Kazakhstan's Resource Economy:   
Diversification Through   
Global Value Chains

This draft: 31 July 2023

Contents

[Tables, Figures, and Boxes 3](#_Toc141647934)

[Foreword 5](#_Toc141647935)

[Acknowledgments 6](#_Toc141647936)

[Abbreviations 7](#_Toc141647937)

[Highlights 8](#_Toc141647938)

[1 Introduction 13](#_Toc141647939)

[2 Overview of Economy and Trade 16](#_Toc141647940)

[3 Participation in Global Value Chains 25](#_Toc141647941)

[4 Specialization and Competitiveness 38](#_Toc141647942)

[5 Special Topics 48](#_Toc141647943)

[The Eurasian Economic Union 48](#_Toc141647944)

[Adjusting for inflation 53](#_Toc141647945)

[6 Conclusion 55](#_Toc141647946)

[References 58](#_Toc141647947)

[Appendices 63](#_Toc141647948)

# Tables, Figures, and Boxes

**Tables**

[Table A1: Economies in the ADB Multiregional Input–Output Database 63](#_Toc141647949)

[Table A2: Sectors in the ADB Multiregional Input–Output Database 65](#_Toc141647950)

**Figures**

[Figure 2.1: Real Gross Domestic Product Growth Rate and Brent Crude Prices, 1990–2028 13](#_Toc141689880)

[Figure 2.2: Trade Openness at Various Levels of Economic Size, 2021 15](#_Toc141689881)

[Figure 2.3: Network Diagram of Global Merchandise Trade, 2021 17](#_Toc141689882)

[Figure 2.4: Merchandise Exports by Broad Product Groupings, 2002–2021 18](#_Toc141689883)

[Figure 2.5: Merchandise Export Concentration, Selected Countries, 2005, 2010, 2015, 2021 20](#_Toc141689884)

[Figure 3.1: Decomposition of Exports into Value-Added Categories, Kazakhstan, 2000, 2007–2022 24](#_Toc141689885)

[Figure 3.2: Top Ten Trading Partners by Value Added Category, Kazakhstan, 2021 vs 2022 25](#_Toc141689886)

[Figure 3.3: Global Value Chain Participation Rates, Kazakhstan, 2000, 2007–2022 26](#_Toc141689887)

[Figure 3.4: Global Value Chain Participation Rates, Selected Countries, 2000, 2010, 2022 27](#_Toc141689888)

[Figure 3.5: Decomposition of Exports into Value Added Categories by Sector, Kazakhstan, 2022 28](#_Toc141689889)

[Figure 3.6: GVC Production Lengths by Sector, Kazakhstan, 2000, 2010, 2022 31](#_Toc141689890)

[Figure 3.7: Forward GVCs Lengths for Selected Sectors, Kazakhstan, 2000, 2010, 2020, 2022 32](#_Toc141689891)

[Figure 4.1: Revealed Comparative Advantage Indices, Kazakhstan, 2017–2022 35](#_Toc141689892)

[Figure 4.2: Positioning in Mining and Metals GVCs, Selected Countries, 2010 and 2022 36](#_Toc141689893)

[Figure 4.3: Real Effective Exchange Rate Weights, Selected Sectors, Kazakhstan, 2007–2022 38](#_Toc141689894)

[Figure 4.4: Change in Real Effective Exchange Rate Index, Kazakhstan and Russian Federation, Selected Sectors, 2007–2021 40](#_Toc141689895)

[Figure 4.5: Real Effective Exchange Rate Mean and Volatility, 2007–2021 41](#_Toc141689896)

[Figure 5.1: Regional Concentration Indices, Selected RTAs, 2000, 2007–2022 45](#_Toc141689897)

[Figure 5.2: Skyline Chart for the EAEU Countries, 2022 47](#_Toc141689898)

[Figure 5.3: Growth in GVC Exports, Constant Price vs Current Price, 2008–2022 49](#_Toc141689899)

**Boxes**

[Box 1: The Asian Development Bank Multiregional Input–Output Database 13](#_Toc141647971)

[Box 2: The Resource Curse 18](#_Toc141647972)

[Box 3: Export Diversification 23](#_Toc141647973)

[Box 3: Decomposing Exports into Value-Added Categories 26](#_Toc141647974)

[Box 4: Measuring Average Production Lengths 34](#_Toc141647975)

[Box 5: Calculating the Revealed Comparative Advantage Index 38](#_Toc141647976)

[Box 6: Calculating the Real Effective Exchange Rate Index 42](#_Toc141647977)

[Box 7: Calculating the Regional Concentration Index 49](#_Toc141647978)

[Box 8: Constructing the Skyline Chart 51](#_Toc141647979)

[Box 10: Constant Price MRIO Tables 53](#_Toc141647980)

# Foreword

To follow.

# Acknowledgments

To follow.

# Abbreviations

ADB Asian Development Bank

ASEAN Association of Southeast Asian Nations

COVID-19 Coronavirus disease 2019

DAVAX Directly absorbed value-added exports

DVA Domestic value added

EAEU Eurasian Economic Union

FVA Foreign value added

GDP Gross domestic product

GVC Global value chain

GVCP GVC participation rate

HHI Herfindahl-Hirschman Index

HS Harmonized system

IMF International Monetary Fund

IsDB Islamic Development Bank

METI Japan Ministry of Economy, Trade and Industry

MRIO Multiregional Input–Output

NAFTA North American Free Trade Agreement

PDC Pure double-counting

PRC People’s Republic of China

RCA Revealed comparative advantage

RCI Regional concentration index

REER Real effective exchange rate

REF Reflection

REX Reexports

RTA Regional trade agreement

VAX Value-added exports

WIOD World Input–Output Database

WTO World Trade Organization

# Highlights

To follow.

# Introduction

This report examines the economy and trade of Kazakhstan in the context of global value chains (GVCs), a form of fragmented production that has affected everything from automobiles to vaccines. It combines innovative analytical tools with the latest available data to produce indicators that describe Kazakhstan’s rate of GVC participation, the lengths of its GVC production, its patterns of specialization, and the price competitiveness of its exports—among many others. This report’s key data source is the Asian Development Bank’s (ADB) Multiregional Input–Output (MRIO) Database, a time series of intercountry input–output tables featuring extensive coverage of developing Asia. Box 1 provides more information on this dataset. It is hoped that the insights this report presents will prove useful for policymakers and the general public alike.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Box : The Asian Development Bank Multiregional Input–Output Database  The Asian Development Bank (ADB) Multiregional Input–Output (MRIO) Database is a time series of intercountry input–output tables maintained by a dedicated team in ADB. Information on cross-sectoral linkages are provided for 72 countries for the years 2017–2022 and for 62 countries for the years 2000 and 2007–2016. A residual “Rest of the world” entity is also included, allowing the table to capture the entirety of global flows.  The ADB MRIO Database was originally an extended version of the World Input–Output Database, 2013 release. Each country or economy is divided into 35 sectors, based on Table A2 of Timmer, et al. (2015). There are five final demand categories: household final consumption expenditure (FCE), non-profit institutions serving households FCE, government FCE, gross fixed capital formation, and changes in inventories.  Officially published national supply–use tables (SUTs) and/or input–output tables (IOTs) serve as benchmarks in the construction of the ADB MRIO. In each national SUT or IOT, sectoral and product classifications were harmonized to follow the 35 sectors, and whenever necessary, SUTs were transformed into IOTs following the industry technology transformation assumption discussed in European Commission (2008).  Benchmark IOTs also serve as the base structure for producing time-series of the ADB MRIO tables using published estimates on gross output, gross value added, taxes less subsidies on products, imports, and exports sourced from national statistical agencies and central bank databases as control totals. The structure of imports and exports are based on bilateral trade data extracted from the United Nations COMTRADE Database and government trade and balance of payments statistics. Once the national IOTs are integrated into the MRIO, accounts for the sectors of “Rest of the world” are manually and systematically adjusted to ensure consistency with economy–sector totals in the MRIO.  The basic structure of each of MRIO table is given below. It is composed of **Z**, a matrix of intermediates use; **Y**, a matrix of final demand; **va**, a vector of country-sector value added; and **x**, a vector of output. Read vertically, the table shows the purchases of each country-sector, distinguished between intermediate inputs and primary inputs, the latter also called value added. Read horizontally, it shows the sales of each country-sector, distinguished between intermediate sales and final sales. The market-clearing condition stipulates that total purchases and total sales for each country-sector must equal. This amount is total output.  **A Schematic Representation of the ADB MRIO**   |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | |  |  | **Country A** |  | **Rest of the world** | **Country A** |  | **Rest of the world** | **Total output** | |  |  | c1 c35 |  | c1 c35 | f1 f5 |  | f1 f5 | | **Country A** | c1  c35 | **Z** | | | **Y** | | | **x** | |  |  | | **Rest of the world** | c1  c35 | | **Value added** | | **va** | | |  |  |  |  | | **Total output** | | **x** | | |  |  |  |  |   Source: Asian Development Bank. Multiregional Input–Output Database.  **References**  European Commission. 2008. *Eurostat Manual of Supply, Use and Input-Output Tables*. Luxembourg: European Commission. Retrieved from https://ec.europa.eu/eurostat/web/products-manuals-and-guidelines/-/KS-RA-07-013.  M. P. Timmer, E. Dietzenbacher, B. Los, R. Stehrer, and G. J. de Vries. 2015. An Illustrated User Guide to the World Input-Output Database: The Case of Global Automotive Production. *Review of International Economics*. 23(3). pp. 575–605. |

Kazakhstan is a vast, land-locked country that sits at the heart of the Eurasian landmass. Migrants, traders, armies, and pastoral nomads have crossed its steppes for centuries. Historians date the emergence of a distinct Kazakh identity in the 16th century, when tribes sharing a common culture formed a loose federation known as the Kazakh Khanate. It fell under increasing Russian influence in the 18th century, culminating in its incorporation into the Union of Soviet Socialist Republics in the 20th century. Upon the dissolution of that body in 1991, the modern state of Kazakhstan was born (Pavlović 2003).

Following independence, the exploitation of Kazakhstan's sizable oil reserves led to rapid growth, particularly during the 2000s boom in oil prices. It transitioned from lower-middle to upper-middle income status by 2006 according to the World Bank.[[1]](#footnote-2) It has the highest Human Development Index among the states of the former Soviet Union.[[2]](#footnote-3) However, overdependence on an extractive resource sector naturally poses risks, making diversification crucial to Kazakhstan's long-term economic health (Azretbergenova and Syzdykova 2020).

The next chapter examines Kazakhstan's economy and trade in more detail. Chapter 3 introduces an array of indicators obtained from the literature that characterizes Kazakhstan's place in international production sharing. Chapter 4 draws further insights into its specialization and competitiveness by refining two classic trade indicators to account for GVCs. A number of special topics are discussed in chapter 5, including its membership in the Eurasian Economic Union and whether or not its GVC participation was significantly altered by the global inflationary episode seen in 2022. Chapter 6 concludes with recommendations for maximizing the benefits of GVCs and minimizing their risks.

# Overview of Economy and Trade

Kazakhstan is a country rich in extractive resources, namely oil, gas, and ores. The export of these, particularly that of crude oil, has been the defining characteristic of its economic development since attaining independence from the Soviet Union in 1991. This chapter documents how this has contributed to double-digit growth rates while at the same time putting the economy at risk of the resource curse. It shows that over the last two decades, crude oil and a handful of other minerals have dominated its exports—with few signs of change anytime soon. Major destinations of these extractive resources are Europe for crude oil, the Russian Federation for mineral ores, and the People's Republic of China (PRC) for both. The chapter ends by quantifying the degree of concentration in Kazakhstan's exports, finding that while progress has been made over the last decade, much still needs to be done. The findings here set the stage for analyses in succeeding chapters, where input–output data and novel accounting methods are used to provide a deeper understanding of Kazakhstan's trade in the age of global value chains.

Throughout the 1990s, Kazakhstan, along with the other states of the former Soviet Union, faced severe economic dislocation as they transitioned into independent, market-based economies. Hyperinflation struck the region after price controls were lifted in January 1992. Though Kazakhstan replaced the Russian ruble with its own currency, the tenge, in 1993, it was not until 1996 when monthly inflation fell below 50%. Some 1 million people, mostly ethnic Russians, would go on to emigrate (Pomfret 2019). Coal production, once a major industry, fell from 138 million tons in 1989 to 58 million tons in 1999.[[3]](#footnote-4) In real terms, the economy in 1999 was just 63% of its size in 1990.[[4]](#footnote-5)

The economy eventually stabilized and then thrived by 1999, due mainly to a prolonged period of rising oil prices. This enticed foreign capital to invest in the exploitation of Kazakhstan's vast oil reserves, which at 30 billion barrels per day is among the world's largest.[[5]](#footnote-6) For instance, the offshore Kashagan oil field, discovered in 2000, was developed by a consortium of European, American, Chinese, and Japanese firms. New modes of transport were also constructed to complement the Russian state-owned Transneft pipeline, connecting Kazakhstan to broader markets (Pomfret 2019). Consequently, oil production rose steadily from 558,000 barrels per day in 1998 to a peak of 1.7 million barrels per day by 2013.[[6]](#footnote-7) At the height of the boom years in 2000–2007, average annual GDP growth was at 10% (see Figure 2.1).

