ADBI Working Paper Series

Manufacturing as the Key Engine of Economic Growth for Middle-Income Economies

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No. 573
May 2016

Asian Development Bank Institute

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Suggested citation:

Su, D. and Y. Yao. 2016. Manufacturing as the Key Engine of Economic Growth for Middle-Income Economies. ADBI Working Paper 573. Tokyo: Asian Development Bank Institute. Available: http://www.adb.org/publications/manufacturing-key-engine-economic-growth-middle-income-economies/

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Abstract

This paper revisits the role of the manufacturing sector during the middle-income stage. By exploiting a large dataset that covers internationally comparable sectoral information, we prove that the manufacturing sector is imbued with three important characteristics. First, for middle-income economies, manufacturing pulls along services, instead of the other way around. A decline in the manufacturing sector growth rate will negatively affect the growth rate of the services sector, in both the short-run and long-run meanings. Second, we show that manufacturing development not only promotes the incentives of savings, but also accelerates the pace of technological accumulation. Third, an increased share of the manufacturing sector in middle-income economies can enhance the utilization of human capital and economic institutions. Our empirical findings indicate that the manufacturing sector is still the key engine of economic growth for middle-income economies.

JEL Classification: L16, O14, O47

Contents

1. INTRODUCTION

Industrialization is viewed as the most important engine of economic growth. The special characteristics attributed to the manufacturing sector can be interpreted in many ways: rapid technological changes, economies of scale, and easy integration into global production networks (Szirmai 2012; Lavopa and Szirmai 2014). Additionally, a number of investigators have empirically confirmed that transformation from agriculture to manufacturing, and further from manufacturing to services is the process of economic development (Clark 1941; Kuznets 1957; Chenery 1979; Fuchs 1980). Therefore, it was once generally accepted that "since the industrial revolution, no country has become a major economy without becoming an industrial power" (Acharya 2007).

However, this rational has been challenged. The increasing importance of the services sector in the world, as well as the development of the information and communications technology (ICT) sector, demonstrates that nowadays the services sector could become the new engine of economic growth in developing economies (Fagerberg, Guerrieri, and Verspagen 1999; Dasgupta and Singh, 2005; Maroto-Sanchez and Cuadrado-Roura 2009; Lee and McKibbin 2014).[1] In addition, the fact that official data may underplay the influence of the services sector in the whole economy has become a growing consensus (Hoekman 2006; Rosen and Bao 2015). In their influential papers, Oliner and Sichel (2000) and Jorgenson and Stiroh (2000) point out that the measurement issues and disregard for spillover effects undermine the real contributions of the ICT sector to the whole economy.

In this situation, it is now a greatly debatable question whether manufacturing should still be the main focus of industrial policy in developing economies. In fact, a lack of consensus reflects our limited understanding of how and why the manufacturing sector matters, especially for middle-income economies. Those well-documented patterns of structural transformation across industries are normally regarded as empirical facts, instead of predictions derived from certain theory.[2] Therefore, it remains questionable whether a poor country nowadays still needs to undergo full industrialization before it gets rich. Additionally, the current literature highlighting sectoral specificity in economic development is largely separated from mainstream theories that regard growth as sector neutral. Therefore, despite a voluminous number of papers attempt to elaborate the role of manufacturing in economic development, we are still unaware of how the manufacturing sector is uniquely related to those well-known growth ingredients.

This paper inquires about the particular role of the manufacturing sector during the middle-income stage, and we prove manufacturing is still the key engine of economic growth for middle-income economies. By exploiting a large dataset that covers internationally comparable sectoral information, we find that the manufacturing sector is

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[1] In a recent paper, Amirapu and Subramanian (2015) argue that five important characteristics allow a sector to serve as an engine of structural transformation and produce sustainable economic growth. These characteristics are a high level of productivity, dynamic productivity growth, expansion of the sector in terms of its use of inputs, comparative advantage for the host country, and exportability. By focusing on India's case, they argue that some services branches, including finance, insurance, and real estate, could replace the role of manufacturing sector.

[2] There are many theoretical explanations for these structural change patterns, including differences in growth rate across sectors, changes in household preference, and globalization. These works indeed provide convincing explanations for this primary–secondary–tertiary transition. However, there is no theory that informs us that this transition process is closely related to the long-run growth rate of any developing economy.

imbued with three main characteristics. To preview our results, first, for middle-income economies, manufacturing pulls along services, instead of the other way around. A(n) decline/increase in manufacturing sector growth rate will negatively/positively affect the growth rate of the services sector, in both the short-run and long-run meanings. Second, we show that the development of the manufacturing sector promotes the incentives of savings, as well as accelerates the pace of technological accumulation. Compared with other sectors, the manufacturing industry has a higher demand for capital and investment, thus providing special opportunities for both capital and technological accumulation. Our last empirical finding is that among those middle-income economies., the contributions of human capital and institution are more pronounced in economies with a higher share of the manufacturing sector. It reveals that the manufacturing sector enhances the utilization of domestic human capital and institutions. Based on these findings, we conclude that the manufacturing sector remains central for middle-income economies.

One possible explanation for our empirical findings is that the major sources of economic growth for middle-income economies are completely different from those for developed economies, where growth is mainly driven by knowledge-based innovation. In contrast, increases of labor productivity in developing economies largely come from structural change or imported technology from developed economies. During this stage, easy adoption from world frontier technology is more essential for middle-income economies. However, different industries play a distinct role in adopting frontier technology. For instance, many studies (e.g., Jones and Olken 2005; Rodrik 2007) have argued that the tradable manufacturing sector is the major channel through which a developing economy absorbs knowledge and industrial science from abroad. Additionally, various works have shown that the vehicle of learning and adopting technology is investment, instead of consumption (Arrow 1962; Romer 1986; Jovanovic and Rousseau 2002; Boucekkine, del Rio, and Licandro 2003). Therefore, the manufacturing sector, which calls for a higher level of capital and investment, takes on the central role of absorbing technology, as well as creating strong externalities of knowledge flows to other sectors. These vital characteristics make the manufacturing sector crucial for all middle-income economies. Moreover, according to Barro (2001), if a country has better institutions and higher human capital level, investors can better introduce advanced technologies for domestic firms. As a consequence, in contrast to other sectors, the manufacturing sector, where technology transfer mainly takes place, can better utilize domestic human capital and economic institutions.

Our paper mainly contributes to two streams of literature. The primary contribution is to the literature on the role of the manufacturing and services sectors during a country's development. Most of those studies take on a macroeconomic perspective, with some directly examining how economic composition is directly related to the labor productivity growth rate, and others evaluating the importance of the manufacturing or service sector in economic convergence rate (Bernard and Jones 1996a, 1996b, 1996c; Pascual and Westermann 2002; Freeman and Yerger 2001; Gouyette and Perelman 1997). Generally speaking, the statistical evidence is not straightforward for us to draw any decisive conclusion. Compared with the prior research, our paper contains three notable differences. To begin with, our investigations focus on the effects of the manufacturing sector development on several important growth determinants, instead of testing their contributions to the growth rate directly. In this way, we can not only test the mechanisms through which the manufacturing sector promotes sustainable economic growth, but also combine the current structuralism literature with classical growth theory. Second, our paper examines the specific role of the manufacturing sector during the middle-income stage. Due to data limitation, most of the previous works concentrate on the Organisation for Economic Co-operation and

Development (OECD) economies. However, as we have noted before, the relative importance of the manufacturing and services sectors is like to depend on the development stage. Even a conclusive argument drawn from data covering only developed economies does not necessarily hold for developing economies. Third, although a cross-sectional approach is widely used in empirical growth literature, we contend that no single method can be perfect. Accordingly, instead of focusing exclusively on one typical kind of methodology, we adopt a wide variety of empirical methodologies to prove the robustness of our findings.

Our paper also contributes to the discussion of the middle-income trap. Despite its prevalence among scholars and policymakers, there is still no precise definition or even consensus for the existence of this term yet. Many scholars claim that the alleged inability of economies to progress from middle-income to high-income stage does not necessarily imply that there exists a "trap".[3] The lack of a conclusive answer actually indicates the fact that there is no satisfactory growth theory for middle-income economies (Gill and Kharas 2015). For those low-income economies, the problem basically lies in the lack of a driving force to transit resources from the agriculture sector to the modern sector. Consequently, the neoclassical growth model that emphasizes efficient physical and human capital accumulation does help us figure out how to promote economic growth for those poor economies. As for developed economies, growth is largely driven by knowledge-based innovation, which makes the endogenous growth model more appropriate for their development. However, for middle-income economies, their main obstacle for economic growth lies in both resource reallocations and intra-sectoral catch-up technological growth, where we lack the guidance of a sound growth theory. Our empirical findings in this paper provide a set of facts that may serve as a guide to develop more suitable growth theories for middle-income economies.

This paper is organized as follows. Section 2 provides the general conceptual framework and Section 3 present the data sources and preliminary analyses. Section 4 discusses the empirical methodology and our major findings. Robustness of our results are tested in Section 5, and finally Section 6 concludes.

2. CONCEPTUAL FRAMEWORK

In the long run, labor productivity is almost everything (Krugman 1994b). For developing economies, catching up with high-income economies is actually a process of eliminating the productivity gap. However, contrary to what the endogenous growth theory predicts, for these middle-income economies, economic growth is essentially the consequence of adopting state-of-the-art technology from developed economies. Admittedly, a couple of factors, including human capital level, the domestic political system, and economic openness, may influence the transmission of foreign technology. However, different industries are also likely to be distinct in terms of exploiting world frontier technology. Such characteristic makes certain sectors particularly relevant for middle-income economies. This is where our paper starts. From our point of view, the effects of the manufacturing sector go beyond the conventional reallocation effects. In this paper, we examine the specific mechanisms for why the manufacturing sector is critical for a middle-income country's development.

3 For instance, Im and Rosenblatt (2013) show that middle-income economies do not really look that different in terms of transitions across the inter-country distribution of income. Additionally, they argue that there is no one clear pattern that can be easily characterized as a trap.

To begin, we inquire about the relationship between manufacturing and services, both of which are considered to be important modern sectors. To be more specific, we want to examine whether manufacturing pulls along services, or the other way around. According to Kaldor (1957) and many references therein (Naude and Szirmai 2012; Szirmai 2012), manufacturing picks up services because the manufacturing sector has several relevant qualities that are not shared by other sectors. In addition, most technological change occurs first in manufacturing, then diffused out to other sectors (Tregenna 2007). Therefore, they conclude that spillover effects are stronger in the manufacturing sector than in any other sector. Additionally, the vehicle of technological accumulation is often regarded as investment (Arrow 1962; Romer 1986; Jovanovic and Rousseau 2002; Boucekkine, del Rio, and Licandro 2003); as a consequence, high demand for investment in the manufacturing sector is inclined to create strong externalities of knowledge flows to other sectors.

