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VOLATILITY OF KAZAKHSTAN'S EXPORT AND IMPORT PRICES

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Kozhamkulov Kanat[1]
Khakimzhanov Sabit[2]
Miller Aliya[3]
Agambayeva Saida[4]

Abstract

The analysis of factors that cause volatility of export and import prices in the Republic of Kazakhstan and lead to the destabilization of foreign trade flows in goods was carried out within the scope of this study.

A methodology for constructing export and import price indices was elaborated. The dynamics of the value of foreign trade flow is decomposed into the following components: price indices and indices of physical volumes of supplies. The index of physical volumes of supplies and conversion of the total value index from the US dollar to the tenge enabled to construct an index of foreign trade prices in the tenge for comparison with the consumer price index (CPI).

Ultimately, an analytical toolkit for foreign trade price indices was implemented with on-the-spot administration that does not require financial costs. This toolkit allows assessing the trends in foreign trade prices.

Key Words: volatility of export and import prices, foreign trade price indices, exchange rate, factor analysis, terms of trade, processed goods, consumer goods, inflation.

JEL-Classification: C43, E31, F10.

[1] Kozhamkulov Kanat – Corresponding Author, Chief Specialist-Analyst, Economic Research Division, Department-Center for Research and Analytics Kanat.K@nationalbank.kz
[2] Khakimzhanov Sabit – Advisor to the Governor, National Bank of Kazakhstan
[3] Miller Aliya – at the time of research – Head of the Economic Research Division, Department-Center for Research and Analytics uataeva@mail.ru
[4] Agambayeva Saida – Department-Center for Research and Analytics Agambayeva.S@nationalbank.kz

Contents

1. Preamble

The purpose of the study is to analyze the factors that cause volatility of export and import prices and lead to the destabilization of foreign trade flows in goods.

A low diversification of Kazakhstan's exports revealed the vulnerability and dependence of the current account on movements in world energy prices. External factors also include variables such as demand for commodities (metals and grain) and market accessibility. The import flow increased imbalance in foreign trade and put pressure on the tenge exchange rate, absorbed external inflation and accelerated the domestic inflation.

Thus, expensive imports in the oil sector and large infrastructure projects during the periods of low prices for raw materials aggravate the trade balance now, and increase income payable in the subsequent.

Rising prices of imports of consumer durables, while boosting inflation expectations, encourage household purchases in installments and on credit thus increasing the debt burden in the absence of an adequate growth of wages.

In the case of Kazakhstan, the terms of trade calculated as the ratio between export and import prices are largely determined by the dynamics of oil prices and do not fully reflect the pricing competitiveness of non-primary exports.

At the same time, the terms of trade for target product groups, for example, high value added goods (exports) and consumer goods (imports), enable to reveal wider the effective condition for the growth of the real sector of the economy and employment. The use of this approach proves that when the terms of trade deteriorate, government support measures for manufacturing industries are canceled out by their pricing uncompetitiveness both in the domestic market and in foreign markets. At the same time, currency fluctuations are instantly reflected in the price of final goods and consumer products. As a result, price volatility sets the trend in the physical volumes of supplies of these goods. Nonetheless, the trend in the physical volumes of supplies of this group of goods, in turn, correlates with the dynamics of the total value of foreign trade flows.

To address these problems, a methodology for constructing export and import price indices was elaborated in this study. Thus, the dynamics of the value of foreign trade flow is decomposed into the following components: price indices and indices of physical volumes of supplies. At the same time, the index of physical volumes of supplies and recalculation of the total value index from the US dollar to the tenge enabled to construct the index of foreign trade prices in the tenge for comparison with inflation.

Based on the results of the study, an analytical toolkit was implemented for foreign trade price indices with on-the-spot administration that does not require financial costs. This toolkit allows assessing the trends in foreign trade prices.

The toolkit of the foreign trade price index, which is the purport of this study, will allow preparing analytical materials and initiate further research in this area. This will provide an opportunity to get feedback from the expert community, to test the capabilities of the toolkit based on the methodology used, and will contribute to the publication of a number of papers on the aspects of Kazakhstan's foreign trade.