Figure .: Real Gross Domestic Product Growth Rate and Brent Crude Prices, 1990–2028

GDP = gross domestic product

Notes: Forecasts are by the International Monetary Fund as of April 2023.

Sources: International Monetary Fund. World Economic Outlook Database (April 2023). https://www.imf.org/en/Publications/WEO/weo-database/2023/April (accessed 19 June 2023); U.S. Energy Information Administration. https://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=RBRTE&f=M (accessed 19 June 2023).

However, this was not to last. Oil prices retreated in 2014 and remained relatively subdued until 2022. Kazakhstan saw more moderate GDP growth during this time—an average of 3.1% in 2013–2019. It weathered the COVID-19 pandemic fairly well, suffering a 2.6% contraction before bouncing back in 2021 with a 4.1% growth rate. Kazakhstan then grew by a modest 3.2% in 2022 in spite of the oil price spike that should have benefited its economy. One possible explanation why it did not stems from the relative ephemerality of the spike, lasting just a few months as global markets adjusted to the Russian invasion of Ukraine rather than the years-long mid-2000s boom that was driven by more wide-ranging factors. The International Monetary Fund forecasts Kazakhstan's growth to hold steady at an average of 3.3% until 2028.

Kazakhstan's reliance on oil puts it in danger of adverse economic outcomes (ADB 2018). As Box 2 explains, the resource curse refers to how countries with rich resource endowments tend to grow slower than their resource-scarce counterparts. Dutch disease may be one cause, where the resource sector crowds out investments in the non-resource sectors that hold the key to long-run sustainable growth. It is important to note that the very nature of extractive resource wealth is its finite supply; estimates suggest that Kazakhstan's oil reserves will be depleted in 45 years[[7]](#footnote-8). But even before that, analysts are expecting world demand for oil to peak and then decline, resulting in a plunge in prices (Fickling 2022). All these make it crucial for Kazakhstan to diversify its economy away from its oil sector.

|  |
| --- |
| Box : The Resource Curse  Intuition might hold that a country blessed with abundant natural resources is well positioned for rapid growth. But this is not always the case: some studies actually point to *slower* growth for resource-rich countries (Sachs and Warner 2001). Rather than a blessing, there may in fact be a "resource curse" (Auty 1993), especially when the resource is of the extractive type—minerals, petroleum  What causes this? One set of explanations revolve around the Dutch disease hypothesis, which states that a booming resource sector causes the non-resource export sector (e.g. manufacturing) to shrink due to two effects. First, by making the real exchange rate appreciate, it makes non-resource exports less competitive. Second, it draws labor and capital away from the non-resource sector (Corden and Neary 1982). Since manufacturing is associated with learning by doing and other positive externalities, its demise may hamper long-run growth. Moreover, since the global prices of natural resources tend to be volatile, an economy specialized in it will also experience much volatility, hampering growth (van der Ploeg 2011).  Another set of explanations focus on the quality of a country's institutions. The wealth generated by natural resources may facilitate more corruption, rent-seeking, and civil conflict. Governments may be less inclined to invest in non-resource sectors or in building up physical and human capital (van der Ploeg 2011). In these analyses, oil wealth appears to be particularly associated with institutional erosion (Ross 2015).  Because econometrically measuring the impact of natural resources on growth is plagued by measurement and identification issues, the existence of a resource curse is still debated. Resource-rich countries can therefore take heart that the curse is "not cast in stone" (van der Ploeg 2011, p. 385).  **References**  R. M. Auty. 1993. *Sustaining Development in Mineral Economies: The Resource Curse Thesis*. Routledge: London, UK.  W. M. Corden and J. P. Neary. 1982. Booming Sector and De-Industrialisation in a Small Open Economy. *Economic Journal*. 92. pp. 825–848.  M. L. Ross. 2015. The Politics of the Resource Curse: A Review. In C. Lancaster and N. van de Walle (eds.), *The Oxford Handbook of the Politics of Development*, pp. 200–223. Oxford University Press: Oxford, UK.  J. D. Sachs and A. M. Warner. 2001. The Curse of Natural Resources. *European Economic Review*. 45. pp. 827–838.  F. van der Ploeg. 2011. Natural Resources: Curse or Blessing? *Journal of Economic Literature*. 49(2). pp. 366–420. |

Figure 2.2 indicates that it has some ways to go. The plot shows trade openness at various levels of economic size, providing a rough metric by which one can gauge whether a country is relatively more trade-oriented or not. Trade is naturally a smaller part of the economy for larger countries like the PRC and India and vice versa for smaller countries like Singapore and the Kyrgyz Republic. Taking this relationship into account, how important is trade for Kazakhstan given its size? For its trade as a whole, it does appear to be fairly open: of its $545 billion GDP, exports and imports accounted for 57.5% in 2021, below Saudi Arabia's 59.1% and Uzbekistan's 63.9% but ahead of the Russian Federation's 52.2% and even the United Kingdom's 56.7%.

Figure .: Trade Openness at Various Levels of Economic Size, 2021

GDP = gross domestic product, PPP = purchasing power parity, PRC = People’s Republic of China.

Notes: Horizontal axis is gross domestic product in current international dollars at purchasing power parity. Vertical axis is the sum of exports and imports of goods and services as a share of gross domestic product.

Source: World Bank. World Development Indicators. https://data.worldbank.org/indicator (accessed 19 June 2023).

However, it is reasonable to wonder whether Kazakhstan's very large oil sector is inflating this ratio. Many studies, including the classic paper by Jeffrey A. Frankel and David Romer (1999), have affirmed that countries who trade more tend to grow faster. The four Asian Tigers—Hong Kong, China; the Republic of Korea; Singapore; and Taipei,China—had famously used an export-oriented development strategy to become advanced economies by the 1990s (Stiglitz 1996), an approach that is now being followed by Viet Nam and Cambodia, among others. But all these cases involve export baskets that lean heavily towards manufactures, not natural resources. Indeed, excluding oil from Kazakhstan's trade lowers its trade-to-GDP ratio to just 18.3%. This back-of-the-envelope calculation strongly suggests that Kazakhstan is not as trade-oriented as its statistics may paint it to be, further highlighting its need for diversification.

visualizes international trading networks as of 2021 and Kazakhstan's place in them. As it utilizes the United Nations COMTRADE Database (as processed by CEPII’s BACI International Trade Database), only merchandise trade is included. Each node is a country or economy, positioned according to an algorithm of simulated annealing to produce an aesthetic chart (Davidson and Harel 1996). For visual clarity, the figure only draws a trading link if the importing country is among the three largest importers of the exporting country. Node sizes are proportional to the number of such links a country is connected to. Thus, the fact that the largest nodes are the United States and the People’s Republic of China (PRC) means that they appear among the top three importers of other countries the most. The thickness of a link, meanwhile, is proportional to the value of trade it is representing. Again, the thickest link is that between the United States and the PRC, indicating that it is the most significant bilateral relationship in the world.

Color-coding by geographic region reveals a gravity-type clustering of nodes, in that countries that are physically near each other on the map tend to trade more with each other. This is the case for Kazakhstan: its large neighbors the People's Republic of China and the Russian Federation are also its largest trading partners. Its exports lean more towards Europe than Asia, with Greece, the United Kingdom, and Germany rounding out its top five export destinations in 2021.

Figure .: Network Diagram of Global Merchandise Trade, 2021

ARE = United Arab Emirates, BEL = Belgium, FRA = France, GER = Germany, IND = India, ITA = Italy, JPN = Japan, KOR = Republic of Korea, NET = Netherlands, POL = Poland, PRC = People’s Republic of China, RUS = Russia, SAU = Saudi Arabia, SIN = Singapore, SPA = Spain, SWI = Switzerland, THA = Thailand, UKG = United Kingdom, USA = United States, ZAF = South Africa.

Notes: Each node represents a country or economy. Nodes appear only if they meet a threshold of connectedness, defined as being among the three largest importers of some country. Node sizes reflect the number of such links connected to the node, while edge thickness reflect the dollar value of the trade flow. Nodes are arranged using the Davidson and Harel (1996) layout algorithm. Regional groupings are from the World Bank. Taipei,China is proxied by “Other Asia, not elsewhere specified”.

Source: CEPII. BACI International Trade Database (January 2023). http://www.cepii.fr/cepii/en/bdd\_modele/presentation.asp?id=37 (accessed 19 June 2023).

The advantage of COMTRADE/BACI data is its granularity, reporting exports of products at the 6-digit level of the Harmonized System (HS). It is possible to establish, therefore, that in 2021, Kazakhstan’s second-largest goods export after crude oil was “Metals: gold, semi-manufactured” (HS code 7108.13), valued at $3.9 billion. Product categories may be aggregated into broader categories if needed. The “chapter” of 7108.13, for example, is 71, “Natural or cultured pearls, precious or semi-precious stones, precious metals, metals clad with precious metal and articles thereof; imitation, jewellery; coin”.

examines the product make-up of Kazakhstan's merchandise exports over 2002–2021 by aggregating HS codes into seven broad groupings. Exports are overwhelmingly dominated by minerals, which in 2021 accounted for 56.4% of export value or $30.5 billion. While down from its 76.7% share in 2013, it is still far larger than any other grouping. Within this group, the single largest product was of course crude oil (HS code 2709.00), with a 40.4% share in 2021. This is largely oriented towards the European market—particularly Greece and Germany—and the PRC. In 2021, Greece took 20.1% of Kazakhstan's crude oil exports while Germany took 16.1% and the PRC 10.0%. Other mining products like ores are significant as well. In fact, while 20.4% of Kazakhstan's exports to the PRC comprised of crude oil, a larger share of 21.8% comprised of iron, copper, and other crude ores.

Figure .: Merchandise Exports by Broad Product Groupings, 2002–2021

Notes: Broad product groupings are based on the chapters of the Harmonized System, 2002 edition. “Food” covers 01–24. “Minerals” covers 25–27, of which "crude oil" (2709.00), "natural gas" (2711.11, 2711.21), and "ores" (2601.11–2617.90) are separately identified. “Chemicals” covers 28–38. "Metals" covers 72–83, of which "ferroalloys" (7202.11–7202.99) and "copper" (7401.10–7419.99) are separately identified. The remaining chapters are collected under "Others".

Source: CEPII. BACI International Trade Database (January 2023). http://www.cepii.fr/cepii/en/bdd\_modele/presentation.asp?id=37 (accessed 19 June 2023).

Metals is Kazakhstan's second-largest export. Using the grouping defined in Figure 2.4, this accounted for 21.1% of exports in 2021, amounting to $11.4 billion. This share is double the trough of about 10% seen in 2013, when the share of oil was at its peak. Europe is no longer Kazakhstan's primary market here: of its 2021 exports, 35.5% went to the PRC, 19.4% to the Russian Federation, and 10.0% to Turkey.