More importantly, we demonstrate that the links between manufacturing and services may depend on the development stage, and externalities from manufacturing to services should be stronger in the middle-income period. This is because for middle-income economies, the tradable manufacturing sector is viewed as the major channel through which a developing economy absorbs best practices from abroad (Jones and Olken 2005; Rodrik 2007). As industrialization progresses, the manufacturing sector increasingly stimulates demand for service inputs (Park and Chan 1989), thus further promoting the development of the services sector. Based on these arguments mentioned above, our first hypothesis on the intersectoral relationship between manufacturing and services is expressed as follows.

Hypothesis 1. Manufacturing sector pulls along services sector during middle-income stage.

Then, we attempt to investigate how the manufacturing sector is related to several important growth ingredients. Savings and economic growth are closely related to each other. On the one hand, according to neoclassical growth theory, savings is one of the most important factors to long-term economic growth. On the other hand, both the Permanent Income Hypothesis (Friedman 1957) and Life Cycle Hypothesis (Modigliani 1966), emphasize the important role of income growth for private savings. These two views are widely tested by abundant empirical research.[4] However, from our point of view, those studies fail to account for the effects of economic composition. Compared with other sectors, manufacturing industries have a higher demand for capital and investment, therefore providing special opportunities for capital accumulation. As a consequence, the emergence of the manufacturing sector is likely to boost the demand for capital, leading to an increase in the private savings ratio. As a matter of fact, many East Asian economies promoting industrialization during their middle-income stage, are also accompanied with a high saving ratio. Our second hypothesis is explained in the following statement.

Hypothesis 2. Manufacturing sector development promotes the incentives of savings for middle-income economies.

Another well-recognized determinant of sustainable economic growth is technological accumulation. Considering its importance, many efforts are devoted to studying its

[4] For example, Hall (1978), Bernanke (1999), Hall and Mishkin (1982), and many others have found that shocks to economic growth lead to changes in savings. Meanwhile, a large number of works, including Barro (1991), Gregorio (1992), and Barro and Sala-i-Martin (2003), prove that savings contribute a lot to higher economic growth rate in the short run.

determinants. Academic works highlight the role of a small number of important factors that promote the productivity growth for developing economies, which include trade openness, education, institutions, and so on (Acemoglu, Johnson, and Robinson 2005; Grossman and Helpman 1991; Loko and Diouf 2009). For developed economies, these findings are consistent with what endogenous growth theory predicts. However, what are the main sources of technological accumulation in middle-income economies?

Consistent with our hypothesis raised before, many papers stress the importance of embodied technological progress (Greenwood, Hercowitz, and Krusell 1997; Greenwood and Jovanovic 1998; Boucekkine and de la Croix 2003), which means new machines that incorporate the latest technological advances, are more crucial to the development of developing economies. For example, Phelps (1962) proves that the composition of technical progress matters a lot for developing economies, and that a larger share of embodied technological progress will help the developing economies move more quickly to the high-income group.

Another influential research study consistent with our view is Greenwood, Hercowitz, and Krusell (1997), who conclude that embodied technical progress explains about 60% of the growth in labor productivity. Although several branches of services also offer special opportunities for disembodied technological progress, such as learning-by-doing, the manufacturing sector allows for faster growth rate in both embodied and disembodied technological progress (Cornwall 1977). After taking this specialty into consideration, our third hypothesis on the relationship between the manufacturing sector and technological accumulation during the middle-income period is displayed below.

Hypothesis 3. Manufacturing sector accelerates the pace of technological accumulation in middle-income period.

Many theoretical models, as well as empirical studies, have also emphasized the role of human capital and economic institutions in the growth process. For example, theoretical works of Nelson and Phelps (1966), Lucas (1988), Becker, Murphy, and Tamura (1990), and empirical findings in Barro (1991: 2001) provide convincing support for the great importance of human capital in a country's development. At the same time, the works of Acemoglu, Johnson, and Robinson (2001), Acemoglu, Johnson, and Robinson (2005), Acemoglu, Gallego, and Robinson (2014) and Acemoglu et al. (2014) mainly view economic institutions as the fundamental cause of long-run economic growth. However, the importance of human capital and institutions, or more specifically, the question whether higher educational attainment and democracy are indispensable for any developing country to become rich, is debatable.

In this paper, we hypothesize that certain sectors in the economy can better utilize human capital and economic institutions, as it has been confirmed in the literature that human capital and economic institutions play an important factor in facilitating the technology adoption in a country (Nelson and Phelps 1966; Romer 1990; Benhabib and Spiegel 1994; Acemoglu et al. 2005). A higher level of educational attainment can help investors more easily introduce advanced technologies to domestic firms, and absorb superior technologies from other leading economies (Barro 2001; Moshirian et al. 2015). In addition, stronger protection of intellectual property rights is likely to create demand for innovation and adopting foreign technology. Hence, we expect the contributions of human capital and economic institutions can be stronger in economies with a higher share of manufacturing sector.

Hypothesis 4. For middle-income economies, an increased share of the manufacturing sector can enhance the utilization of domestic human capital and economic institutions.

3. DATA

3.1 Data Sources

We set up a large dataset with internationally comparable data on employment and value added by sector. The construction procedure is explained as follows. First, we gather the manufacturing and service value-added data in constant terms from a variety of sources, including the World Bank World Development Indicators (WDI) database, the World Input-Output Database (WIOD), the World KLEMS Database, the European Union KLEMS Database, the Asian KLEMS Database, the OECD's Structural Analysis Database (STAN), the Groningen Growth and Development Center 10-sector Database, and the UNIDO INDSTAT2 Database. Then we use the WDI as our basic source, and extrapolate the series by using the corresponding growth rate calculated by additional databases.[5] Our final constructed annual dataset covers 187 economies from 1950 to 2013.[6] We use value-added growth rate of manufacturing (MANVAGW) and services (SERVAGW) as a proxy for the manufacturing and services sector development, respectively.

As for other variables used in this paper, gross national income (GNI) per capita in constant 2005 US dollars is mainly collected and extrapolated by using data from the WDI and Maddison Project Database;[7] the construction of cross-country gross private saving ratio data follows two important works of Grigoli, Herman, and Schmidt-Hebbel (2014) and Loayza et al. (1998); data of total factor productivity (TFP), the share of gross capital formation, and human capital index are accessed directly from the Penn World Tables; the rule of law index (ROL) data is taken from the Polity IV Project.[8]

3.2 Country Classifications

The phenomena of the middle-income trap have attracted attention, but actually there is no consensus in defining what a "middle-income country" or "middle-income trap" should be. The most reliable approach, the income criterion suggested by the World Bank, relies on GNI per capita adjusted by the so-called World Bank Atlas method.[9] Although these yearly published thresholds can be applied to identify a certain country into four major categories (low income, lower-middle income, upper-middle income, and high income), those classifications are not available before 1987. Therefore, we implement alternative practical procedures to classify economies. In building up these criteria, various previous works (Felipe, Abdon, and Kumar 2012; Felipe, Kumar, and Galope 2014; Im and Rosenblatt 2013; Lavopa 2015) are utilized.

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5 One issue is that generally these databases consist of different levels of disaggregation, ranging from 4 to 35 sectors. In order to deal with this problem, in this paper we define manufacturing sector as industries belonging to ISIC divisions 15–37, and services as those belonging to ISIC divisions 50–99. The latter covers several different branches, including trade services, transport services, business services, government services, and personal services.

6 For most economies, the value-added data of manufacturing and services sector starts in 1970s.

7 The Maddison-Project. http://www.ggdc.net/maddison-project/home.html, 2013 version.

8 The Polity IV Project. http://www.systemicpeace.org/polityproject.html, 2014 version.

9 World Bank. http://datahelpdesk.worldbank.org/knowledgebase/articles/378832-what-is-the-world-bank-atlas-method

Generally, we adopt two classification methods widely used in the literature: one in relative terms, and the other in absolute terms. The relative approach is based on the theoretical foundation of neo-classical models, which focus on answering why certain poor economies fail to catch up with the rich ones. To construct our relative criterion of middle-income economies, we use the United States (US) as our comparative country, which is also the conventional approach in literature. In our paper, middle-income economies are defined as those with a GNI per capita lying between 7% and 45% of the US GNI per capita at each corresponding year. The choice of these two thresholds is ad hoc, but conclusions do not change if we choose other sets of classification criteria.[10]

On the contrary, the absolute threshold is more connected with the question why some economies enter the real stage of economic stagnation. We construct the absolute criterion for middle-income economies by directly following the work of Lavopa and Szirmai (2014). The identification thresholds are as follows, all in terms of GNI per capita: low income (less than $2,250 purchasing power parity (PPP), middle income (between $2,250 and $14,999 PPP), and high income ($15,000 PPP and above). According to them, these criteria can match almost 90% of the classifications published by the World Bank. By means of these clear thresholds and our extrapolated GNI per capita data, we determine the income category for each of the economies between 1950 and 2013. Both types of criteria are used here to alleviate the concerns in specific country classifications.[11] To be concise, we only discuss the regression results using relative criterion, and leave out the empirical results that adopt absolute criterion for robustness check.

3.3 Descriptive Analysis

Descriptive statistics for all variables used in our main regression are reported in Table A1.1. In panel A and panel B, we present the statistics of two different samples constructed by using the relative criterion and absolute criterion, respectively. Although there are modest discrepancies in the observations and economies included, statistical characteristics do not change much when we adopt different classification methods. For example, in the relative criterion sample, means of the manufacturing and services sector value-added growth rate are 3.96% and 4.12%, respectively, and we observe sizable standard deviations on these two variables. Meanwhile, when we use absolute criterion, the average numbers of manufacturing and services sector value-added growth rate are 3.52% and 4.19%, with only modest differences from those in the relative criterion sample. Similar conclusions hold for other variables used in this paper.

We start our empirical analysis by computing the correlation coefficients between each pair of variables. Table A1.2 displays two different types of correlation coefficients calculated for manufacturing development and other selected variables. The "annual" term here means we implement our computation by using all the available country-year observations. As for "country average" correlations, we first average the available information for each country, and then carry out the measurement by focusing on the cross-sectional variability. Again, panel A and B exhibit the results of the sample covering middle-income economies by using relative criterion and absolute criterion, respectively.

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[10] We also choose 10% and 55% as relative classification criteria. Empirical results are not sensitive to the small changes in criteria.

[11] Indeed, there are notable differences when we use different classifications. However, in the robustness section we prove that those differences have little impact on the empirical results.