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2. Stages of Works Accomplished

At the first stage of the study, the data was gathered and compiled and a *new flexible toolkit on Kazakhstan's foreign trade,* "Cube of Database on Kazakhstan's Foreign Trade: Ver 2.2021" *was designed* and approved by the Digitalization Office of the National Bank of Kazakhstan.

The "Cube of Database on Kazakhstan's Foreign Trade: Ver 2.2021" is an inquiry tool in the expanded database on foreign trade of the Republic of Kazakhstan, which allows creating pivot tables on existing indicators and derivative classifiers with a high level of granularity.

The new analytical toolkit: a) contains the most accessible base of monthly data on foreign trade of the Republic of Kazakhstan for 1995-2021; b) enables to structure data with a great level of detail on goods up to the level of the 10-digit code of the Foreign Economic Activity Commodity Nomenclature (FEACN/TNVED); c) allows classification of data according to the UN Classification by Broad Economic Categories (BEC) [1] by the degree of processing. The data in this sector includes commodities and processed goods. Also, the data is structured by classes of goods in the system of national accounts and includes such categories as means of production, interim goods, consumer goods. In addition, goods are structured according to the classification of the Common Classifier of Economic Activities (CCEA).

At the second stage, *the methodology for constructing the foreign trade price index was developed and described* that is based on the key principles of the IMF Export and Import Price Index Manual (XMPI, 2009) [2]. As part of the methodological effort:

1. The level of breaks in the statistical series of foreign trade supplies was analyzed and statistics of runs of continuous data were prepared, *determining the level of confidence in the methodology for constructing a chain export and import price index*;

2. Trade flows with extreme outliers in monthly US dollar prices by more or less than 2, 5 and/or 10 times have been identified. Such extreme price outliers *form the basis for mirroring of statistical data* with trading partner countries, thus improving the data quality.

At the third stage, *two models for construction of Kazakhstan's monthly foreign trade price indices were implemented* at different levels of data aggregation and period coverage.

The first model was implemented at the level of the 6-digit code of the FEACN of aggregated data by country with the coverage of a maximum period of monthly indicators. As examples, indices on major export and import commodity categories were constructed;

The second model was implemented at the level of the 10-digit code of the FEACN of disaggregated data by country. Such model enables to construct: a) price indices of particular commodity items for the maximum period from 1995 to 2021; b) price indices on total imports and exports for the last three years from 2019 through 2021. As an example, import price indices on particular consumer goods for the period from 1995 were constructed.

The choice of using the model depends on the objectives, the sample used for the period coverage and the level of detail. The constructed models for calculating foreign trade price indices enable to iterate them based on available indicators and derivative classifiers.

At the fourth stage, *foreign trade price indices were analyzed and major trends were identified*. Export price indices are constructed with a focus on the price of oil and with a focus on the prices of finished goods in the non-primary sector. Import price indices are constructed with a breakdown by trading partner countries and by main product categories, such as interim goods, capital goods, food products and consumer non-food products. An analysis was made of the relationship between the real effective exchange rate of the tenge (REER) and the price, quantity and cost indices of imports. The relationship between inflation and import prices in the context of commodity groups was also reviewed.

The authors' computations were prepared based on the data from the SRC MF RK [3] and ASPR BNS RK [4].

3. Designing a Toolkit on Foreign Trade Data: Collection and Compilation

3.1. The Necessity of Designing a New Analytical Toolkit on Foreign Trade

At the first stage of the study, the data collection and compilation was carried out and *a new flexible analytical toolkit on Kazakhstan's foreign trade*, "Cube of Database on Kazakhstan's Foreign Trade: Ver 2.2021", *was designed* and approved by the Digitalization Office of the National Bank of Kazakhstan.

The "Cube of Database on Kazakhstan's Foreign Trade: Ver 2.2021" is an inquiry tool in the expanded database on foreign trade of the Republic of Kazakhstan, which allows creating pivot tables on existing indicators and derivative classifiers with a high level of granularity.