With mining and metals routinely taking up over 80% of Kazakhstan's annual exports, the issue of diversification becomes salient. Concentrating too much on only a few sectors or products poses risks to an economy since shocks to the dominant sector can more easily cause an economy-wide recession. Compounding this in Kazakhstan's case is the possibility of resource curse-type adverse effects (see Box 2). To inform the discussion, some quantitative measure of concentration in Kazakhstan's exports basket is needed. This is served by the Herfindahl–Hirschman index (HHI), computed here on the 2-digit level of HS product categories. See Box 3 for more details on this methodology.

|  |
| --- |
| Box : Export Diversification  Export diversification refers to the diversity in products exported by an economy. To quantify this, this report uses a widely accepted measure of concentration, the Herfindahl–Hirschman index (HHI), computed by summing the squared share of each entity in the population in question (Shughart 2008). Formally,  where is the share of entity and is the number of entities in the population. The HHI ranges from to 1, with higher numbers indicating greater concentration, or conversely, lower diversification. While originally devised to measure market concentration, it is applicable to a wide range of distribution-related contexts.  The HHI is sensitive to , with the index tending to be lower as gets bigger. For this report, the 4-digit level of the Hamonized System is used, which aggregates 5223 products into 1245 categories.  **Reference**  W. F. Shughart. 2008. Industrial Concentration. In D. R. Henderson (Ed.), *Concise Encyclopedia of Economics*, 2nd ed. Indianapolis, IN: Library of Economics and Liberty. |

plots the exports HHI of Kazakhstan along with, for comparison, its neighbors the Kyrgyz Republic, the Russian Federation, and Uzbekistan. For comparison with another oil exporter, Saudi Arabia is included as well. Note that a higher HHI implies greater concentration (or less diversity) in the country's exports basket. The plot shows that Kazakhstan does tend to be more concentrated than the other Central Asian economies, with its HHI index peaking in 2010 at 0.40. However, it appears to have been steadily diversifying since then, bringing its HHI down to 0.18 by 2021. The opposite trend had been happening in the Kyrgyz Republic, resulting in its 2021 HHI of 0.26 surpassing that of Kazakhstan's. In this regard, Kazakhstan has been more successful at diversification than Saudi Arabia, whose 2021 HHI still stands at 0.32. Nevertheless, it remains behind the Russian Federation, who both exports a lot of oil and gas while at the same time maintaining a fairly diverse export profile.

Figure .: Merchandise Export Concentration, Selected Countries, 2005, 2010, 2015, 2021

Notes: Diversification is measured by the Herfindahl–Hirschman index. A higher index implies more concentration. Products are disaggregated at the 2-digit level of the Harmonized System, 2002 edition.

Sources: CEPII. BACI International Trade Database (January 2023). http://www.cepii.fr/cepii/en/bdd\_modele/presentation.asp?id=37 (accessed 19 June 2023); Asian Development Bank estimates.

In summary, this chapter has used traditional GDP and trade statistics to show that Kazakhstan is a classic case of an extractive resource economy. It exports a lot of crude oil and mineral ores, most of which go to the PRC, Europe, and its neighbors in Central Asia. This specialization has brought it economic riches—10% annual growth at its peak—but at the cost of an undiversified economy whose fortunes are linked to the fluctuations of global oil prices. This has changed somewhat since the end of the oil boom in 2014, but much remains to be done. It is interesting that metals manufactures are its second-largest export product. As succeeding chapters show, metals are a good candidate for instigating greater diversification as it lends itself easily to global value chain participation. To explore this idea, an assortment of new indicators must now be introduced.

# Participation in Global Value Chains

A global value chain (GVC) is a type of production arrangement where different stages are undertaken in different territories, typically by different firms.[[8]](#footnote-9) It intensified in the 1990s as several trends took shape, including leaps in information and communications technologies, the spread of market economies in the former Communist states, and perhaps most importantly, the opening up of the People’s Republic of China (PRC) to world trade. All these encouraged managers to relocate certain stages of production to where they can be performed at the lowest cost.

Among the numerous consequences of GVCs is statistical. Trade is generally reported in gross bilateral terms: country A’s exports to country B. GVCs complicate this in two ways. First, some of A’s exports may contain value added that did not originate in A. Second, not all of A’s exports to B are finally consumed in B. Imported inputs on the one hand and reexports on the other mean that third countries may have an indirect relationship with each other via the bilateral link between A and B, relationships that are hidden in standard trade data.

This chapter explores Kazakhstan’s engagement with GVCs by combining the rich information found in the Asian Development Bank Multiregional Input–Output (ADB MRIO) Database with the GVC-focused input–output models that have been developed in the literature. The ADB MRIO is available for the years 2017–2022 and covers 72 economies, including 48 of the 68 ADB member countries. Tables are also available for the years 2000 and 2007–2016, albeit for a smaller set of 62 economies. Each country's economy is exhaustively divided into 35 sectors, meaning unlike the previous chapter, trade in both goods and services will be part of the analysis. More details on the MRIO database are given in Box 1.

Accounting for intersectoral linkages allows this chapter to take a value added approach to Kazakhstan’s trade. This begins with a careful decomposition of its exports into various value added categories. Using the methodology in ADB (2021), gross exports are divided into those whose value added originated domestically (DVA), those that originated from foreign sources (FVA), and those that did not originate from value added at all. The last, called pure double-counting (PDC), refers to duplicated recordings of the same value added crossing the same border more than once. DVA, in turn, is further divided into those that are directly absorbed by the importer (DAVAX), those that are reexported by the importer and eventually absorbed abroad (REX), and those that are reexported by the importer and eventually returns to and is consumed by the exporter (“reflection”, or REF). See Box 4 for more details on this framework.

|  |
| --- |
| Box : Decomposing Exports into Value-Added Categories  The prevalence of cross-border production sharing—what this report calls global value chains (GVCs)—has meant that flows of value added may increasingly diverge from the flows captured in standard trade statistics. Datasets like balance of payments accounts and the United Nations COMTRADE database record bilateral flows from one economy to another, but do not typically provide information on the value added make-up of such flows.  In a framework pioneered by Koopman, Wang, and Wei (2014) and refined by Borin and Mancini (2019), information from an intercountry input–output table is used to decompose export flows into value added categories. An exposition of the particular methodology employed in this report is given in Asian Development Bank (ADB) (2021). To summarize, exports are broken down into five main categories, as shown in the figure below.  Decomposition of Home’s Exports to Partner  H = home, P = partner  Source: Asian Development Bank. 2021. *Key Indicators for Asia and the Pacific 2021*. Manila, Philippines: Asian Development Bank.  DAVAX are exports of domestic value added that are directly absorbed by the importer. It will be useful to subdivide this into DAVAX1 and DAVAX2, corresponding to exports of final goods and exports of intermediates, respectively. REX and REF are exports of domestic value added that are reexported by the importer, to eventually be absorbed abroad (REX) or returned to and absorbed by the exporter (REF). FVA are foreign value added embedded in exports, arising from the use of imported inputs. Finally, PDC are the pure double-counting that results from value-added crossing the same border more than once. The levels, shares, and trends of each of these categories provide insights into an economy’s engagement with GVCs.  A useful statistic derived from this framework is the GVC participation rate. ADB (2021) identifies two approaches to measuring this. The trade-based approach, used among others by Hummels, Ishii, and Yi (2001) and Borin and Mancini (2019), is computed as  This rate may be divided into a forward participation rate and a backward participation rate, given by the first and second terms respectively.  The second approach is due to Wang, Wei, Yu, and Zhu (2017). This production-based GVC participation rate is computed as  **References**  Asian Development Bank. 2021. *Key Indicators for Asia and the Pacific 2021*. Manila, Philippines: Asian Development Bank.  A. Borin and M. Mancini. 2019. Measuring What Matters in Global Value Chains and Value-Added Trade. *Policy Research Working Paper No. 8804*. Washington, DC: World Bank.  D. Hummels, J. Ishii, and K. M. Yi. 2001. The Nature and Growth of Vertical Specialization in World Trade. *Journal of International Economics*. 54. pp. 75–96.  R. Koopman, Z. Wang, and S. Wei. 2014. Tracing Value-Added and Double Counting in Gross Exports. *American Economic Review*. 104 (2). pp. 459–494.  Z. Wang, S. Wei, X. Yu, and K. Zhu. 2017. Measures of Participation in Global Value Chains and Global Business Cycles. *NBER Working Paper No. 23222*. Cambridge, MA: National Bureau of Economic Research. |

Figure 3.1 presents the decomposition of Kazakhstan’s exports into the five categories described. DAVAX, also called direct trading, takes up a little over half of total exports in any given year. This is the portion of exports whose value added originates solely from Kazakhstan and is finally consumed by the direct importer without passing through any further production stages in some third country. In 2022, Kazakhstan's DAVAX exports amounted to $35.6 billion against gross exports of $66.8 billion. This is nearly unchanged from pre-pandemic, pre-Russian invasion figures from 2019, which stood at $35.5 billion and $63.4 billion respectively.

The remaining portion of exports may then be called indirect trading. For Kazakhstan, only the REX and FVA categories are significant. REX exports indicate the continued flow of Kazakh value added down the production chain and is thus a measure of forward integration. FVA exports, meanwhile, indicate the extent of imported inputs embedded in Kazakhstan’s exports and is thus a measure of backward integration. In 2022, REX amounted to $25.0. billion while FVA amounted to $6.1 billion. Total indirect trading, equal to the sum of REX, REF, FVA, and PDC, was $31.2 billion.

Figure .: Decomposition of Exports into Value-Added Categories, Kazakhstan, 2000, 2007–2022

GVC = global value chain.

Notes: Gross exports are decomposed using the methodology in Asian Development Bank (2021). DAVAX are directly absorbed domestic value-added exports. REX are domestic value-added exports reexported by direct importer and eventually absorbed abroad. REF are domestic value-added exports reexported by direct importer and eventually returned to and absorbed at home. FVA are foreign value added embedded in gross exports. PDC are pure double-counting, a result of value added crossing the same border more than once. The boxed portions measure global value chain production according to Wang, Wei, Yu, and Zhu (2017).

Sources: Asian Development Bank. 2021. *Key Indicators for Asia and the Pacific 2021*. Manila, Philippines: Asian Development Bank; Z. Wang, S. Wei, X. Yu, and K. Zhu. 2017. Measures of Participation in Global Value Chains and Global Business Cycles. *NBER Working Paper No. 23222*. Cambridge, MA: National Bureau of Economic Research; Asian Development Bank. Multiregional Input–Output Database (July 2023); Asian Development Bank estimates.

While the sum of REX, REF, FVA, and PDC—what we call indirect trade—comprise GVCs under the trade-based approach, all trade in intermediates comprise GVCs in the production-based approach (see Box 4). This is indicated in Figure 3.1 by the boxed regions, which are just indirect trade plus the portion of DAVAX that consist of intermediate exports. In this approach, almost all of Kazakhstan's exports are counted as GVCs. This is mainly because most of its exports consist of oil, which is used as an input to production.

Kazakhstan’s top trading partners are its two large neighbors the People's Republic of China (PRC) and the Russian Federation, though the 2022 Russian invasion of Ukraine appears to have brought Kazakhstan much closer to the PRC. Figure 3.2 shows that in 2021, 17.7% of exports went to the PRC while 13.0% went to the Russian Federation. The PRC's lead widened in 2022 as its share rose to 20.1% while the Russian Federation's share dropped to 9.0%. Elsewhere, Italy as an export destination surged in importance in 2022, with its share leaping from 1.3% to 13.9%. It remains to be seen whether this is a one-time jump or the beginning of a more lasting relationship; government and business leaders have so far leaned on the latter (Sakenova 2023).

Figure .: Top Ten Trading Partners by Value Added Category, Kazakhstan, 2021 vs 2022

AUT = Austria, FRA = France, GER = Germany, GRC = Greece, ITA = Italy, JPN = Japan, KGZ = Kyrgyz Republic, KOR = Republic of Korea, NET = Netherlands, PRC = People’s Republic of China, RUS = Russian Federation, SPA = Spain, SWI = Switzerland, THA = Thailand, TUR = Turkey, UKG = United Kingdom, USA = United States.

Notes: Top ten are based on 2022 values. Gross exports are decomposed using the methodology in Asian Development Bank (2021). DAVAX are directly absorbed domestic value added exports. REX are domestic value added exports reexported by direct importer and eventually absorbed abroad. FVA are foreign value added embedded in gross exports.

Sources: Asian Development Bank. 2021. *Key Indicators for Asia and the Pacific 2021*. Manila, Philippines: Asian Development Bank; Asian Development Bank. Multiregional Input–Output Database (July 2023); Asian Development Bank estimates.

The nature of Kazakhstan's trade differ among its top three partners. This is evident when looking at partners by value added category. Much of the rise in exports to Italy appears to have comprised of GVC exports; that is, exports that go on to be reexported. On the other hand, the PRC retains a dominant share of Kazakhstan's DAVAX exports, or exports that are finally consumed by the direct partner. In short, exports to Italy connect Kazakh value added to global production chains while exports to the PRC tend to remain within the PRC.

While the Russian Federation's share in total exports, DAVAX, and REX retreated in 2022, its share in Kazakhstan's foreign value added rose dramatically from 7.9% to 33.9%. In other words, of the foreign value added in Kazakhstan's exports, a third was contributed by the Russian Federation in 2022. This is a curious development given the disruptions in Russian trade linkages caused by Western sanctions. One explanation may be that as the Russian Federation moves closer economically to the PRC (Wang 2023), Kazakhstan might be acting as a conduit through which Russian value added reaches the PRC. Nevertheless, the fact that FVA from the PRC also rose dramatically (from 8.9% in 2021 to 14.1% in 2022) speaks to a tightening integration between Kazakhstan and the PRC independent of the Russian Federation.

