PART III

Dollar Price Wedge between Nominal and Real Global Value Chain Participation
**Introduction**

Global value chains (GVCs) describe the flow of goods and services across economies through sequential processes of production, distribution, and value addition within supply chains, capitalizing on location-specific competitive advantages including changes in relative prices. With supply chains now highly globalized, an important question to ask is, have the significant price increases seen worldwide since mid-2021, resulted in changes in economies’ participation in GVCs? Using the nominal and real multiregional input-output tables (MRIOTs) produced by the Asian Development Bank (ADB 2023) for the period 2007–2022, this chapter tracks the evolution of GVC participation indicators of certain economies, and the effects that price changes have had.

While trends in GVC participation based on nominal MRIOTs are affected by changes in economic structures, production technologies, prices, and exchange rates, those based on the real MRIOTs are affected only by the first two having been expressed in constant prices. Analyzing both the nominal and real trends provides a richer context, and this chapter reports on the effects of dollar price changes1 on GVC participation rates, especially in the context of post-pandemic inflation.

**Nominal and Real MRIOTs**

ADB has been publishing nominal MRIOTs since 2015, and the real MRIOTs since 2020, with 35-industry and 5-final demand category disaggregation for 62 economies and the rest of the world. Nominal MRIOTs are compiled using the same methodology employed by the World Input-Output Database (WIOD)2. Real MRIOTs, expressed in 2010 prices, are compiled to remove changes in the trends driven by price fluctuations, so that these are in constant terms and relate only to other factors such as quantity, value-addition, and compositional changes3.

Both the nominal and real MRIOTs tables are expressed in US dollars (USD). For the nominal MRIOTs, data are sourced from the official national accounts, and international trade databases such as United Nations Comtrade and Balanced Trade in Services. Data in local currency units are converted to USD using the period average exchange rates obtained from the International Monetary Fund (IMF 2022) International Financial Statistics. Real tables are calculated by deflating the nominal counterparts using implicit

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1 Price changes are referred to as dollar price changes since all MRIOT are expressed in US dollars (USD).

2 World Input–Output Database is developed by the Groningen Growth and Development Centre at the University of Groningen in the Netherlands.

price indices (deflators)\textsuperscript{4}. The main data source for deflators is the United Nations Statistics Division (UNSD) National Accounts Estimates of Main Aggregates database.

Table 3.1 is a simplified representation of a real MRIOT, assuming a two-economy, two-industry, and three-final use category universe. Notations with and without asterisks refer respectively to real and nominal values.

\textbf{Table 3.1: Simplified Representation of a Real Multiregional Input-Output Table}

<table>
<thead>
<tr>
<th>Economy A</th>
<th>Economy B</th>
<th>Economy A</th>
<th>Economy B</th>
<th>Gross Output (GO)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industry 1</td>
<td>Industry 2</td>
<td>Industry 1</td>
<td>Industry 2</td>
<td>F1 (FCE) F2 (GFCF) F3 (INV) F1 (FCE) F2 (GFCF) F3 (INV)</td>
</tr>
<tr>
<td>INT\textsuperscript{RA}\textsubscript{12}</td>
<td>INT\textsuperscript{RA}\textsubscript{11}</td>
<td>INT\textsuperscript{RA}\textsubscript{AB}</td>
<td>INT\textsuperscript{RA}\textsubscript{AB}</td>
<td>FIN\textsuperscript{RA}\textsubscript{12}</td>
</tr>
<tr>
<td>INT\textsuperscript{RA}\textsubscript{21}</td>
<td>INT\textsuperscript{RA}\textsubscript{22}</td>
<td>INT\textsuperscript{RA}\textsubscript{AB}</td>
<td>INT\textsuperscript{RA}\textsubscript{AB}</td>
<td>FIN\textsuperscript{RA}\textsubscript{22}</td>
</tr>
<tr>
<td>TINT\textsubscript{1}</td>
<td>TINT\textsubscript{2}</td>
<td>TINT\textsubscript{1}</td>
<td>TINT\textsubscript{2}</td>
<td>TFIN\textsubscript{1}</td>
</tr>
<tr>
<td>GVA\textsuperscript{A}</td>
<td>GVA\textsuperscript{A}</td>
<td>GVA\textsuperscript{B}</td>
<td>GVA\textsuperscript{B}</td>
<td>FIN\textsuperscript{A}</td>
</tr>
</tbody>
</table>

