economies seem to suffer the brunt of the crisis, others remain uncorrelated – decoupled, perhaps. While the 1997 crisis seems to have had a more homogeneous effect on East Asia, perhaps by definition, such is not the case for the more recent shock.

This remarkable pattern is not an artefact of a sample focused on seven economies only. Figures 11.3 and 11.4 consider the nine and ten economies with data since 1993 and 1995. The results are similar. The precrisis subperiod is characterized by a distribution centered around zero. Admittedly, this may simply

Source: author.

reflect the shorter time series, because the data start later in both cases. But from this standpoint it is reassuring that the precrisis distribution was already centered around zero in Figure 11.2. The Asian crisis distribution shifts to the right, with a mode around the 10% confidence level for quarterly data (i.e. 0.35). The distribution in the global crisis period continues to be centered around zero, but with a second mode at 0.8.

The apparent heterogeneous effect of the global crisis on East Asian business cycles raises the question of the identity of the economies with increased synchronization and those without much of a response. As a first pass at this question, a multilateral correlation is computed for each economy in the sample, as a simple average of all bilateral correlation coefficients. Two groups clearly emerge from the data. Six economies have average correlations significantly different from zero, ranging from 0.406 to 0.485: Hong Kong, China; Japan; Republic of Korea; Malaysia; Singapore; and Taipei, China. In contrast, four
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Source: author.

economies have average correlations that are indistinguishable from zero, ranging from $-0.073$ to $0.133$ – the PRC, Indonesia, the Philippines, and Thailand. Heuristically, the former group comprises economies that are open to both goods and asset trade, and are slightly richer than the latter group.

Finally, Figure 11.5 presents kernel estimates of the cross-sectional distribution of interest for all 11 East Asian economies with data available since 1999Q1. The analysis is focused on the Asian crisis sample, and purports to identify the shock that created the bimodal distributions apparent in Figures 11.2–11.4. To do so, the kernel continues to be estimated on a window of 25 quarters, but it is rolled forward in time by 1 year exactly. Thus, Figure 11.5 presents seven kernel estimates, corresponding to seven periods of 25 quarters between 1999Q1–2003Q3 and 2005Q1–2009Q2. The onset of the global financial crisis is often dated after 2008Q3. Interestingly, the first five kernel estimates in Figure 11.5
concern periods that end prior to 2008Q3. All of them point to relatively symmetric unimodal distributions, centered around zero. In contrast, the last two kernels in the figure point to bimodal distributions, akin in their shapes to the estimates in Figures 11.2–11.4. The second mode appears as soon as the period post-2008Q3 is included.3

### 11.2.2 Synchronization elsewhere

This section draws comparisons between the dynamics observed in East Asia and in the rest of the world. A sample of 33 developed countries is used to estimate the kernel distribution of bilateral correlations, over the same subperiods as the ones considered in East Asia.4 The data unambiguously confirm that the average

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Source: author.
What happened to the East Asian business cycle?

Figure 11.5 Distribution of correlations, 11 economies (1999–2009, quarterly data, national currencies): (A) 1999Q1–2003Q3; (B) 2000Q1–2004Q3; (C) 2001Q1–2005Q3; (D) 2002Q1–2006Q3; (E) 2003Q1–2007Q3; (F) 2004Q1–2008Q3.

Source: author.
bilateral correlation in the rest of the world has increased significantly since the 1980s. Annual data are available from 1980 for this sample, so that 30 years of data can be split halfway. Figure 11.6 plots kernel densities, corresponding to the periods 1980–94 and 1994–2009. The distribution in the earlier period is centered around zero, and is very slightly skewed to the right. In contrast, the distribution in the more recent period shifts upward, is heavily skewed to the right with most of its mass at correlations above 0.8, and has no negative correlation coefficients. Just as in East Asia, the shift is significant at any conventional confidence level.

For nine developed countries, quarterly data are available from 1984Q1. This coverage makes it possible to estimate distributions for four periods of 25 quarters each. The kernel distributions are reported in Figure 11.7. Correlations
What happened to the East Asian business cycle?

Figure 11.7 Distribution of correlations, 9 developed economies (1984–2009, quarterly data, national currencies): (A) 1984–1990Q2; (B) 1991–1997Q2; (C) 1997Q2–2003Q2; (D) 2003Q3–2009.