Quantifying the importance of GVCs in Kazakhstan's economy is the GVC participation rate, which is just the amount of GVC trade expressed as a share of some base. As mentioned briefly above, two approaches are possible: a trade-based approach and a production-based approach. The trade-based participation rate divides indirect trade by gross exports, thereby measuring the *intensive* importance of GVCs. It may further be divided into a forward and a backward participation rate, corresponding to the forward and backward integration into GVCs discussed above. The production-based approach, meanwhile, divides indirect plus intermediate trade with domestic value added (i.e. gross domestic product or GDP), thereby measuring the *extensive* importance of GVCs. More details on computing participation rates are provided in Box 4.

Figure 3.3 looks at the historical trend in Kazakhstan's participation rates while compares these rates with those of related economies. The fact that forward participation is much higher than backward participation in the trade-based approach implies that Kazakhstan tends to be situated at the more upstream sections of GVCs. That is, Kazakhstan's inputs (mainly oil) are used by other economies to a greater degree than other economies’ inputs are used by Kazakhstan. As of 2022, the forward trade-based GVC participation rate stood at 37.5% while the backward rate was 9.2%. This gives an overall trade-based GVC participation rate of 46.7%, which as seen in Figure 3.4, is below the world average.

Figure .: Global Value Chain Participation Rates, Kazakhstan, 2000, 2007–2022

Notes: Participation rates are computed using the methodology in Asian Development Bank (2021). The forward trade-based participation rate is the share of domestic value-added exports re-exported by the direct importer in gross exports. The backward trade-based participation rate is the share of foreign value-added and pure double-counting in gross exports. The production-based participation rate is the share of unfinished exports in gross exports.

Sources: Asian Development Bank. 2021. *Key Indicators for Asia and the Pacific 2021*. Manila, Philippines: Asian Development Bank; Asian Development Bank. Multiregional Input–Output Database (July 2023); Asian Development Bank estimates.

While Kazakhstan's trade-based participation rates have been relatively stable over the last decade, its production-based trade has declined markedly. The GVCs in its economy as a whole peaked at 45.7% in 2008; by 2022, it stands at just 27.3%. Given the prominence of oil in Kazakhstan's GVC sector, the volatility in its production-based participation rate is likely a result of the volatility in global oil prices. Indeed, the 2015 nadir in GVC participation (24.5%) coincides with the end of the oil price boom (see Figure 2.1).

Figure 3.4 contextualizes Kazakhstan's participation rates by comparing it with its neighbors and fellow oil exporters. Its trade-based participation rate trails that of fellow Central Asian economies Kyrgyz Republic, Georgia, and Mongolia. Among oil exporters, it is well below the participation rate of Brunei Darussalam but remains ahead of the Russian Federation and Saudi Arabia. As for its production-based participation, despite having declined over the decades, it remains well above the world average.

Figure .: Global Value Chain Participation Rates, Selected Countries, 2000, 2010, 2022

Notes: Participation rates are computed using the methodology in Asian Development Bank (2021). The trade-based participation rate is the share of indirect trade in gross exports. The production-based participation rate is the share of unfinished exports in gross exports.

Sources: Asian Development Bank. 2021. *Key Indicators for Asia and the Pacific 2021*. Manila, Philippines: Asian Development Bank; Asian Development Bank. Multiregional Input–Output Database (July 2023); Asian Development Bank estimates.

Aggregate-level rates may mask differences across sectors. With this in mind, Figure 3.5 applies the exports decomposition framework at the sector level. Sectors here are identified by the sector that actually exports, rather than the sector from which the value added originated from. Thus, mining exports, for example, may contain value added from other sectors, but the good that is actually exported is classified under the mining sector. This approach was chosen to allow for comparability with the aggregate decomposition.

Figure .: Decomposition of Exports into Value Added Categories by Sector, Kazakhstan, 2022

Notes: Gross exports are decomposed using the methodology in Asian Development Bank (2021). DAVAX are directly absorbed domestic value-added exports. REX are domestic value-added exports re-exported by direct importer and eventually absorbed abroad. REF are domestic value-added exports re-exported by direct importer and eventually returned to and absorbed at home. FVA are foreign value-added embedded in gross exports. PDC are pure double-counting, a result of value-added crossing the same border more than once. Sectors disaggregation is by export sector.

Sources: Asian Development Bank. 2021. *Key Indicators for Asia and the Pacific 2021*. Manila, Philippines: Asian Development Bank; Asian Development Bank. Multiregional Input–Output Database. https://mrio.adbx.online (accessed 1 August 2021); Asian Development Bank estimates.

The sector with the highest (trade-based) rate of GVC participation was mining, with a forward rate of 43.9% and a backward rate of 9.5% in 2022. As it makes up 59.7% of gross exports ($39.9 billion), the mining sector undoubtedly leads trends in Kazakhstan's overall GVC participation. Other sectors with relatively high participation rates like water transport services and leather and wood manufacturing have miniscule exports (less than 0.1% of the total) and so are not really relevant for Kazakhstan. Its most significant GVC sector besides mining is metals manufacturing, which holds a respectable 17.9% share of total exports ($11.9 billion). Its forward and backward participation rates are 36.1% and 8.8%, placing it relatively upstream in the production chain like mining. Given that metals manufacturing is associated with more sophisticated, higher value added production processes than mining, it is a good candidate sector for Kazakhstan to expand to in its pursuit of diversification.

To formalize the idea of upstreamness and downstreamness in GVCs, it helps to have a measure of production lengths. Distance in production can be measured if one adopts the simplification of treating value chains like actual “chains”—that is, as a sequence of stages that progresses in one direction from beginning to end. Any given firm, therefore, may be positioned in its value chain by measuring, on the one hand, the number of stages separating its output from final consumers, and on the other, the number of stages separating its output from primary inputs. These are forward and backward production lengths, respectively. Averaging these lengths for all the firms in a sector or economy gives average production lengths. Furthermore, isolating the GVC component of a firm’s production results in GVC production lengths. provides more details.

|  |
| --- |
| Box : Measuring Average Production Lengths  While production can take many forms, it is useful to conceive of it as a series of sequential stages where each stage adds value until a finished product results at the very end. This simplification allows for the calculation of a firm’s production length, computed from two perspectives. The forward length counts the number of stages separating the firm’s output from the final consumer. The backward length counts the number of stages separating its output from primary inputs. Averaging these lengths for all the firms in a sector or economy gives average production lengths.  Antràs and Chor (2013) propose a methodology for computing average production lengths using information in an input–output table. They first identify the share of an entity’s output produced after every possible number of stages. They then use these to take a weighted average of the integers 1, 2, 3, 4, and so on. The result provides the number of stages the bulk of the entity’s production concentrates on.  Wang, Wei, Yu, and Zhu (2017b) refine this by defining average lengths for both forward and backward perspectives. Not only can adding them give the total length of a particular value chain, taking their ratio also gives the relative position of the entity in that chain, whether it is relatively more upstream (longer forward length compared with backward length) or more downstream. Moreover, they apply the decomposition of production in Wang, Wei, Yu, and Zhu (2017a) to isolate the global value chain (GVC) activity of the entity, defined according to the production-based approach (see ).  The resulting GVC production lengths may be divided into two segments: the number of stages that occur within the domestic economy of the exporter and the number of stages that occur abroad.  When computing lengths at the sector level, Wang, et al.’s (2017b) methodology identify sectors by the origin of value added.  **References**  P. Antràs and D. Chor. 2013. Organizing the Global Value Chain. *Econometrica*. 81(6). pp. 2127–2204.  Z. Wang, S. Wei, X. Yu, and K. Zhu. 2017a. Measures of Participation in Global Value Chains and Global Business Cycles. *NBER Working Paper*. No. 23222. Cambridge, MA: National Bureau of Economic Research.  Z. Wang, S. Wei, X. Yu, and K. Zhu. 2017b. Characterizing Global Value Chains: Production Length and Upstreamness. *NBER Working Paper*. No. 23261. Cambridge, MA: National Bureau of Economic Research. |

Longer production lengths, by involving more rounds of value added contribution, are associated with more complex value chains (Escaith and Inomata 2013). Thus, it complements the essentially binary approach of the GVC participation rate, which classifies each dollar of exports as either belonging to GVCs or not. In Figure 3.6, GVC lengths in Kazakhstan at both the aggregate and the sector level for the years 2000, 2010, and 2022 are plotted, specifically highlighting changes between 2000 and 2010 and between 2010 and 2022. Note that in contrast to Figure 3.6, sectors are identified by the sector from which the value added originated from following the Wang, et al. (2017b) methodology. At the aggregate, total GVC length was at 8.32 stages in 2000, shortened slightly to 8.24 in 2010, then lengthened to 8.46 in 2022. Across sectors, the general conclusion is that lengths decreased between 2000 and 2010 then increased between 2010 and 2022. The mining sector has been lengthening consistently throughout the decades, from 7.83 stages in 2000, to 8.06 in 2010, to 8.36 in 2022. The same is not true for metals, which was 8.27 stages long in 2000 but only 8.19 stages long in 2022. Insofar as more production stages imply greater complexity, this suggests that Kazakhstan's metals sector has remained at the same level of sophistication for over two decades.

Figure .: GVC Production Lengths by Sector, Kazakhstan, 2000, 2010, 2022

AHF = agriculture, hunting, forestry and fishing; GVC = global value chain; MFM = basic metals and fabricated metal; MIN = mining and quarrying; WST = wholesale trade, except of motor vehicles and motorcycles.

Notes: Average global value chain production lengths are computed using the methodology of Wang, Wei, Yu, and Zhu (2017). Values are the sum of forward and backward lengths. Sectors with no global value chain production have no lengths and are not included in the chart. Sectors are disaggregated by value-added origins.

Sources: Z. Wang, S. Wei, X. Yu, and K. Zhu. 2017. Characterizing Global Value Chains: Production Length and Upstreamness. *NBER Working Paper No. 23261*. Cambridge, MA: National Bureau of Economic Research; Asian Development Bank. Multiregional Input–Output Database (July 2023); Asian Development Bank estimates.

takes a closer look at the forward GVC length by breaking it down into two segments: stages that occur within the domestic economy and stages that occur abroad. Note that this only looks at the forward GVC length, meaning production stages are counted from when value added is created in Kazakhstan; the stages that foreign value added underwent are not counted. In the aggregate, 1.64 stages of the GVC sector occur domestically while 2.84 stages occur abroad, for a total GVC production length of 4.48. Mining has a shorter GVC production length at 4.20 stages. Moreover, much of it occurs abroad: 2.95 stages versus the 1.25 stages that occur domestically. This suggests that Kazakhstan exports largely raw mining products, leaving it to foreign firms to process the materials further. The same is the case for the metals sector, where 1.39 stages occur domestically and 2.70 stages occur abroad.

Figure .: Forward GVCs Lengths for Selected Sectors, Kazakhstan, 2000, 2010, 2020, 2022

GVC = global value chain.

Notes: Average global value chain production lengths are computed using the methodology of Wang, Wei, Yu, and Zhu (2017). Sectors are disaggregated by value added origins.

Sources: Z. Wang, S. Wei, X. Yu, and K. Zhu. 2017. Characterizing Global Value Chains: Production Length and Upstreamness. *NBER Working Paper No. 23261*. Cambridge, MA: National Bureau of Economic Research; Asian Development Bank. Multiregional Input–Output Database (July 2023); Asian Development Bank estimates.

The only major sector for which both domestic and foreign stages are increasingly significantly is wholesale trade. Forward GVC length here was 4.26 stages in 2000, of which 1.79 occurred domestically and 2.47 occurred abroad. By 2022, forward length was at 4.93 stages, of which 2.16 was domestic and 2.78 was foreign. The lengthening of wholesale trade suggests that exports here have been growing in complexity, with its value added undergoing more and more production stages both domestically and abroad.

In conclusion, this survey into Kazakhstan's GVC activities points to an economy whose GVC participation revolves mainly around the export of oil, a major input to production used the world over. Unfortunately, Kazakhstan appears to have remained in the relatively simple segment of this value chain, exporting raw materials that other countries process. The only other significant GVC sector is metals manufacturing, which is the second-largest source of exports. However, it likewise remains on the simple end of the value chain. In terms of trading partners, Kazakhstan appears to be moving closer to the PRC at the expense of the Russian Federation.

