


# “Assessing the determinants of export-oriented production in Kazakhstan: An OLS and ARMAX Approach”

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# ASSESSING THE DETERMINANTS OF EXPORT-ORIENTED PRODUCTION IN KAZAKHSTAN: AN OLS AND ARMAX APPROACH

## Abstract

In the context of Kazakhstan's resource-based economy, the issue of developing export-oriented production and its diversification is becoming particularly relevant. This paper examines the macroeconomic factors determining export-oriented production in Kazakhstan. The study uses an econometric model to analyze the dynamics of export growth over time. Empirical results show positive coefficients for terms of trade (0.676,  $p < 0.01$ ) and socio-economic development (0.001,  $p < 0.01$ ), as well as a negative coefficient for the indicator determining the share of the manufacturing industry in GDP (-0.598,  $p < 0.01$ ). In addition, foreign direct investment has not demonstrated a statistically significant relationship with export volumes. The results show that Kazakhstan's export structure remains relatively concentrated, with a significant share of exports associated with mineral resources and energy products, making export performance sensitive to external market conditions. The results obtained emphasize the need to strengthen industrial, export, and investment policies, as well as stimulate the production of high-value-added products and increase the country's technological potential to achieve sustainable export growth, which are priorities for Kazakhstan's long-term economic development.

## Keywords

economic growth, export, export-oriented production, terms of trade, manufacturing sector, export diversification, raw material dependence, ARMAX model

## JEL Classification

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## INTRODUCTION

In the current global economic environment, increased exports are considered a key driver of economic growth. Export activities contribute to expanding production, technological modernization, and increased competitiveness. However, in developing countries, a significant share of exports consists of raw materials, which increases the economy's dependence on commodity prices in foreign markets. This is an urgent problem for countries like Kazakhstan, which have huge raw material resources. Despite significant export growth over the past decade, Kazakhstan's economy remains heavily dependent on oil, gas, and metals. Consequently, the structure of raw material exports has increased the volatility of export earnings, potentially threatening long-term sustainable growth. To improve this situation, Kazakhstan has adopted several government programs to modernize production and expand exports (Adilet, 2018, 2021). However, attempts to achieve the main export development goals fell short of expectations. In this regard, there is a need to analyze the main macroeconomic determinants that will help determine the vectors of export diversification and export-oriented production. At the same time, there is a noticeable gap in the scientific literature regarding the quantitative analysis of the main macroeconomic determinants of Kazakhstan's exports, which this study aims to address.

## 1. LITERATURE REVIEW

Exports are a key factor in economic growth, structural transformation, and the integration of national economies into the global economy, and there are many studies devoted to this issue in the scientific community. Some scientists believe that through exports, countries gain access to broader markets, foreign exchange, technologies, and knowledge that contribute to productivity growth, sustainable competitive advantages, and economic diversification (Basile et al., 2018; Tampubolon et al., 2021; Matezo et al., 2021). Other scientists believe that developed countries have achieved economic benefits through an export-oriented development model (Garnaut et al., 1998; Kukharska, 2022; Ogochukwu et al., 2025), based mainly on manufacturing, high-tech sectors, and integration into global value chains (Güvercin, 2020; Grytsenko & Hallini, 2025). Some countries benefit economically from exporting raw materials (Fung & Korinek, 2013; Madiyarova et al., 2018; Juliet et al., 2024; Van Vien et al., 2025). However, the first type of development differs in that developed countries export high-value-added products, while others remain vulnerable to external price shocks, geopolitical risks, and changes in the international regulatory framework (Leonidou & Katsikeas, 1996; Katsikeas et al., 2000; Chen et al., 2016). In this regard, there is a need to identify the factors underlying the sustainability and vulnerability of export specialization at the country, regional, and firm levels.

In this context, it is also necessary to consider the impact of external economic shocks on exports, namely political tensions between countries, natural disasters, and pandemics. When the political situation is unstable, sanctions and trade restrictions may arise, restricting market access (Lytvynova et al., 2022; Trocinescu & Den, 2024; Białowas et al., 2025). Amid natural disasters, there is a risk of destruction of export-oriented industrial infrastructure, reduction of production capacity, and impact on the supply of export goods or services (Martincus & Blyde, 2012; Asgary et al., 2019). Another shock is the pandemic. As previous experience shows, global demand decreases during quarantine measures, with consumption declining and logistical issues arising due to border closures and movement restrictions (Hayakawa &

Mukunoki, 2021; Narayan et al., 2024). Thus, not only do changes in the global market affect export volume, but there is also a risk of a decrease in export volume due to non-economic shocks.