Where: INT Intermediate Use
FIN Final Use
TINT Taxes, Subsidies, International transport margins, etc. (TAX)
TFIN Taxes, Subsidies, International transport margins, etc. on Final Use
TAX Total Taxes, Subsidies, International transport margins, etc.
GVA Gross Value-Added
GO Gross Output
* Value at Constant Prices

Thus:
\text{INT}\textsuperscript{RA}\textsubscript{12} Intermediate Use of industry 1 of Economy B exported to industry 2 of Economy A
\text{INT}\textsuperscript{RA}\textsubscript{21} Intermediate Use of industry 2 of Economy A domestically acquired by Industry 1 of Economy A
\text{FIN}\textsuperscript{RA}\textsubscript{11} Final Use of Industry 1 of Economy B exported to Final Consumption Expenditure of Economy B

In general,
Let: \text{M} Row Economy (Exporting Economy)
\text{N} Column Economy (Importing Economy)
i Row Industry
j Column Industry
f Column Final Use
p Implicit Price Deflator

\textsuperscript{4} The conversion to USD by the UNSD is done using appropriate annual monthly average of annual average end of month quotations of exchange rates. The market exchange rates are obtained from the International Monetary Fund (IMF 2022), International Financial Statistics, which are communicated by the Monetary Authority of each member economy or from end-of-month quotations in the market of that economy. The implicit price index is computed as the ratio of current value to constant value multiplied by 100.
Thus:

\[
GO_i^M = \frac{GO_i^M}{p_{GO_i}}
\]

\[
FIN_{iMN} = \frac{FIN_{iMN}}{p_{FIN}}
\]

\[
FIN_{iJ}^M = \frac{FIN_{iJ}^M}{(GO_i^M - \sum_M FIN_{iJ}^M_N)} \times (GO_i^M - \sum_M FIN_{iJ}^M_N)
\]

\[
INT_{iJ}^M_N = \frac{INT_{iJ}^M_N}{(GO_i^M - \sum_M INT_{iJ}^M_N)} \times (GO_i^M - \sum_M INT_{iJ}^M_N)
\]

\[
TINT_{iJ}^N = \frac{TINT_{iJ}^N}{p_{TINT}}
\]

\[
GVA_i^N = \frac{GVA_i^N}{(GO_i^M - \sum_M INT_{iJ}^M_N)} \times (GO_i^M - \sum_M INT_{iJ}^M_N)
\]

\[
TAX^* = \sum_N TINT_{iJ}^N + \sum_N TFIN_{iJ}^N
\]

\[
GVA^* = \sum_M GVA_i^N
\]

\[
GO^* = \sum_M GO_i^M
\]

Source: Asian Development Bank (ADB) framework.

Deflator indices for the gross value-added (GVA) of the industries and final use categories are critical to the construction of the real MRIOTs. GVA deflators are used to segregate the effects of price changes on outputs. Ideally, each industry has its own unique deflator. However, implicit price indices are available only at an aggregated level for some industry categories. In such cases, price indices of closely related industries are used as deflators. Since changes in inventories could also be negative, using the standard inventory deflators has been shown to distort the real MRIOTs compilation process. Thus, economy-wide GDP deflators are used for inventories.