Source: author.

are on average zero between 1984Q1 and 1990Q2, with values between $-0.4$ and 0.6. The distribution is slightly skewed to the right, but with most values barely significantly different from zero. The precrisis subperiod, 1991Q1–1997Q2, is rather similar, albeit perhaps slightly shifted to the right. But extremes take larger values, ranging from $-0.7$ to 0.8. Interestingly, the Asian crisis subperiod entails a significant shift upward of the distribution, with a mode that now is significantly greater than zero at around 0.5. These dynamics are similar to what is observed in East Asia in Figures 11.2–11.4. In contrast, the distribution of correlations for the latest period is drastically different. The fourth panel in Figure 11.7 shows a very large shift of the distribution toward high values of the correlation coefficients. The kernel is now bounded between 0.5 and 1, with a mode close to 0.9. All correlations in this panel are significantly different from zero at the 10% confidence level. The shift observed in the 2003Q3–2009 period is remarkable and has no equivalent in any earlier periods. It is also fundamentally different from what is observed
in East Asia, where the global crisis has heterogeneous effects across economies. Here, the effect seems universal, as all economies become more synchronized.

The result is not an artefact of the fact that the sample only covers nine economies. Similar patterns are evident from Figure 11.8 for the 17 economies with data since 1988, and from Figure 11.9 for the 27 economies with data since 1995. In both cases, the latest period is characterized by a large shift of the whole distribution of bilateral correlations. Most correlations are in fact significantly higher in the latest period than they were ever before, at least since the early 1980s. The post-1997 shift upward of the distribution is much less apparent in Figures 11.8 and 11.9 than it is in Figure 11.7. In a large sample of developed economies, there is not much of a shift in bilateral cycle correlations around the 1997 date that is so relevant for East Asia. But there is a much larger, and more universal, shift in correlations after 2003. The heterogeneity observed in East Asia is absent from this larger sample, even though more economies are included.

Figure 11.8 Distribution of correlations, 17 developed countries (1988–2009, quarterly data, national currencies): (A) 1988–1990Q2; (B) 1990–1997Q2; (C) 1997Q3–2003Q2; (D) 2003Q3–2009.

Source: author.
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Finally, 33 countries have quarterly data from 1998Q1. In Figure 11.10, the 25-quarter window is rolled forward 1 year at a time, to identify a hypothetical time period as the culprit for the upward shift documented in Figures 11.7–11.9. As is patent from Figure 11.10, the distribution becomes heavily skewed to the right only when observations after 2008Q3 are included in the sample. This is remarkable, for it really points to a truly global shock, which appears to be unprecedented at least in available quarterly data. It points to the 2008Q3 global crisis as the driver for the shift documented in this section.

Even though the sample of 33 countries includes economies as different as the US and Slovakia, it is focused on developed economies. Such relative homogeneity may explain why the bimodal property prevalent in East Asia is not present here. Figure 11.11 reports distribution estimates that arise from seven Latin American countries with data available from 1997. Two conclusions continue to be apparent: distribution estimates are centered around zero for all time periods.
Figure 11.10 Distribution of correlations, 33 developed economies (1998–2009, national currencies): (A) 1998Q1–2002Q3; (B) 1999Q1–2003Q3; (C) 2000Q1–2004Q3; (D) 2001Q1–2005Q3; (E) 2002Q1–2006Q3; (F) 2003Q1–2007Q3.

Source: author.
What happened to the East Asian business cycle?

Figure 11.10 Distribution of correlations, 33 developed economies (1998–2009, national currencies): (G) 2004Q1–2008Q3; (H) 2005Q1–2009Q3—Cont’d.

excluding the global crisis, and they shift rightward when recent data are included. But they are not bimodal. The comparison suggests that the shock from the global financial crisis has had a heterogeneous effect in East Asia alone. This is in fact a specificity of the region relative to the rest of the world. In the next section, two candidate explanatory variables are proposed to account for this specificity.