Along with non-economic shocks affecting export volumes, there are also economic factors, such as fluctuations in world prices, the maturity of the industrial sector, the attractiveness of foreign investment, and socio-economic development within the country. Consequently, price changes in the global market are one of these factors. This relationship is reflected in the fact that higher prices on world markets can increase foreign exchange earnings, expand the production of exported products, and thereby increase the country's GDP (Diao et al., 2021; Muter, 2025; Morán-Santamaría et al., 2026). Lower prices on the global market may lead to lower export earnings, a deterioration in the trade balance, and a decrease in investment activity in export-oriented sectors (Dargınoğlu & Hepaktan, 2025; Hangal & Shalini, 2025). Thus, changes in prices in the world market can significantly affect the country's exports. In this case, the level of development of the country's industrial sector should also be considered. For example, in more industrialized countries with a high level of export basket diversification, sensitivity to shocks is low (Kandil, 2016; Adilkhanov & Sabden, 2021). In countries with small export baskets, exports depend on global commodity prices (Akosah et al., 2024; Nantob, 2025). Thus, to determine a country's export sensitivity, it is important to examine its response to price changes, as this reveals the vector of potential development for both export policy and the country as a whole.

In this context, another important macroeconomic factor determining the export orientation of production is a country's socio-economic development. GDP per capita reflects the efficiency of resource use, human capital (Kangalakova & Rakhmetova, 2021), the technological base, the quality of infrastructure, and the country's institutional base (Mukayev et al., 2023), which also affect the country's exports. A high level of per capita income in a country indicates that the economy is capable and has the resources to develop export opportunities through a high-quality raw-material base, technological preparedness, and the effective use of human capital. In contrast, a

low-income level shows that the country does not have enough raw materials, technological resources, and financial and human resources to increase exports, which leads to the fact that the country is limited to exporting only raw materials and is highly sensitive to world prices on the commodity market (Habenko, 2023; Saif & Islam, 2025). Thus, socio-economic development is considered a source of export potential due to a balanced allocation of resources and effective management of the country.

In addition to factors related to socio-economic development within the country and shock events, the literature highlights the importance of technological readiness of production, which affects export potential (Fonchamnyo & Akame, 2016; Zhao, 2022; Wahab, 2023; Kim, 2025). In this regard, value added in the manufacturing industry reflects the maturity of the economy and its industrial development. Consequently, countries with more complex and advanced technological preparedness have a high share of manufacturing in GDP, which ensures a high share of manufacturing exports, contributes significantly to GDP due to high foreign currency earnings, and reduces dependence on the commodity market. Kapoor (2016) and Gao and Rong (2023) demonstrate another interesting position, according to which the complexity factor of production itself is a factor of economic growth through the export channel. There is also a theory of “economic complexity” developed by Hausmann et al. (2006), among others, which assumes the risk of falling into an “institutional trap” during the transition to production. This is reflected in institutions’ unwillingness to effectively pursue industrial policies and to discourage long-term investments in non-resource sectors. Thus, the value-added factor in the manufacturing industry can be considered as a qualitative indicator of a country’s ability to reduce its dependence on raw materials and avoid institutional dependence.

Considering international trade and export issues, investment is a driver of expanding production opportunities, developing science and technology, which leads to technological industrial progress and contributes favorably to the competitiveness of the country (Boakye-Gyasi & Li, 2015; Sawada, 2019; Gunasekaran et al., 2024; Reddy & Pushpa,

2026). Accordingly, foreign direct investment plays an important role in export policy as a factor that increases export activity by integrating national enterprises into global value chains, increasing product quality, and expanding access to international markets (Temiz & Gökmen, 2011; Liu et al., 2016; Khan & Bilal, 2017; Norimov, 2024). On the other hand, investments are the driver of the expansion of the export basket, through the renovation of infrastructure, machinery, and technology, and the transition from the extraction of raw materials to the production of finished products ready for export. However, other studies show a negative short-term impact of foreign direct investment or the presence of barriers to foreign investors entering the country’s industrial sector, as there is a risk of crowding out domestic producers (Harding & Javorcik, 2012; Kumar et al., 2025). Thus, the impact of foreign direct investment on exports is ambiguous and context-dependent, as its effect is determined by the host country’s economic structure and institutional conditions.

Numerous studies have examined factors influencing export-oriented production. However, there is little data on how external shocks, structural factors, and investment dynamics collectively affect export performance in transition economies such as Kazakhstan.

Therefore, the purpose of this study is to assess the impact of key economic determinants on export-oriented production in Kazakhstan.

