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COMPETITIVENESS OF KAZAKHSTAN'S INDUSTRIES IN THE CONTEXT OF GLOBAL VALUE CHAIN PARTICIPATION

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Competitiveness of Kazakhstan's Industries in the Context of Global Value Chain Participation

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Abstract

This paper analyzes the competitiveness of Kazakhstan's economic sectors, taking into account their participation in global value chains. Sectoral real effective exchange rate indices are constructed, including measures based on domestic value added and accounting for imported intermediate inputs. The results reveal substantial cross-sectoral heterogeneity in competitiveness and a predominantly forward-oriented pattern of Kazakhstan's participation in GVCs.

The empirical analysis shows that the effect of the exchange rate on exports is statistically insignificant for the economy as a whole, but becomes significant for the manufacturing sector. The findings also indicate a stronger role of the price channel and a more moderate role of the cost channel in transmitting exchange rate changes to export dynamics.

The results allow for a more accurate assessment of the impact of exchange rate movements on exports and may be useful in analyzing the implications of exchange rate policy for the real sector of the economy.

Keywords: *value added, global value chains, real effective exchange rate, domestic value added, position and participation indicators, panel data.*

JEL Classification: F14, F31, F41, O24

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Introduction

In the context of deepening global integration and increasing fragmentation of production, assessing exporters' competitiveness requires going beyond the traditional real effective exchange rate (REER). The conventional approach assumes that countries compete primarily as producers of final goods. In reality, however, production processes are increasingly organized through global value chains (GVCs), in which countries simultaneously act as suppliers and users of intermediate inputs. In this context, the impact of exchange rate fluctuations becomes heterogeneous. For firms with a high share of imported inputs, currency depreciation increases production costs, whereas for exporters it strengthens price competitiveness (Goldberg, 2004).

These effects are also relevant for Kazakhstan, where the structure of trade and the degree of participation in global value chains differ across industries. Accordingly, this study estimates sectoral REER indices adapted to the realities of global value chains.

ISreer (Industry-Specific REER) – a sectoral REER based on export and import weights, as well as aggregate trade weights, allowing for differences in exchange rate sensitivity across sectors;

VAreer (Value-Added REER) – a REER based on domestic value added, designed to exclude the influence of re-exports and imported intermediate inputs;

FVAreer (Foreign Value-Added REER) – REER reflecting the cost of imported intermediate inputs used in producing a country's exports.

IOreer (Input-Output REER) – a cost-based REER combining FVAreer and ISreer, accounting for both price competitiveness and the cost of imported intermediate inputs embodied in exports, thereby capturing their joint effect on overall sectoral competitiveness.

Such an approach allows for a more realistic assessment of changes in sectoral price competitiveness, the identification of differences between export- and import-oriented sectors, and the analysis of sensitivity to exchange rate fluctuations taking into account the degree of participation in global value chains.

The aim of this study is to construct sectoral REER indices adapted to the realities of global value chains and to examine heterogeneity across industries in terms of competitiveness and the sensitivity of exports to the estimated sectoral REER measures.

The study consists of three sections. The first section provides a literature review. The second section presents an analysis of Kazakhstan's participation in global value chains, describes the methodology for calculating sectoral REER indices, and reports the results of the sectoral REER estimates. The third section evaluates the elasticity of sectoral exports with respect to the estimated sectoral REER using panel regression analysis. The paper concludes with a section summarizing the main findings.

1. Literature Review

The concept of global value chains (GVCs) began to take shape between 1994 and 2001, initially through the work of (Gereffi, 1994), and was later given a quantitative

and statistical foundation in the study by (David Hummels, Jun Ishii, Kei-Mu Yi, 2001). These studies laid the groundwork for assessing countries' participation in global value chains.

Since the late 2000s, GVCs have been extensively studied by international organizations, including the Organisation for Economic Co-operation and Development (OECD), the World Trade Organization (WTO), and the World Bank (WB). Between 2012 and 2014, more advanced databases were developed, such as Trade in Value Added (TiVA) and Multiregional Input-Output (MRIO) tables.

Before the emergence of international GVC tables, (Goldberg, 2004) showed that exchange rates affect industries differently depending on their trade structure and currency exposure. She proposed the concept of industry-specific exchange rate indices, which later formed the basis for the development of ISreer.

Later, (Linda Goldberg, Jose Campa, 2010) emphasized the importance of the cost channel and showed that industries with a high share of imported inputs respond more strongly to exchange rate shocks through changes in production costs.

(Rudolfs Bems, Robert C. Johnson, 2012) introduce the concept of a value-added reer at the country level, showing that participation in global value chains significantly alters the assessment of price competitiveness. In contrast, (N. Patel, Zhi Wang, Shang-Jin Wei, 2017) extend this idea by constructing a GVC-based reer at the sectoral level, accounting for differences in forward and backward participation in global value chains and the structure of international production. Their study demonstrates that each industry faces its own effective exchange rate, which cannot be captured by the country-level aggregates proposed by (Rudolfs Bems, Robert C. Johnson, 2012).

A significant contribution to the empirical application of the GVC-reer was made by the European Central Bank (ECB) in the report (The impact of global value chains on the euro area economy, 2019). The study provides a detailed comparison between VAreer and IOreer and supports the idea that currency appreciation may benefit exports if it reduces the cost of imported intermediate inputs, thereby improving price competitiveness. The authors clearly distinguish between the effects of exchange rate movements through the price channel (via exports) and the cost channel (via imports).

An example of the applied estimation of a cost-based REER is provided in the study by the Central Bank of Russia (Bogacheva, Porshakov, and Turdyeva, 2020). In this study, sectoral data on the share of imported intermediate inputs were incorporated, making it possible to estimate the REER from the perspective of production costs.

An important source of data and methodology is the study by (Joaquim Martins Gulihoto, Colin Webb, Norihiko Yamano, 2022), which presents approaches to measuring value added in international trade at the sectoral level.

The guidelines provided by (ADB, 2022) on the use of inter-country input-output tables offer tools for constructing GVC-reer measures applicable to the economies of Asia and the CIS, including Kazakhstan. Based on the methodology developed by (N.

Patel, Zhi Wang, Shang-Jin Wei, 2017) the ADB provides sectoral GVC-reer estimates for Asian economies, including Kazakhstan.

Thus, the academic literature of the past decade has established a solid methodological foundation for calculating GVC-adjusted sectoral indices of competitiveness. The use of GVC-reer allows for accounting for both export orientation and import cost structures, as well as countries' integration into global value chains. This is particularly important for economies undergoing structural transformation and characterized by high external sensitivity, such as Kazakhstan.

2. Sectoral REER in Kazakhstan depending on industries' participation in global value chains.

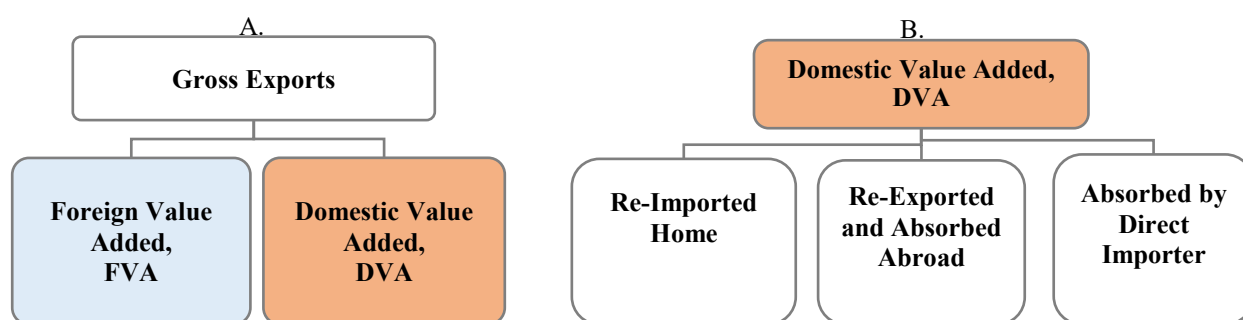
2.1. Analysis of Kazakhstan's participation in global value chains.

The seminal work by (Robert Koopman, William Powers, Zhi Wang, Shang-Jin Wei, 2010/2011) proposed a conceptual framework that allows gross exports to be decomposed into interconnected value-added components. According to their approach, gross exports can be represented as the sum of several elements (Scheme 1).

Scheme 1 illustrates that gross exports cannot be interpreted as a country's net contribution to global production. In reality, a significant share of exports may consist of value added produced in other countries and only assembled or processed within the domestic economy. Scheme 1A shows that a country's gross exports consist of foreign value added (FVA) and domestic value added (DVA). Foreign value added reflects imported intermediate inputs used in the production of exported goods.