Industry-specific gross outputs are deflated using the relevant implicit price indices. The resulting gross outputs in volume or real terms serve to calibrate, from both supply (row) and use (column) perspectives, transaction values in the MRIOTs resulting from subsequent estimation processes. Gross outputs, net of inventories in real terms, are proportionally allocated row-wise based on the structure of the nominal tables (with the columns for inventories excluded). Then, the total use of intermediate inputs by economy-industry is derived by summing up the deflated values in each column. For each economy-industry, the residual derived by subtracting the deflated total intermediate inputs from the deflated gross output (column totals) is proportionally distributed to GVA, taxes, subsidies, and international transport margins based on their corresponding shares in the nominal MRIOTs. Total final use by economy-category is calculated by summing up the deflated values in each column in the final use block.

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5 Given the limitations in the price indices adopted for the current methodology, improvements to the compilation process are underway. These include the collection of disaggregated deflators (per industry), including export and import price indices, as officially reported by National Statistics Offices. Gross value-added deflators will also be separately collected from gross output deflators, with intermediate consumption derived residually. The current methodology treats the gross value-added as a residual, while assuming that the gross output deflators are the same as the gross value-added deflators.
To ensure that the resulting estimates in the real MRIOTs are coherent with the UN official deflators, and the nominal MRIOTs, are consistent with relevant statistical and economic concepts and identities, a series of consistency and validation checks are conducted, and adjustments are made accordingly.

**Methodology**

The underlying data for the statistics and analysis presented in this chapter are the nominal and real MRIOTs produced by ADB. Time series of nominal MRIOTs account for changes in production technology, economic structure, prices, and exchange rates over time. The series of real MRIOTs, on the other hand, expressed in 2010 (base year) prices, reflect only the technological and structural changes. Thus, price and exchange rate changes together account for the differences between corresponding data points in the two tables or statistics derived from them. The combined effects of such are referred to as the dollar price wedge in this chapter since all transactions in the MRIOTs are expressed in US dollars.
The objective of this chapter is to document this dollar price wedge, or the difference between nominal and real GVC participation. To this end, data on gross exports from the nominal and real MRIOTs are decomposed into value-added components following Borin and Mancini's (2019) framework.

An economy's gross exports can be decomposed as follows:

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DAVAX</td>
<td>Traditional type of trade where value-added exports cross one international border</td>
</tr>
<tr>
<td>REX</td>
<td>Value-added exports that are re-exported and are ultimately absorbed abroad</td>
</tr>
<tr>
<td>REF</td>
<td>Value-added exports eventually absorbed back at home</td>
</tr>
<tr>
<td>FVA</td>
<td>Foreign value-added embedded in an economy's exports</td>
</tr>
<tr>
<td>PDC</td>
<td>Purely double counted trade resulting from back-and-forth trading</td>
</tr>
</tbody>
</table>

Economy i’s GVC participation rates for any given year t are given as follows:

Let $j \in \{\text{constant price}, \text{current price}\}$,

$$GVC \text{ participation rate}_{i,t}^j = \frac{REX_{i,t}^j + REF_{i,t}^j + FVA_{i,t}^j + PDC_{i,t}^j}{Gross \ exports_{i,t}^j} \quad (1)$$

$$Backward \ GVC \ PR_{i,t}^j = \frac{FVA_{i,t}^j + PDC_{i,t}^j}{Gross \ exports_{i,t}^j} \quad (2)$$

$$Forward \ GVC \ PR_{i,t}^j = \frac{REX_{i,t}^j + REF_{i,t}^j}{Gross \ exports_{i,t}^j} \quad (3)$$

Each of these equations provide two sets of GVC participation rates: nominal – based on nominal MRIOTs; and real – based on real MRIOTs. The two sets of GVC participation rates for selected regions and economies will be examined in the following sections.