# Specialization and Competitiveness

This chapter uses GVC-adjusted versions of two classic trade indicators to explore Kazakhstan's specialization and competitiveness. First, the revealed comparative advantage index, proposed by Balassa (1965), describes patterns of specialization given a country’s trade flows. Second, the real effective exchange rate, developed by the International Monetary Fund (Bayoumi 2005), summarizes changes in the price levels of a country’s exports relative to its competitors, thereby measuring price competitiveness. Using the frameworks discussed in the previous chapter, both these indicators may be adjusted to reflect value added rather than gross flows, lending them new relevance in the GVC era.

The concept of comparative advantage originated with the English economist David Ricardo in the 19th century. Balassa operationalized it with his revealed comparative advantage (RCA) index, a ratio that compares the share of a sector in a given country’s exports to the average share of that sector across all countries. By convention, an RCA index of greater than 1 indicates a comparative advantage in that sector. This chapter uses two versions of the RCA index to examine Kazakhstan's sectoral specialization: the standard RCA that uses gross exports and a GVC-adjusted RCA that uses value-added exports. Details of this methodology are in .

|  |
| --- |
| Box : Calculating the Revealed Comparative Advantage Index  Comparative advantage is used to explain prevailing patterns of trade, the theory being that countries export goods and services they have a comparative advantage in and import the rest. If there are two goods, cars and shirts, and two countries, A and B, and if A’s proficiency in making cars relative to shirts is better than B’s proficiency in making cars relative to shirts, then A will be exporting cars to B and B will be exporting shirts to A. Note that B might be absolutely better than A at making both cars and shirts: what is crucial is *comparative* proficiency.  Balassa (1965) operationalized this concept with a ratio called the revealed comparative advantage (RCA) index. Take the share of sector in a given country’s exports and compare it with the average share of sector across all countries’ exports. If it is higher, then the country’s export make-up “reveals” it to have a comparative advantage in sector . If it is lower, then it reveals the absence of a comparative advantage in that sector. Formally, country ’s RCA index for sector is given by  where the denominator sums across all economies in the world. An RCA index of higher than 1 indicates a comparative advantage in that sector while an index lower than 1 indicates the lack of a comparative advantage.  As discussed in Asian Development Bank (2021), the RCA index may be adjusted to account for global value chains by using value-added exports. This removes foreign value added and pure double-counting from the country’s exports, resulting in an RCA index that is based on domestic value added flows that are absorbed abroad (see ). In this chapter, sector disaggregations are by value added origins.  **References**  Asian Development Bank. 2021. *Key Indicators for Asia and the Pacific 2021*. Manila, Philippines: Asian Development Bank.  B. Balassa. 1965. Trade Liberalisation and “Revealed” Comparative Advantage. *The Manchester School*. 33(2). pp. 99–123. |

Figure 4.1 charts both RCA indices for Kazakhstan across sectors, ranking them from highest to lowest and tracing how these rankings change as the standard index is adjusted for GVCs. Given the extraordinary circumstances of the last few years, the underlying data were averaged over 2017–2022 to make observed patterns more reliable. Consistent with previous chapters, mining had by far the highest RCA index in both gross and value added terms. Using gross exports, mining had an index of 7.7, meaning its share in Kazakhstan’s exports was 7.7 times larger than its average share across the world in 2022. Removing foreign value added and pure double-counting reduces this to a still-high 4.7. The related sector of inland transport services also notches high RCA indices—3.1 in gross terms and 2.9 in value added terms. This likely stems from pipeline services used to transport oil and gas.

The only other sectors for which Kazakhstan has a high RCA index is metals manufacturing, with indices of 2.2 in both gross and value added terms, and wholesale trade services, with indices of 1.3 (gross) and 1.7 (value added). While Kazakhstan does exhibit an RCA index of greater than 1 for refined fuels in value added terms, it is just barely. This highlights its relatively upstream, low-value added participation in the extractive energy supply chain. Furthermore, emphasizing Kazakhstan's concentration in natural resources are its very low RCA indices for all other manufacturing sectors. Electricals, a staple of fast-growing GVC-oriented economies like Viet Nam, registered gross and value added indices of 1/29 and 1/28. The same pattern is seen for other sophisticated manufacturing sectors like chemicals and transport equipment.

Another piece of evidence pointing to Kazakhstan's relatively low GVC participation is the fact that the top sectors it is specializing in under the gross RCA index are the same under the value added RCA index. In short, trading patterns for the country's largest export sectors are unchanged when foreign value added and pure double-counting are accounted for, suggesting that these are negligible to begin with. Interestingly however, the only major sector for which the two RCA indices differ is agriculture, whose index drops from 1.1 to 0.6. That is, the supposed comparative advantage of Kazakhstan in agriculture is an illusion resulting from exports that are inflated by foreign value added. The country, in fact, is less of an agricultural exporter than traditional trade statistics suggest.

Figure .: Revealed Comparative Advantage Indices, Kazakhstan, 2017–2022

RCA = revealed comparative advantage.

Notes: Revealed comparative advantage (RCA) index computed according to Balassa (1965) and ADB (2021), using averaged data from 2017–2022. Sectors with revealed comparative advantage indices of greater than 1 are sectors Kazakhstan is said to have a revealed comparative advantage in. Value-added exports are exports of domestic value added that are absorbed abroad disaggregated by origin sectors, computed following ADB (2021). Sectors with no value-added exports are omitted.

Sources: Asian Development Bank. 2021. *Key Indicators for Asia and the Pacific 2021*. Manila, Philippines: Asian Development Bank; B. Balassa. 1965. Trade Liberalisation and “Revealed” Comparative Advantage. *The Manchester School*. *33*(2). pp. 99–123; Asian Development Bank. Multiregional Input–Output Database (July 2023); Asian Development Bank estimates.

Specialization based on export patterns say nothing about where along the chain a country is specializing in. Is it in the more upstream segments, closer to primary producers? Or is it in the more downstream segments, closer to final consumers? Production length indicators can provide a quantitative measure. As described in Box 5, the methodology of Wang, Wei, Yu, and Zhu (2017b) computes the number of forward and backward GVC production stages for any given sector or country. Comparing the two gives a sense of where the sector or country lies in the production chain: if the forward length is longer, then it is said to be more upstream, while if the backward length is longer, it is more downstream.

Using this approach, Figure 4.2 traces Kazakhstan’s position in the mining and metals value chains from 2010 to 2022. For reference, the figure also includes other countries that were found to be specializing in these sectors: Brunei Darussalam, Norway, the Russian Federation, and the United States for mining and Germany, Japan, the People's Republic of China, and the United States for agriculture. Dots above the 45-degree line are upstream countries while dots below the 45-degree line are downstream countries.

Figure .: Positioning in Mining and Metals GVCs, Selected Countries, 2010 and 2022

GVC = global value chain

Notes: Global value chain production lengths are computed according to Wang, Wei, Yu, and Zhu (2017). Sector breakdown is by value added origins.

Sources: Asian Development Bank. 2021. *Key Indicators for Asia and the Pacific 2021*. Manila, Philippines: Asian Development Bank; Z. Wang, S. Wei, X. Yu, and K. Zhu. 2017. Characterizing Global Value Chains: Production Length and Upstreamness. *NBER Working Paper No. 23261*. Cambridge, MA: National Bureau of Economic Research; Asian Development Bank. Multiregional Input–Output Database (July 2023); Asian Development Bank estimates.

For mining, Kazakhstan joins Brunei Darussalam and the United States in the upstream region of the value chain. However, all three have moved more downstream in the last decade, with their backward stages increasing and (to a lesser degree) their forward stages decreasing. For Kazakhstan, the backward stages of its mining sector rose from 3.8 stages in 2010 to 4.2 in 2022 while its forward stages stayed at roughly 4.2 stages. This means it has embedded itself deeper within mining GVCs. In contrast, the Russian Federation appears to lie even deeper, with backward stages at 4.6 and forward stages at 4.3 in 2022. This may be puzzling given the extensive sanctions placed on it following its invasion of Ukraine, but note that the chart specifically looks only at the GVC component of trade. This may have isolated the trade that is most robust from sanctions, explaining why it remains deeply embedded.

There is less movement across the last decade in the GVC production lengths of metals manufacturing. The five countries included in the chart all lie close to the 45-degree line, indicating neutral positions along the value chain—neither upstream nor downstream. The PRC exhibits the highest numbers of backward and forward stages while Germany exhibits the lowest. Kazakhstan's stages are similar to the United States at 4.2 backward stages and 4.1 forward stages.

Having established the position of Kazakhstan in the value chains of these two sectors, this chapter turns next to how its price competitiveness has changed over the decades. This is measured by the real effective exchange rate (REER) index. The REER is a price index in the spirit of the GDP deflator and the consumer price index, though it accounts not just for a country’s domestic prices but also the prices of its international competitors, weighted by the degree to which it competes with them. If the REER goes up, then the country’s prices have gone up relative to its competitors; thus, it is said to have lost in competitiveness. Likewise, if the REER goes down, then it has gained in competitiveness. Moreover, like the RCA index, this chapter implements a refinement of the REER that considers value added rather than gross flows. See for more details.

|  |
| --- |
| Box : Calculating the Real Effective Exchange Rate Index  The real effective exchange rate (REER) is a price index that summarizes a country’s prices relative to its trade competitors. Changes in the REER can be thought of as the residual price change after inflation rates and nominal exchange rate movements have been taken into account. Changes in the REER would always be zero under purchasing power parity (PPP), but it generally is not due to factors like home bias, market frictions, and policy (Itskhoki 2020). Because of this, the REER acts like an inverse competitiveness index. Depreciation, which by convention means a fall in the REER, implies that the home country’s goods have become relatively cheaper in the markets it competes in and can therefore expect higher demand; appreciation, conversely, is associated with lower demand.  The REER index is a weighted average of bilateral real exchange rates (Chinn 2006). Price levels in countries with whom the home country has more trade have a larger influence in its REER. Formally, the weight country assigns to the prices of country is  That is, it is proportional to two fractions summed across all markets . The first is the importance of market in ’s exports and the second is the market share of in market . The higher either of these are, the higher the weight.  The REER itself is obtained by multiplying the weights matrix with the vector of price changes:  Calculating the weights matrix typically relies on trade statistics that only report gross exports, resulting in the implicit assumption that all trade is in final goods (see ). This has grown increasingly untenable with the rise of global value chains (GVCs) (Bems and Johnson 2017). To illustrate, consider a trading relationship where Japan exports electronic components to the People’s Republic of China (PRC), who assembles them into toys that then compete with toys from the United States. Suppose there is no direct trade between Japan and the United States. Then in computations of the United States REER, a depreciation of the yen registers no impact, though by decreasing PRC input costs, it may well result in cheaper PRC exports, making United States exports less competitive. In short, if the presence of global value chains is not taken into account, the resulting REER index may miss a lot of relevant nuances.  This chapter implements the GVC-adjusted REERs of Patel, Wang, and Wei (2019). Expanding on Bems and Johnson (2017), they build a dynamic stochastic general equilibrium model using Armington (1969) demand functions to derive a weights matrix at the country-sector level, which may be aggregated to the country level through value added-weighted averages. This chapter simplifies their model by assuming constant and uniform elasticities.  **References**  P. S. Armington. 1969. A Theory of Demand for Products Distinguished by Place of Production. *Staff Papers (International Monetary Fund).* 16(1). pp. 159–78.  T. Bayoumi, J. Lee, and S. Jayanthi. 2005. New Rates from New Weights. *IMF Working Paper WP/05/99*. Washington, DC: International Monetary Fund.  R. Bems and R. C. Johnson. 2017. Demand for Value Added and Value-Added Exchange Rates. *American Economic Journal: Macroeconomics*. 9(4). pp. 45–90.  M. D. Chinn. 2006. A Primer on Real Effective Exchange Rates: Determinants, Overvaluation, Trade Flows and Competitive Devaluation. *Open Economies Review*. 51. pp. 115–43.  O. Itskhoki. 2020. The Story of the Real Exchange Rate. *NBER Working Paper*. No. 28225. Cambridge, MA: National Bureau of Economic Research.  S. Patel, Z. Wang, and S. Wei. 2019. Global Value Chains and Effective Exchange Rates at the Country-Sector Level. *Journal of Money, Credit, and Banking*. 51(1). pp. 7–42. |

The two panels of show the countries whose prices have the largest weights in Kazakhstan's mining and metals manufacturing REERs. These weights reflect the market leaders in the markets Kazakhstan competes in. For mining in panel (a), the People's Republic of China has steadily gained to become the country with the single largest weight, beating Italy and the United States. The PRC itself has a major mining sector, and since Kazakhstan exports much of its oil to the PRC, it is no surprise that PRC prices play a large role in the competitiveness of Kazakh mining. Nevertheless, this result should be interpreted with caution. The mining sector aggregates several distinct products, from oil to ores and rocks. The PRC remains the world's biggest importer of oil, so it is unlikely that it is competing with Kazakhstan in the specific product. More relevant, then, is the United States, which is a major seller of oil in the world.