## 2. METHOD

This study analyzes the macroeconomic determinants of export-oriented production in Kazakhstan using OLS and ARMAX regression models. The study’s statistical database consists of World Bank data for 1991–2024 (World Bank, n.d.). The main determinants include exports of goods and services, value added in the manufacturing industry, net inflows of foreign direct investment, the terms of trade index, GDP per capita, and inflation (Table 1).

To assess the main determinants of exports, the ordinary least squares (OLS) method was used as a baseline approach to estimate the relationships

**Table 1.** Variable definitions and data sources

Variable	Description	Interpretation
NEEXPGNFSZS	Exports of goods and services (% of GDP)	dependent variable characterizing export activity
NVINDMANFZS	Manufacturing value added (% of GDP)	characterizes the impact of an industrial structure on exports
BXKLT DINVWDGDZS	FDI net inflows (% of GDP)	assesses the role of external capital
NETRDGNFSZS	Terms of trade index (2000 = 100)	as an external conjunctural factor
NYGDPPCAPKD	GDP per capita (constant 2015 USD)	shows the level of economic development
NYGDPDEFKLDZG	Inflation, GDP deflator (%)	measures macroeconomic stability

between the variables. The classical OLS assumptions were tested, including stationarity, multicollinearity, and autocorrelation. The model is specified as follows:

$$Exports_t = \beta_0 + \beta_1 Manuf_t + \beta_2 FDI_t + \beta_3 ToT_t + \beta_4 GDPpc_t + \beta_5 Infl_t + \varepsilon_t, \tag{1}$$

where  $Exports_t$  – share of exports in GDP;  $Manuf_t$  – manufacturing industry value added;  $FDI_t$  – foreign direct investment;  $ToT_t$  – Terms of trade index;  $GDPpc_t$  – GDP per capita;  $Infl_t$  – Inflation;  $\varepsilon_t$  – random error member.

Preliminary use of this model revealed correlations and interdependencies between variables, which served as the basis for the ARMAX model. This model accounts for time series and other external factors and includes autoregressive (AR), moving-average (MA), and exogenous (X) components with specified lag structures. The ARMAX model has the following wording:

$$Exports_t = \alpha + \sum_{i=1}^p \varphi_i Exports_{t-i} + \sum_{j=1}^q \theta_j \varepsilon_{t-j} + \sum_{k=1}^K y_k X_{k,t} + u_t, \tag{2}$$

where  $Exports_t$  – share of exports in GDP;  $Exports_{t-i}$  – export indicators in the past (autogression);  $X_{k,t}$  – a set of exogenous variables (macroeconomic factors);  $\varepsilon_{t-j}$  – random error member;  $u_t$  – random error.

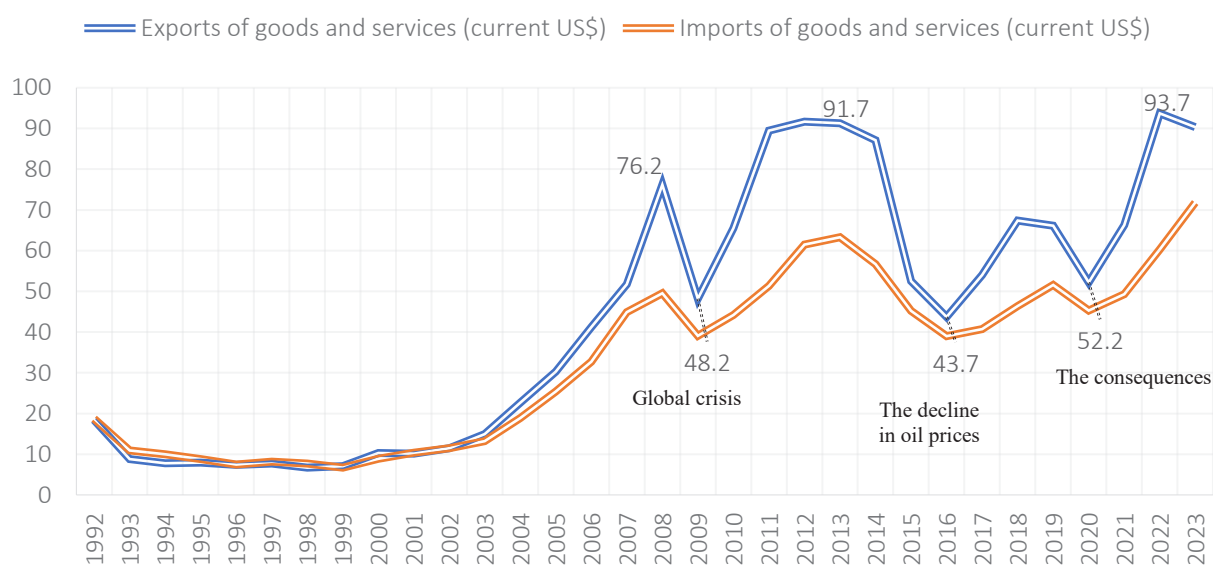
To obtain more accurate results, the model parameters were estimated using the maximum likelihood method based on the Kalman filter. This estimation method is appropriate for time-series models with unobserved components and improves efficiency compared to standard OLS estimation. The vector autoregression (VAR) model was used to analyze the impact of external shocks on exports. This approach is used to track the im-