The Cube (Ver 1.2014) that was earlier used by the National Bank's business units does not fully meet the objectives of the study since it:

1) includes a short period of data from 2014. Short data series allow solving the National Bank's operational problems and analyzing the current state of foreign trade and balance of payments. However, for the purposes of the study, it is advisable to use longer data series, thus enabling to conduct research on the horizon of more than 1 business cycle as well as improving the quality and reliability of assessments and conclusions;

2) allows classifying goods only up to the 6-digit code of the Foreign Economic Activity Commodity Nomenclature (FEACN). For the purposes of the study, it is more efficient to use a greater level of detail of goods up to the 10-digit code of the FEACN; the data on such goods is available in the "Customs Statistics" Automated Workstation (AWS) in the Automated Information Subsystem (AIS) "Balance of Payments" (hereinafter – the "Customs Statistics" AWS);

3) does not allow classifying goods under the Common Classifier of Economic Activities (CCEA).

The "Customs Statistics" AWS contains the data on Kazakhstan' foreign trade in the period from 1995 with the level of detail of up to the 10-digit. However, the data is only uploaded in a fixed format and is used primarily for balance of payments reporting. The "Customs Statistics" AWS is a repository of initial data on Kazakhstan's foreign trade and is not a flexible tool for research. As a result, the National Bank employees have access to a huge amount of data but do not have flexible tools to establish relationships between such data and draw meaningful conclusions on their basis.

Therefore, a new analytical toolkit on foreign trade was designed that meets the purposes of research to a greater extent and allows handling the big data contained in the "Customs Statistics" AWS.

3.2. Description of the New Flexible Analytical Toolkit

The new analytical toolkit:

1) contains the maximally accessible base of monthly data on Kazakhstan's foreign trade from 1995 through 2021;

2) allows the data structuring at a great level of detail on goods up to the 10-digit code of the FEACN;

3) enables to classify the data in accordance with the United Nations Classification by Broad Economic Categories (UN BEC) (based on the degree of processing (primary commodities and processed goods) and main commodity classes of the system of national accounts (means of production, interim goods and consumer goods);

4) allows structuring the data with commodity classifications under the Common Classifier of Economic Activities (CCEA).

The results are compiled in the Access Database Management System (DBMS) with a rendering capability in the Excel spreadsheet.

The "Customs Statistics" AWS is the data source. The data is supplied to this source by the Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan (ASPR BNS RK) (on the Eurasian Economic Union member countries) and the State Revenue Committee of the Ministry of Finance of the Republic of Kazakhstan (SRC RK) (on the rest of countries).

The input data includes information on foreign trade at an aggregate level for the month (not at the level of an individual enterprise) with a breakdown of up to the 10-digit code of the FEACN by trading partner countries. The "Customs Statistics" AWP was chosen as the source of data, since publicly available information on the websites of government agencies contains data only from 2004 and it lacks the data for the first half of 2011 on the Eurasian Economic Union member countries (i.e. during the period of accession to the Customs Union).

The commodity classification according to the UN BEC classification is used in the international practice in order to achieve uniformity in determining trends in the global trade. In Kazakhstan, this classification is used as a unified methodology for classifying goods into primary commodities and processed goods when conducting statistical computations and determining the final targets for development of non-primary exports.

To structure the historical data on Kazakhstan's foreign trade since 1995, the transition keys FEACN – BEC and the keys FEACN – CCEA have been updated in accordance with the upgraded classifiers. Transitional keys allow structuring foreign trade flows and provide an opportunity to consider international trade statistics together with other components of macroeconomic statistics for a comprehensive economic analysis.

The UN BEC Classification Use Guide highlights the importance of the classifier for global value chain analysis and GDP estimation. In addition, the use of the UN Manual to BEC Classification made it possible to sample finished goods of non-primary exports and consumer goods included in the calculation of the consumer price index (CPI). This simplifies the analytical task of data structuring to assess the impact of foreign trade flows on inflation.