11.3 What happened to trade and financial linkages?

This section presents conventional regressions of the determinants of business cycle synchronization, in the tradition pioneered by Frankel and Rose (1998) and Frankel and Romer (1999), and followed subsequently in a vast literature. The focus is on the time changes in the cross-section of bilateral correlations for East Asia and for a measure of the rest of the world. The previous sections have illustrated an intriguing difference between the two samples in terms of how both regions have responded to the global financial shock. This section rigorously examines the determinants of cycle synchronization during the early 2000s (2000Q1–2004Q3) and contrasts them with the most recent period, including the global crisis (2005Q1–2009Q2). Then it asks how both trade and financial linkages contribute to explaining changes in cycle synchronization in both regions.

The focus is squarely on trade in goods and assets, assuming away alternative explanatory variables. Still, the literature has documented other determinants for cycle synchronization. For example, Imbs (2001) argued that the sectoral specialization of trade matters in the presence of sectoral shocks. Baxter and Kouparitsas (2005) considered gravity variables or the composition of trade. Rose (2000) argued that exchange rate arrangements and (particularly) currency unions act to synchronize international business cycles. This section focuses on trade and financial linkages. The foremost reason is that this chapter is concerned with the time pattern in $\rho_{i,j}$ during the 2000s. Such a focus immediately rules out
Figure 11.11 Distribution of correlations, 11 Latin American economies (1997–2009, quarterly data, local currencies): (A) 1997Q1–2001Q3; (B) 1998Q1–2002Q3; (C) 1999Q1–2003Q3; (D) 2000Q1–2004Q3; (E) 2001Q1–2005Q3; (F) 2002Q1–2006Q3.

Source: author.
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Figure 11.11 Distribution of correlations, 11 Latin American economies (1997–2009, quarterly data, local currencies): (G) 2003Q1–2007Q3; (H) 2004Q1–2008Q3; (I) 2005Q1–2009Q3—Cont’d.

correlates that are time invariant or persistent over time. This rules out not only gravity variables, but also the structure of production or of trade, which change over time at low frequencies. By the same token, currency unions or exchange rate regimes have not observably changed in the recent years. Inasmuch as we can observe them, goods and financial trade have altered drastically with the global crisis. They are also at center stage of policy discussions about the international diffusion of a shock originating in the US.

The specification of the estimated regressions takes inspiration from Frankel and Rose (1998), Imbs (2004, 2006), and Papaioannou, Peydro, and Kalemli-Ozcan (2009). The chapter regresses a given cross-section of bilateral correlations, denoted $\rho_{i,j}$, on the corresponding measure of financial openness, $\Phi_{i,j}$, and either measure of trade intensity, $T_{i,j}^1$ or $T_{i,j}^2$. The specification is

$$\rho_{i,j} = \alpha_0 + \alpha_1 \Phi_{i,j} + \alpha_2 T_{i,j} + \varepsilon_{i,j}. \quad (11.1)$$
The chapter focuses on Pearson correlation coefficients $\rho_{i,j}$ for the sake of comparability and intelligibility. The metric captured by $\rho_{i,j}$ has an immediate intuitive interpretation, and has indeed been used in the vast majority of this empirical literature, starting with Backus, Kehoe, and Kydland (1992) and Frankel and Rose (1998). There are exceptions, such as the residual measure used in Alesina and Barro (2002) or the coherence measure computed in the frequency domain proposed by Giannone and Reichlin (2006). For simplicity, however, this analysis uses only the Pearson correlation coefficient.5

The residual, $\varepsilon_{i,j}$, is liable to have a heteroskedastic structure corresponding to a measurement error specific to a given country, $i$. This may contaminate all pairs of which $i$ is a part. This possibility is accounted for via clustering of the residual along the country dimension. The coefficients of interest are $\alpha_1$ and $\alpha_2$ but more as a check against standard results than for causal interpretation. In particular, Frankel and Rose (1998) famously established that $\alpha_2$ is positive and significant for a wide range of country coverages and time periods. Imbs (2004, 2006) showed that $\alpha_1$ is also positive and significant, even when it is instrumented with institutional variables capturing the depth of financial markets.

Table 11.1 reports the results for simple ordinary least squares estimations of equation (11.1) performed on East Asia. Both goods trade and financial openness have the conventional association with cycle correlation. As far as goods trade is concerned, the measure scaled by GDP, $T_1$, appears to account best for the

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<tr>
<td></td>
<td>(4.575)</td>
<td>(4.358)</td>
<td>(3.821)</td>
<td>(0.396)</td>
<td>(0.936)</td>
<td>(0.935)</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.062</td>
<td>0.050</td>
<td>0.228</td>
<td>0.088</td>
<td>0.075</td>
<td>0.075</td>
</tr>
<tr>
<td>$N$</td>
<td>45</td>
<td>45</td>
<td>28</td>
<td>45</td>
<td>45</td>
<td>28</td>
</tr>
</tbody>
</table>

Source: author.