Domestic value added is generated within the country, but may either be directly absorbed by the importing country, undergo further cross-border processing and be absorbed abroad, or even return to the country of origin through complex production chains (Scheme 1B).

Scheme 1. Export decomposition



Source: Based on (Robert Koopman, William Powers, Zhi Wang, Shang-Jin Wei, 2010/2011)

Building on this decomposition (Zhi Wang, Shang-Jin Wei, Xinding Yu, Kunfu Zhu, 2017) formalize the concepts of GVC participation and GVC position, which make it possible to assess both the depth of a country's integration into global value chains and its position along the production chain. The participation indicator reflects

the extent to which a country is integrated into global value chains and consists of two complementary components – forward participation and backward participation.

Forward participation reflects the extent to which a country's domestic value added is used by other countries in their exports (either as intermediate or final products). The indicator is calculated as the ratio of the total domestic value added generated by a country and embodied in other countries' exports to the country's total gross exports.

At the same time, backward participation is calculated as the ratio of foreign value added embodied in a country's exports to its total exports. Countries with high backward participation tend to occupy positions in the lower stages of global value chains and rely heavily on imported technologies and intermediate inputs. Production in such countries is based on the incorporation of a significant amount of foreign value added into final products, including complex components, equipment, electronic modules, and specialized materials. This profile implies that the competitiveness of sectors in these economies is determined not only by domestic factors such as labor and capital, but also by access to foreign technologies, the quality of imported components, and the stability of global supply chains.

The GVC position indicator reflects whether a country is located “upstream” or “downstream” within global value chains. It is based on a comparison of forward and backward participation. The index is defined as the logarithm of the ratio of these two components. A positive value indicates that the industry occupies an upstream position. This reflects specialization in the early stages of production, including the extraction of raw materials, the production of basic materials, and intermediate semi-finished goods. In such sectors, a significant share of domestic value added is embodied in other countries' exports and used in subsequent stages of production. Exports from upstream sectors generally depend more on global prices and contractual conditions and are less sensitive to exchange rate fluctuations. In contrast, a downstream position reflects participation in the final stages of the production process, such as assembly, final processing, and the production of goods oriented toward final demand. Downstream industries are typically characterized by a higher dependence on imported intermediate inputs, technologies, and components. At the same time, their export performance is more strongly driven by price competitiveness and demand conditions in final markets. In this sense, a downstream position is structurally closer to final demand, although it does not necessarily imply direct sales to the final consumer.

Several international databases are used to assess and analyze trade in value-added terms (Table 1). All of these databases are based on global input-output tables, national accounts data, and international trade statistics, as well as other socio-economic indicators (employment, education, gross output, and others).

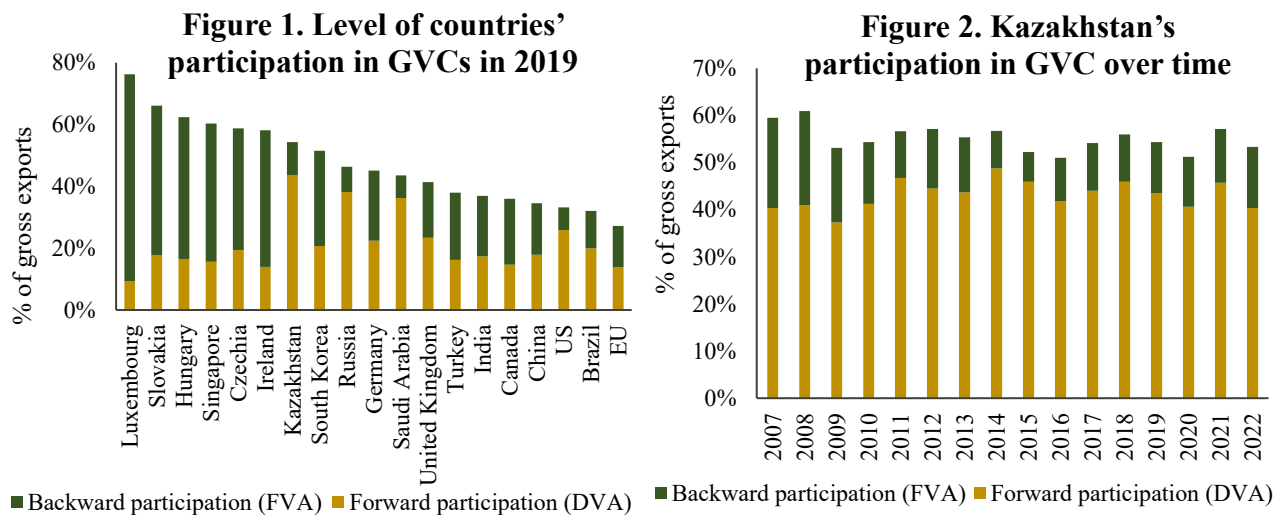
Table 1. Overview of international initiatives for measuring value added

	OECD TiVA (Trade in Value-Added)	UNCTAD-EORA	WIOD (World Input-Output Database)	ADB MRIO (Multi-Regional Input-Output)
Geographical coverage	80 countries plus the “Rest of the World” group	189 countries plus the “Rest of the World” group	43 countries	62 countries plus the “Rest of the World” group
Sectoral coverage	50 sectors and 30 aggregated sectors within the hierarchy	25-500 sectors depending on the country	56 sectors	35 sectors
Time coverage	1995–2022	1990–2018 (2018 estimated using a nowcasting approach based on IMF forecasts)	2000–2014	2007–2023

Source: Compiled by the author

A comparison of the main international GVC databases shows that, despite differences in coverage and methodology, their results are generally comparable. Studies, including (A.Asalam, N.Novta, F. Rodrigues-Bastos, 2017), confirm a high degree of consistency in the indicators both in terms of levels and dynamics. UNCTAD reports also indicate that discrepancies between databases tend to decline over time. The remaining differences are typically related to variations in the treatment of re-exports, limitations in national statistics, and differing methodological approaches and assumptions used in the construction of input-output tables.

Given that the OECD TiVA database is considered a reliable source and offers the longest available time series, this study relies on TiVA data to calculate value added and GVC participation indicators.



Source: OECD TiVA

According to TiVA data, Kazakhstan's participation in global value chains remains relatively high (Figures 1,2), largely due to the high share of domestic value added in gross exports (averaging 88% in 2007-2022). This indicates that Kazakhstan participates in global value chains mainly through forward participation, with its

products used as intermediate inputs in subsequent stages of production abroad. In 2021, the main destinations of Kazakhstan's value added were the European Union (about 31%), China (about 12%), Russia (8%), and the United States (6%). At the same time, the share of foreign value added in Kazakhstan's exports remains relatively low, averaging about 12% over the period 2007-2022.

Over the period 2007-2022, Kazakhstan's indicators of participation in global value chains (GVCs) were characterized by considerable volatility (Appendix 1). Throughout the entire period, forward participation, measured by domestic value added embodied in other countries' subsequent exports (DVX), substantially exceeded backward participation, reflected by foreign value added in Kazakhstan's exports (FVA). As a result, Kazakhstan maintained a predominantly forward-oriented position in GVCs throughout the period.

Between 2007 and 2014, the GVC position indicator increased. This was driven simultaneously by a decline in the share of FVA in exports from 19% to 8% and an increase in DVX. Thus, the strengthening of the forward position during this period reflected both a reduced dependence of exports on imported intermediate inputs and a greater role of domestic value added in other countries' subsequent exports. At the same time, this increase should not be interpreted unambiguously as a deepening of Kazakhstan's integration into GVCs, since the position indicator is strongly affected by the sectoral structure of exports. In particular, the high share of resource-based industries contributes to a pronounced upstream position, as domestic value added exported in the form of raw materials and intermediate goods may be used in the production and subsequent exports of other countries.

In 2022, Kazakhstan's total GVC participation amounted to about 53% of exports, of which 40% was accounted for by forward participation and 13% by backward participation. This confirms the persistence of a predominantly upstream pattern of Kazakhstan's integration into global value chains.

According to the TiVA methodology, a country's participation in global value chains can be analyzed not only through linkages reflected in foreign value added in exports (FVA) and domestic value added embodied in other countries' exports (DVAX), but also through final demand (DVA in foreign final demand – FFD_DVA). The latter approach is particularly relevant for Kazakhstan, since under the traditional assessment of GVC participation, domestic value added embodied in other countries' subsequent exports remains relatively low compared with indicators reflecting foreign final demand and the use of imported intermediate value added (Appendix 2). For most industries, the amount of value added absorbed through foreign final demand substantially exceeds the amount of value added embodied in other countries' exports. This indicates that Kazakhstan's domestic value-added passes only to a limited extent through subsequent export stages of GVCs and is predominantly oriented toward final demand abroad. Therefore, FFD_DVA is used as an additional indicator of sectoral

participation in GVCs, reflecting the extent to which domestic production is oriented toward final foreign demand.