Automation of the toolkit was difficult due to the difference in the forms of input data (forms of foreign trade statistics) and downloaded data, as well as because of the lack of ready-made transition keys for structuring historical data. As a result, the input data on foreign trade was manually brought into a unified format of pass-through indicators. In addition, when calculating foreign trade prices, gaps were identified in the quality of initial statistics for individual goods, including abnormal price deviations for certain goods, the presence of different units of measurement for one product in different periods.

The following efforts were made in developing the new toolkit: a) more than 600 original monthly Excel files on exports and imports were processed and combined into one database with pass-through indicators and data for 26 years; b) FEACN - BEC - CCEA transitional keys were manually updated (more than 6000 FEACN codes), as the data series were broken due to five updates of the FEACN classifier since 1995 and the FEACN - BEC transitional keys (version BEC Rev.4) were changed, accordingly) and FEACN-CCEA.

The updating of transitional keys will further facilitate the transfer to the new classifier, since all historical data on the FEACN have already been classified by the BEC (version BEC Rev.4). The fifth revision of the BEC Classification, in addition to goods, also includes services.

The use of the Cube Ver 2.2021 by the National Bank business units in carrying out the analytical and research work reduces their labor costs for the search and processing of statistical data, eliminates duplication of operational processes, and reduces the risk of human error. The National Bank employees use this toolkit in forecasting and in the analysis of the external sector of Kazakhstan's economy. The User Guide and the Toolkit Administration Manual have been developed.

4. Implementation of the Models for Foreign Trade Price Indices: Construction Methodology

4.1. The Methodology for Constructing Indices and the Use of Formulas

The methodology for constructing the export and import price index has been implemented by calculating monthly chain price changes using the Fisher index, which is the geometric mean of the Laspeyres index and the Paasche index. The choice of the monthly chain index is justified by the presence of breaks in the statistical series on foreign trade and is described in detail below.

Chain *Laspeyres* Price Index is calculated under the following formula:

$$P_L = \frac{\sum_{i=1}^{n} p_i^t q_i^{t-1}}{\sum_{i=1}^{n} p_i^{t-1} q_i^{t-1}} \equiv \sum_{i=1}^{n} \left(\frac{p_i^t}{p_i^{t-1}}\right) s_i^{t-1} \quad \textit{(formula 1),}$$

where *i* – commodity sub-item*;*
p – its price,
q – its quantity,
t – period;
s_i^{t-1} – the commodity share *i* in terms of cost in the period *t-1*:

$$s_i^{t-1} = \frac{p_i^{t-1} q_i^{t-1}}{\sum_{i=1}^{n} p_i^{t-1} q_i^{t-1}} \quad \textit{(formula 2).}$$

Chain *Paasche* Price Index is calculated under the following formula:

$$P_P = \frac{\sum_{i=1}^{n} p_i^t q_i^t}{\sum_{i=1}^{n} p_i^{t-1} q_i^t} \equiv \left\{\sum_{i=1}^{n} \left(\frac{p_i^t}{p_i^{t-1}}\right)^{-1} s_i^t\right\}^{-1} \quad \textit{(formula 3),}$$

where s_i^t – a similar share of commodity *i* in terms of cost in period *t:*

$$s_i^t = \frac{p_i^t q_i^t}{\sum_{i=1}^{n} p_i^t q_i^t} \quad \textit{(formula 4).}$$

Chain *Fisher* Price Index is calculated as the geometric mean of Laspeyres and Paasche indices:

$$P_F \equiv \sqrt{P_L * P_P} \quad \textit{(formula 5).}$$

It is worth mentioning that the breaks in the series of statistical data on Kazakhstan's foreign trade are stemming from the periodic updating of the FEACN international classifier as part of the improvement (5 updates for the period of 1995-2021), a change in the units of measurement of physical volumes of trade in certain goods, the cessation of trade in obsolete goods and the appearance of new goods in trade; the seasonal absence of trade in certain periods as well as from the factors protecting the domestic market with tariff and non-tariff barriers and from other factors.