Notes: IV = instrumental variable. The left-hand side is $\rho_{i,j}$ as defined in the text. The correlations are computed over 2000Q1–2004Q3 in specifications (1) and (2), and 2005Q1–2009Q2 in specifications (3) and (4). $T_1$ is the measure of trade intensity scaled by gross domestic product (GDP), and $T_2$ denotes trade intensity normalized by total trade. Trade is measured in 2000Q1 for the early period, and in 2005Q1 for the later one. $\Phi$ is a measure of bilateralized financial openness, measured by reporting banks’ total assets and liabilities relative to the reporting economy’s GDP. The ratios are summed pair-wise to form a bilateral measure. $\Phi$ is measured in 2000Q1 for the early period, and in 2005Q1 for the later one. Estimates of $\alpha_1$ are multiplied by 1,000. Standard errors are clustered by economy. Specifications (3) and (6) instrument $\Phi$ with actual bilateral asset holdings measured in 2007 by the International Monetary Fund’s Coordinated Portfolio Investment Survey.

***, **, and * denote significance at the 1%, 5%, 10% confidence levels, respectively.
cross-sectional dispersion in cycle correlation. Across both periods and all four specifications, $\alpha_2$ is estimated to be positive and significant at least at the 10% confidence level. Interestingly, instrumenting $\Phi_{i,j}$ using the CPIS data reinforces the finding that $\alpha_1$ is positive and significant in East Asia. In addition, the instrumental variable (IV) results are stable across subperiods. These results are perfectly conventional and reminiscent of findings in Frankel and Rose (1998) and Imbs (2006).

Table 11.2 estimates equation (11.1) on the sample formed by 33 developed economies. In the period prior to the global crisis, all results are conventional and indeed similar to East Asia. Estimates of $\alpha_1$ and $\alpha_2$ are positive and significant at least at the 10% confidence level. Both measures of trade intensity appear to have a significant association with $\rho_{i,j}$, and $\Phi_{i,j}$ becomes more significant when instrumented with CPIS bilateral data. Things are very different in the later sample starting in 2005Q1. While goods trade continues to display a positive association, irrespective of how it is measured, the association between cycle synchronization and financial linkages becomes significantly negative, at the 1% confidence level.

Remarkably, instrumenting $\Phi_{i,j}$ with 2007 CPIS data now reverts the sign of $\alpha_1$. This could be happening for two reasons. Either the power of CPIS data in explaining $\Phi$ fell after 2008, or the negative estimates of $\alpha_1$ in specifications (4) and (5) of Table 11.2 were actually driven by the endogenous negative response of $\Phi$ to

### Table 11.2 Period-by-period determinants of cycle synchronization: rest of the world

<table>
<thead>
<tr>
<th>Variable</th>
<th>(1) 2000</th>
<th>(2) 2000</th>
<th>(3) IV 2000</th>
<th>(4) Crisis</th>
<th>(5) Crisis</th>
<th>(6) IV Crisis</th>
</tr>
</thead>
<tbody>
<tr>
<td>$T^1$</td>
<td>5.553***</td>
<td>(0.981)</td>
<td>4.148***</td>
<td>(0.973)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$T^2$</td>
<td>1.607***</td>
<td>(0.399)</td>
<td>1.714***</td>
<td>(0.407)</td>
<td>1.076***</td>
<td>(0.335)</td>
</tr>
<tr>
<td>$\Phi$</td>
<td>0.167*</td>
<td>(0.088)</td>
<td>0.284***</td>
<td>(0.088)</td>
<td>1.216**</td>
<td>(0.498)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-0.218**</td>
<td>(0.088)</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.054</td>
<td>0.065</td>
<td>0.065</td>
<td>0.069</td>
<td>0.070</td>
<td>0.070</td>
</tr>
<tr>
<td>$N$</td>
<td>496</td>
<td>496</td>
<td>435</td>
<td>496</td>
<td>496</td>
<td>435</td>
</tr>
</tbody>
</table>

Source: author.