**World and Developing Asia’s GVC Participation**

Nominal and real GVC-related trade shares in total world exports have largely remained stable and consistent with each other since 2007, with averages of 45.2% and 45.0%, respectively, as shown in Figure 3.1. This observed stability of world GVC shares over time reflects the long-term relationships among economies, industries, and businesses involved in global production networks. Since GVCs rely on efficient coordination amongst various economic actors and integration of different stages of production across multiple jurisdictions, this consistency underlines the deep and enduring interdependencies within global supply chains.
The effect of the recent inflationary surge is apparent for 2021, when total nominal exports exceeded real estimates by nearly 8%, the largest gap in the series. The corresponding gap in 2022 was more than 7%, the third largest gap in the series. This implies that price effects on the measurement of GVC participation have become large enough to affect our understanding of GVC levels and trends. It is therefore no longer sufficient to study GVC in nominal terms only.

The relative stability in GVC trade as a share of total exports and the consistency of the ratios in nominal and real terms seen above are also reflected in the GVC participation rates at the world level (Figure 3.2). The recent inflationary surges are reflected in 2022, which saw a 0.9 percentage point separating the nominal and real GVC participation rates that year, the highest in the series. The earlier stability could be explained by two factors. First, the combined inflation and exchange rate pass-through effects may not have caused substantial shifts in the distribution of global value chain activities at the world level. Further, long-term contracts, pricing, and hedging arrangements may have helped to stabilize prices and trade volumes within GVCs over time.

It is noteworthy, that from 2012 to 2016, globally, producer price inflation fell below consumer price inflation before increasing at a much faster rate and diverging post-pandemic. The difference between producer price inflation and consumer price inflation is a key determinant of the size of the dollar price wedge. All else being equal, given formulas (1)–(3) above, when producer price inflation is lower than consumer price inflation, real GVC participation rates tend to be higher than nominal participation rates.
While GVC trade shares to total exports have remained relatively stable since 2007, participation rates have been considerably affected by major events such as the global financial crisis (GFC) (2007–2009), the United States and People’s Republic of China (US-PRC) trade conflict (2016–2019), and the COVID-19 pandemic (2020 onward). The sharpest increases in real and nominal participation rates since the GFC were seen in 2021 and 2022. However, while both series reached record-high levels by 2022, real participation fell further below nominal participation with surging producer price inflation far outpacing consumer price inflation.

Compared to the drop in GVC participation following the GFC, the decline in 2020 was significantly smaller. This could be attributed to a few key developments: (1) the normal trade cycle and the intensifying US-PRC trade conflict which had significantly dampened trade and GVC participation by 2019; (2) the unprecedented degree of fiscal and monetary measures which many governments rolled out attenuated the pandemic’s impact on demand and supply; and (3) the acceleration and adoption of digital technologies which largely ensured the continuation of economic activities, created major opportunities in new and emerging areas such as e-commerce, and increased the demand for digital goods and services.

Developing Asia's nominal and real GVC participation rates have generally trodden close to global rates since 2007 (Figure 3.3). However, during the periods of major crises discussed above, the region’s participation declined faster than the global average, indicating that its GVC trade was more sensitive to the impact of such events and shocks.

Moreover, the region's nominal and real participation rates were relatively less closely aligned than the global averages. The largest dollar price wedges for the region were seen between 2012 and 2016, before narrowing considerably in recent years. It should be noted that developing Asia's GVC participation is largely driven by the PRC’s
GVC-related trade, which in 2022 accounted for nearly 40% of the region's total trade in intermediate products.

Between 2012 and 2016, the PRC's producer price inflation fell well below its consumer price inflation with the gap widest in 2015. The average difference between the two inflation rates narrowed quite significantly between 2017 and 2021, which seemed to be reflected in the region's dollar price wedge during the period. Producer price inflation surged between 2020 and 2022, while consumer price inflation remained relatively flat, contributing not only to the widening of the wedge but also to the surpassing of the real rate by the nominal rate for the first time in the series.

**Economy-Specific GVC Participation**

To study the effects of the dollar price changes on GVC participation statistics at a more granular level, the nominal and real participation trends of selected economies are analyzed in this subsection with statistics on backward and forward participation. The economies were chosen based on their relative importance in the global supply chains (PRC and US), and on the unique characteristics of their participation in GVCs (Türkiye, Singapore, and Kazakhstan).