In 2022, this orientation was highest in the mining sector: about 90% of its value added was associated with foreign final demand, confirming its key role in the export-oriented upstream segment of Kazakhstan's economy.

Overall, sectoral GVC participation indicators have been highly volatile over time. Domestic value added embodied in other countries' exports (DVAX) remained low for most industries throughout the period under review, indicating that Kazakhstan's industries continue to have a limited presence in GVCs. At the same time, foreign value added and domestic value added in final demand show an improving trend. This improvement is particularly characteristic of industries with higher backward integration into GVCs: the manufacture of rubber and plastic products, the chemical and pharmaceutical industries, and the manufacture of textiles, wood, and paper products. These industries are characterized by a relatively high share of FVA in exports, indicating more intensive use of imported intermediate value added and a downstream position in GVCs.

At the same time, more technologically advanced industries – machinery, electrical and electronic equipment, and transport equipment – are characterized by a moderate share of FVA, indicating relatively limited integration into GVCs compared with similar industries in developed economies. According to TiVA data, the share of FVA in OECD exports amounted to 44.5% in 2020, while in Kazakhstan it averaged no more than 12% across industries over 2007-2022 (with a maximum of 19% in 2007).

Metallurgy and petroleum refining occupy an upstream position according to the traditional metric (DVAX), reflecting their role as suppliers of raw materials and intermediate products. Mining and agriculture are predominantly oriented toward the early stages of the value chain and are absorbed by foreign final demand at the initial stages of GVCs.

Given that most industries are characterized by a high share of FFD_DVA in demand and a low share of DVAX, the REER calculations in this study focus specifically on domestic value added in foreign final demand.

2.2. Methodology for calculating sectoral REER taking into account participation in global value chains (VAreer, FVAreer, IOreer).

This study constructs several real effective exchange rate (REER) indices:

1. The traditional country-level REER, based on Kazakhstan's merchandise trade shares in total external trade, calculated using both the consumer price index (CPI) and the producer price index (PPI);
2. The sectoral REER (ISreer), based on export, import, and total trade weights by sector, calculated using CPI and PPI;

3. The value-added REER (VAreer) by sector, based on weights reflecting the share of domestic value added from sector i in final demand in country j , calculated using CPI and PPI;
4. The foreign value-added REER (FVAreer) by sector, based on weights reflecting the share of imported intermediate inputs embodied in exports of sector i to country j , calculated using CPI and PPI.
5. The input-output REER (IOreer) by sector, which accounts for exports and imports of final goods net of the share of intermediate imports in sector i from country j , calculated using CPI and PPI.

For each country j , the real exchange rate index is calculated for each sector i as an index of the bilateral nominal exchange rate of currency j against the tenge, adjusted by relative price indices based on either the producer price index (PPI) or the consumer price index (CPI). At the same time, the PPI differs across sectors only for Kazakhstan and its main trading partners (Russia, China, Uzbekistan, Kyrgyzstan, Turkey, and EU countries), except for agriculture.

$$rer_t^j = ner_t^j * \frac{p_t^j}{p_t^{Kaz}} \quad (1)$$

The economy-wide REER is traditionally calculated by weighting trading partners according to their shares in total trade:

$$reer_t = \prod_{j=1}^N (rer_t^j)^{w_{jt}} \quad (2)$$

The sectoral REER for each sector i is weighted by the share of each country j in trade, according to the following formula:

$$reer_t^i = \prod_{j=1}^N (rer_t^j)^{w_{jt}^i} \quad (3)$$

The weights are defined differently for each type of REER (Table 2).

Table 2. Weights used in the calculation of sectoral REER indices

ISREER	Xreer	$w_{jt}^i = \frac{ex_{jt}^i}{\sum ex_{kt}^i}$	The share of country j in exports of sector i in total exports of sector i in period t .
	Mreer	$w_{jt}^i = \frac{im_{jt}^i}{\sum im_{kt}^i}$	The share of country j in imports of sector i in total imports of sector i in period t .
	XMreer	$w_{jt}^i = \frac{trade_{jt}^i}{\sum trade_{kt}^i}$	The share of country j in trade of sector i in total trade of sector i in period t .
VAreer		$w_{jt}^i = \frac{VA_{jt}^i}{\sum VA_{kt}^i}$	The share of domestic value added in final demand of country j from sector i in total domestic value added of sector i in period t .
FVAreer		$w_{jt}^i = \frac{IntermediateIM_{jt}^i}{\sum IntermediateIM_{kt}^i}$	The share of intermediate imports from country j in exports of sector i in total intermediate imports of sector i in period t .
IOreer		$w_{jt}^i = \frac{EX_{jt}^i + FIM_{jt}^i - IntermediateIM_{jt}^i}{\sum (EX_{jt}^i + FIM_{jt}^i - IntermediateIM_{jt}^i)}$	The share of country j in trade excluding intermediate imports of sector i in total trade excluding intermediate imports of sector i in period t . EX_{jt}^i – exports of goods in sector i from country j FIM_{jt}^i – imports of final goods in sector i from country j $IntermediateIM_{jt}^i$ – imports of intermediate goods in the exports of sector i from country j

To calculate $VAreer$, we use the share of domestic value added from sector i embodied in exports to country j , based on TiVA data. In calculating $FVAreer$ and $IOreer$, TiVA data on the share of intermediate imports in exports of sector i are also used.

According to the methodology of (Rudolfs Bems, Robert C. Johnson, 2012), $IOreer$ captures two distinct channels through which the exchange rate affects competitiveness, operating in opposite directions:

1. An appreciation of the currency increases the price of domestic goods relative to foreign goods, which reduces competitiveness.
2. An appreciation lowers domestic production costs by reducing the price of imported intermediate inputs (a decline in $FVAreer$), thereby increasing competitiveness. This channel (operating through intermediate inputs) is not captured in traditional REER measures.

If the share of imported intermediate inputs is small (or, as in the case of the traditional REER, not considered at all), an appreciation reduces a country's competitiveness (upper-left part of Table 3). Accordingly, a nominal depreciation of the currency in this case restores competitiveness (lower-left part of Table 3). However, if the effect of a high share of imported intermediate inputs in exports is taken into account, an appreciation may instead be beneficial for competitiveness.

Table 3. Impact of the share of intermediate imports in a country's trade on sectoral competitiveness

	Share of intermediate imports from country j in total trade		
		Low	High
Exchange rate change with partner j	Appreciation	Decrease in competitiveness	Increase in competitiveness
	Depreciation	Increase in competitiveness	Decrease in competitiveness

Source: ECB

The separation of REER calculations into value-added REER ($VAreer$), intermediate-import REER ($FVAreer$), and the cost-based REER ($IOreer$) is also justified by the country structure of value added and intermediate imports embodied in Kazakhstan's exports. The country distribution of domestic value added in foreign final demand is broader and relatively evenly distributed (Figure 4). At the same time, the distribution of intermediate imports across countries is more concentrated (Figure 5). Differences between the markets supplying intermediate imports and the markets to which domestic products are exported may lead to differences in sectoral competitiveness depending on periods of currency depreciation and appreciation.

Figure 4. Country distribution of domestic value added in exports (Top 20 countries)

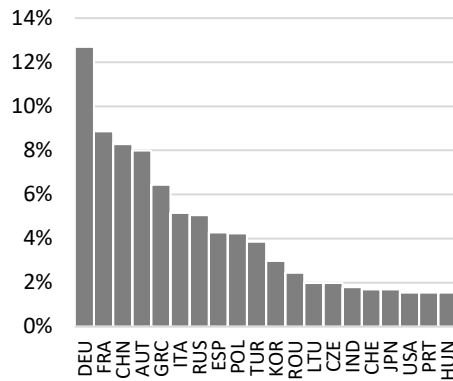
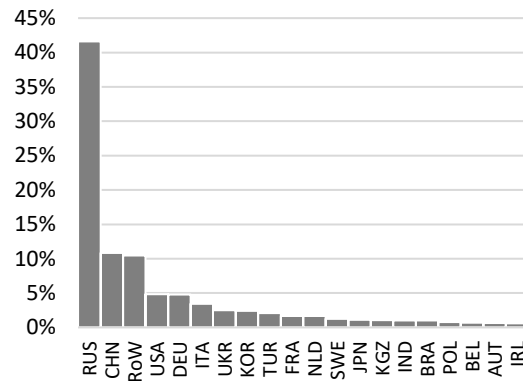


Figure 5. Country distribution of intermediate inputs embodied in exports (Top 20 countries)



Source: OECD; authors' calculations.