Notes: IV = instrumental variable. The left-hand side is $\rho_{i,j}$ as defined in the text. The correlations are computed over 2000Q1–2004Q3 in specifications (1) and (2), and over 2005Q1–2009Q2 in specifications (3) and (4). $T^1$ is the measure of trade intensity scaled by gross domestic product (GDP), and $T^2$ denotes trade intensity normalized by total trade. Trade is measured in 2000Q1 for the early period, and in 2005Q1 for the later one. $\Phi$ is a measure of bilateralized financial openness, measured by reporting banks’ total assets and liabilities relative to the reporting economy’s GDP. The ratios are summed pair-wise to form a bilateral measure. $\Phi$ is measured in 2000Q1 for the early period, and in 2005Q1 for the later one. Estimates of $\alpha_1$ are multiplied by 100. Standard errors are clustered by economy. Specifications (3) and (6) instrument $\Phi$ with actual bilateral asset holdings measured in 2007 by the International Monetary Fund’s Coordinated Portfolio Investment Survey.

***, **, and * denote significance at the 1%, 5%, 10% confidence levels, respectively.
the crisis. The answer rests ultimately on the explanatory power of CPIS data after 2008. The (unreported) first-stage $R^2$ in specification (3) of Table 11.2 is 0.152. It falls to 0.093 in specification (6). This suggests CPIS data become inadequate to explain international capital holdings after 2008. The shock fundamentally altered the pattern of $\Phi_{i,j}$.

Some caution is therefore in order when it comes to interpreting this result. There is nothing causal in this correlation. Given the descriptive evidence presented earlier in this chapter, negative estimates of $\alpha_1$ in specifications (4) and (5) of Table 11.2 presumably reflect the fact that $\rho_{i,j}$ increased in the more recent period, and financial openness conjointly fell as financial intermediaries “deleveraged.” Both phenomena likely happened in response to the same (omitted) shock. The interpretation is drastically different from the similar result presented in Papaioannou, Peydro, and Kalemi-Ozcan (2009), for at least two reasons. First, the similarly negative coefficient they estimated arises from a fixed effect estimation (i.e. one that focuses on the change in synchronization, not unlike what is presented in Table 11.3 here). Second and more important, they propose to instrument changes in financial integration using measures of regulatory change in the banking sector. Their intention is therefore to interpret estimates of $\alpha_1$ causally. Unfortunately, the instruments they use are simply not available for the type of economy coverage endeavored in this chapter.

Be that as it may, Tables 11.1 and 11.2 point to a specificity in East Asia, where the determinants of cycle correlations continue to be conventional even in the global crisis. The same is not true in the rest of the world. Table 11.3 estimates a first-differenced version of equation (11.1), where differences are measured between the two periods considered in this section. The results crystallize the

<table>
<thead>
<tr>
<th>Variable</th>
<th>(1) East Asia</th>
<th>(2) East Asia</th>
<th>(3) Developed</th>
<th>(4) Developed</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\Delta T^1$</td>
<td>$-2.835^{***}$</td>
<td>$-1.365$</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.817)</td>
<td>(3.717)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\Delta T^2$</td>
<td></td>
<td>$-1.607^{**}$</td>
<td>$-0.964$</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.385)</td>
<td>(1.121)</td>
<td></td>
</tr>
<tr>
<td>$\Delta \Phi$</td>
<td>$4.234^{***}$</td>
<td>$3.236^{**}$</td>
<td>$-0.623^{***}$</td>
<td>$-0.628^{***}$</td>
</tr>
<tr>
<td></td>
<td>(1.316)</td>
<td>(1.301)</td>
<td>(0.163)</td>
<td>(0.163)</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.174</td>
<td>0.209</td>
<td>0.037</td>
<td>0.037</td>
</tr>
<tr>
<td>N</td>
<td>45</td>
<td>45</td>
<td>496</td>
<td>496</td>
</tr>
</tbody>
</table>

Source: author.