Figure .: Real Effective Exchange Rate Weights, Selected Sectors, Kazakhstan, 2007–2022

 (a) Mining

(b) Metals

Notes: Weights reflect the importance of each country’s prices to Kazakhstan's sector-level real effective exchange rate index, computed according to Patel, Wang, and Wei (2019).

Sources: S. Patel, Z. Wang, and S. Wei. 2019. Global Value Chains and Effective Exchange Rates at the Country-Sector Level. *Journal of Money, Credit, and Banking*. *51*(1). pp. 7–42; Asian Development Bank. Multiregional Input–Output Database (July 2023); Asian Development Bank estimates.

The PRC remains the largest weight for the REERs of Kazakhstan's metals manufacturing sector. This stems from the fact that the PRC is both a major market for Kazakhstan's metals and itself a major producer of metals. The PRC's large weight suggests that Kazakhstan may stand to gain from any kind of restrictions placed on the PRC's export of metals, as has been the case since a trade conflict erupted between the United States and the PRC in 2018. As a recent example, the PRC announced curbs to its export of gallium and germanium—both key metals in the manufacture of semiconductors—beginning August 2023 (Tan 2023).

Using these weights to take an average of Kazakhstan's bilateral exchange rates yields the REER index. plots percent-changes in REERs for mining and metals as well as for the aggregate country. The figure also plots these REERs for the Russian Federation given their shared history and deep economic interlinkages. The figure ends in 2021 as sector-level price data for 2022 are not yet available.

Figure .: Change in Real Effective Exchange Rate Index, Kazakhstan and Russian Federation, Selected Sectors, 2007–2021

Note: Real effective exchange rate indices are computed according to Patel, Wang, and Wei (2019). Inflation for 2007 is annual average over 2000–2007.

Sources: S. Patel, Z. Wang, and S. Wei. 2019. Global Value Chains and Effective Exchange Rates at the Country-Sector Level. *Journal of Money, Credit, and Banking*. *51*(1). pp. 7–42; Asian Development Bank. Multiregional Input–Output Database (July 2023); Asian Development Bank estimates.

Owing to the dominance of mining and metals to Kazakhstan's exports, it is no surprise that its aggregate REER tracks these two closely. However, there are years when the two sectors diverge from the aggregate, as in 2007–2008, 2015–2016, and 2020–2021. Comparing this figure to Figure 2.1 reveals how global oil prices serve as the primary driver of Kazakhstan's REERs. Indeed, the mining REER tends to be more volatile than the aggregate REER, demonstrating how diversification away from its extractive resource sector can help stabilize Kazakhstan's export competitiveness. Overall however, Kazakhstan remains less volatile than the Russian Federation, whose aggregate REER has taken wild swings over the period covered.

While a declining REER indicates that the country's exports are becoming cheaper and therefore more competitive, it should not necessarily be the goal. Indeed, the steep devaluations of the tenge in 2009, 2014, and 2015 resulted in hardship in an economy heavily dependent on imported consumer goods (Kumenov 2018). Research suggests that maintaining a stable exchange rate rather than competitive devaluations is most conducive to trade (Eichengreen 2008; Rodrik 2008). In the aggregate, the standard deviation in Kazakhstan's REER change was 9.9 points, much lower than the Russian Federation's 13.0 points.

To place these numbers into context, plots the mean appreciation and standard deviation in aggregate REERs across the 62 countries and economies included in the ADB MRIO Database. Stable currencies mean being as close to 0% mean appreciation as possible with low standard deviation, a feat achieved most successfully by Singapore. This stems from having a diverse basket of exports and export destinations, which in turn diversifies competitors and minimizes the impact of price changes in each one. On the other end are the commodities-oriented countries of the Russian Federation and Brunei Darussalam, both registering high mean appreciations at high standard deviations. This is no surprise given their heavy reliance on oil exports.

Figure .: Real Effective Exchange Rate Mean and Volatility, 2007–2021

Notes: REER indices are computed according to Patel, Wang, and Wei (2019).

Sources: S. Patel, Z. Wang, and S. Wei. 2019. Global Value Chains and Effective Exchange Rates at the Country-Sector Level. *Journal of Money, Credit, and Banking*. *51*(1). pp. 7–42; Asian Development Bank. Multiregional Input–Output Database (July 2023); Asian Development Bank estimates.

Kazakhstan's mean annual appreciation was 1.2%, lower than the Russian Federation's 2.0% but higher than Brunei Darussalam's 0.0%. Kazakhstan does exhibit lower volatility than either of them, though as evident from the figure, it remains far higher than most of the other countries in the sample.

To conclude, the RCA index show that Kazakhstan is specializing heavily in the mining and metals manufacturing sectors. This remains the case regardless of whether the RCA index is adjusted for value added, indicating a relatively low degree of GVC penetration. GVC production lengths suggest that Kazakhstan sits at a relatively neutral position in these value chains, neither upstream nor downstream. A value added-adjusted REER weighting methodology reveals that Kazakhstan's main competitor is the People's Republic of China, which has a major presence in both mining and metals manufacturing. This offers an opportunity for Kazakhstan to benefit from recent attempts by the West to pivot away from Chinese reliance.

# Special Topics

This chapter covers some further issues relating to Kazakhstan's economy and trade with a focus on global value chains. In the first section, its membership in the Eurasian Economic Union is analyzed using a regional concentration index and visualized via a skyline chart. The objective here is to measure how deep this regional trade agreement is and in what sectors, using both gross and value added flows.

In the second section, ...

## The Eurasian Economic Union

As globalization picked up pace in the 1990s, so did initiatives to deepen and regulate trade on a regional basis. Notwithstanding the success of multilateral initiatives like the creation of the World Trade Organization (WTO) in 1995, negotiating regional trade agreements (RTAs) remained less challenging given the fewer stakeholders involved and the greater immediacy of its benefits (WTO 2011; Limão 2016). During this period, the North American Free Trade Agreement (NAFTA) was formed and the free trade areas of the European Union and the Association of Southeast Asian Nations (ASEAN) were substantially expanded, among others. RTA initiatives continued into and after the 2010s with the signing of the Comprehensive and Progressive Agreement for Trans-Pacific Partnership and the Regional Comprehensive Economic Partnership.

Among these initiatives is the Eurasian Economic Union, or EAEU, conceptualized as a means to economically integrate the post-Soviet states in Europe and Central Asia. The EAEU traces its beginnings to a customs union established by Belarus, Kazakhstan, and the Russian Federation in 2010. This deepened into an economic union by 2015 and expanded to include Armenia and the Kyrgyz Republic. Its main regulatory body is the Eurasian Economic Commission, where the five EAEU members have equal voting rights. Progress in the common labor market has generally been more extensive that that of the common goods and services market (Vinokurov 2017; Mostafa and Mahmood 2018).

A common way of measuring the extent of regional trade integration is to take the share of intraregional trade in the region’s total trade (exports plus imports). This has been criticized by Frankel (1997), who argues that such a share monotonically increases as the number of members goes up. He proposes normalizing this by the share of the region in world trade, a methodology detailed in . To illustrate, the intra-regional trade share of the 27-member European Union was 54.9% in 2022, compared with 4.7% for the five-member EAEU, suggesting the former is over 11 times more integrated than the latter. However, the European Union takes up 30.1% of world trade against the 1.7% of the EAEU. Thus, the countries of the European Union trade among themselves 1.8 times more than they do with the world, while the SAARC countries trade among themselves 2.8 times more. These two numbers, called regional concentration indices (RCI), paint a more comparable picture of the groups' relative degree of integration.

|  |
| --- |
| Box : Calculating the Regional Concentration Index  The regional concentration index (RCI) measures the extent to which a collection of countries (a “region”) is trading among themselves relative to the rest of the world. Following Frankel (1997), it is computed as a ratio of two fractions: the share of the region’s trade with itself and the share of the region in world trade. Formally, the RCI for region is given by  Note that and . That is, the exports of a region to itself is necessarily equal to its imports from itself.  A random collection of countries would have an RCI of close to 1, meaning they trade among each other at about the same rate they trade with the world. If the collection is, for example, geographically close, or share cultural ties, or belong to a deep trading agreement, its RCI would be higher than 1. Conversely, an RCI below 1 means trade within the region is less significant than trade outside it.  Because of international production sharing, the RCI based on gross exports may misstate regional integration in two ways. First, exports may contain value added from outside the region. Second, reexporting by the region’s members may result in regional value added actually being absorbed outside the region. To correct for these, an adjusted RCI is also computed that accounts for value added from beginning to end, ensuring that regional flows are truly regional. This is called the end-to-end RCI.  **Reference**  J. A. Frankel. 1997. *Regional Trading Blocs in the World Economic System*. Washington, DC: Peterson Institute for International Economics. |

The RCIs for five major RTAs are plotted in . RCIs on the left panel use gross exports to measure regional integration. These show that among the five, the EAEU since its creation in 2015 has tended to have the highest integration, registering an RCI of over 3 until 2021. The European Union, being the most institutionally mature of the group, exhibited the most stable RCI, hovering between 1.5 and 2.0. Its relatively low RCI may be surprising given the institutional extent of the European Economic Community, but note that the three largest economies in the world—the United States, the People's Republic of China, and Japan—lie outside the EU.

Figure .: Regional Concentration Indices, Selected RTAs, 2000, 2007–2022

ASEAN = Association of Southeast Asian Nations, NAFTA = North American Free Trade Agreement, RTA = regional trade agreement, SAARC = South Asian Association for Regional Cooperation.

Notes: Groupings are missing some members if they are not identified in the Asian Development Bank Multiregional Input–Output Database. ASEAN includes Brunei Darussalam, Cambodia, Indonesia, Lao People's Democratic Republic, Malaysia, Philippines, Singapore, Thailand, and Viet Nam and is missing Myanmar. EAEU includes Kazakhstan, the Kyrgyz Republic and the Russian Federation and is missing Armenia (before 2017) and Belarus. EU includes Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovak Republic, Slovenia, Spain, and Sweden. NAFTA includes Canada, Mexico, and the United States. SAARC includes Bangladesh, Bhutan, Sri Lanka, India, Maldives, Nepal, and Pakistan and is missing Afghanistan.

Sources: Asian Development Bank. Multiregional Input–Output Database (July 2023); Asian Development Bank estimates.

As explained in , using gross exports to calculate RCI may be misleading due to imported inputs on the one hand and reexporting on the other. In other words, value added from outside the region may be mixed in, a possibility all the more relevant in the age of GVCs. Thus, an “end-to-end” RCI that traces value added from creation to final consumption is also presented in . This adjusted RCI is significantly lower for the EAEU, so much so that it is only higher than ASEAN's RCI for one year—2016. Nevertheless, it remains generally higher than the RCIs of NAFTA and the EU. For NAFTA in particular, regional integration is much lower in the end-to-end metric compared with the gross metric, suggesting that much of what appears to be intra-NAFTA trade actually involves much outside value added.

The rise in the EAEU's RCI from 2015 onwards points to a high degree of enthusiasm for intra-regional trade among its members immediately following its establishment, heralding a promising start for the young bloc. However, this initial burst has tempered somewhat. Several problems face the EAEU, not least of which are the political complications associated with the Russian invasion of Ukraine. As the West moves to isolate the Russian Federation, the other EAEU members find themselves caught between their obligations to the economic union and the vital trading links they have with the rest of the world. Such concerns raise existential questions for the EAEU (Aidarkhanova 2023).