2.3. Data

REER calculations were conducted using annual data for three sectors of the economy: agriculture, mining, and manufacturing. The manufacturing sector was further disaggregated into 10 subsectors (Appendix 3) according to the classification of the International Standard Industrial Classification of All Economic Activities (ISIC Rev. 4).

For the calculation of ISreer weights, merchandise trade data with 124 countries (export/import/total trade share $\geq 0.5\%$) were used based on United Nations data (UN Comtrade). Weights for the GVC-based REER were calculated using Trade in Value Added data from the OECD and include all available partner countries (80 trading partners).

The study uses nominal exchange rates for 40 countries provided by the National Bank of Kazakhstan. For EU countries not included in the NBK dataset, calculations were conducted in euros, while for the remaining countries they were performed in U.S. dollars.

As a price indicator for the sectoral REER, the producer price index (PPI) is used, as it more accurately reflects price dynamics in the tradable sector compared with the consumer price index (CPI), which includes prices of non-tradable goods and services. At the same time, the PPI is closer to export prices, as it does not include consumer mark-ups and taxes. According to the literature, when constructing sectoral REER indicators under conditions of global value chains, it is important to use sector-specific price indices (deflators or PPI) in order to properly assess competitiveness. In addition, the consumer price index (CPI) is also used in the calculations, which is consistent with the methodology of the National Bank of Kazakhstan.

A comparison of the dynamics of Kazakhstan's CPI and PPI reveals substantial differences, with some sectors experiencing faster price growth than the CPI, while others grow more slowly. Differences in price index levels may significantly affect REER dynamics, as (Rudolfs Bems, Robert C. Johnson, 2012) show that much of the

variation in REER analysis under GVC conditions is explained by the use of different price indices rather than differences in weights.

The calculations were conducted for the period 2007-2022 due to the limited availability of TiVA data. The table presents the main data sources used in the study.

Table 4. Data

Данные	Source	Description
Nominal exchange rate	NBK, World Bank	2007–2022
Producer price index (PPI)	IMF, WB, UN FAO	2007–2022
Consumer price index (CPI)	IMF, WB	2007–2022
Merchandise trade by country	UN COMTRADE	2007–2022
Participation in GVC	Trade in Value Added OECD	2007–2022

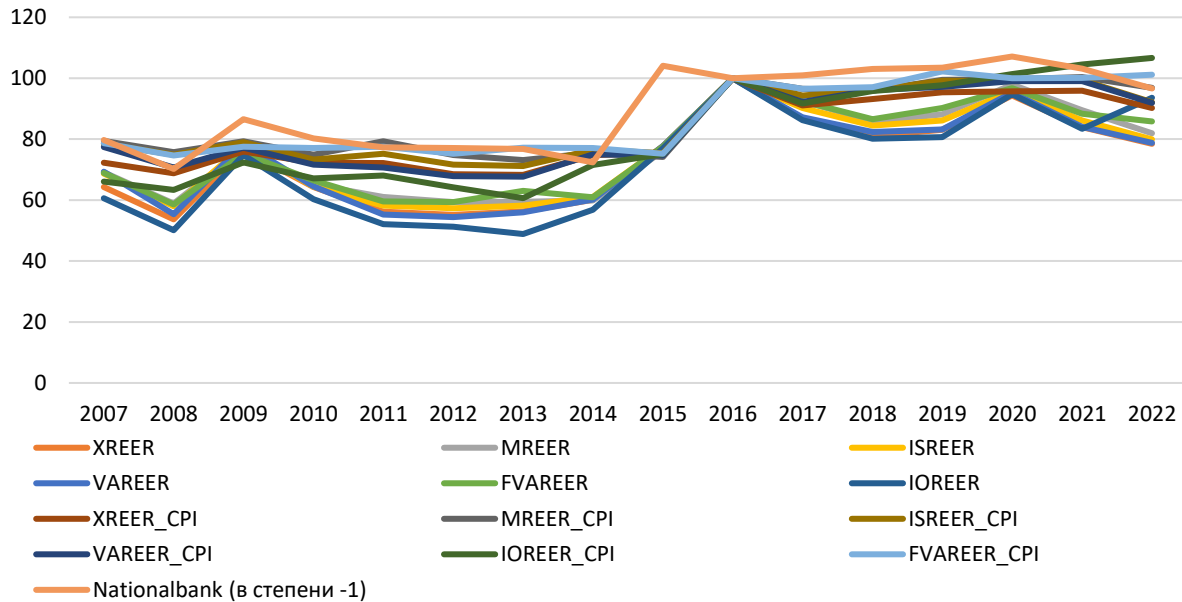
2.4. Estimates of sectoral ISreer, VAreer, FVAreer, IOreer for Kazakhstan

In this study, eleven different REER indices were calculated for 13 sectors of the economy. The dynamics of the sectoral indices (Xreer, Mreer, ISreer, VAreer, FVAreer, IOreer) generally follow the trajectory of the traditional REER indicator of the National Bank of Kazakhstan: a decline in the pre-crisis periods, a sharp increase during years of currency devaluations, and a gradual weakening in 2021-2022 (Figure 6). At the same time, the dynamics of the official index are higher than the alternative estimates. This can be explained by methodological differences, as the National Bank of Kazakhstan uses the end-of-year (December) exchange rate, which amplifies the effect of short-term fluctuations, whereas the alternative calculations employ the annual average exchange rate, which smooths volatility spikes.

IOreer is slightly lower than other REER indicators, as accounting for backward participation in global value chains reflects higher costs of imported intermediate inputs, measured through FVAreer, which leads to a decline in sectoral competitiveness. At the same time, the proximity of IOreer to alternative REER measures is largely explained by the country's forward-oriented model of participation in GVCs and the relatively low share of imported intermediate inputs in exports (Appendix 4), which limits larger divergences between the indicators. At the sectoral level, the degree of difference between IOreer and other REER indicators varies depending on the extent of the weakening of FVAreer and the level of backward participation of each sector in global value chains.

According to the calculations, differences are observed between REER indicators calculated on the basis of the CPI and the PPI. The CPI-based index shows a higher estimate of the economy's price competitiveness compared with the PPI-based index (due to the faster growth of the PPI relative to the CPI). It should be noted that, at the country level, the PPI is largely determined by price dynamics in the mining sector, which accounts for a significant share of the production structure. As a result, the aggregate PPI may not reflect price conditions in other sectors of the economy, which limits its applicability for analyzing overall competitiveness and makes the sectoral approach more preferable.

Figure 6. Comparison of REER dynamics for the overall economy (2016=100)



Source: Authors' calculations; National Bank of Kazakhstan.

Sectoral REER

In the sectoral analysis, a distinction can be made between resource-based and non-resource-based industries. The most resource-based industries are characterized by weaker and more volatile competitiveness dynamics; these include mining, agriculture, petroleum refining, and metallurgy. Since 2007, no sustained strengthening of price competitiveness has been observed in these sectors; the indices have mostly remained below the base level (2016), while short-term improvements were quickly offset by reversals. The volatility and weak dynamics are explained by the dominance of external price cycles. An exception is the chemical industry, where an improvement in competitiveness over time is observed.

In the remaining manufacturing sectors, compared with resource-based sectors, a gradual improvement in competitiveness is observed, particularly after the transition to a floating exchange rate regime (Appendix 5).

In most manufacturing industries, competitiveness measured by the cost-based IOREER is lower than that measured by the value-added-based indicator, reflecting the role of imported intermediate inputs in the production costs of these exporters. According to the methodology of the cost-based IOreer, in sectors where the volume of intermediate imports from partner country j exceeds the total volume of exports and imports of final goods, the weight of country j takes a negative value. This leads to a decrease in the overall level of IOreer and reduces the influence of the price channel during periods of national currency depreciation. As a result, despite the increase in price competitiveness during depreciation, the simultaneous increase in the contribution of imported intermediate inputs may limit the overall effect and lead to weaker dynamics of sectoral competitiveness. In addition, divergences between IOreer and other REER indicators are amplified by the influence of FVAreer. The stronger

dynamics of the latter (FVA_{reer}) reflect an increase in the cost of imported intermediate inputs and exert downward pressure on IO_{reer}. This effect is most pronounced in petroleum refining, the production of other manufactured goods, the wood processing industry, and the food industry (Appendix 3).

Competitiveness Channels

It should be noted that for Kazakhstan the influence of the cost channel in the formation of sectoral REER is moderate. This is explained by the fact that only a small number of sectors are characterized by backward participation, whereas imports of final goods account for a significant share in the structure of trade. As a result, the price channel dominates the cost channel in most cases, and the impact of imported intermediate inputs (including FVA_{reer}) on export competitiveness remains relatively limited (Appendix 4).