Taking into account the assumptions about the causes of such breaks, an effort was made to eliminate them by imputing and calibrating those values that are missing or incorrect. Table 1 shows an example of constructing indices for import flows of one of the commodity sub-items for the period from March 2020 to October 2020.

Table 1. Examples of the price index construction on flows of one of commodity sub-items

#	Period	03.2020	04.2020	05.2020	06.2020	07.2020	08.2020	09.2020	10.2020
1	PERIOD_M (t)	303	304	305	306	307	308	309	310
2	Cost*	imputation 1 cent	imputation 1 cent	**C^{305}**	imputation 1 cent	**C^{307}**	**C^{308}**	imputation 1 cent	**C^{310}**
3	Quantity	-	-	**Q^{305}**	-	**Q^{307}**	**Q^{308}**	-	**Q^{310}**
4	Relative Share	min $S^{303}\approx 0$	min $S^{304}\approx 0$	**S^{305}**	min $S^{306}\approx 0$	**S^{307}**	**S^{308}**	min $S^{309}\approx 0$	**S^{310}**
5	Unit Price	-	-	**P^{305}**	-	**P^{307}**	**P^{308}**	-	**P^{310}**
6	R_Price	1	1	**1**	1	**1**	**RP^{308}**	1	**1**
7	Laspeyres Price Index	P_L^{303}	min $P_L^{304}\approx 0$	min $P_L^{305}\approx 0$	P_L^{306}	min $P_L^{307}\approx 0$	**P_L^{308}**	P_L^{309}	min $P_L^{310}\approx 0$
8	Paasche Price Index	min $P_P^{303}\approx 0$	min $P_P^{304}\approx 0$	P_P^{305}	min $P_P^{306}\approx 0$	P_P^{307}	**P_P^{308}**	min $P_P^{309}\approx 0$	P_P^{310}
9	Fisher Price Index	P_F^{303}	min $P_F^{304}\approx 0$	P_F^{305}	P_F^{306}	P_F^{307}	**P_F^{308}**	P_F^{309}	P_F^{310}

**In the first model for constructing the price index, the total value of one commodity sub-item is recorded according to two criteria: according to the 6-digit code of the FEACN and the unit of measurement of physical volume (real import flows according to FEACN 310390 are shown). In the second model for constructing the price index at the maximum available disaggregated level, the total value of the commodity sub-item is recorded in three ways: based on the 10-digit code of the FEACN, by country and by unit of measurement of physical volume.*

It should be noted that the foreign trade statistics is presented in the US dollars.

Imputation of the missing values of the cost of commodity sub-items, *Cost*, with non-zero values (1 cent) and calibration of the change in prices, *R_Price*, on such sub-items (without the price change =1) is substantiated by the following factors:

1) if the missing values of the cost of commodity sub-items with non-zero values are not imputed and if price changes are not calibrated, their distorted index is obtained, since the corresponding indices will be calculated only in those periods where there is the possibility of chain price comparison (P_L^{308}, P_P^{308}, P_F^{308} in the period t=308);

2) without imputing the missing values of commodity sub-item with non-zero values, but with the price change calibration (no price change =1) only in periods with trade data, the price index will also be distorted. Indices are calculated using the *Paasche* formula (P_P^{305}, P_P^{307}, P_P^{308}, P_P^{310}) only in the periods with trade data (t= 305, 307, 308 and 310), and according to the *Laspeyres* formula, only in the periods where there is a possibility of chain price comparison (P_L^{308} in the period t=308). Further, the Fisher index is calculated for the commodity basket. Therefore, in this case, the *Paasche* formula works, but the *Laspeyres* formula does not work (including for P_L^{306}, P_L^{309} due to the lack of price calibration for the missing trade). The *Fisher* Index will tend to zero underestimating the price factor. Whereas the quantitative factor will be overestimated and will tend to infinity throughout the entire period, capturing the appearance of a product in the data series and missing its disappearance. This is because the change in the cost of trade depends on changes in prices and quantity:

*R_COST= R_Quantity *R_PRICE (formula 6);*

3) imputation of the missing values of cost with non-zero values (1 cent) and calibration of their price changes (without price change = 1) allow obtaining adequate results, since the *Paasche* and *Laspeyres* indices in this case are calculated in all periods and capture the appearance and disappearance of goods in the trade flow. The uniqueness of the Fisher formula lies in its reversibility over time, which is one of the mandatory criteria described in the IMF Export and Import Price Manual. In this case, the results of calculations of the dollar price indices according to *Fisher* give adequate results and are proved by approbation of the tenge price indices.