Türkiye is ranked among the 20 largest economies in the world and is located at the crossroads of Asia and Europe. Between 2007 and 2022, the economy's GVC participation appeared to be rising in nominal terms (Figure 3.4.a). However, since 2008, Turkish lira has been depreciating against the US dollar, and when this is taken into consideration, Türkiye's GVC participation is shown to be flat over the course of the data series, fluctuating between 36% and 42% in real terms.

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6 While the real participation rates were above nominal rates throughout 2011 to 2019, the reverse is seen in the estimates for years prior to 2010 due to the choice of that year as the base year for the MRIO deflation.
Similarly, Türkiye's backward participation rate has been rising in nominal terms (Figure 3.4.b). However, once currency depreciation and price effects have been controlled for, the trend is reversed. In real terms, Türkiye's backward participation rate has in fact been declining since 2007.

In terms of forward participation, currency depreciation has had the opposite trend effect. Türkiye's forward participation rate has been underestimated in nominal terms, as the real rates are a few percentage points higher (Figure 3.4.c). The price wedge has also grown over time, with the largest gaps in 2021–2022, reflecting recent inflationary pressures.

**Figure 3.4: GVC Participation Rate, Türkiye, 2007–2022**

GVC = Global Value Chains.

Click here for figure data
High services content in trade characterizes Singapore’s participation in GVCs. Although a relatively small economy, Singapore’s involvement in global supply chains was quite high between 2007 and 2022, with its overall GVC participation rate averaging above 60% both in nominal and real terms (Figure 3.5.a). Although the two series were closely aligned between 2007 and 2014, the dollar price wedge started to increase in 2015 and has sustained a relatively wide gap until 2020.

Singapore’s economic slowdown in 2015–2016, which coincided with a sharp depreciation of its currency, evidently affected its GVC participation. The backward participation rates had their steepest decline during this period, subsequently creating a dollar price wedge that reached its peak in the years leading up to the US-PRC trade dispute (Figure 3.5.b). Both nominal and real forward participation rates of Singapore have been rising since 2015 before declining in 2022 (Figure 3.5.c). During this period, the combined effects of inflation and exchange rate pass-through appear to have pulled nominal rates upward relative to real rates.

Figure 3.5: GVC Participation Rate, Singapore, 2007–2022

GVC = Global Value Chains.

Click here for figure data
Between 2007 and 2022, Kazakhstan’s currency (Kazakhstani Tenge) was steadily declining. After the pandemic, the economy also experienced one of the largest surges in overall inflation in developing Asia. Yet, even with these developments, the dollar price wedge between its nominal and real GVC participation rates remained rather narrow throughout the period (Figure 3.6.a).

Kazakhstan’s economy is dominated by the mining sector, with intermediate products like crude petroleum, gas and crude metals—prices of which are globally determined in US dollars—consistently constituting the bulk of its exports (averaging 70%). On the other hand, products for final use made only a small contribution to exports (10%). Imports, meanwhile, were dominated by final products (80%). Such an economic landscape may have contributed to the close alignment of nominal and real forward GVC participation rates even in times of persistent inflation and tenge depreciation (Figure 3.6.c). As for backward participation rates, although trends in nominal and real terms exhibited similarity in movement, a seemingly permanent and consistent price wedge between the two is observed from 2015 all the way to 2022.

Figure 3.6: GVC Participation Rate, Kazakhstan, 2007–2022

GVC = Global Value Chains.

Click here for figure data
Between 2007 and 2022, the PRC’s nominal and real GVC participation rates were generally closely aligned with each other, although real participation had been higher since 2011, with the dollar price wedge narrowing between 2017 and 2019 before starting to widen after 2020 (Figure 3.7.a). The price wedge also changed direction in 2022, occurring alongside a producer price inflation surge and yuan depreciation.