This can be particularly clearly observed by examining Russia's contribution to IO_{reer} (Appendix 6). Despite the high share of the Russian Federation in the structure of intermediate imports, Russia's overall contribution to the cost-based REER is formed mainly through the price competitiveness channel. This is explained by the fact that Russia accounts for a significant share in both exports and imports of final goods in a number of sectors (food industry, textiles and leather products, paper products, and rubber and plastic products). In addition, the price channel in these sectors during periods of depreciation is realized only partially, as in such periods the tenge previously appreciated against the ruble in both nominal and real terms. This limited the positive effect of the national currency depreciation on the competitiveness of sectors with a high Russian component (Appendix 6; Russia's contribution declines across many sectors in 2008, 2015, and 2020).

Overall, sectoral competitiveness indicators (VA_{reer} and IO_{reer}) show a common pattern: until 2015, the situation in most sectors remained weak. Following the transition to a floating exchange rate regime, the trajectories of sectoral REER estimates became more stable. The floating exchange rate regime led to the dominance of the price channel over the cost channel. As a result, the differences between IO_{reer} and VA_{reer} narrowed, and their dynamics became more synchronized, despite some episodes of incomplete realization of the price effect. The transition to the new exchange rate regime allowed a number of manufacturing sectors to recover part of the price competitiveness lost in 2013–2014. In the food industry, chemicals, rubber and plastics, as well as machinery, the competitiveness index increases noticeably, whereas resource-based sectors continue to show cycles reflecting fluctuations in global market conditions, as well as domestic pricing policies in the case of petroleum products production.

Differences in REER Calculations Based on CPI and PPI

As noted earlier in the study by (Rudolfs Bems, Robert C. Johnson, 2012), differences in REER estimates are largely driven by the use of different price indices. The authors show that a significant part of the divergence between the traditional REER and indicators calculated on a value-added basis is explained by the price component rather than solely by differences in trade weights.

When comparing indicators at the sectoral level, differences emerge in the dynamics of REERs calculated using the CPI and PPI. In a number of sectors, both indices follow similar trajectories, indicating comparable dynamics of consumer and producer prices. At the same time, substantial differences are observed in certain industries: in some cases, the PPI-based REER indicates a more pronounced improvement in competitiveness, while in others, the CPI-based indicator shows higher values. This confirms that the choice of price index affects the assessment of competitiveness and requires sector-specific characteristics to be taken into account in the analysis (Appendix 7).

In industries oriented toward the domestic market and whose price structure is close to that of the consumer basket, the use of the CPI provides a comparable and appropriate assessment of competitiveness dynamics (food manufacturing). At the same time, for major industrial and export-oriented sectors, where price dynamics are determined by production costs and global prices, the use of the PPI is more appropriate (for example, mining and metallurgy). In these sectors, the CPI may less accurately capture the price position, as it does not reflect the specific features of producer price formation and the export structure.

Robustness of Weights over Time

Finally, to assess the robustness of the sectoral REER estimates, we conducted a correlation analysis between indices calculated using fixed base-year weights (2016) and those based on actual weights that vary over time. Such an approach is widely used in empirical studies on global value chains, as international GVC tables are typically compiled on an annual basis and are published with a significant time lag. Under these conditions, indicators of GVC participation and position are treated as slowly changing structural characteristics, which allows them to be used in the analysis under the assumption of relative stability of weights over time. The high correlation coefficients obtained confirm the robustness of the estimates and indicate that changes in weights do not have a significant effect on REER dynamics across most sectors (Appendix 8).

At the same time, unlike the findings of (Rudolfs Bems, Robert C. Johnson, 2012), the differences in REER levels in Kazakhstan are explained not only by the price component but also by differences in weights, reflecting discrepancies between the geographical structure of total trade and the GVC distribution.

3. Empirical assessment of the impact of REER on Kazakhstan's real exports.

This chapter evaluates the elasticity of exports with respect to REER. To determine the impact of REER on exports, a panel data model was constructed. To account for the influence of Kazakhstan's sectoral participation in GVC, the participation indicator was included.

$$\Delta X_{it} = \alpha + \beta \Delta REER_{it-1} + \gamma \Delta REER_{it-1} * participation_{it-1} + \delta_i + \delta_t + \theta FD_{it} + \varepsilon_{it}, \quad (3)$$

where ΔX_{it} – the change in real exports by sector, $\Delta REER_{it-1}$ – the change in the real effective exchange rate index by sector, δ_i and δ_t represent sectoral and time fixed effects, respectively. FD_{it} – denotes sectoral external demand (the aggregated GDP of partner countries weighted by export shares). The variable $\gamma \Delta REER_{it-1} * participation_{it}$ captures the effect of the degree of participation in GVC. The inclusion of this interaction term in similar studies is theoretically justified and follows the model proposed by (Cheng, Kevin C., Gee Hee Hong, Dulani Seneviratne, and Rachel N. van Elkan. , 2016).

The lagged , $\Delta REER_{it-1}$ is used in the literature to assess its impact on real exports in order to avoid the endogeneity problem, since exports in the current period may also affect the exchange rate in the same period.

The model is estimated using panel data with sectoral fixed effects, which allows for the control of unobserved individual heterogeneity that is constant over time and potentially correlated with the explanatory variables. The Hausman test does not reveal statistically significant differences between the estimates obtained from the fixed-effects and random-effects models, which formally allows for the use of the random-effects specification. Nevertheless, this study gives preference to the fixed-effects model, as it does not require the strict assumption of no correlation between individual effects and regressors, which is important in the context of our analysis.

Taking this into account, the baseline specification includes fixed effects for individual units without time effects, which allows the model to remain identifiable and focuses the analysis on cross-sectoral variation in export responses to exchange rate changes.

In the first group of specifications, the model is estimated using the full sample covering all sectors of the economy. Alternative measures of price competitiveness – IOreer and VAreer – are used as indicators of the real effective exchange rate, along with their interaction with GVC participation indicators.

The results obtained show that, in the aggregated sample, the effect of the exchange rate on exports is not statistically significant, regardless of the REER measure used (Table 5). Similarly, the interaction between REER changes and GVC participation indicators is statistically insignificant across all specifications. This indicates the absence of a robust exchange rate effect on exports when all 15 sectors are considered simultaneously. Economically, this result reflects substantial cross-sectoral heterogeneity in export responses to exchange rate changes. In the most

forward-oriented sectors (mining, metallurgy, petroleum refining), exports are largely determined by global prices and contractual arrangements and respond weakly to changes in relative prices, whereas in backward-oriented industries the price channel may play a more significant role. When all sectors are aggregated, these opposing effects offset each other, leading to attenuation and the loss of statistical significance of the exchange rate coefficients. At the same time, real exports in the economy depend on external demand for its products.

The results for the models estimated for manufacturing industries show that exchange rate changes have a statistically significant effect on exports (VAreer and IOreer). The use of IOreer, which accounts for imported intermediate inputs, is less statistically significant and shows a lower elasticity than VAreer, which may be related to the partial offset of the positive effect of depreciation by higher costs of imported components. In addition to REER, exports in downstream sectors are also affected by external demand.

Overall, many studies confirm a persistent decline in the elasticity of exports with respect to REER. While changes in relative prices previously had a substantial impact on exports, this relationship has weakened noticeably over the past two decades. According to (Swarnali Ahmed, Maximiliano Appendino and Michele Ruta, 2015), the key reason is the increasing participation of countries in GVC: the higher the degree of GVC integration, the weaker the response of exports to currency depreciation or appreciation. Similar conclusions are reached by Patel, Wang, and Wei (2019) and de Soyres et al. (2018), who show that the growing share of imported intermediate inputs, the fragmentation of production across countries, and the increasing complexity of cross-border value-added flows weaken the traditional price channel.

However, the results obtained for Kazakhstan indicate that the interaction between REER changes and the GVC participation indicator remains statistically insignificant. This may reflect the relatively low degree of integration of manufacturing industries into GVC, as well as the limited role of imported intermediate inputs in the formation of export costs. Under conditions of weak integration into cross-border production networks, participation in GVCs does not act as a significant factor modifying the exchange rate elasticity of exports.

Table 5. Results of the fixed-effects panel data model estimating the elasticity of real exports with respect to REER

	All sectors		Manufacturing industries (excluding Basic metals)	
Variable	VAREER	IOREER	VAREER	IOREER
$\Delta REER_{it}$	0.543762	0.534595	0.590520***	0.401627*
$\Delta REER_{it} * Participation_{it}$	0.058397	0.087175	-0.722158	-0.743130
ΔFD_{it}	0.43957***	0.41816***	0.4481351***	0.48484***
Constant	-0.060659	-0.022213	-0.047877	-0.054508
R ²	0.274107	0.217113	0.257636	0.074645
Observations	210		182	
Number of (id)	15		11	

**** statistically significant at the 1% level, ** – statistically significant at the 5% level, * – statistically significant at the 10% level.*

Overall, the results suggest that price competitiveness has a significant effect on exports in the manufacturing sector, while VAreer serves as a more informative indicator of price competitiveness. At the same time, the structural characteristics of GVC participation in the sample considered do not yet play an independent role in transmitting exchange rate changes to export dynamics.