4.2. Level of Price Calibrations at Breaks and the Statistics of Runs

Using the example of Table 1 mentioned in the previous Section, the calculation of the price calibration level at breaks and the statistics of runs of continuous data are shown, which reveal the degree of confidence in the results of the applied price index construction methodology. Thus, the total value of trade adjacent to the points of breaks, for which there is an assumption of "no price change" due to the absence of trade, require the calculation of their amount and share in the total volume.

Determining the price calibration level at breaks by summing and finding the proportion of the total value of trade with breaks on the left (t-1) shows the maximum value of the calibration level.

This approach meets the condition of using the Laspeyres and Paasche formulas in comparing chain prices in periods "t" and "t-1". In this case, the price calibration level takes into account all the first unknown price changes at the beginning of trading after the break, regardless of the further continuity of series and the number of runs.

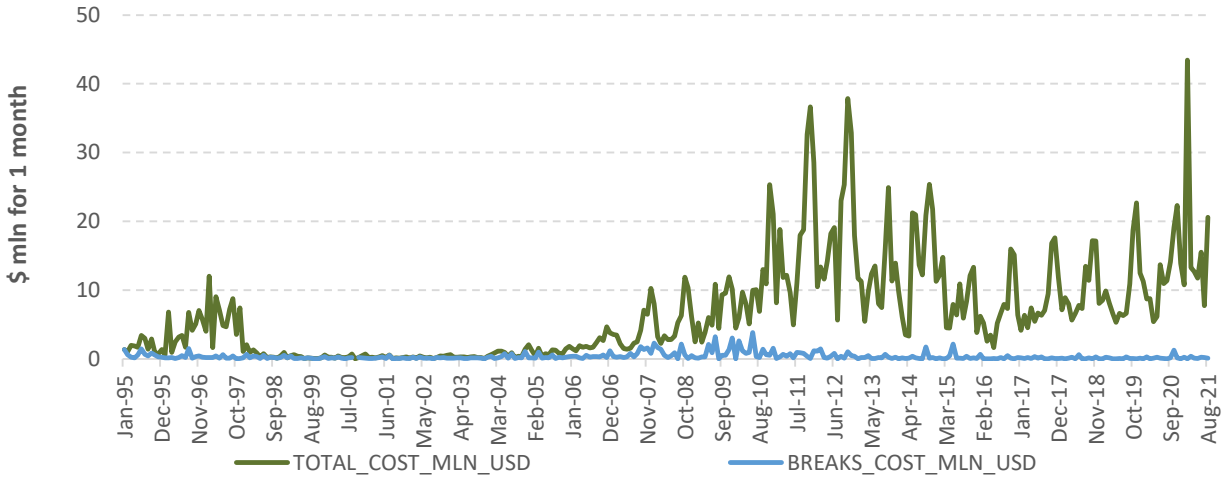
For example, in comparing prices of the periods t/(t-1): P^{305}/P^{304}, P^{307}/P^{306} and P^{310}/P^{309} changes in prices of goods ("R_Price") in the periods "t": 305, 307, 310 go with the assumption "without change = 1" to period "t-1" (no trading), the total value of goods is summed up at points "t" and their share is calculated as the price calibration level at breaks (Table 1).

Thus, in imports of the TV sets in Kazakhstan, the price calibration level – the share of total value at points *with breaks on the left* – accounted for 5.5%, that is $117 million of $2112 million in 1995-2021 (Figure 1).