The first conclusion we can draw from Table A1.2 is that manufacturing sector development is significantly related to each of the selected variables. Moreover, the correlation coefficients are always positive, no matter which calculation method we adopt in practice. It indicates that a higher growth rate of manufacturing sector is positively correlated with larger private saving ratio, technological accumulation speed, and more rapid growth rate of the services sector. Second, we find that saving-manufacturing growth correlations, and services-manufacturing growth correlations are somewhat higher than TFP-manufacturing growth correlations, although they are all significant in terms of magnitude. Third, when we investigate the sample of year-averaged observations, correlation coefficients slightly decrease in most cases, except for that service-manufacturing correlation is much stronger when we use cross-sectional data.

4. EMPIRICS

4.1 Empirical Methodology

We are aware of the potential drawbacks of regression analyses in empirical growth literature: highly correlated explanatory variables, country heterogeneity, reverse causality, and so on. In fact, many scholars have proven that the conventional ordinary least squares (OLS) estimation is only consistent under strict and unrealistic assumptions (Caselli, Esquivel, and Lefort 1996). Therefore, in order to alleviate such concern, we analyze each relationship by adopting a wide variety of estimation techniques, which are the long-run Granger causality test, cross-section regression, and panel analysis. Normally, Granger causality tests allow for various dynamic specifications, which can be utilized to investigate the effects of the manufacturing sector in individual economies in a more appropriate way. Cross-sectional analysis is a convenient way to evaluate the average influences of the manufacturing sector development across economies, but the conclusion can be largely undermined by the possibilities of omitted country characteristics. In contrast, the panel data enables us to deal with the influences of unobserved fixed country heterogeneity. We briefly describe these methods in the following part of this section.

4.1.1 Long-Run Granger Causality

The advantage of time series analysis lies in its rich dynamic specifications. Additionally, testing the existence of Granger causality as a first step can help to characterize the relationship of the variables that we are interested in. A general representation of a dynamic time-series model linking two variables x and y is as shown as follows:

$$y_{i,t} = \alpha_{0,i} + \sum_{j=1}^{q} \alpha_{i,t,j}^{y} y_{i,t-j} + \sum_{k=1}^{p} \beta_{i,t,k}^{y} x_{i,t-k} + \varepsilon_{i,t}^{y} \quad (1)$$

$$x_{i,t} = a_{0,i} + \sum_{j=1}^{m} a_{i,t,j}^{x} y_{i,t-j} + \sum_{k=1}^{n} b_{i,t,k}^{x} x_{i,t-k} + v_{i,t}^{x} \quad (2)$$

However, such a system cannot be directly estimated without extra assumptions or restrictions on its parameters. Generally speaking, the assumption is relevant to the sample data, and can be divided into two categories. If the sample covers a relatively long time horizon, one could impose the assumption of constancy in parameters over time but allow them to be variable across economies. And if the dataset covers a rather large number of economies in cross-section, one could allow the parameters constant across economies but differ over time. For the simplest model used in the baseline regression, we introduce additional assumption of both no country and no time heterogeneity[12], as our dataset covers a large number of economies for a relatively long time. Therefore, the basic equation estimated for each pair of variables is shown as the following specification:

$$y_{i,t} = \alpha_{0,i} + \sum_{j=1}^{6} \alpha_j y_{i,t-j} + \sum_{k=1}^{6} \beta_k x_{i,t-k} + \varepsilon_{i,t} \quad (3)$$

In the literature, β_k here is also called the standard within-estimator. We choose six lags in our basic setup, in order to balance between the dynamic effects of dependent variable itself and the data availability. Following corresponding literature (Attanasio, Picci, and Scorcu 2000), we also incorporate country fixed-effects in our regression model.

We construct two statistics here to make inferences. One is the sum of all β coefficients, which represents the short-run effects from variable x to y, and the other is calculated as $\sum_{k=1}^{6} \beta_k / \left(1 - \sum_{j=1}^{6} \alpha_j\right)$, which means the long-run effects of changes in x to y after considering the persistence of dependent variable. Zero hypothesis for the former statistic is the sum of all β coefficients equals to zero, which is asymptotically consistent to a chi-square distribution. Zero hypothesis for the latter statistic is that all β coefficients are jointly zero. We calculate the corresponding *p*-values for each statistic.

4.1.2 Cross-sectional Regression

Our proposed cross-sectional regression takes the following form:

$$m_i = c + b_0 m_{0,i} + b_1 MANPC_{0,i} + b_2 MANVAGW_i + CX_i + e_i \quad (4)$$

where m_i is our selected dependent variables in country i, $m_{0,i}$ is the initial value for this proxy in country i. $MANPC_{0,i}$ is the initial manufacturing sector percentage for country i. Additionally, $MANVAGW_i$ is the average manufacturing value-added growth rate. Two initials are added here to absorb the effects of pre-determined factors. X_i are a bunch of selected control variables included in the regression. Specifically, the latitude index measures the absolute value of the latitude of a country, ranging from 0 to 1. A smaller value means closer to equator. Colonial dummies are indicators of whether a country was a British, French, German, Spanish, Italian, Belgian, Dutch or Portuguese colony. In addition, we control the effects of legal origins and regions by introducing corresponding dummies.

4.1.3 Panel Regression

Our regression model for analyzing the panel data is shown as follows:

$$m_{i,t} = c + \sum_{j=0}^{p} \alpha_j m_{i,t-j} + \sum_{k=0}^{p} \beta_k y_{i,t-k} + \gamma MANVAGW_{i,t} + \delta_i + \eta_t + e_{i,t} \quad (5)$$

Again, $m_{i,t}$ is one of our interested variables in country i at year t, and $MANVAGW_{i,t}$ is the proxy for manufacturing sector development in country i at time t. Here, $y_{i,t}$ is the log of GNI per capita at year t for country i. We also include several lags of GNI per capita and dependent variable on the right side, in order to control potential residual serial correlation in the error term $e_{i,t}$. Country fixed effects δ_i and year effects η_t

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[12] In the robustness check, we implement the Granger causality test here under the assumption of constancy over time.

are also incorporated here to absorb the impacts of any time-invariant country characteristics and country-invariant time trends.

4.2 Empirical Findings

4.2.1 Manufacturing versus Services Sector

In this section, we investigate the intersectoral linkages between manufacturing and services. We begin our discussion with Granger causality tests. The basic empirical results of long-run Granger causality are presented in Table A1.3, where the dynamic model of Equation (3) is estimated by OLS with annual data. We include six lags of each variable into the OLS regression, as well as the country-specific intercepts. Conclusions based on time-series analysis are twofold. First, the significantly positive signs of manufacturing sector development indicate that there are important effects running from manufacturing growth to services sector advancement: if a country's manufacturing sector continues to grow fast, the services sector growth rate will be higher. This finding is consistent with one of the many reasons why the manufacturing sector is of great importance to one country's development. Moreover, due to small persistence in services sector value-added growth rate, the long-term effect is slightly larger than the short-run effect. These two findings indicate that a decline in manufacturing sector growth rate will negatively affect the growth rate of services sector, in both short-run and long-run meanings. In this case, serious attention should be paid to premature deindustrialization that many developing economies now experience (Rodrik 2015). The results of Granger causality are in line with our hypothesis that the development of manufacturing firms can create the corresponding demand for services sector.

Cross-section results summarized in Table A1.4, and panel estimation results in Table A1.5 further confirms our hypothesis. For cross-sectional regression, we include initial value of gross private saving ratio, as well as the initial manufacturing share of the total economy, to control other predetermined information that could lead to an imprecise inference of our interested variables. The estimated coefficients of manufacturing value-added growth is positive and statistically significant: a 1% difference in value-added growth rate in the manufacturing sector is related to 0.15% gap in the services sector value-added growth rate. Such magnitude is economically considerable. As to our panel regression results, generally speaking, the estimation results once again prove that the manufacturing sector has strong spillover and externalities for the services sector. In Table A1.5, columns (9) to (12) present the empirical results of different model specifications by using within-estimator. Following the work of Acemoglu et al. (2014), we control for lags of the dependent variable, in order to eliminate the residual serial correlation in the error term. Although there indeed exists some persistency in the data, adding more lags in the regression model only has slight effects on our estimations.[13] Based on Table A1.5, a 1% increase of the value-added growth rate of manufacturing sector in the total economy is likely to lead to a 0.12%–0.14% increase in growth rate of services sector. And such effects are statistically significant in 1% level.

[13] Based on Levin, Lin, and Chu (2002), we also provide the Levin–Lin–Chu test results for a unit root in panel data. A significance in 1% level indicates that we reject the zero hypothesis that there is a unit root in the panel data. Modifications in the number of lags and estimation method do not change our main conclusion.

4.2.2 Manufacturing Sector Development and Gross Private Savings

Similarly, we begin our discussion of manufacturing sector development and private saving ratio with Granger causality results. Table A1.3 indicates that the sum of the coefficients on lagged manufacturing sector development is highly significant at 1% significance level: manufacturing development is likely to Granger cause the following increases of gross private saving ratio. Compared with other sectors, the manufacturing industry has a higher demand for capital, which provides special opportunities for capital accumulation. In addition, the economic value is also impressive. A 1% increase in value-added growth rate of the manufacturing sector is likely to result in a 0.17% short-run increase in the private saving ratio. Due to the high persistence of savings, the long-run effect of manufacturing development on saving is much stronger, which is nearly four times the short-run effect. Our Granger causality results show that economic composition does have effects on the private saving ratio.

Then we turn to cross-section results to see whether the differences of manufacturing sector development have explanatory over the cross-country discrepancies in the saving ratio. Based on the results summarized in Table A1.4, our proposed indicator of manufacturing development enters with large and positive coefficients that are statistically significant in 1% level. Based on basic results, a 1% difference in value-added growth rate in manufacturing is related to 0.52% discrepancy in private saving ratio. Again, cross-sectional results are consistent with our previous hypothesis. As a matter of fact, many East Asian economies that promote industrialization are also accompanied with a high saving ratio. Although culture and relative price differences also contribute to various levels of the saving ratio across economies, the emergence of the manufacturing sector could also lead to significant shifts by boosting the demand for capital, as well as increasing the investment return. Panel estimation results presented in Table A1.5 further confirm our hypothesis about the important role of the manufacturing sector in promoting savings.