Conclusions

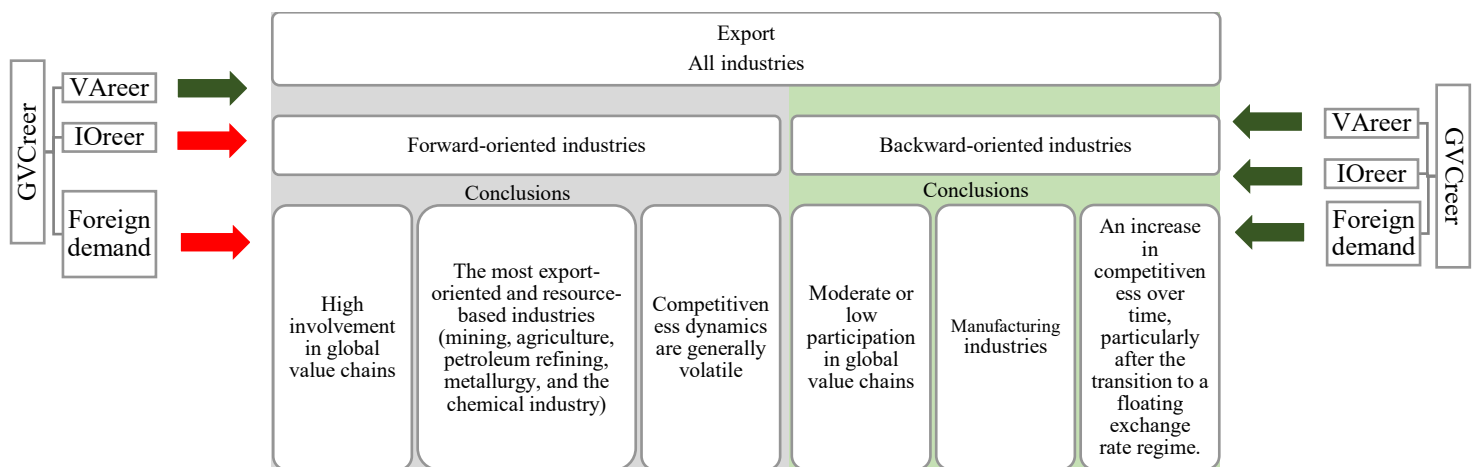
This study provides a comprehensive assessment of the price competitiveness of Kazakhstan's economic sectors, taking into account the country's participation in global value chains. Unlike the traditional approach based on the aggregate real effective exchange rate, the analysis constructs and applies sectoral REER indices adapted to the conditions of fragmented international production. These include the industry-specific reer (ISreer), the value-added reer (VAreer), the reer accounting for imported intermediate inputs (FVAreer), and the cost-based reer (IOreer).

The results show that the dynamics of sectoral REER indicators differ significantly both across industries and relative to the official aggregate indicator. The use of indices calculated on the basis of the producer price index allows for a more accurate assessment of changes in price competitiveness in tradable sectors. Taking GVC into account leads to a more moderate assessment of the gains from currency depreciation, particularly in industries with a substantial share of imported intermediate inputs.

The analysis of Kazakhstan's participation in global value chains shows that the country's economy is characterized by a forward-oriented integration model, based on a high share of domestic value added in exports and a relatively low use of imported intermediate inputs. Such a structure is typical of countries with a dominance of forward-oriented sectors and largely determines the way exports respond to exchange rate changes.

Empirical estimates of export elasticity to REER changes confirm significant cross-industry heterogeneity. In the aggregate sample of the 15 industries considered, no exchange rate effect on exports is detected, reflecting the offsetting effects between forward- and backward-oriented industries. At the same time, a statistically significant exchange rate effect is observed for the manufacturing sector (Scheme 2). Given the prevailing share of resource-based sectors in exports, which are not elastic to changes in the real exchange rate, it can be concluded that a significant share of exports is determined by factors that are not directly related to exchange rate dynamics. More than half of exports (mining, metallurgy, agriculture, and petroleum refining) remain dependent on external price cycles, external demand, and domestic production processes and sector-specific characteristics.

Scheme 2. The impact of REER on Kazakhstan's real exports.



 no statistically significant effect is observed.
 a statistically significant effect is found.

The results also show that the interaction between exchange rate changes and indicators of participation in global value chains remains statistically insignificant. This likely reflects the limited depth of backward integration in most industries in Kazakhstan and the relatively minor role of imported intermediate inputs in export cost formation. Under these conditions, participation in GVC is not an independent factor affecting the exchange rate elasticity of exports.

Overall, the study demonstrates that the use of GVC-adapted sectoral REER indices significantly deepens the analysis of competitiveness and helps reveal structural features of export responses that remain hidden in aggregate indicators. The findings have practical implications for evaluating exchange rate policy and for developing economic diversification strategies. They indicate that, under Kazakhstan's current pattern of participation in global value chains, the exchange rate affects exports mainly through the price channel, whereas the role of the cost channel remains moderate.

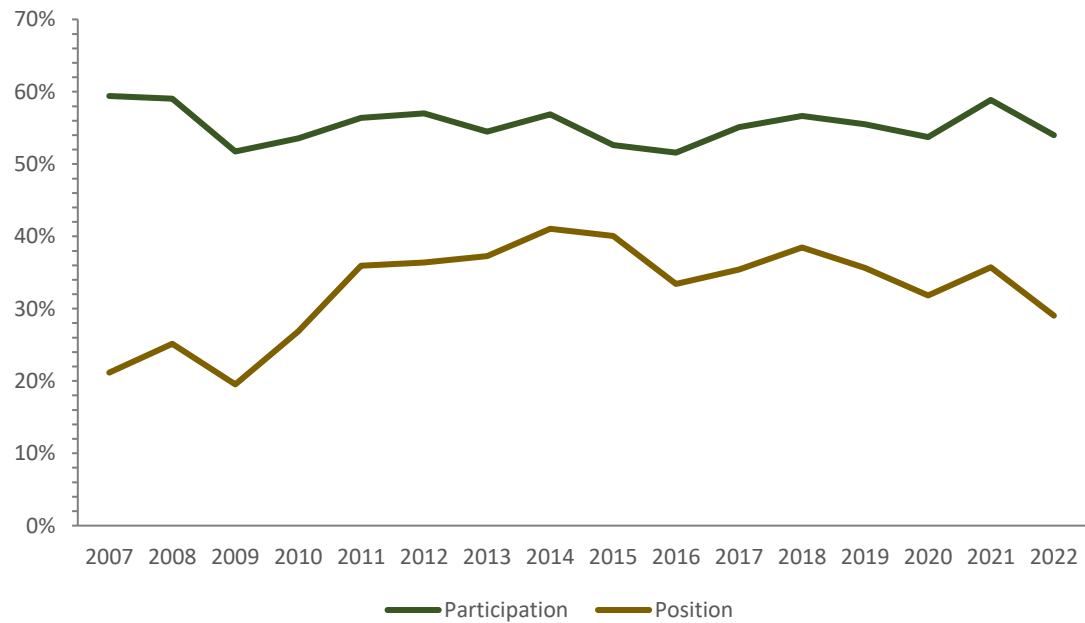
Given the annual frequency of TiVA data publication and the time lag in their updates, the study can be updated as new data become available to reflect the latest trends in industries' participation in GVCs.