port of shocks on key variables. Thus, the VAR model complements the ARMAX structure, reflecting multidimensional feedback effects.

### 3. RESULTS AND DISCUSSION

Kazakhstan’s exports and imports show its own specifics, shaped by the country’s raw material base and production facilities. Figure 1 shows the dynamics of nominal exports and imports of Kazakhstan (in billions of US dollars) for the period 1992–2023. It can be seen that exports exceed imports, indicating an imbalance in Kazakhstan’s foreign trade market.

Figure 1 indicates that exports and imports are highly sensitive to a country’s economic structure, geopolitical shocks, and global market conditions. The low levels of exports and imports in the early 1990s are explained by the geopolitical changes in the country, which led to the severance of production ties and the formation of domestic market institutions. Since the early 2000s, the volume of foreign trade has grown steadily due to favorable pricing conditions in global commodity markets, especially amid growing demand for oil and metals. Although exports increased significantly in 2007–2008, both exports and imports declined sharply in 2009 due to the global financial and economic crisis. In 2010–2013, export growth resumed, reaching a historic peak in 2012–2013. However, the sharp drop in oil prices in 2014–2016 led to a marked decrease in foreign trade, indicating the dependence of the Kazakh economy’s export structure on raw materials. The decline in exports and imports during the COVID-19 pandemic in 2020 was driven by disruptions to international trade networks and a decline in global demand. Nevertheless, in 2021–2023, export volumes increased again, reaching one of the highest levels in 2022. Thus, the dynamics of exports and imports in Kazakhstan are volatile due to external



**Figure 1.** Dynamics of exports and imports of goods and services of Kazakhstan (1992–2023)

factors. Over the past five years (2020–2024), the volume of Kazakhstani exports has grown significantly, and this export structure increases vulnerability to external price shocks and geo-economic risks. Maintaining the share of export in gross domestic product at 34–35%, despite its significant multiplier effect on economic growth, may pose difficulties for the country's economy in the future. Thus, the chronology of Kazakhstan's export and import dynamics shows that exports account for a significant share of GDP, while import demand remains high. These findings highlight the importance of diversifying the production structure and expanding the export basket. The development of processing industries and an increase in the share of high-value-added products in exports can reduce the national economy's vulnerability to external price shocks and enhance the sustainability of long-term economic growth. As mentioned earlier, the OLS-based analysis of indicators is insufficient because it fails to account for temporary changes in export dynamics. In this regard, the analysis results are interpreted using the ARMAX model, which accounts for hidden shocks and temporary changes in the country that affect the economy.

The ARMAX model (Table 2) shows that the factor determining the terms of trade (0.676) has a strong positive effect on exports and is statistically significant ( $p < 0.001$ ). This indicates that export dynamics are sensitive to global price conditions. These find-

ings are consistent with the results of Cashin et al. (2004), who demonstrate that commodity-exporting economies are highly dependent on fluctuations in global prices. In addition, this indicator shows that Kazakhstan's exports remain relatively poorly diversified and that export revenues are closely related to external conditions rather than domestic production efficiency.

According to this model, another determining factor has been identified: GDP per capita. This indicator reflects the importance of the country's socio-economic development for exports. The results of the OLS (1995–2023) and ARMAX (1995–2023) models show a positive relationship between exports and socio-economic development within the country ( $\beta = 0.001$ ;  $p < 0.01$ ); however, differences across models indicate that the results are sensitive to model specification. This means that while social development, including education, healthcare, and other sectors, can boost exports, sustainable growth also requires an effective government export policy and a country's production capacity.

The results also show that the share of manufacturing in GDP negatively affects exports ( $-0.598$ ), and this effect persists in the dynamic model (significant at the 10% level). At first glance, this result may seem paradoxical. However, in Kazakhstan, this is due to a significant proportion of the manufacturing industry being focused on the domestic market.