4.2.3 Manufacturing Sector Development and Total Factor Productivity (TFP)

TFP is recognized as perhaps the most important factor in long-term economic growth. For middle-income economies, catching up with high-income economies is a process of eliminating the productivity gap. Regarding its importance, many papers focus on studying the determinants of TFP. First, we investigate the relationship between manufacturing sector development and TFP from the view of Granger causality. Based on the results shown in Table A1.3, we find a moderate short-run relationship runs from lagged manufacturing sector development to TFP in middle-income economies. Such a relationship is stronger in the long-run. It seems odd at first glance since theoretically speaking, TFP should promote the long-term growth of the total economy as well as the manufacturing sector, instead of the other way around. Our explanation is such a relationship between TFP and the manufacturing sector development may not hold for developing economies. For many middle-income economies, the productivity growth mainly comes from the technology in high-income economies, where growth reflects inside the capital investment, instead of in the form of TFP. Our findings in this section are closely related to the previous debate about the growth miracle of East Asia. Some scholars hold the view that in those miracle economies, high capital accumulation is the main reason why they grow fast in the history, instead of efficiency growth (Krugman 1994a). We find similar conclusions based on the results of Granger causality tests.

Additionally, empirical results of both cross-section and panel analysis further support our hypothesis about the relationship between manufacturing sector development and TFP. As shown in Tables A1.4 and A1.5, a higher growth rate of manufacturing value-added does contribute to the increase of technological accumulation in middle-income economies. This finding is also consistent with several old literature reviews (Cornwall 1972, 1977). They stick to the argument that the economies of scale, as well as its embodied and disembodied technological progress should contribute to the TFP growth in developing economies.

4.2.4 Manufacturing Can Better Utilize Human Capital and Economic Institutions

Human capital and institutions are often viewed as important growth determinants. A number of influential research studies have found that investors with higher human capital play a crucial role in facilitating the technology adoption (Nelson and Phelps 1966; Romer 1990; Benhabib and Spiegel 1994; Luong et al. 2014; Bena et al. 2016). However, different sectors may utilize these two growth ingredients to a different degree. One main difference between the manufacturing sector and other sectors is that the degree of technology adoption is higher in the manufacturing sector. Therefore, if a country has a larger share in the manufacturing sector, the whole economy is more likely to make advantage of its better economic institutions and higher human capital level, to absorb superior technologies from other leading economies (Barro 2001). Thus, we expect that the contribution of human capital and economic institutions should be more pronounced in economies with a larger share of the manufacturing sector. To test this conjecture, we add an interaction term of manufacturing share and human capital index, as well as the rule of law index in the panel regression (5).

We summarize the empirical outcome in Table A1.6. In all model specifications, the estimated coefficients of interaction term are positive and significant at the 10% level or even higher. Empirical results in this section suggest that the positive effects of human capital and rule of law on each of our selected variables are more pronounced in economies with a high share of the manufacturing sector.

5. DISCUSSION

5.1 Robustness Checks

To check the robustness of our empirical findings, we implement an array of additional tests. For the sake of brevity, we report those detailed results in Appendix 2.

First, we redo all the basic regressions by using the absolute criterion sample of middle-income economies. Certainly, there are notable differences in economies and their sample period when we adopt various classifications. However, it shows that our main findings discussed in the previous sector are not driven by specific choice of classification method. Our results are quite robust across different datasets, in both qualitative and quantitative meanings.

Second, for several interested variables, we use alternative measures. For example, we use the educational attainment data of Barro and Lee (2013) as a substitute for human capital index obtained from the Penn World Table. In addition, since the economic activities that really matter for long-term growth are gross investments instead of pure savings, we implement the same regressions by adopting a gross capital formation variable instead of gross private savings as dependent variables. We find that these changes do not alter our empirical results qualitatively.

Third, for our Granger causality tests and panel regressions, given the size of the time span, it is highly possible that our proposed within-estimator does not approximate well. A small T could lead to an asymptotic bias. This is the well-known Nickell bias documented in the literature (Nickell 1981). Therefore, we use the generalized method of moments (GMM) estimator developed by Arellano and Bond (1991) to deal with the potential effects of the Nickell bias. Based on the results listed in the Appendix 2, the empirical results are still consistent with our hypothesis. Compared with the results of using within-estimator, there is only a marginal difference in the magnitudes of the estimated coefficients: the within-estimator used in our paper has at most a small bias. Similarly, we also report the results of AR(2) residual correlation tests in the bottom of the tables. The *p*-value results indicate that we cannot reject the original assumption that there is no serial correlation in the results. Our model specification control for the dynamics of dependent variables appropriately.

Fourth, we relax the assumption of no country heterogeneity in our long-run Granger causality tests, so that the coefficients of the dynamic model can differ in the cross-sectional dimension. We construct the mean-group estimators proposed by Pesaran and Smith (1995) and follow the corresponding statistical inferences to test whether such approach will change our previous results significantly. P-values for those mean-group estimators are constructed based on the count tests.[14] Qualitatively, the results do not differ sensibly from what was found by imposing the homogeneity assumption.

Fifth, for our Granger causality tests and panel regressions, we alternate the model specifications by increasing the number of lags included in the regressions to 8 or 12, in order to see whether different numbers of lags introduced here will significantly change our results. Based on the outcome, we find that our baseline results are robust to alternative changes of lag numbers. This is not a surprising result since we have shown that our preferred model specification has already controlled for the dynamics of dependent variables appropriately.

Sixth, we add a number of selected control variables included in the cross-sectional regression. Specifically, the latitude index measures the absolute value of the latitude of a country, ranging from 0 to 1. A smaller value means closer to equator. Colonial dummies are indicators of whether a country was a British, French, German, Spanish, Italian, Belgian, Dutch, or Portuguese colony. We also control the effects of legal origins and regions by introducing the corresponding dummies. We also add various other controls to this regression model. The controls are latitude representing the distance from the country to the equator, dummies for British and French colonies, and dummies for different continents. Many research studies show that these indicators are potentially important to control the effects of omitted variables (Acemoglu, Johnson, and Robinson 2005). We find that the empirical results do not change in all of the model specifications.

5.2 Endogeneity Issues

Although results of the baseline regressions and several robustness checks are consistent with our hypotheses, we have to admit that the endogeneity issues may be serious in any growth regression. One normal source comes from the unobserved omitted variable bias. To address the issue of spurious correlation through

[14] According to Attanasio et al. (2000), this framework is suitable for the analysis of heterogeneity among economies. A detailed analysis of the nature of cross-sectional heterogeneity would be particularly relevant whenever relaxing the homogeneity assumption leads to qualitatively different results.

the omission of relevant country-specific information, we implement the regressions with fixed effects specifications by exploiting the advantages of dynamic panel data.

Another important source is reverse causality: for instance, the services sector may lead to the development of the manufacturing sector, instead of the other way around. A higher level of savings and TFP may contribute to the rapid growth of the manufacturing sector. All these potential endogeneity issues may undermine our arguments on the role of the manufacturing sector during the middle-income stage. We should be even more careful about this problem if we want to estimate such effects quantitatively. The first test we implement to deal with the potential endogeneity issues is to test the reverse causality through the Granger causality tests. By this way, we can directly examine the relationship between manufacturing sector development and our interested variables.

To completely address the endogeneity issues, an ideal research design would be a randomized controlled experiment that arbitrarily allocates economies to two different groups: economies in one group are designed to develop only the manufacturing sector, while economies in the other group grow with services activities. Only in this case, we can accurately estimate the real effects of manufacturing development. However, this type of experiment is infeasible in the real world. In the following work, we choose to adopt an instrument variable regression to help identify the effect of manufacturing development in middle-income economies.

5.2.1 Reverse Causality Tests

Reverse causality is one of the major concerns that lead to endogeneity. To further address the reverse causality concern, we conduct a test to directly examine the relationship between manufacturing sector development and our interested variables. We report the test results of Granger causality running from certain growth ingredient to manufacturing sector value-added, in order to test whether the reverse causality indeed exists. The empirical results are summarized in the right columns of Table A1.3. Similarly, we report both the sum of coefficients on the lagged independent variables, as well as the calculated long-run effects. Based on these results, although we find strong relationships running from manufacturing sector development to savings, TFP and services sector development, there is no significant short-run effect running from one of them to manufacturing sector development. Moreover, the long-run effect is only slightly different from the short-run effect, reflecting the lack of persistency in manufacturing sector development. One exception is that in the long-run, services sector development turns out to have significantly negative externalities on manufacturing sector development. This finding is consistent with the work of Gordon (2000a; 2000b). By exploiting the US data, he finds no significantly positive spillovers are taking place from the services sector[15] to the rest of the economy. Although it is true that the traditional view that manufacturing and services are completely separate and fundamentally different sectors is outdated, the services sector can hardly substitute manufacturing in developing economies.

5.2.2 Instrument Variable Regression

To provide more convincing evidence, we adopt GMM-IV regression. GMM instead of conventional OLS is used for addressing the issues of heteroskedasticity. In this way, if errors are heteroskedastic, by implementing a series of orthogonal equations, we can

15 In his original paper, Gordon focuses on the relationship between information technology and growth.

still efficiently and consistently estimate the regression without knowing the actual form of the error distribution.[16]

Finding an appropriate instrumental variable (IV) for manufacturing sector development is difficult. We construct our proposed IV in the following ways. The manufacturing sector in developing economies is often regarded as closely related to the situation in the same industry of developed economies. Therefore, by using the INDSTAT2 database, we decompose the value-added growth of the manufacturing sector in each country into different branches. For a certain year, by using the growth rate of each branch in the US as proxy for that in developed economies, we can calculate an indicator for developing country A by using the value-added growth in the US and the share of each branch in this country. Such an indicator is closely related to the manufacturing growth rate of country A at that year, but is also unrelated to other unobserved effects, such as the macroeconomic condition and domestic policy changes, in this country.

We directly prove that our proposed instruments are valid instruments. The basic requirements are relevance and validity. In this paper, we use excluded F-statistics of the joint significance of instruments in the first-stage regression to test the relevance of our instruments. Hansen's J statistic will be exploited to evaluate the over-identification restrictions. For testing orthogonality conditions of our proposed instrument variables, we also use the Durbin–Wu–Hausman (DWH) statistic here, which involves estimating both OLS and IV models, and comparing the resulting coefficients. This orthogonality test was first proposed by Durbin (1954), Hausman (1978), and Wu (1973). Test statistics listed in Table A1.7 show that our proposed variable meets both requirements. The excluded F-statistics of the joint significance of instruments in the first-stage regression are used to test the relevance of our instruments. Strong significance in Table A1.7 shows that our proposed indicator is closely related to manufacturing sector value-added growth. Moreover, for Hansen's J statistic, the joint null hypothesis is that the instruments are valid instruments. The J statistic is consistent in the presence of heteroskedasticity and autocorrelation. Failing to reject the null indicates the validity of our IVs. For testing orthogonality conditions of our proposed instrument variables, we use the Durbin–Wu–Hausman test here. The null hypothesis is that the testing regressor is exogenous. Failing to reject assures the validity of our instruments.