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APPENDICES

Appendix 1. Kazakhstan's participation rates and positions in dynamics



Source: TiVA OECD

Appendix 2. Indicators of industry participation in GVC in dynamics

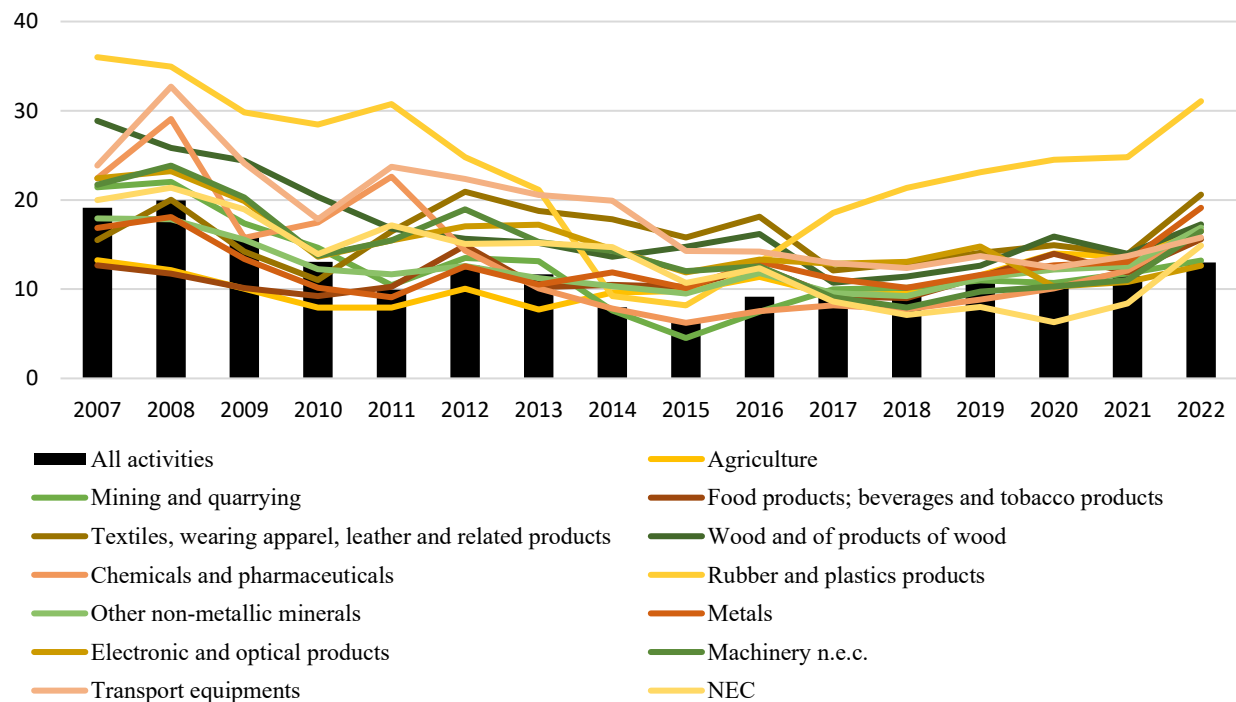


Source: TiVA OECD

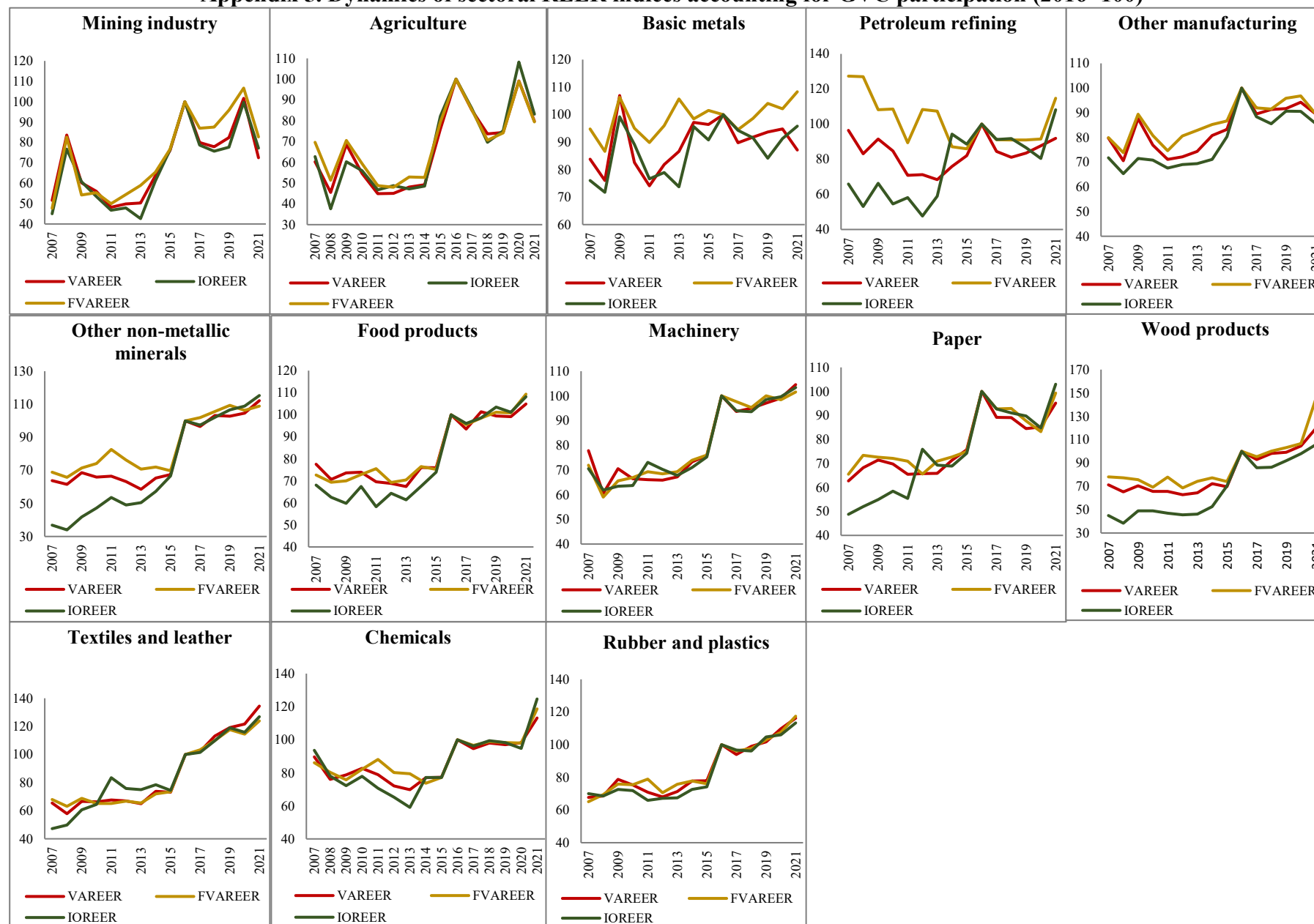
Appendix 3. List of industries analyzed in the study

	Industry name	ISIC Rev.4
1	Agriculture, hunting, forestry, and fishing	01-03
2	Mining and quarrying	05-09
3	Food, beverages, and tobacco	10-12
4	Textiles and textile products and leather, leather products, and footwear	13-15
5	Wood and products of wood and cork	16
6	Pulp, paper, paper products, printing, and publishing	17-18
7	Coke, refined petroleum, and nuclear fuel	19
8	Chemicals and chemical products	20-21
9	Rubber and plastics	22
10	Other nonmetallic minerals	23
11	Basic metals and fabricated metal	241,2431,242,2432,25
12	Machinery, nec	28
13	Electrical and optical equipment	26
14	Transport equipment	29, 301, 302, 303,304,309
15	Manufacturing, nec; recycling	31-33

Appendix 4. Share of Imported Intermediate Inputs in Exports by Industry (%).