Notes: The left-hand side is the change in $\rho_{i,j}$ over the two periods 2000Q1–2004Q3 and 2005Q1–2009Q2. $T^1$ is the measure of trade intensity scaled by gross domestic product (GDP), and $T^2$ denotes trade intensity normalized by total trade. The change is measured between 2000Q1 and 2005Q1. $\Phi$ is a measure of bilateralized financial openness, measured by reporting banks’ total assets and liabilities relative to the reporting economy’s GDP. The ratios are summed pair-wise to form a bilateral measure. The change in $\Phi$ is measured between 2000Q1 and 2005Q1. Estimates of $\alpha_1$ are multiplied by 100. Standard errors are clustered by economy.

$^{***}$, $^{**}$, and $^*$ denote significance at the 1%, 5%, 10% confidence levels, respectively.
specifity of East Asia. In the developed world at large, the change in business cycle correlations (which is an overwhelming increase) is associated with a fall in financial linkages, but no observable response of goods trade. In East Asia, in contrast, goods trade falls. Financial integration, in contrast, tends to correlate positively with cycle correlations. The results point to the possibility that financial integration was actually not stopped by the global crisis in East Asia, at least not to the same extent as it was elsewhere. In East Asia, it is goods trade that fell as the crisis hit. Such a specificity may reflect the fact that East Asia is relatively less financially integrated than is the world, perhaps because its banks are less invested internationally. As a result, the response of financial linkages in East Asia remains muted.

Finally, Table 11.4 confirms these findings in a data set that pools both samples and uses interacted binary variables to capture the differential importance of \( T \) and \( \Phi \) across subsamples. This sets to rest the possibility that some results draw from different sample sizes in Tables 11.1, 11.2, and 11.3. The following estimation is performed:

\[
\rho_{i,j} = \alpha_0 + \alpha_1 \Phi_{i,j} + \alpha_2 \Phi_{i,j} \cdot EA + \alpha_3 T_{i,j} + \alpha_4 T_{i,j} \cdot EA + \epsilon_{i,j},
\]

(11.2)

Table 11.4 Pooled data

<table>
<thead>
<tr>
<th>Variable</th>
<th>(1) 2000</th>
<th>(2) 2000</th>
<th>(3) Crisis</th>
<th>(4) Crisis</th>
<th>(5) Panel</th>
<th>(6) Panel</th>
</tr>
</thead>
<tbody>
<tr>
<td>( T^1 )</td>
<td>5.657***</td>
<td>4.705***</td>
<td>7.568*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.006)</td>
<td>(1.067)</td>
<td>(4.595)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( T^1 \cdot EA )</td>
<td>-4.006***</td>
<td>-3.928</td>
<td>-8.585*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.068)</td>
<td>(3.021)</td>
<td>(4.994)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( T^2 )</td>
<td>1.661***</td>
<td>1.360***</td>
<td>7.592**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.402)</td>
<td>(0.397)</td>
<td>(2.401)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( T^2 \cdot EA )</td>
<td>-1.816***</td>
<td>-3.195***</td>
<td>-8.633**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.456)</td>
<td>(0.530)</td>
<td>(2.549)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \Phi )</td>
<td>2.145**</td>
<td>3.211***</td>
<td>-1.117</td>
<td>-0.095</td>
<td>-2.575***</td>
<td>-2.538***</td>
</tr>
<tr>
<td></td>
<td>(0.915)</td>
<td>(0.912)</td>
<td>(1.184)</td>
<td>(0.106)</td>
<td>(0.159)</td>
<td>(0.156)</td>
</tr>
<tr>
<td>( \Phi \cdot EA )</td>
<td>-1.338</td>
<td>2.161</td>
<td>-11.406***</td>
<td>-1.853</td>
<td>4.186***</td>
<td>3.485**</td>
</tr>
<tr>
<td></td>
<td>(3.924)</td>
<td>(3.580)</td>
<td>(3.443)</td>
<td>(5.238)</td>
<td>(1.618)</td>
<td>(1.477)</td>
</tr>
<tr>
<td>( R^2 )</td>
<td>0.053</td>
<td>0.062</td>
<td>0.056</td>
<td>0.112</td>
<td>0.316</td>
<td>0.328</td>
</tr>
<tr>
<td>( N )</td>
<td>541</td>
<td>541</td>
<td>541</td>
<td>541</td>
<td>1,082</td>
<td>1,082</td>
</tr>
</tbody>
</table>

Source: author.