During the period of 1995-2021, the following data is available for computation of the import price index for TV sets (FEACN 852812, FEACN 852872) in Kazakhstan on a statistical flow at the maximum accessible disaggregated level of the 10-digit code of the FEACN by country, broken down by units of measurement of physical volumes:

1) 1172 units (structure) – a quantity of unique items under three features: CODE_TNVED, ID_COUNTRY, ID_MEASURE, obtained by aggregating a real import flow in the reviewed period. *(With the coverage of 65 codes of the FEACN 10-digit code, 97 countries and 2 units of measurement).*
2) 375 040 units (data array) – the number of points for the reviewed period taking account of the fourth feature – time, obtained as follows: 1172 units x 320 months (from Jan.1995 through Aug.2021).
3) 9796 units (actual) – the number of points with the actual data on imports of TV sets based on all four features.

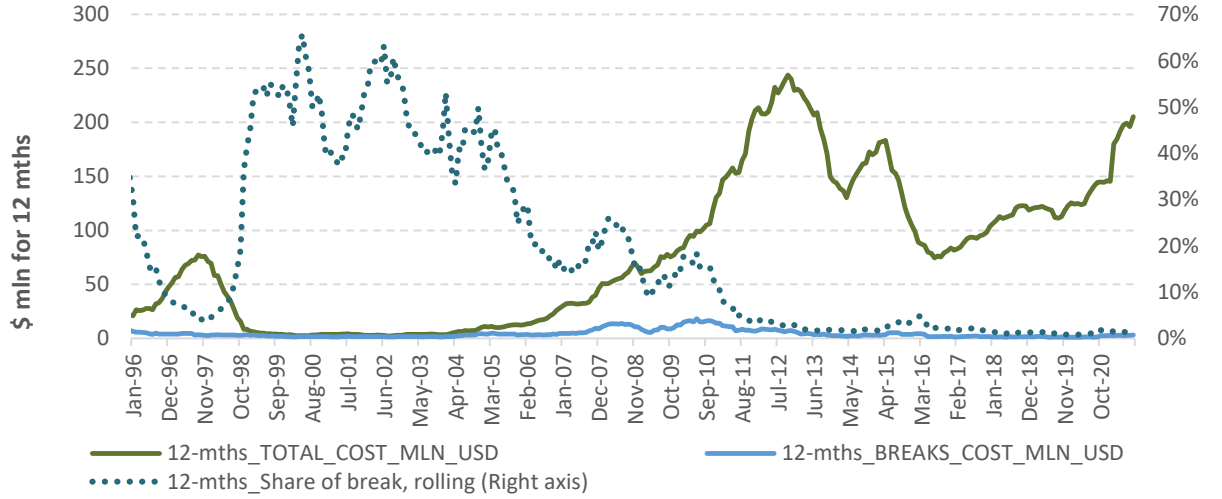
Figure 1. Imports of TV sets in Kazakhstan and the cost at the points of break on the left



Source: computations by authors based on the data from the SRC MF RK and ASPR BNS RK

Imports of TV sets represented by the accumulation during the 12-month rolling period starting from 2017 shows a reduction in the share of the cost at the points of break up to the level of less than 2%, that is, the decline in the price calibration level at the points of break (see Figure 2).

Figure 2. The share of the cost at the points of break on the left for imports of TV sets in Kazakhstan for the 12-month rolling period from 2017 below 2%



Source: computations by authors based on the data from the SRC MF RK and ASPR BNS RK

As noted earlier, this option for determining the price calibration level at breaks gives the maximum value, since the price of the period "t" in the absence of trading in the period "t-1" is considered as "without price change" and the cost of the period "t" is included to determine the price calibration level.

However:

a) if there is trading in period "t+1", then the price of period "t" is included in the price change calculation and the value of period "t" should not be summed up to calculate the price calibration level at breaks. For example, this is revealed when comparing prices of periods (t+1)/t: P308/P307 (see Table 1).