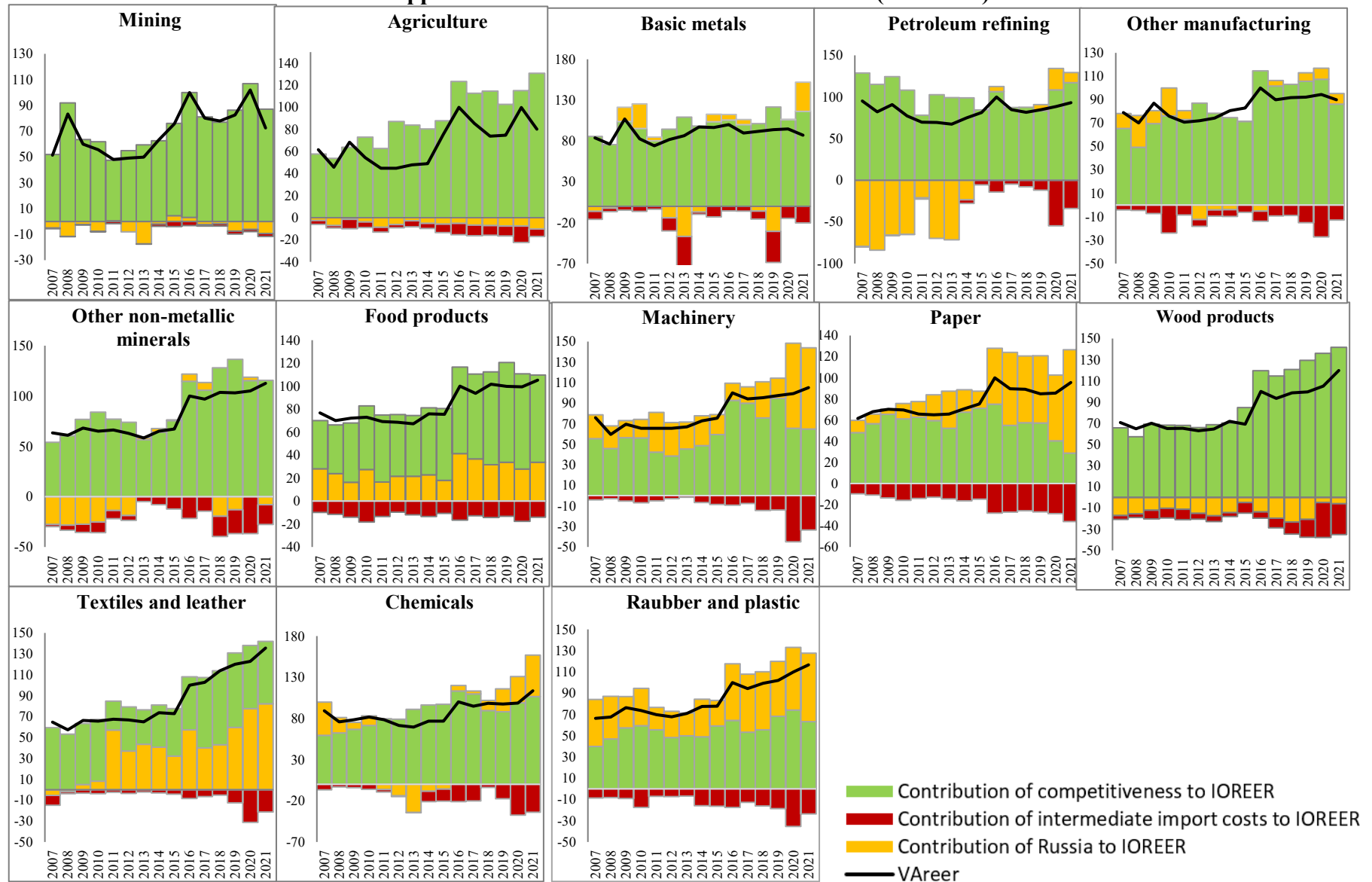


Appendix 5. Dynamics of sectoral REER indices accounting for GVC participation (2016=100)



Source: Authors' calculations.

Appendix 6. Contribution of factors to IOreer³ (2016=100)



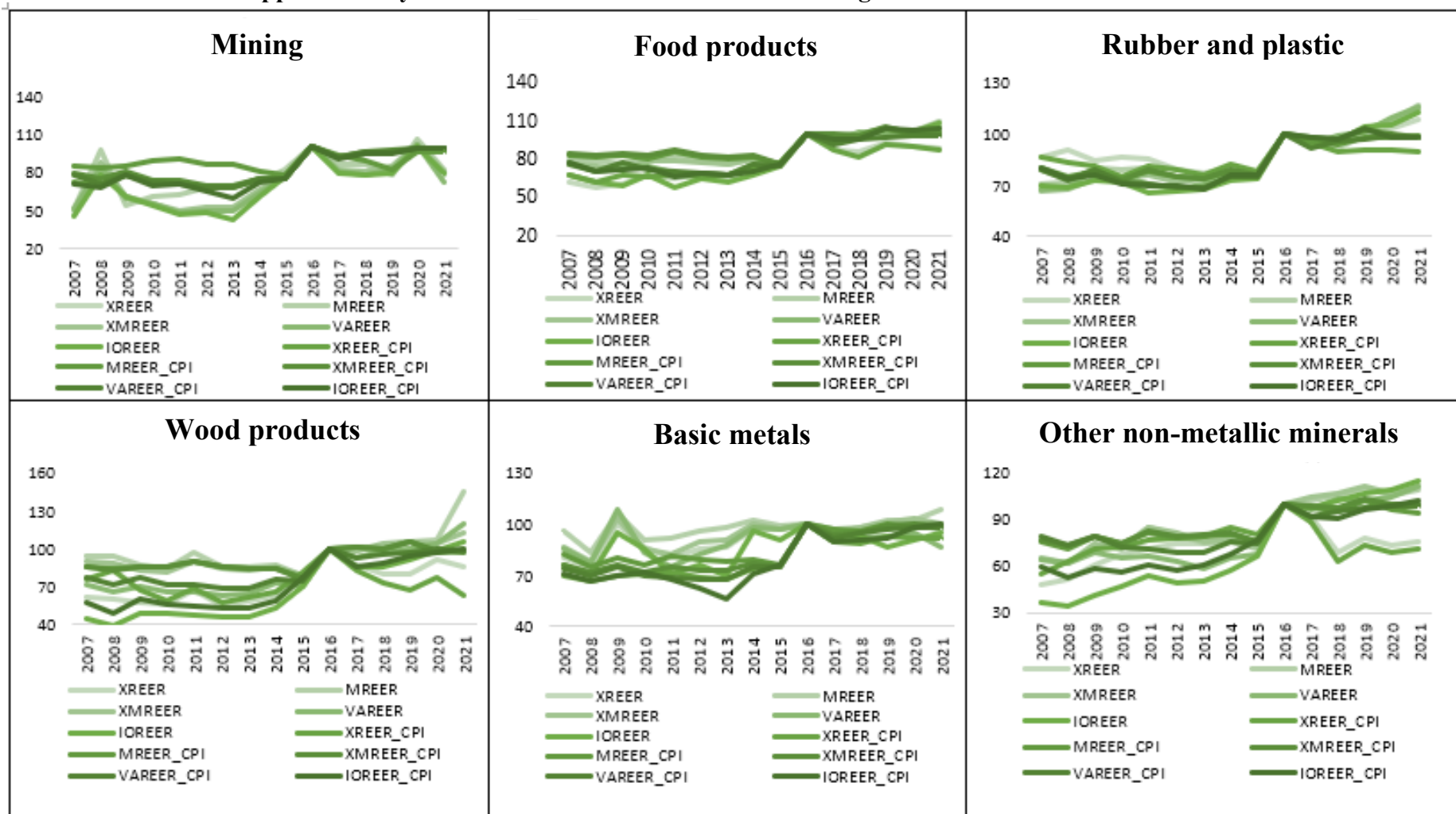
³ Note to the figure:

If the sum of exports and imports of final goods exceeds the volume of intermediate imports in the industry, competitiveness operates through the price channel (green bar).

If the sum of exports and imports of final goods is lower than the volume of intermediate imports in the industry, competitiveness operates through the cost channel (red bar).

Russia's contribution through either the price or the cost channel is shown by the yellow bar.

Appendix 7. Dynamics of Sectoral Real Effective Exchange Rates Based on CPI and PPI



Appendix 8. Correlation matrix of REER with fixed weights (2016) and time-varying weights

	XREER	MREER	XMREER	VAREER	IOREER	XREER_CPI	MREER_CPI	XMREER_CPI	VAREER_CPI	IOREER_CPI
(All)	0.997	0.996	0.997	0.998	0.995	0.993	0.993	0.994	0.996	0.992
Agriculture, hunting, forestry, and fishing	0.917	0.663	0.980	0.997	0.992	0.878	0.870	0.968	0.997	0.992
Mining and quarrying	0.996	0.929	0.998	0.997	0.992	0.992	0.710	0.994	0.994	0.985
Food, beverages, and tobacco	0.991	0.997	0.987	0.996	0.993	0.982	0.996	0.994	0.996	0.991
Textiles and textile products, leather and leather products	0.970	0.992	0.997	0.995	0.978	0.899	0.982	0.962	0.982	0.900
Wood and products of wood and cork	0.895	0.795	0.900	0.984	0.878	0.809	0.844	0.907	0.976	0.905
Pulp, paper, paper products, printing, and publishing	0.968	0.990	0.981	0.997	0.965	0.919	0.984	0.985	0.997	0.910
Coke, refined petroleum, and nuclear fuel	0.755	0.984	0.888	0.984	0.591	0.949	0.988	0.924	0.995	0.974
Chemicals and chemical products	0.974	0.998	0.986	0.995	0.960	0.959	0.997	0.980	0.996	0.933
Rubber and plastics	0.924	0.996	0.988	0.997	0.987	0.916	0.992	0.982	0.995	0.970
Other nonmetallic minerals	0.818	0.979	0.985	0.995	0.996	0.527	0.980	0.986	0.994	0.995
Basic metals and fabricated metal	0.983	0.752	0.969	0.986	0.917	0.983	0.981	0.990	0.997	0.971
Machinery	0.904	0.960	0.978	0.991	0.988	0.675	0.971	0.970	0.983	0.978
Manufacturing, nec; recycling	0.746	0.955	0.842	0.992	0.886	0.932	0.994	0.974	0.997	0.977