**Table 2.** Determinants of exports: OLS vs ARMAX estimates

Variable	OLS (2003–2023)	OLS (1995–2023)	ARMAX (1995–2023)
Manufacturing	-0.865*	-0.664**	-0.598*
FDI	n.s.	n.s.	n.s.
Terms of Trade	0.629***	0.670***	0.676***
GDP per capita	n.s.	0.001***	0.001***
Inflation	0.187*	n.s.	–
AR(1)	–	–	n.s.
MA(1)	–	–	n.s.
R <sup>2</sup> / LogL	0.956	0.951	-57.66

Note: \*\*\* p < 0.01, \*\* p < 0.05, \* p < 0.10, n.s. – not significant.

The transformation and modernization of the manufacturing sector will not only increase the country's export potential but also boost domestic production, thereby creating conditions to reduce imports. The results suggest that Kazakhstan's industrial policy is not export-oriented but rather import-substitution. However, Rodrik (2008) and Heydenreich (2010) reported findings consistent with this study's conclusions and emphasized that as domestic industrial production capacity increases, exports will grow.

Another indicator used in this model is foreign investment. Investments are undoubtedly necessary to increase and diversify production (Alfaro et al., 2003). However, foreign direct investment does not have a statistically significant impact on exports in Kazakhstan. This is because foreign investment is mainly concentrated in Kazakhstan's resource-based sector, as well as the presence of regional or institutional barriers that prevent the attraction of foreign investment in the manufacturing sector. Thus, to increase investment in exports, Kazakhstan suggests reviewing the investment policy. These conclusions are consistent with North's institutional theory (North, 1990), which emphasizes the importance of effective government regulation to increase foreign investment.

The results show that the dynamic components of AR and MA are not statistically significant, indicating the absence of obvious inertial or self-sustaining mechanisms in export dynamics. The fulfillment of the conditions of stationarity and invertibility confirms the correctness of the model specification and the reliability of the calculated results.

The impulse response functions obtained based on the VAR model showed that exports respond quickly and positively to shocks in the terms of trade. A posi-

tive change in the terms of trade leads to an increase in exports in the short and medium term, which is consistent with previous empirical studies (Mendoza, 1995). However, this effect diminishes over time, indicating that export dependence on external price factors is short-term, while structural factors play a crucial role in long-term, sustainable growth.

Unlike OLS, the ARMAX model is estimated via maximum likelihood and incorporates a dynamic error structure. Consequently, the conventional R<sup>2</sup> statistic is used for model comparison. Regarding the above model, OLS has a DW of 1.35–1.73 (Table 3), indicating autocorrelation and limiting the interpretation of the time series analysis. According to the ARMAX AIC (131.31) and BIC (142.25) models, the information is adequate, and the model is stable.

**Table 3.** Model diagnostics

Model	AIC	BIC	DW / Stability
OLS			1.35–1.73
ARMAX	131.31	142.25	Stable

Thus, the analysis of the economic determinants of exports shows that improvements in export performance largely depend on external factors, and the internal structural features of production still do not fully create opportunities for sustainable export promotion. To increase export potential, conditions should be created for comprehensive support, ranging from developing domestic production and supporting domestic producers to government regulation and reorienting foreign direct investment toward export-oriented industries. In this context, the study's results provide an important empirical basis for rethinking Kazakhstan's export policy and industrial development strategy.

## CONCLUSION

The purpose of this study is to assess the impact of key economic determinants on export-oriented production in Kazakhstan. The analysis results indicate that the factors determining the terms of trade and the country's socio-economic development positively affect exports. On the contrary, the share of manufacturing in GDP reduces exports. In addition, foreign direct investment is insignificant relative to Kazakhstani exports. Summing up, Kazakhstan's manufacturing industry is focused on the domestic market and import substitution, rather than on the foreign market. However, with the right and effective government policy, the situation can shift the vector, thereby creating conditions that will contribute to improving the export basket. In addition, as the industrial sector develops, the country should review its investment policy. From a theoretical perspective, this study expands understanding of the potential of export-oriented production in Kazakhstan. In practice, the results obtained emphasize the need to review Kazakhstan's export, industrial, and investment policies. Future research may aim to identify industries with high and low export potential and analyze the main factors within each industry, thereby deepening understanding of how to expand Kazakhstan's export basket.

## AUTHOR CONTRIBUTIONS

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Writing – review & editing: Dana Kangelakova, Olzhas Adilkhanov, Kymbat Zhanaliyeva, Zaira Satpayeva.

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