It is striking that the PRC’s GVC participation rates, in nominal and real terms, reached near peak levels in 2022 despite the US-PRC trade conflict, the pandemic and the Russian invasion of Ukraine. Interestingly, the economy’s real participation trend was largely driven by its backward participation while the nominal one was driven by forward participation. Even as nominal rates showed PRC’s backward participation to have stagnated since 2018, in real terms it seemed not only to have recovered from the effects of both the trade conflict and the pandemic but to have further strengthened in 2022 (Figure 3.7.b). The converse appeared to be the case with forward participation (Figure 3.7.c.).

**Figure 3.7: GVC Participation Rate, People’s Republic of China, 2007–2022**

GVC = Global Value Chains.
Between 2007 and 2013, the nominal and real GVC participation rates of the US largely coincided with each other (Figure 3.8.a). Between 2014 and 2020, the US dollar generally appreciated against the currencies of the largest exporters to the economy, coinciding with the real series dominating, while the dollar price wedge expanded, narrowing only by 2021. Further, by 2022, the US dollar picked up strength, and the economy’s participation rate reached record levels both in nominal and constant terms.

In nominal terms, the US’s backward participation rates had generally been stable from 2007–2022, varying within a relatively narrow range, except in 2009, 2016, and 2020 (Figure 3.8.b.). The real participation rate, on the other hand, had been increasing overall since 2009, surging in 2018, and recovering quickly from the 2020 pandemic slump to surpass even the 2018 levels by 2022. The real trend started to diverge from the nominal trend, and dominate it from 2014. The price wedge between the nominal and real trends has been significant ever since, reaching the maximum in the series in 2022.

**Figure 3.8: GVC Participation Rate, United States, 2007–2022**

GVC = Global Value Chains.

Between 2007 and 2022, forward GVC participation of the US increased both in nominal and constant terms, with the nominal rates trending consistently above the real rates after 2014 (Figure 3.8.c.). Further, the corresponding wedge in the forward series was considerably smaller than the one in the backward series for any given year. While the same inflation and exchange rate factors influenced the price wedge in both series, the impact was considerably attenuated in forward participation.

**Conclusion**

Most of the research and analysis—whether it be for statistical, economic, or policy purposes—on GVCs are principally based on nominal value supply-use tables (SUTs), input-output tables (IOTs), and multi-regional input-output tables (MRIOTs). While these nominal statistical frameworks can be used to discern the state and evolution of GVCs and to support relevant policy formulation, their relevance and accuracy can be diminished in times of significant changes in product prices or in currency exchange rates, as seen from the analysis presented in this chapter. As is the case with gross domestic product, for instance, the relevance and accuracy issue could largely be resolved by basing the relevant estimation and analysis on real value statistical frameworks.

However, while economies with advanced statistical systems produce real value national SUTs and IOTs periodically, to date, no organization has published real value MRIOTs ever since a WIOD initiative that culminated in 2016 with the release of tables for reference years 2001–2014. With the 2023 release of the nominal and real value MRIOTs for reference years 2007–2022, ADB has served to bridge this critical data gap which has been impeding GVC-related research and analysis at a time characterized by the post-pandemic inflation surge and currency volatility.

Using nominal and real MRIOTs for 2007–2022, this chapter highlights the polarity effects that inflation and exchange rate changes have on GVC-related statistics and analysis, thereby affecting information and inferences that could illuminate policy. Further, this chapter details a method to isolate the dollar price effect on GVC statistics and discern the pure effect of technological and structural changes on the state and evolution of GVCs and of an economy’s participation in them.

Revealing the presence of differences between nominal and real values at the global and select-case economy level is intended to facilitate further discourse and research on the subject matter. This would be particularly useful in cases of economies that display large, persistent, and unpredictable disparities, or even polarity. Taking further steps to capture and understand the dollar price wedge could become an important statistical and economic tool as it offers the possibility of potential interventions with more information to base decisions on.
References