After proving the efficacy of our instrument variables, we turn to the discussion of regression results. We use two-stage feasible efficient GMM-IV estimation for our regression methodology, and adopt the corresponding variance-covariance matrix based on an Eicker–Huber–White robust covariance estimator. The basic estimation results are tabulated in Table A1.7. For various model specifications, the estimated coefficients of manufacturing sector development all remain significant at 1% level. The importance of the manufacturing sector for middle-income economies continues to hold even when we adopt IV regression. Compared with panel regression results in Table A1.5, the economic value of manufacturing sector development is impressive. For example, columns from (1) to (4) report our GMM-IV regression results on the effects of manufacturing on private savings. It shows that after we control the possible

[16] However, the flaws of using GMM are also clear: optimal weighting matrix at the core of efficient GMM is a function of fourth moments, whose accuracy actually requires a very large sample size (Hayashi 2000). The consequences of implementing GMM when unnecessary is that an efficient GMM estimator may have poor small sample properties and some inference tests could lead to inaccurate results (Baum, Schaffer, and Stillman 2003). For eliminating that concern, we also use a test proposed by Pagan and Hall (1983) to test for heteroskedasticity. Based on the unreported results, we significantly reject the null hypothesis of no heteroscedasticity in the data.

issue of endogeneity, a 1% increase in manufacturing value-added growth rate will promote 2.04%–2.24% increase in saving ratios, which is considerable in terms of economic value.

6. CONCLUSION

In this paper we highlight the influences of manufacturing development for middle-income economies. To begin, we investigate the strong externalities of manufacturing sector development on the services sector. Moreover, we find that manufacturing development can not only improve the incentives of savings, but also enhance the technological accumulation. Last, we prove that compared with other sectors, manufacturing can better utilize human capital and economic institutions.

Our empirical findings in this paper not only have strong policy implications, but also provide a set of facts that may serve as a guide to further development of economic growth theory. The most important policy implication drawn from our work is on the necessary industrial policy for middle-income economies. It seems that governments in developing economies should play an important strategy in preventing a country from premature deindustrialization (Rodrik 2016), especially in the era of globalization. The poor performance of manufacturing and the relatively strong performance of services in some developing economies may not be a good sign for maintaining sustainable long-term economic growth.

More importantly, our empirical findings on sectoral differences between manufacturing and the services sector are also important for economic growth theory. Despite the prevalence of one-sector neo-classical theory (Blanchard and Fischer 1989; Barro and Sala-i-Martin 2003), many studies try to extend those basic growth models to a multi-sector one (Zhang 2011; Herrendorf and Valentiny 2006), in attempt to investigate the theoretical effects of structural change and sectoral differences. However, in addition to the discussions on the existence and uniqueness of the equilibrium in multi-sector model, how to incorporate different sectors and their interactions into the model remain to be a vital question. Our empirical findings on the special characteristics of the manufacturing sector during the middle-income stage should shed light on the economic modeling in the future.

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[*] The Asian Development Bank refers to China by the name People's Republic of China.

APPENDIX 1

Table A1.1: Statistical Description

	Obs	# of Economies	Mean	St. Dev.	Min	Max
Panel A: Relative criterion						
Manufacturing value-added growth	2,449	119	3.96%	11.08%	–12.10%	16.34%
Services value-added growth	2,216	109	4.12%	7.81%	–3.79%	10.94%
GNI per capita	3,658	179	2.88%	6.71%	–6.65%	9.86%
Gross private saving ratio	1,685	91	26.34%	50.93%	6.41%	60.72%
Gross capital formation	2,707	103	21.10%	10.05%	9.44%	40.53%
TFP	2,074	81	0.71	0.49	0.41	1.21
Human capital index	2,144	76	2.30	0.50	1.47	3.13
Rule of law	2,414	107	6	7.41	–10	10
Panel B: Absolute criterion						
Manufacturing value-added growth	2,318	102	3.52%	11.19%	–12.05%	16.67%
Services value-added growth	2,216	109	4.18%	5.08%	–3.58%	10.94%
GNI per capita	3,548	172	2.50%	6.83%	–6.89%	10.09%
Gross private saving ratio	1,593	71	26.78%	52.14%	10.47%	61.19%
Gross capital formation	2,594	91	20.98%	15.43%	9.16%	40.53%
TFP	1,934	72	0.80	0.51	0.40	1.28
Human capital index	2,264	85	2.33	0.46	1.56	3.05
Rule of law	2,607	119	6	7.31	–9	10

GNI = gross national income; TFP = total factor productivity.

Table A1.2: Correlations of Growth Determinants and Sectoral Development

	Savings		TFP		Services	
	Corr. Coeff	Rank Corr. Coeff	Corr. Coeff	Rank Corr. Coeff	Corr. Coeff	Rank Corr. Coeff
Panel A: Relative criterion						
Annual	0.4140***	0.2171***	0.0864***	0.0953***	0.3391***	0.4287***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Country averages	0.1641***	0.2683**	0.0817***	0.1396***	0.4731***	0.5353***
	(0.000)	(0.026)	(0.000)	(0.009)	(0.000)	(0.000)
Panel B: Absolute criterion						
Annual	0.4073***	0.1933***	0.1218***	0.1451***	0.2396***	0.4296***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Country averages	0.1481***	0.2373**	0.0814***	0.0813***	0.4918***	0.6310***
	(0.000)	(0.032)	(0.000)	(0.001)	(0.000)	(0.000)

TFP = total factor productivity.

Notes: ***, **, * denote statistical significance at 1%, 5%, and 10%, respectively. Calculated p-values are shown in parentheses.

Table A1.3: Long-Run Granger Causality: Annual Data with OLS Estimator

	Manufacturing			Reverse Causality		
	Savings	TFP	Services	Savings	TFP	Services
Sum	0.169***	0.090**	0.193***	–0.017	–0.005	–0.027
	(0.002)	(0.046)	(0.000)	(0.698)	(0.647)	(0.758)
Long-run	0.615***	0.904**	0.218***	–0.014	–0.006	–0.030***
	(0.010)	(0.040)	(0.000)	(0.205)	(0.344)	(0.005)
# of Obs	1,092	1,240	1,617	1,092	1,240	1,616
# of Economies	64	49	65	64	49	65

OLS = ordinary least square; TFP = total factor productivity.

Notes: ***, **, * denote statistical significance at 1%, 5%, and 10%, respectively. Calculated p-values are shown in parentheses.

Table A1.4: Manufacturing Development and Growth Determinants: Cross-Sectional Regressions

	Savings	TFP	Services
Initial dependent variable	0.52***	0.52***	0.15***
	(0.000)	(0.000)	(0.000)
Initial manufacturing share	–0.52***	–0.73***	0.05
	(0.005)	(0.000)	(0.273)
MANVAGW	1.16***	0.43***	0.36***
	(0.004)	(0.000)	(0.000)
Constant	17.89***	40.98***	0.87
	(0.001)	(0.000)	(0.266)
# of Obs	63	57	47
Adj, R^2	0.59	0.38	0.65

MANVAGW = value-added growth rate of manufacturing; TFP = total factor productivity.

Notes: ***, **, * denote statistical significance at 1%, 5%, and 10%, respectively. Calculated p-values are shown in parentheses.

Table A1.5: Manufacturing Development and Growth Determinants: Panel Regressions

	Savings			
	(1)	**(2)**	**(3)**	**(4)**
MANVAGW	0.09***	0.10***	0.09***	0.09***
	(0.000)	(0.000)	(0.000)	(0.000)
Dep, 1st lag	0.69***	0.63***	0.60***	0.60***
	(0.000)	(0.000)	(0.000)	(0.000)
Dep, 2nd lag		0.05*	0.07**	0.07**
		(0.050)	(0.045)	(0.026)
Dep, 3rd lag			–0.01	–0.03
			(0.622)	(0.378)
Dep, 4th lag				0.07***
				(0.010)
GNI pca, 1st lag	0.12	0.46	0.64	0.51
	(0.324)	(0.292)	(0.151)	(0.235)
GNI pca, 2nd lag		–0.36	–0.19	–0.46
		(0.417)	(0.779)	(0.488)
GNI pca, 3rd lag			–0.31	0.57
			(0.500)	(0.394)
GNI pca, 4th lag				–0.66
				(0.144)
Constant	3.86	5.36	8.32**	6.29
	(0.516)	(0.200)	(0.047)	(0.117)
Obs	1,448	1,385	1,322	1,259
Adj. R^2	0.52	0.51	0.47	0.50
Unit root test	(0.00)	(0.00)	(0.00)	(0.00)
	TFP			
	(5)	**(6)**	**(7)**	**(8)**
MANVAGW	0.11***	0.12***	0.13***	0.15***
	(0.000)	(0.000)	(0.000)	(0.000)
Dep, 1st lag	0.92***	0.94***	0.93***	0.91***
	(0.000)	(0.000)	(0.000)	(0.000)
Dep, 2nd lag		–0.04	0.04	0.04
		(0.203)	(0.338)	(0.271)
Dep, 3rd lag			–0.07***	0.01
			(0.009)	(0.751)
Dep, 4th lag				–0.08***
				(0.003)
GNI pca, 1st lag	0.06	2.96***	2.39***	2.29***
	(0.664)	(0.000)	(0.000)	(0.000)

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Table A1.5 *continued*

	TFP			
	(5)	**(6)**	**(7)**	**(8)**
GNI pca, 2nd lag		–2.88***	–1.57*	–1.65*
		(0.000)	(0.073)	(0.063)
GNI pca, 3rd lag			–0.69	–0.72
			(0.212)	(0.421)
GNI pca, 4th lag				0.29
				(0.619)
Constant	5.51**	7.28***	5.57**	11.32***
	(0.040)	(0.004)	(0.035)	(0.000)
Obs	1,539	1,505	1,469	1,433
Adj. R^2	0.88	0.88	0.88	0.88
Unit root test	(0.00)	(0.00)	(0.00)	(0.00)
	Services			
	(9)	**(10)**	**(11)**	**(12)**
MANVAGW	0.12***	0.12***	0.12***	0.14***
	(0.000)	(0.000)	(0.000)	(0.000)
Dep, 1st lag	0.16***	0.11***	0.10***	0.10***
	(0.000)	(0.000)	(0.000)	(0.000)
Dep, 2nd lag		0.04*	0.02	0.02
		(0.083)	(0.338)	(0.437)
Dep, 3rd lag			0.04	0.02
			(0.102)	(0.362)
Dep, 4th lag				0.03
				(0.119)
GNI pca, 1st lag	–0.19***	1.49***	1.33***	1.27***
	(0.007)	(0.000)	(0.000)	(0.000)
GNI pca, 2nd lag		–1.72***	–1.02**	–1.06**
		(0.000)	(0.041)	(0.032)
GNI pca, 3rd lag			–0.61*	0.08
			(0.070)	(0.875)
GNI pca, 4th lag				–0.63*
				(0.059)
Constant	7.15	2.67	2.65	5.31
	(0.120)	(0.555)	(0.557)	(0.231)
Obs	1,948	1,880	1,813	1,747
Adj. R^2	0.13	0.16	0.15	0.17
Unit root test	(0.00)	(0.00)	(0.00)	(0.00)

GNI pca = gross national income per capita; MANVAGW = value-added growth rate of manufacturing; TFP = total factor productivity.