Turning to the sector level, regional integration may be visualized with a skyline chart, whose construction is described in . It represents each sector as a “tower” whose width is its share in the region’s output and whose height is its output expressed as a share of the portion induced by domestic demand. The portion of the tower corresponding to the output suppressed due to imports is also indicated. The skyline chart’s main purpose is to show where the region is self-sufficient in, these being the sectors for which its own internal demand is enough to exhaust its output.

|  |
| --- |
| Box : Constructing the Skyline Chart  The skyline chart visualizes the industrial structure of an economy and the extent to which it relies on imports (METI, 2011; WTO, 2011b). Each sector is represented by a “tower”, as in the figure. The width of the tower measures the share of that sector in the economy’s output. The height of the tower measures output induced by demand for that sector, computed using data from an input–output table. Output induced by domestic demand is normalized at 100%, with anything above it corresponding to output induced by export demand. Part of the tower is shaded red to indicate the reduction in output induced by imports, which, being negative, starts from the top of the tower and extends downward.  **A Tower in a Skyline Chart**  Share in output  100%  Domestic demand-induced output  Export demand-induced output  Import demand-induced output (negative)  Self-sufficiency ratio  Source: Authors’ drawing based on World Trade Organization (2011b).  If the blue region of the tower is above the 100% line, then the sector it represents is said to be self-sufficient. That is, its own output is enough to satisfy its induced domestic demand. If it is below the 100% line, however, then domestic output is insufficient and the economy has had to import the shortfall in supply. The actual height of the blue region is called the sector’s self-sufficiency ratio.  In this chapter, the skyline chart is constructed at the regional level. Thus, the underlying input–output table is aggregated at the regional level, meaning imports and exports now refer to flows going in and out of the region while flows between economies within the region are treated as “domestic” flows. Self-sufficiency then refers to the ability of the region to supply its induced demand without having to import from outside the region.  **References**  METI (Japan Ministry of Economy, Trade and Industry). 2011. *White Paper on International Economy and Trade,* *Supplementary Notes*. Retrieved from https://www.meti.go.jp/english/report/data/gWT2011fe.html.  WTO (World Trade Organization). 2011a. *World Trade Report 2011: The WTO and Preferential Trade Agreements: From Co-Existence to Coherence*. Geneva, Switzerland: World Trade Organization.  WTO. 2011b. *Trade Patterns and Global Value Chains in East Asia: From Trade in Goods to Trade in Tasks*. Geneva, Switzerland: World Trade Organization. |

The skyline chart for EAEU using 2022 data is presented in . The heft of the Russian Federation, by far its largest member, is evident in the large share attributable to mining. Together with the companion sector of refined fuels, the chart makes it starkly clear that the EAEU produces much more oil than it can possibly consume, necessitating significant exports out of the region. Nevertheless, looking at the width-wise distribution across sectors, it is evident that services—not the primary sectors—make up the largest share of the region's output. This speaks to the relative sophistication of the Russian economy, unlike other countries with large extractive resource sectors.

Figure .: Skyline Chart for the EAEU Countries, 2022

AHF = agriculture, hunting, forestry and fishing; CCP = chemicals and chemical products; CON = construction; CRP = coke, refined petroleum and nuclear fuel; EAEU = Eurasian Economic Union; EDU = education; EOE = electrical and optical equipment; FBT = food, beverages and tobacco; FIN = financial intermediation; HRS = hotels and restaurants; HSW = health and social work; ITR = inland transport; MCH = machinery, not elsewhere classified; MFM = basic metals and fabricated metal; OBA = renting of machinery & equipment and other business activities; ONM = other non-metallic mineral; OSV = other community, social and personal services; PAD = public administration and defense; compulsory social security; REA = real estate activities; RTR = retail trade and repair, except of motor vehicles and motorcycles; TEL = post and telecommunications; TEX = textiles and textile products; TRE = transport equipment; UTL = electricity, gas and water supply; WST = wholesale trade, except of motor vehicles and motorcycles.

Notes: The Eurasian Economic Union includes Armenia, Kazakhstan, the Kyrgyz Republic, and the Russian Federation and is missing data for Belarus.

Sources: Asian Development Bank. Multiregional Input–Output Database (July 2023); Asian Development Bank estimates.

Interestingly, apart from a few minor manufacturing sectors, the EAEU appears to be largely self-sufficient, with most of the blue areas in the skyline chart exceeding the 100% line. This makes it robust to shocks coming from outside the bloc. At the same time however, this also complicates efforts to decouple member economies from the Russian Federation. As mentioned above, this is a particularly salient issue in light of the geopolitical conflicts hounding the EAEU's largest member.

## Adjusting for Inflation

Much of the world experienced an inflationary episode beginning in 2022. This was caused by a host of factors, the most important of which are the aggressive stimulus measures pursued by many governments in rich countries during the pandemic, the resulting post-pandemic surge in consumer demand and the supply chain bottlenecks the followed, and the spike in the prices of food and energy products following the Russian invasion of Ukraine. Double-digit inflation rates—not seen since the 1970s—were reported in the United States, the United Kingdom, and the European Union. Many central banks have since embarked on a vigorous interest hiking program to manage demand, and by extension, prices (*The Economist* 2022).

The new inflationary environment raises concerns over the use of economic indicators expressed in current prices. Given the sharp rise in benchmark crude oil prices for example, any contemporaneous rise in the dollar value of oil exports by countries like Kazakhstan may be entirely driven by price rather than volume changes. It is therefore ideal to express economic quantities in constant prices. This, of course, is a nontrivial task and requires a careful methodology to ensure that clarity rather than noise is being added to the raw data.

To this end, the team behind the Asian Development Bank's Multiregional Input–Output (MRIO) Database has released a constant price version of the MRIO tables, with prices pegged at 2010 levels. The methodology behind these tables is briefly described in Box 10; the interested reader may also consult the GVC chapter of the ADB *Key Indicators 2023* publication.

|  |
| --- |
| Box : Constant Price MRIO Tables  [Text] |

The preliminary data in these tables suggest that in Kazakhstan's case, the inflation of 2022 had not significantly altered the patterns of its GVC trade. Figure 5.3 shows the annual growth rates of its GVC exports in the aggregate as well as for the mining, metals, and wholesale trade sectors—all of which were established in previous chapters as being Kazakhstan's major GVC-oriented industries. In all cases, growth rates at constant and current prices more or less coincided in 2022. Notwithstanding the attention it has received, it appears that the recent inflationary episode has done little to alter Kazakhstan's real trading patterns.

Figure .: Growth in GVC Exports, Constant Price vs Current Price, 2008–2022

GVC = global value chains.

Source: Asian Development Bank. Multiregional Input–Output Database (July 2023); Asian Development Bank estimates.

There were occasions in the last two decades, however, where constant and current growth rates do diverge significantly. In general, constant growth rates are less volatile than current growth rates. For example, whereas aggregate GVC exports in current prices grew 32.2% in 2010 and 50.1% in 2011, in constant prices the growth rates were more modest at 13.3% and 29.6%. There are even cases where one measure recorded growth while the other recorded a contraction. For example, GVC exports in metals manufacturing logged deeply negative growth rates for the period 2013–2016 according to current price measures, whereas under constant price measures, growth was near zero in 2014 and highly positive in 2015–2016. This suggests that a drop in metals prices masked real growth in the sector. Indeed, Figure 4.4 shows that during this period, the metals real effective exchange rate index declined, indicating greater price competitiveness for Kazakhstan. It appears to have benefited from this as its GVC exports here grew in real terms.

[Update further when KI comes out.]

# Conclusion

To follow.

# References

E. Aidarkhanova. 2023, June 12. Who Benefits from the Eurasian Economic Union? *The Diplomat*. Retrieved from https://thediplomat.com/2023/06/who-benefits-from-the-eurasian-economic-union.

P. Antràs and D. Chor. 2013. Organizing the Global Value Chain. *Econometrica*. 81(6). pp. 2127–2204.

P. S. Armington. 1969. A Theory of Demand for Products Distinguished by Place of Production. *Staff Papers (International Monetary Fund).* 16(1). pp. 159–78.

G. Azretbergenova and A. Syzdykova. 2020. The Dependence of the Kazakhstan Economy on the Oil Sector and the Importance of Export Diversification. *International Journal of Energy Economics and Policy.* 10(6). pp. 157–163.

Asian Development Bank (ADB). 2018. *Kazakhstan: Accelerating Economic Diversification*. Mandaluyong City, Philippines: Asian Development Bank.

ADB. 2021. *Key Indicators for Asia and the Pacific 2021*. Manila, Philippines: Asian Development Bank.

B. Balassa. 1965. Trade Liberalisation and “Revealed” Comparative Advantage. *The Manchester School*. 33(2). pp. 99–123.

R. Banga. 2014. Linking into Global Value Chains Is Not Sufficient: Do You Export Domestic Value Added Contents? *Journal of Economic Integration*. 29(2). pp. 267–297.

D. Bartelme and Y. Gorodnichenko. 2015. Linkages and Economic Development. *NBER Working Paper*. No. 21251. Cambridge, MA: National Bureau of Economic Research.

T. Bayoumi, J. Lee, and S. Jayanthi. 2005. New Rates from New Weights. *IMF Working Paper WP/05/99*. Washington, DC: International Monetary Fund.

R. Bems and R. C. Johnson. 2017. Demand for Value Added and Value-Added Exchange Rates. *American Economic Journal: Macroeconomics*. 9(4). pp. 45–90.

A. Borin and M. Mancini. 2019. Measuring What Matters in Global Value Chains and Value-Added Trade. *Policy Research Working Paper*. No. 8804. Washington, DC: World Bank.

A. B. Bernard, J. B. Jensen, S. J. Redding, and P. K. Schott. 2007. Firms in International Trade. *Journal of Economic Perspectives*. 21(3), pp. 105–130.

S. Chatterjee and A. Subramanian. 2020. India’s Export-Led Growth: Exemplar and Exception. *Ashoka Centre for Economic Policy Working Paper No. 1*. Sonipat, India: Ashoka University.

M. D. Chinn. 2006. A Primer on Real Effective Exchange Rates: Determinants, Overvaluation, Trade Flows and Competitive Devaluation. *Open Economies Review*. 51. pp. 115–43.

D. Dollar, B. Khan, and P. Pei. 2019. Should High Domestic Value Added in Exports Be an Objective of Policy? In World Bank and World Trade Organization. *Global Value Chain Development Report 2019: Technological Innovation, Supply Chain Trade, and Workers in a Globalized World.* Washington, DC: World Bank.

*The Economist*. 2023, December 21. 2022 Has Been a Year of Brutal Inflation. *The Economist*. Retrieved from https://www.economist.com/finance-and-economics/2022/12/21/2022-has-been-a-year-of-brutal-inflation.

H. Escaith and S. Inomata. 2013. Geometry of Global Value Chains in East Asia: The Role of Industrial Networks and Trade Policies. In D. K. Elms and P. Low (eds.), *Global Value Chains in a Changing World* (pp. 135–157). Geneva, Switzerland: World Trade Organization.

European Commission. 2008. *Eurostat Manual of Supply, Use and Input-Output Tables*. Luxembourg: European Commission. Retrieved from https://ec.europa.eu/eurostat/web/products-manuals-and-guidelines/-/KS-RA-07-013.

D. Fickling. 2022, September 29. Peak Oil Has Finally Arrived. No, Really. *Bloomberg*. https://www.bloomberg.com/opinion/articles/2022-09-28/the-oil-peak-is-here-as-steep-rate-hikes-curb-consumption (accessed 27 June 2023).

J. A. Frankel. 1997. *Regional Trading Blocs in the World Economic System*. Washington, DC: Peterson Institute for International Economics.

J. A. Frankel and D. Romer. 1999. Does Trade Cause Growth? *American Economic Review*. 89(3). pp. 379–399.

S. Giglioli, G. Giovannetti, E. Marvasi, and A. Vivoli. 2021. The Resilience of Global Value Chains During the Covid-19 Pandemic: The Case of Italy. *UniFI* *DISEI Working Paper No. 07/2021*. Florence, Italy: Università degli Studi Firenze Dipartimento di Scienze per L’Economia e L’Impresa.

D. Hummels, J. Ishii, and K. M. Yi. 2001. The Nature and Growth of Vertical Specialization in World Trade. *Journal of International Economics*. 54. pp. 75–96.

S. Inomata. 2017. Analytical Frameworks for Global Value Chains: An Overview. In World Bank, *Global Value Chain Development Report 2017: Measuring and Analyzing the Impact of GVCs on Economic Development.* pp. 15–35. Washington, DC: World Bank.

IMF (International Monetary Fund). 2019. *World Economic Outlook: Global Manufacturing Downturn, Rising Trade Barriers*. Washington, DC: International Monetary Fund.

O. Itskhoki. 2020. The Story of the Real Exchange Rate. *NBER Working Paper No. 28225*. Cambridge, MA: National Bureau of Economic Research.

C. I. Jones. 2011. Intermediate Goods and Weak Links in the Theory of Economic Development. *American Economic Journal: Macroeconomics*.3(2). pp. 1–28.

Kearney. 2021. *Global Pandemic Roils 2020 Reshoring Index, Shifting Focus from Reshoring to Right-Shoring*. Chicago, IL: Kearney.

R. Koopman, Z. Wang, and S. Wei. 2014. Tracing Value-Added and Double Counting in Gross Exports. *American Economic Review*. 104(2). pp. 459–494.

A. Kumenov. 2018, September 6. Kazakhstan: Devaluation Deflates a Dispirited Population. *Eurasianet*. Retrieved from https://eurasianet.org/kazakhstan-devaluation-deflates-a-dispirited-population.