Notes: The left-hand side is the correlation \( \rho_{i,j} \) for the two periods 2000Q1–2004Q3 and 2005Q1–2009Q2. \( T^1 \) is the measure of trade intensity scaled by gross domestic product (GDP), and \( T^2 \) denotes trade intensity normalized by total trade. The change is measured between 2000Q1 and 2005Q1. \( \Phi \) is a measure of bilateralized financial openness, measured by reporting banks’ total assets and liabilities relative to the reporting economy’s GDP. The ratios are summed pair-wise to form a bilateral measure. The change in \( \Phi \) is measured between 2000Q1 and 2005Q1. \( EA \) denotes a binary variable taking value 1 for economy-pairs that belong to East Asia. Estimates of \( \alpha_i \) are multiplied by 100. Standard errors are clustered by economy.

***, **, and * denote significance at the 1%, 5%, 10% confidence levels, respectively.
where $E_A$ takes value 1 for East Asian economy pairs. As is patent from the table, trade and finance correlate more weakly with $\rho_{ij}$ in East Asia, for both cross-sections, in 2000 and in the global crisis period. But the correlations continue to be conventional across all samples. Panel estimations continue to show the case that goods trade fell most in synchronized East Asian economies, whereas financial trade fell among developed economies.

11.4 Conclusion

This chapter presents descriptive evidence of the changes in the patterns of international business cycle correlations in East Asia and draws comparison with the rest of the world. The 1997 crisis had a sizeable effect on bilateral cycle correlations within East Asia, but not in the rest of the developed world. The 2008 crisis, in contrast, has affected East Asia in a differentiated manner. Some pairs of economies have seen their correlations increase observably. Typically these are open and relatively richer economies within East Asia. But others appear to have decoupled so far from the global cycle. Figure 11.12 plots yearly growth rates in East Asia since 2007. Clearly, relatively closed economies maintained higher growth rates throughout the period, while the whole East Asia zone recovered sooner and more sharply than the rest of the world in the early quarters of 2009.

The global financial crisis has had a very different effect on the rest of the developed world, whose cycle correlations have shifted upward in an unprecedented, and quite universal, manner. An explanation is sought for this specificity of East Asia, on the basis of the conventional explanations for

![Figure 11.12](image)

*Figure 11.12* Annual growth rates in East Asia.

Source: author.
international cycle correlations, namely goods and asset trade. In East Asia, goods trade fell markedly as cycles became more synchronized with the 2008 global recession. In stark contrast, in the rest of the world, asset trade fell significantly as countries entered the global recession. This may reflect different adjustment margins in the two regions. In particular, the difference may rest in the fact that banks contributed heavily to the diffusion of the global financial shock in the developed world, but not in East Asia.

Notes

1 One of the attractions of IMF data is that they make it possible to decompose international positions into portfolio, direct investment, or financial derivatives. The importance of the latter in journalistic accounts of developments surrounding the global financial crisis make the International Financial Statistics data an interesting alternative to those released by the BIS. However, the International Financial Statistics report flow data, as opposed to the stocks of assets and liabilities reported for banks in the locational banking statistics used here. Financial linkages are surely best captured by stock data.

2 They are Brunei Darussalam; Cambodia; the PRC; Hong Kong, China; Indonesia; Japan; the Republic of Korea; the Lao People’s Democratic Republic; Malaysia; Myanmar; the Philippines; Singapore; Taipei, China; Thailand; and Viet Nam.

3 These results are similar to findings in Kim and Lee (2008) and Kim, Lee, and Park (2009), who focused on linkages between the East Asian region and the rest of the world. The focus here is within regions, rather than between them.

4 The countries are Australia; Austria; Belgium; Canada; Cyprus; the Czech Republic; Denmark; Finland; France; Germany; Greece; Hong Kong, China; Iceland; Ireland; Israel; Italy; Japan; Republic of Korea; Luxembourg; Malta; the Netherlands; New Zealand; Norway; Portugal; Singapore; Slovakia; Slovenia; Spain; Sweden; Switzerland; Taipei, China; the United Kingdom; and the US.

5 Forbes and Rigobon (2002) argued that the correlation coefficient is an imperfect measure of contagion, for it does not hold constant the variance of shocks. Here, however, the focus is on business cycle correlations, rather than on crisis contagion. In the case of the global crisis, the two happen to be closely related. This is unprecedented.

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