Notes: ***, **, * denote statistical significance at 1%, 5%, and 10%, respectively. Calculated p-values are shown in parentheses.

Table A1.6: Manufacturing Development, Human Capital, and Rule of Law

	Savings		TFP	
	(1)	(2)	(3)	(4)
MANPC*HCI	2.18***		0.14*	
	(0.002)		(0.071)	
MANPC*ROL		0.01***		00.0067**
		(0.007)		(0.024)
Dep, 1st lag	0.82***	0.68***	0.92***	0.93***
	(0.000)	(0.000)	(0.000)	(0.000)
Dep, 2nd lag	–0.35*	–0.03	0.026	0.0016
	(0.086)	(0.373)	(0.496)	(0.967)
Dep, 3rd lag	0.39*	–0.002	0.033	0.023
	(0.070)	(0.965)	(0.393)	(0.564)
Dep, 4th lag	–0.19	0.05*	–0.10***	–0.079***
	(0.251)	(0.082)	(0.000)	(0.008)
GNI pca, 1st lag	37.55***	–0.31	3.32***	2.46***
	(0.000)	(0.551)	(0.000)	(0.000)
GNI pca, 2nd lag	–45.46***	0.19	–3.11***	–1.83*
	(0.000)	(0.820)	(0.000)	(0.050)
GNI pca, 3rd lag	–3.18	0.60	–0.71	–0.87
	(0.461)	(0.479)	(0.437)	(0.353)
GNI pca, 4th lag	13.38***	–0.70	0.65	0.29
	(0.000)	(0.209)	(0.269)	(0.634)
Constant	–93.51**	7.35**	24.69***	14.19***
	(0.019)	(0.041)	(0.000)	(0.000)
Obs	857	941	1,446	1,331
Adj. R^2	0.38	0.52	0.95	0.90
Unit root test	(0.00)	(0.00)	(0.00)	(0.00)
	Services		GNI per capita	
	(5)	(6)	(7)	(8)
MANPC*HCI	0.26***		0.0052***	
	(0.001)		(0.000)	
MANPC*ROL		0.003*		0.00035**
		(0.059)		(0.034)
Dep, 1st lag	0.11***	0.11***		
	(0.000)	(0.000)		
Dep, 2nd lag	0.0077	0.011		
	(0.802)	(0.716)		
Dep, 3rd lag	0.027	0.023		
	(0.382)	(0.419)		
Dep, 4th lag	–0.060**	–0.044*		
	(0.025)	(0.087)		
GNI pca, 1st lag	1.71***	1.85***	1.23***	1.04***
	(0.000)	(0.000)	(0.000)	(0.000)
GNI pca, 2nd lag	–0.86	–1.35**	–0.21***	0.044
	(0.215)	(0.045)	(0.000)	(0.262)
GNI pca, 3rd lag	–0.89	–1.35**	–0.014	–0.015
	(0.215)	(0.045)	(0.734)	(0.746)
GNI pca, 4th lag	–0.41	–0.41	–0.034	–0.10***
	(0.410)	(0.545)	(0.221)	(0.001)
Constant	21.04***	–0.48	0.11	0.27*
	(0.000)	(0.285)	(0.334)	(0.051)
Obs	1,283	1,355	1,444	1,544
Adj. R^2	0.24	0.21	0.97	0.95
Unit root test	(0.00)	(0.00)	(0.00)	(0.00)

GNI pca = gross national income per capita; HCI = human capital index; MANPC = value-added share of manufacturing; ROL = rule of law index; TFP = total factor productivity.

Notes: ***, **, * denote statistical significance at 1%, 5%, and 10%, respectively. Calculated p-values are shown in parentheses.

Table A1.7: Endogeneity Issues: GMM-IV Regression

	Savings			
	(1)	**(2)**	**(3)**	**(4)**
MANVAGW	2.11***	2.44***	2.04***	2.21***
	(0.005)	(0.001)	(0.005)	(0.006)
Dep, 1st lag	0.63***	0.48*	0.28	0.22
	(0.000)	(0.099)	(0.305)	(0.463)
Dep, 2nd lag		–0.09	0.33	0.11
		(0.747)	(0.382)	(0.781)
Dep, 3rd lag			–0.20	0.20
			(0.445)	(0.604)
Dep, 4th lag				–0.27
				(0.347)
GNI pca, 1st lag	–0.42	43.83***	52.45***	52.33***
	(0.213)	(0.000)	(0.000)	(0.000)
GNI pca, 2nd lag		–44.89***	–77.40***	–74.63***
		(0.000)	(0.000)	(0.000)
GNI pca, 3rd lag			24.25***	20.35**
			(0.000)	(0.026)
GNI pca, 4th lag				1.23
				(0.779)
Constant	3.26	5.99	6.74	10.19**
	(0.511)	(0.187)	(0.126)	(0.024)
Obs	633	606	579	546
Adj. R^2	0.36	0.58	0.62	0.64
Exc. IV. F-stat	26.11***	27.28***	25.46***	20.83***
Hansen's J-stat	0.092	0.093	0.093	0.093
DWH-stat	0.739	0.739	0.738	0.738
	TFP			
	(5)	**(6)**	**(7)**	**(8)**
MANVAGW	0.34***	0.31**	0.30**	0.32**
	(0.000)	(0.012)	(0.017)	(0.016)
Dep, 1st lag	0.22***	0.16***	0.16***	0.16***
	(0.000)	(0.000)	(0.000)	(0.000)
Dep, 2nd lag		0.18	0.17	0.13
		(0.660)	(0.735)	(0.612)
Dep, 3rd lag			0.03	0.07
			(0.421)	(0.172)
Dep, 4th lag				0.03***
				(0.004)
GNI pca, 1st lag	0.02**	0.71**	0.79***	0.84***
	(0.028)	(0.013)	(0.005)	(0.005)
GNI pca, 2nd lag		–0.71**	–0.42**	–0.10**
		(0.020)	(0.014)	(0.010)

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Table A1.7 *continued*

	TFP			
	(5)	**(6)**	**(7)**	**(8)**
GNI pca, 3rd lag			–0.39	–1.51
			(0.302)	(0.528)
GNI pca, 4th lag				0.77
				(0.593)
Constant	1.80	1.50	1.47	1.22
	(0.354)	(0.361)	(0.316)	(0.211)
Obs	845	823	799	722
Adj. R^2	0.21	0.28	0.29	0.29
Exc. IV. F-stat	23.90***	20.55***	19.90***	21.68***
Hansen's J-stat	0.088	0.088	0.087	0.080
DWH-stat	0.491	0.492	0.499	0.488
	Services			
	(9)	**(10)**	**(11)**	**(12)**
MANVAGW	0.27**	0.23**	0.22*	0.22**
	(0.034)	(0.049)	(0.055)	(0.039)
Dep, 1st lag	0.97***	0.99***	0.98***	0.98***
	(0.000)	(0.000)	(0.000)	(0.000)
Dep, 2nd lag		–0.02***	0.02***	0.02***
		(0.000)	(0.000)	(0.000)
Dep, 3rd lag			–0.03	0.06*
			(0.436)	(0.065)
Dep, 4th lag				–0.10
				(0.547)
GNI pca, 1st lag	0.09	2.05	2.38	2.36*
	(0.412)	(0.147)	(0.158)	(0.069)
GNI pca, 2nd lag		–2.02	–2.83	–3.08
		(0.171)	(0.730)	(0.865)
GNI pca, 3rd lag			0.48	0.51
			(0.335)	(0.125)
GNI pca, 4th lag				0.25
				(0.297)
Constant	0.75***	0.79***	0.87***	1.10***
	(0.001)	(0.001)	(0.001)	(0.009)
Obs	895	885	875	865
Adj. R^2	0.95	0.95	0.95	0.95
Exc. IV. F-stat	42.63***	34.88***	36.20***	26.41***
Hansen's J-stat	0.020	0.023	0.024	0.029
DWH-stat	0.752	0.753	0.753	0.753

GMM = Generalized Method of Moments; GNI pca = gross national income per capita; MANVAGW = value-added growth rate of manufacturing; TFP = total factor productivity.

Notes: ***, **, * denote statistical significance at 1%, 5%, and 10%, respectively. Calculated p-values are shown in parentheses.

APPENDIX 2

A. Robustness Check: Absolute Criteria

Table A2.1: Long-Run Granger Causality: Annual Data with OLS Estimator

	Manufacturing			Reverse causality		
	Savings	**TFP**	**Services**	**Savings**	**TFP**	**Services**
Sum	0.150***	0.088**	0.371***	–0.028	0.001	–0.008
	(0.004)	(0.044)	(0.000)	(0.536)	(0.916)	(0.920)
Long-run	0.529***	0.729***	0.264***	–0.023	0.001	–0.007
	(0.007)	(0.040)	(0.000)	(0.341)	(0.322)	(0.754)
# of Obs	1,080	1,186	1,656	1,080	1,186	1,656
# of Economies	74	59	82	74	59	82

OLS = ordinary least square; TFP = total factor productivity.

Notes: ***, **, * denote statistical significance at 1%, 5%, and 10%, respectively. Calculated p-values are shown in parentheses.

Table A2.2: Manufacturing Development and Growth Determinants: Cross-Sectional Regressions

	Savings	**TFP**	**Services**
Initial Dependent variable	0.75***	0.49***	0.15***
	(0.000)	(0.000)	(0.000)
Initial manufacturing share	–0.40***	–0.44	0.07**
	(0.007)	(0.134)	(0.016)
MANVAGW	1.02***	2.40***	0.35***
	(0.008)	(0.008)	(0.000)
Constant	17.89***	25.61**	0.93*
	(0.000)	(0.049)	(0.074)
# of Obs	45	31	40
Adj, R^2	0.61	0.63	0.69

MANVAGW = value-added growth rate of manufacturing; TFP = total factor productivity.

Notes: ***, **, * denote statistical significance at 1%, 5%, and 10%, respectively. Calculated p-values are shown in parentheses.