N. Limão. 2016. Preferential Trade Agreements. *NBER Working Paper No. 22138*. Cambridge, MA: National Bureau of Economic Research.

B. McCaig and N. Pavcnik. 2018. Export Markets and Labor Allocation in a Low-Income Country. *American Economic Review*. 108(7). pp. 1899–1941.

V. Mercer-Blackman, A. Foronda, and M. J. Mariasingham. 2017. Using Input–Output Analysis Framework to Explain Economic Diversification and Structural Transformation in Bangladesh. *ADB Economics Working Paper*. No. 513. Manila, Philippines: Asian Development Bank.

METI (Japan Ministry of Economy, Trade and Industry). 2011. *White Paper on International Economy and Trade,* *Supplementary Notes*. Retrieved from https://www.meti.go.jp/english/report/data/gWT2011fe.html.

G. Mostafa and M. Mahmood. 2018. Eurasian Economic Union: Evolution, Challenges and Possible Future Directions. *Journal of Eurasian Studies*. 9. pp. 163–172.

S. Patel, Z. Wang, and S. Wei. 2019. Global Value Chains and Effective Exchange Rates at the Country-Sector Level. *Journal of Money, Credit, and Banking*. 51(1). pp. 7–42.

Z. Pavlović. 2003. *Kazakhstan*. New York, NY: Chelsea House.

R. Pomfret. 2019. *The Central Asian Economies in the Twenty-First Century: Paving a New Silk Road*. Princeton, NJ: Princeton University Press.

S. Sakenova. 2023, April 27. Kazakhstan Sees Booming Trade and Investment Relations with Italy. *The Astana Times*. Retrieved from https://astanatimes.com/2023/04/kazakhstan-sees-booming-trade-and-investment-relations-with-italy.

W. F. Shughart. 2008. Industrial Concentration. In D. R. Henderson (Ed.), *Concise Encyclopedia of Economics*, 2nd ed. Indianapolis, IN: Library of Economics and Liberty.

J. E. Stiglitz. 1996. Some Lessons from the East Asian Miracle. *The World Bank Research Observer*. 11(2). pp. 151–77.

C. Tan. 2023, July 3. China Slaps Export Curbs on Chipmaking Metals in Tech War Warning to U.S., Europe. *CNBC*. Retrieved from https://www.cnbc.com/2023/07/04/china-imposes-export-curbs-on-chipmaking-metals-in-tech-war-with-the-us.html (accessed 21 July 2023).

M. P. Timmer, E. Dietzenbacher, B. Los, R. Stehrer, and G. J. de Vries. 2015. An Illustrated User Guide to the World Input-Output Database: The Case of Global Automotive Production. *Review of International Economics*. 23(3). pp. 575–605.

M. P. Thomas. 2019. Impact of Services Trade on Economic Growth and Current Account Balance: Evidence from India. *Journal of International Trade and Economic Development*. 28(3). pp. 331–347.

E. Vinokurov. 2017. Eurasian Economic Union: current state and preliminary results. *Russian Journal of Economics*. 3(1). pp. 54–70.

P. Wang. 2023, June 7. China Sees Biggest Trade Increase with Russia in 2023, Chinese Customs Data Shows. *CNN*. Retrieved from https://edition.cnn.com/2023/06/07/business/china-russia-trade-increase-intl/index.html (accessed 12 July 2023).

Z. Wang, S. Wei, X. Yu, and K. Zhu. 2017a. Measures of Participation in Global Value Chains and Global Business Cycles. *NBER Working Paper*. No. 23222. Cambridge, MA: National Bureau of Economic Research.

Z. Wang, S. Wei, X. Yu, and K. Zhu. 2017b. Characterizing Global Value Chains: Production Length and Upstreamness. *NBER Working Paper*. No. 23261. Cambridge, MA: National Bureau of Economic Research.

World Bank. 2020b. *Global Economic Prospects: Slow Growth, Policy Challenges (January 2020)*. Washington, DC: World Bank.

WTO (World Trade Organization). 2011a. *World Trade Report 2011: The WTO and Preferential Trade Agreements: From Co-Existence to Coherence*. Geneva, Switzerland: World Trade Organization.

WTO. 2011b. *Trade Patterns and Global Value Chains in East Asia: From Trade in Goods to Trade in Tasks*. Geneva, Switzerland: World Trade Organization.

# Appendices

Table A: Economies in the ADB Multiregional Input–Output Database

|  |  |  |  |
| --- | --- | --- | --- |
| **ID** | **Code** | **Name** | **Region** |
| 1 | AUS | Australia | East Asia and Pacific |
| 2 | AUT | Austria | Europe and Central Asia |
| 3 | BEL | Belgium | Europe and Central Asia |
| 4 | BGR | Bulgaria | Europe and Central Asia |
| 5 | BRA | Brazil | Latin America and the Caribbean |
| 6 | CAN | Canada | North America |
| 7 | SWI | Switzerland | Europe and Central Asia |
| 8 | PRC | People's Republic of China | East Asia and Pacific |
| 9 | CYP | Cyprus | Europe and Central Asia |
| 10 | CZE | Czech Republic | Europe and Central Asia |
| 11 | GER | Germany | Europe and Central Asia |
| 12 | DEN | Denmark | Europe and Central Asia |
| 13 | SPA | Spain | Europe and Central Asia |
| 14 | EST | Estonia | Europe and Central Asia |
| 15 | FIN | Finland | Europe and Central Asia |
| 16 | FRA | France | Europe and Central Asia |
| 17 | UKG | United Kingdom | Europe and Central Asia |
| 18 | GRC | Greece | Europe and Central Asia |
| 19 | HRV | Croatia | Europe and Central Asia |
| 20 | HUN | Hungary | Europe and Central Asia |
| 21 | INO | Indonesia | East Asia and Pacific |
| 22 | IND | India | South Asia |
| 23 | IRE | Ireland | Europe and Central Asia |
| 24 | ITA | Italy | Europe and Central Asia |
| 25 | JPN | Japan | East Asia and Pacific |
| 26 | KOR | Republic of Korea | East Asia and Pacific |
| 27 | LTU | Lithuania | Europe and Central Asia |
| 28 | LUX | Luxembourg | Europe and Central Asia |
| 29 | LVA | Latvia | Europe and Central Asia |
| 30 | MEX | Mexico | Latin America and the Caribbean |
| 31 | MLT | Malta | Middle East and North Africa |
| 32 | NET | Netherlands | Europe and Central Asia |
| 33 | NOR | Norway | Europe and Central Asia |
| 34 | POL | Poland | Europe and Central Asia |
| 35 | POR | Portugal | Europe and Central Asia |
| 36 | ROU | Romania | Europe and Central Asia |
| 37 | RUS | Russia | Europe and Central Asia |
| 38 | SVK | Slovak Republic | Europe and Central Asia |
| 39 | SVN | Slovenia | Europe and Central Asia |
| 40 | SWE | Sweden | Europe and Central Asia |
| 41 | TUR | Turkey | Europe and Central Asia |
| 42 | TAP | Taipei,China | East Asia and Pacific |
| 43 | USA | United States | North America |
| 44 | BAN | Bangladesh | South Asia |
| 45 | MAL | Malaysia | East Asia and Pacific |
| 46 | PHI | Philippines | East Asia and Pacific |
| 47 | THA | Thailand | East Asia and Pacific |
| 48 | VIE | Viet Nam | East Asia and Pacific |
| 49 | KAZ | Kazakhstan | Europe and Central Asia |
| 50 | MON | Mongolia | East Asia and Pacific |
| 51 | SRI | Sri Lanka | South Asia |
| 52 | PAK | Pakistan | South Asia |
| 53 | FIJ | Fiji | East Asia and Pacific |
| 54 | LAO | Lao People's Democratic Republic | East Asia and Pacific |
| 55 | BRU | Brunei Darussalam | East Asia and Pacific |
| 56 | BHU | Bhutan | South Asia |
| 57 | KGZ | Kyrgyz Republic | Europe and Central Asia |
| 58 | CAM | Cambodia | East Asia and Pacific |
| 59 | MLD | Maldives | South Asia |
| 60 | NEP | Nepal | South Asia |
| 61 | SIN | Singapore | East Asia and Pacific |
| 62 | HKG | Hong Kong, China | East Asia and Pacific |
| 63 | ROW | Rest of the world | South Asia |

ADB = Asian Development Bank.

Source: Asian Development Bank. Multiregional Input–Output Database. https://mrio.adbx.online (accessed 1 August 2021).

Table A: Sectors in the ADB Multiregional Input–Output Database

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **ID** | **Name** | **Short Name** | **Code** | **ISIC 3.1** |
| 1 | Agriculture, hunting, forestry and fishing | Agriculture | AHF | A–B |
| 2 | Mining and quarrying | Mining | MIN | C |
| 3 | Food, beverages and tobacco | Food & beverages | FBT | D15–16 |
| 4 | Textiles and textile products | Textiles | TEX | D17–18 |
| 5 | Leather, leather products and footwear | Leather | LTH | D19 |
| 6 | Wood and products of wood and cork | Wood | WDC | D20 |
| 7 | Pulp, paper, printing and publishing | Paper | PPP | D21–22 |
| 8 | Coke, refined petroleum and nuclear fuel | Refined fuels | CRP | D23 |
| 9 | Chemicals and chemical products | Chemicals | CCP | D24 |
| 10 | Rubber and plastics | Rubber | RBP | D25 |
| 11 | Other non-metallic mineral | Other minerals | ONM | D26 |
| 12 | Basic metals and fabricated metal | Metals | MFM | D27–28 |
| 13 | Machinery, not elsewhere classified | Other machinery | MCH | D29 |
| 14 | Electrical and optical equipment | Electricals | EOE | D30–33 |
| 15 | Transport equipment | Transport equipment | TRE | D34–35 |
| 16 | Manufacturing, not elsewhere classified; recycling | Other manufacturing | MFG | D36–37 |
| 17 | Electricity, gas and water supply | Utilities | UTL | E |
| 18 | Construction | Construction | CON | F |
| 19 | Sale and repair of motor vehicles and motorcycles; retail sale of fuel | Sale of motor vehicles | MTV | G50 |
| 20 | Wholesale trade, except of motor vehicles and motorcycles | Wholesale trade | WST | G51 |
| 21 | Retail trade and repair, except of motor vehicles and motorcycles | Retail trade & repair | RTR | G52 |
| 22 | Hotels and restaurants | Hotels & restaurants | HRS | H |
| 23 | Inland transport | Inland transport | ITR | I60 |
| 24 | Water transport | Water transport | WTR | I61 |
| 25 | Air transport | Air transport | ATR | I62 |
| 26 | Other supporting transport activities | Other transport services | OTR | I63 |
| 27 | Post and telecommunications | Telecommunications | TEL | I64 |
| 28 | Financial intermediation | Finance | FIN | J65–67 |
| 29 | Real estate activities | Real estate | REA | K70 |
| 30 | Renting of machinery & equipment and other business activities | Other business services | OBA | K71–74 |
| 31 | Public administration and defence; compulsory social security | Public administration | PAD | L |
| 32 | Education | Education | EDU | M |
| 33 | Health and social work | Social work | HSW | N |
| 34 | Other community, social and personal services | Other personal services | OSV | O |
| 35 | Private households with employed persons | Private households | PHE | P |

ADB = Asian Development Bank.

Source: Asian Development Bank. Multiregional Input–Output Database. https://mrio.adbx.online (accessed 1 August 2021).

1. World Bank. https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups (accessed 19 June 2023). [↑](#footnote-ref-2)
2. United Nations. Human Development Index. https://hdr.undp.org/data-center/human-development-index#/indicies/HDI (accessed 22 June 2023). [↑](#footnote-ref-3)
3. BP. *Statistical Review of World Energy* *2022*. https://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy/downloads.html (accessed 21 June 2023). [↑](#footnote-ref-4)
4. World Bank. World Development Indicators (May 2023). https://data.worldbank.org/indicator/NY.GDP.MKTP.KN (accessed 21 June 2023). [↑](#footnote-ref-5)
5. BP. *Statistical Review of World Energy* *2022*. https://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy/downloads.html (accessed 21 June 2023). [↑](#footnote-ref-6)
6. BP. *Statistical Review of World Energy* *2022*. https://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy/downloads.html (accessed 21 June 2023). [↑](#footnote-ref-7)
7. BP. *Statistical Review of World Energy* *2022*. https://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy/downloads.html (accessed 21 June 2023). [↑](#footnote-ref-8)
8. For an overview of the concept, see Inomata (2017). [↑](#footnote-ref-9)