Table A2.3: Manufacturing Development and Growth Determinants: Panel Regressions

	Savings			
	(1)	**(2)**	**(3)**	**(4)**
MANVAGW	0.07***	0.09***	0.07***	0.08***
	(0.000)	(0.000)	(0.000)	(0.000)
Dep, 1st lag	0.68***	0.62***	0.59***	0.59***
	(0.000)	(0.000)	(0.000)	(0.000)
Dep, 2nd lag		0.05*	0.06*	0.06*
		(0.064)	(0.069)	(0.061)
Dep, 3rd lag			–0.01	–0.02
			(0.721)	(0.545)
Dep, 4th lag				0.06**
				(0.026)
GNI pca, 1st lag	0.10	0.79	0.77	0.46
	(0.527)	(0.203)	(0.247)	(0.478)
GNI pca, 2nd lag		–0.69	0.71	0.45
		(0.267)	(0.501)	(0.677)
GNI pca, 3rd lag			–1.33*	–0.38
			(0.053)	(0.731)
GNI pca, 4th lag				–0.05
				(0.941)
Constant	5.72	7.19	8.55	7.07
	(0.283)	(0.237)	(0.206)	(0.381)
Obs	1,491	1,415	1,339	1,266
Adj. R^2	0.51	0.49	0.46	0.48
Unit root test	(0.00)	(0.00)	(0.00)	(0.00)
	TFP			
	(5)	**(6)**	**(7)**	**(8)**
MANVAGW	0.13***	0.14***	0.14***	0.16***
	(0.000)	(0.000)	(0.000)	(0.000)
Dep, 1st lag	0.90***	0.91***	0.91***	0.90***
	(0.000)	(0.000)	(0.000)	(0.000)
Dep, 2nd lag		–0.01	0.04	0.04
		(0.721)	(0.293)	(0.305)
Dep, 3rd lag			–0.06***	0.01
			(0.032)	(0.792)
Dep, 4th lag				–0.07**
				(0.016)
GNI pca, 1st lag	0.26	3.36***	2.66***	2.56***
	(0.104)	(0.000)	(0.000)	(0.000)
GNI pca, 2nd lag		–3.16***	–1.64	–1.82
		(0.000)	(0.121)	(0.101)

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Table A2.3 *continued*

	TFP			
	(5)	**(6)**	**(7)**	**(8)**
GNI pca, 3rd lag			–0.79	–0.34
			(0.231)	(0.760)
GNI pca, 4th lag				–0.05
				(0.942)
Constant	6.72**	7.40***	7.08***	11.17***
	(0.005)	(0.001)	(0.002)	(0.000)
Obs	1,548	1,502	1,455	1,409
Adj. R^2	0.88	0.88	0.88	0.88
Unit root test	(0.00)	(0.00)	(0.00)	(0.00)
	Services			
	(9)	**(10)**	**(11)**	**(12)**
MANVAGW	0.16***	0.15***	0.15***	0.16***
	(0.000)	(0.000)	(0.000)	(0.000)
Dep, 1st lag	–0.02	–0.09***	–0.11***	–0.12***
	(0.363)	(0.000)	(0.000)	(0.000)
Dep, 2nd lag		–0.06***	–0.08***	–0.10***
		(0.006)	(0.000)	(0.000)
Dep, 3rd lag			–0.04*	–0.06*
			(0.082)	(0.016)
Dep, 4th lag				0.03
				(0.391)
GNI pca, 1st lag	–0.11	4.80***	4.40***	4.39***
	(0.422)	(0.000)	(0.000)	(0.000)
GNI pca, 2nd lag		–5.03***	–3.39***	–3.74***
		(0.000)	(0.002)	(0.001)
GNI pca, 3rd lag			–1.32*	0.16
			(0.063)	(0.893)
GNI pca, 4th lag				–1.22*
				(0.100)
Constant	3.01	–0.40	–0.55	–2.69
	(0.395)	(0.910)	(0.879)	(0.470)
Obs	2,096	2,008	1,920	1,833
Adj. R^2	0.13	0.17	0.18	0.18
Unit root test	(0.00)	(0.00)	(0.00)	(0.00)

GNI pca = gross national income per capita; MANVAGW = value-added growth rate of manufacturing; TFP = total factor productivity.

Notes: ***, **, * denote statistical significance at 1%, 5%, and 10%, respectively. Calculated p-values are shown in parentheses.

Table A2.4: Manufacturing Development, Human Capital, and Rule of Law

	Savings		TFP	
	(1)	(2)	(3)	(4)
MANPC*HCI	1.34**		0.005*	
	(0.017)		(0.060)	
MANPC*ROL		0.0063*		0.0067**
		(0.100)		(0.91)
Dep, 1st lag	0.60***	0.065***	–0.124***	
	(0.000)	(0.000)	(0.000)	
Dep, 2nd lag	–0.25	–0.038	0.023	
	(0.171)	(0.299)	(0.001)	
Dep, 3rd lag	0.34*	–0.002	0.030	
	(0.091)	(0.965)	(0.424)	
Dep, 4th lag	–0.16	0.05*	–0.085**	
	(0.292)	(0.082)	(0.004)	
GNI pca, 1st lag	54.05***	–0.31	3.32***	
	(0.000)	(0.551)	(0.000)	
GNI pca, 2nd lag	–70.45***	0.19	–3.81***	
	(0.000)	(0.820)	(0.000)	
GNI pca, 3rd lag	–3.78	0.60	–0.096	
	(0.517)	(0.479)	(0.932)	
GNI pca, 4th lag	17.29***	–0.70	0.25	
	(0.000)	(0.209)	(0.719)	
Constant	4.35	7.35**	18.43***	
	(0.895)	(0.041)	(0.000)	
Obs	850	941	1,416	1,331
Adj. R^2	0.49	0.52	0.88	0.93
Unit root test	(0.00)	(0.00)	(0.00)	(0.00)
	Services		**GNI per capita**	
	(5)	**(6)**	**(7)**	**(8)**
MANPC*HCI	0.042***		0.0040***	
	(0.007)		(0.001)	
MANPC*ROL		0.0052***		0.00021**
		(0.007)		(0.045)
Dep, 1st lag	0.11***	–0.13***		
	(0.000)	(0.000)		
Dep, 2nd lag	–0.10	–0.11***		
	(0.802)	(0.000)		
Dep, 3rd lag	–0.079***	–0.083***		
	(0.009)	(004)		
Dep, 4th lag	–0.054	–0.050		
	(0.252)	(0.251)		
GNI pca, 1st lag	4.71***	5.34***	1.27***	1.01***
	(0.000)	(0.000)	(0.000)	(0.000)
GNI pca, 2nd lag	–4.49***	–5.38***	–0.28***	0.088**
	(0.003)	(0.000)	(0.000)	(0.025)
GNI pca, 3rd lag	1.24	1.27	0.016	–0.085**
	(0.446)	(0.409)	(0.733)	(0.078)
GNI pca, 4th lag	–1.88**	–1.74**	–0.033	–0.037
	(0.069)	(0.074)	(0.260)	(0.248)
Constant	0.084	–1.32	0.069	0.184*
	(0.985)	(0.751)	(0.469)	(0.093)
Obs	1,299	1,423	1,419	1,580
Adj. R^2	0.15	0.17	0.97	0.96
Unit root test	(0.00)	(0.00)	(0.00)	(0.00)

GNI pca = gross national income per capita; HCI = Human capital index; MANPC = value-added share of manufacturing; ROL = rule of law index; TFP = total factor productivity.

Notes: ***, **, * denote statistical significance at 1%, 5%, and 10%, respectively. Calculated p-values are shown in parentheses.

Table A2.5: Endogeneity Issues: GMM-IV Regression

	Savings			
	(1)	**(2)**	**(3)**	**(4)**
MANVAGW	2.57***	2.34***	1.82***	1.86***
	(0.001)	(0.004)	(0.032)	(0.026)
Dep, 1st lag	0.66***	0.37	0.21	0.19
	(0.000)	(0.114)	(0.327)	(0.525)
Dep, 2nd lag		0.11	0.51	0.36
		(0.619)	(0.105)	(0.267)
Dep, 3rd lag			–0.16	0.03
			(0.509)	(0.933)
Dep, 4th lag				–0.12
				(0.634)
GNI pca, 1st lag	–1.35***	49.66***	67.27***	67.67***
	(0.002)	(0.000)	(0.000)	(0.000)
GNI pca, 2nd lag		–51.91**	–110.53***	–113.41***
		(0.000)	(0.000)	(0.000)
GNI pca, 3rd lag			41.95***	51.71***
			(0.000)	(0.000)
GNI pca, 4th lag				–7.41
				(0.216)
Constant	5.31	8.11*	6.72*	9.59**
	(0.289)	(0.065)	(0.089)	(0.012)
Obs	635	604	572	535
Adj. R^2	0.13	0.43	0.51	0.51
Exc. IV. F-stat	23.23***	19.69***	16.57***	17.36***
	TFP			
	(5)	**(6)**	**(7)**	**(8)**
MANVAGW	0.29***	0.23**	0.19*	0.20**
	(0.000)	(0.019)	(0.057)	(0.041)
Dep, 1st lag	0.95***	0.93***	0.93***	0.93***
	(0.000)	(0.000)	(0.000)	(0.000)
Dep, 2nd lag		0.02	0.06	0.06
		(0.556)	(0.239)	(0.234)
Dep, 3rd lag			–0.03	0.04
			(0.363)	(0.405)
Dep, 4th lag				–0.08**
				(0.015)
GNI pca, 1st lag	0.13**	2.56**	3.42***	3.29***
	(0.011)	(0.019)	(0.004)	(0.005)
GNI pca, 2nd lag		–2.52**	–4.51***	–4.90***
		(0.028)	(0.005)	(0.004)

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Table A2.5 *continued*

	TFP			
	(5)	**(6)**	**(7)**	**(8)**
GNI pca, 3rd lag			1.15*	1.82
			(0.057)	(0.123)
GNI pca, 4th lag				–0.14
				(0.826)
Constant	1.36*	1.53**	1.56**	1.68**
	(0.082)	(0.042)	(0.041)	(0.026)
Obs	861	846	832	817
Adj. R^2	0.96	0.96	0.96	0.96
Exc. IV. F-stat	39.96***	31.74***	30.06***	31.06***
	Services			
	(9)	**(10)**	**(11)**	**(12)**
MANVAGW	0.19*	0.22*	0.21**	0.22*
	(0.113)	(0.067)	(0.044)	(0.127)
Dep, 1st lag	0.06	–0.09**	–0.11***	–0.13***
	(0.182)	(0.015)	(0.003)	(0.001)
Dep, 2nd lag		0.09***	0.06*	0.04
		(0.004)	(0.087)	(0.027)
Dep, 3rd lag			0.14***	0.14***
			(0.000)	(0.000)
Dep, 4th lag				0.06*
				(0.069)
GNI pca, 1st lag	–0.02	4.23***	4.31***	4.46***
	(0.683)	(0.000)	(0.000)	(0.000)
GNI pca, 2nd lag		–4.39***	–4.08***	–4.23***
		(0.000)	(0.004)	(0.005)
GNI pca, 3rd lag			–0.42	0.16
			(0.606)	(0.918)
GNI pca, 4th lag				–0.28
				(0.776)
Constant	3.42***	3.58***	3.30***	3.25***
	(0.000)	(0.000)	(0.000)	(0.000)
Obs	867	837	804	770
Adj. R^2	0.16	0.24	0.25	0.25
Exc. IV. F-stat	24.62***	23.49***	21.11***	23.47***

GMM = Generalized Method of Moments; GNI pca = gross national income per capita; MANVAGW = value-added growth rate of manufacturing; TFP = total factor productivity.

Notes: ***, **, * denote statistical significance at 1%, 5%, and 10%, respectively. Calculated p-values are shown in parentheses.

B. Robustness Check: Long-Run Granger Causality Test

Table A2.6: Long-Run Granger Causality Test: GMM and Different Number of Lags

	GMM			8 lags		
	Savings	**TFP**	**Services**	**Savings**	**TFP**	**Services**
Sum	0.191***	0.086*	0.182***	0.211***	0.075*	0.178***
	(0.000)	(0.056)	(0.000)	(0.002)	(0.072)	(0.000)
Long-run	0.659***	0.861	0.203***	0.701**	0.586*	0.194***
	(0.010)	(0.152)	(0.000)	(0.018)	(0.081)	(0.000)
# of Obs	1,028	1,240	1,617	966	1,144	1,489
# of Economies	62	49	65	61	46	61

GMM = Generalized Method of Moments; TFP = total factor productivity.

Notes: ***, **, * denote statistical significance at 1%, 5%, and 10%, respectively. Calculated p-values are shown in parentheses.

Table A2.7: Long-Run Granger Causality Test: With Country Heterogeneity

	Manufacturing and Saving			
		25%	**50%**	**75%**
Sum	0.263***	–0.081	0.056	0.329
	(0.021)			
Long-run	0.422**	–0.406	0.096	0.623
	(0.040)			
# of Obs	1224			
# of Economies	66			
	Manufacturing and TFP			
		25%	**50%**	**75%**
Sum	0.073**	–0.157	0.057	0.311
	(0.017)			
Long-run	0.422**	–1.013	0.383	1.193
	(0.017)			
# of Obs	1749			
# of Economies	66			
	Manufacturing and Services			
		25%	**50%**	**75%**
Sum	0.257***	–0.115	0.122	0.441
	(0.000)			
Long-run	0.3117***	–0.113	0.151	0.473
	(0.000)			
# of Obs	1388			
# of Economies	49			

TFP = total factor productivity.

Notes: ***, **, * denote statistical significance at 1%, 5%, and 10%, respectively. Calculated p-values are shown in parentheses.

C. Robustness Check: Cross-Sectional Regression

Table A2.8: Manufacturing Development and Growth Determinants: Cross-Sectional Regressions

	Savings			
	(1)	**(2)**	**(3)**	**(4)**
Initial dependent variable	0.44***	0.45***	0.51***	0.47***
	(0.000)	(0.000)	(0.000)	(0.000)
Initial manufacturing share	–0.53***	–0.52***	–0.45***	–0.37*
	(0.001)	(0.001)	(0.005)	(0.046)
MANVAGW	1.14***	1.14***	0.84**	1.02**
	(0.001)	(0.001)	(0.030)	(0.035)
Latitude	–14.17***	–18.45**	–22.55***	–28.77**
	(0.005)	(0.011)	(7.950)	(0.005)
Colony		–0.49	–0.46	–0.76
		(0.410)	(0.437)	(0.263)
English			–3.05	–4.63
			(0.011)	(0.000)
French			–5.22	–4.91
			(0.001)	(0.004)
Africa				2.37
				(0.498)
Asia				–1.74
				(0.752)
Latin America				–2.16
				(0.718)
Constant	17.89***	25.01***	27.07***	30.45***
	(0.000)	(0.000)	(0.000)	(0.000)
Obs	62	60	55	55
Adj. R^2	0.67	0.67	0.67	0.69
	TFP			
	(5)	**(6)**	**(7)**	**(8)**
Initial dependent variable	0.52***	0.50**	0.49*	0.44**
	(0.000)	(0.000)	(0.000)	(0.000)
Initial manufacturing share	–0.64***	–0.58***	–0.39***	–0.29**
	(0.000)	(0.000)	(0.005)	(0.054)
MANVAGW	0.41***	0.38***	0.35***	0.28***
	(0.000)	(0.000)	(0.000)	(0.000)
Latitude	–11.28***	–27.27***	–33.49***	–16.39**
	(0.007)	(0.000)	(0.000)	(0.034)
Colony		–1.99***	–3.05***	–3.65***
		(0.000)	(0.000)	(0.000)

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Table A2.8 *continued*

	Savings			
	(1)	**(2)**	**(3)**	**(4)**
English			10.06***	7.51***
			(0.001)	(0.016)
French			–1.40	–2.76
			(0.601)	(0.372)
Africa				20.82***
				(0.000)
Asia				17.03***
				(0.000)
Latin America				14.85***
				(0.000)
Constant	43.28***	53.16***	54.77***	51.69***
	(0.000)	(0.000)	(0.000)	(0.000)
Obs	57	57	56	56
Adj. R^2	0.38	0.39	0.41	0.44
	Services			
	(9)	**(10)**	**(11)**	**(12)**
Initial dependent variable	0.13**	0.13***	0.12***	0.13***
	(0.000)	(0.000)	(0.000)	(0.000)
Initial manufacturing share	0.07*	0.07*	0.05	0.05
	(0.080)	(0.088)	(0.164)	(0.211)
MANVAGW	0.36***	0.36***	0.47***	0.46***
	(0.000)	(0.000)	(0.000)	(0.000)
Latitude	–2.74**	–3.13	–1.30	–0.16
	(0.017)	(0.110)	(0.482)	(0.952)
Colony		–0.04	–0.09	–0.02
		(0.794)	(0.543)	(0.926)
English			1.51	1.59
			(0.086)	(0.130)
French			1.57**	1.58**
			(0.003)	(0.013)
Africa				–0.17
				(0.843)
Asia				0.22
				(0.866)
Latin America				0.55
				(0.562)
Constant	1.76**	1.96	0.17	–0.36
	(0.026)	(0.089)	(0.888)	(0.808)
Obs	47	47	47	47
Adj. R^2	0.71	0.70	0.77	0.77

MANVAGW = value-added growth rate of manufacturing; TFP = total factor productivity.

Notes: ***, **, * denote statistical significance at 1%, 5%, and 10%, respectively. Calculated p-values are shown in parentheses.

D. Robustness Check: Panel Regression

Table A2.9: Manufacturing Development and Growth Determinants: Panel Regressions with GMM

	Savings			
	(1)	**(2)**	**(3)**	**(4)**
MANVAGW	0.09***	0.08***	0.08***	0.08***
	(0.000)	(0.003)	(0.004)	(0.004)
Dep, 1st lag	0.68***	0.62***	0.60***	0.60***
	(0.000)	(0.000)	(0.000)	(0.000)
Dep, 2nd lag		0.06	0.06	0.07
		(0.436)	(0.528)	(0.447)
Dep, 3rd lag			–0.00	–0.03
			(0.999)	(0.611)
Dep, 4th lag				0.07***
				(0.007)
GNI pca, 1st lag	–0.07	0.30	0.37	0.44
	(0.543)	(0.393)	(0.311)	(0.194)
GNI pca, 2nd lag		–0.37	–0.13	–0.36
		(0.274)	(0.847)	(0.578)
GNI pca, 3rd lag			–0.27	0.16
			(0.624)	(0.803)
GNI pca, 4th lag				–0.34
				(0.339)
Constant	8.36***	8.20***	8.32***	7.24***
	(0.000)	(0.000)	(0.000)	(0.000)
Obs	1,378	1,316	1,254	1,191
Adj. R^2	0.56	0.31	0.35	0.86
	TFP			
	(5)	**(6)**	**(7)**	**(8)**
MANVAGW	0.16***	0.15***	0.15***	0.16***
	(0.000)	(0.000)	(0.000)	(0.000)
Dep, 1st lag	0.92***	0.94***	0.93***	0.92***
	(0.000)	(0.000)	(0.000)	(0.000)
Dep, 2nd lag		–0.02	0.04	0.04
		(0.385)	(0.280)	(0.330)
Dep, 3rd lag			–0.06**	0.01
			(0.016)	(0.689)
Dep, 4th lag				–0.07**
				(0.029)
GNI pca, 1st lag	0.02	2.92**	2.38***	2.24**
	(0.854)	(0.018)	(0.016)	(0.012)

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Table A2.9 *continued*

	TFP			
	(5)	**(6)**	**(7)**	**(8)**
GNI pca, 2nd lag		–2.97***	–1.49***	–1.56***
		(0.021)	(0.007)	(0.001)
GNI pca, 3rd lag			–0.94	–0.59
			(0.271)	(0.315)
GNI pca, 4th lag				–0.10
				(0.897)
Constant	4.93***	5.46***	6.02***	6.44***
	(0.000)	(0.000)	(0.000)	(0.000)
Obs	1,485	1,451	1,415	1,382
Adj. R^2	0.36	0.31	0.35	0.56
	Services			
	(9)	**(10)**	**(11)**	**(12)**
MANVAGW	0.15***	0.16***	0.16***	0.17***
	(0.000)	(0.000)	(0.000)	(0.000)
Dep, 1st lag	0.18**	0.13***	0.11**	0.11**
	(0.010)	(0.009)	(0.038)	(0.034)
Dep, 2nd lag		0.04	0.02	0.02
		(0.168)	(0.557)	(0.532)
Dep, 3rd lag			0.04	0.03
			(0.139)	(0.318)
Dep, 4th lag				–0.03
				(0.192)
GNI pca, 1st lag	–0.19**	1.31	1.32*	1.28*
	(0.021)	(0.113)	(0.071)	(0.064)
GNI pca, 2nd lag		–1.53*	–1.15**	–1.15**
		(0.056)	(0.024)	(0.020)
GNI pca, 3rd lag			–0.43	–0.01
			(0.434)	(0.988)
GNI pca, 4th lag				–0.40
				(0.352)
Constant	4.09***	4.12***	4.21***	4.53***
	(0.000)	(0.000)	(0.000)	(0.000)
Obs	1,879	1,812	1,746	1,680
Adj. R^2	0.55	0.33	0.34	0.83

GMM = Generalized Method of Moments; GNI pca = gross national income per capita; MANVAGW = value-added growth rate of manufacturing; TFP = total factor productivity.

Notes: ***, **, * denote statistical significance at 1%, 5%, and 10%, respectively. Calculated p-values are shown in parentheses.