At the same time,

b) if there is no trading in the period "t+1" (gap on the right), then the price of the period "t" is not taken into account when comparing and the price at this point "t" is included in the calculation of the calibration level. For example, this is revealed when comparing prices of periods (t+1)/t: P^{306}/P^{305} (see Table 1).

In case “b”, where there is no trading in periods “t-1” and “t+1”, period “t” is characterized by a 1-month flow of trade with breaks on both sides, a chain comparison of their prices is impossible, and prices are calibrated as “without change”. Such points in this study are defined as runs of 1 month.

As in the example of TV set imports, the price calibration level, that is, the share of a total value of points with a run of 1 month was 3.5%, namely $73 mln of $2112 mln for 1995-2021.

In addition, when constructing a price index, price calibration at breaks absorbs multidirectional price changes in the basket of trade flows, since price increases and declines partially offset each other, compensating for the impossibility of chain price comparison. In this case, the error and the estimated level of price calibration are reduced.

In determining confidence in the methodology for constructing a chain price index and the impact of the gap level of a number of foreign trade supplies, the statistics of runs were built in terms of the number of observations and total value by the length of runs: for 1 month, for 2 continuous months, for 3, 4, 5 months, etc. Run ranges have also been grouped.

The statistics of runs showed that the value of TV set imports is concentrated in long runs with continuous supplies (Table 2, Figures 3 and 4).

Table 2. Statistics of runs on TV set imports in Kazakhstan during 1995-2021

Runs	Quantity of points, thousand	Cost, USD million	Share of the total cost
1 month	3.682	73.3	**3.5%**
2 months	1.336	34.6	1.6%
3-4	1.198	43.3	2.1%
5-8	1.109	82.7	3.9%
9-16	0.869	52.1	2.5%
17-32	0.602	197.4	9.3%
33-64	0.698	373.1	17.7%
139-163	0.302	1 255.7	59.4%
Total imports of TV sets	**9.796**	**2 112.3**	**100.0%**

Source: computations by authors based on the data from the SRC MF RK and ASPR BNS RK

Figure 3.

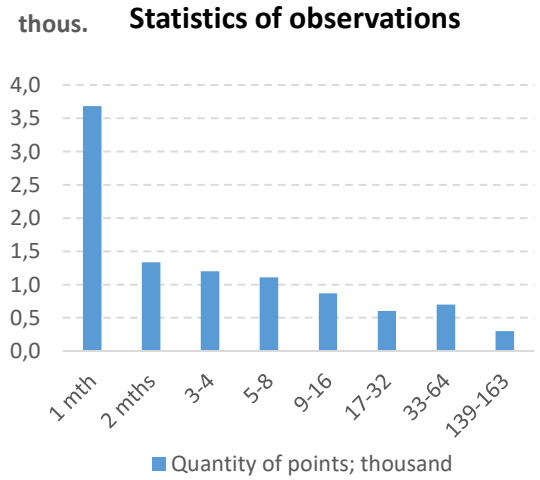
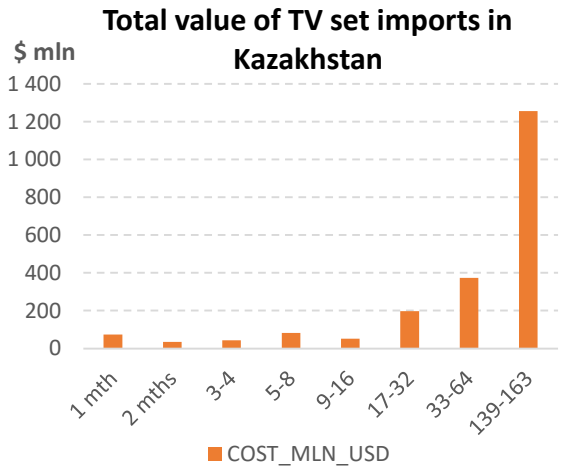


Figure 4.



Source: computations by authors based on the data from the SRC MF RK and ASPR BNS RK

The statistics of runs studied by periods expands the degree of confidence in the methodology for constructing the chain price index (see Figure 5).

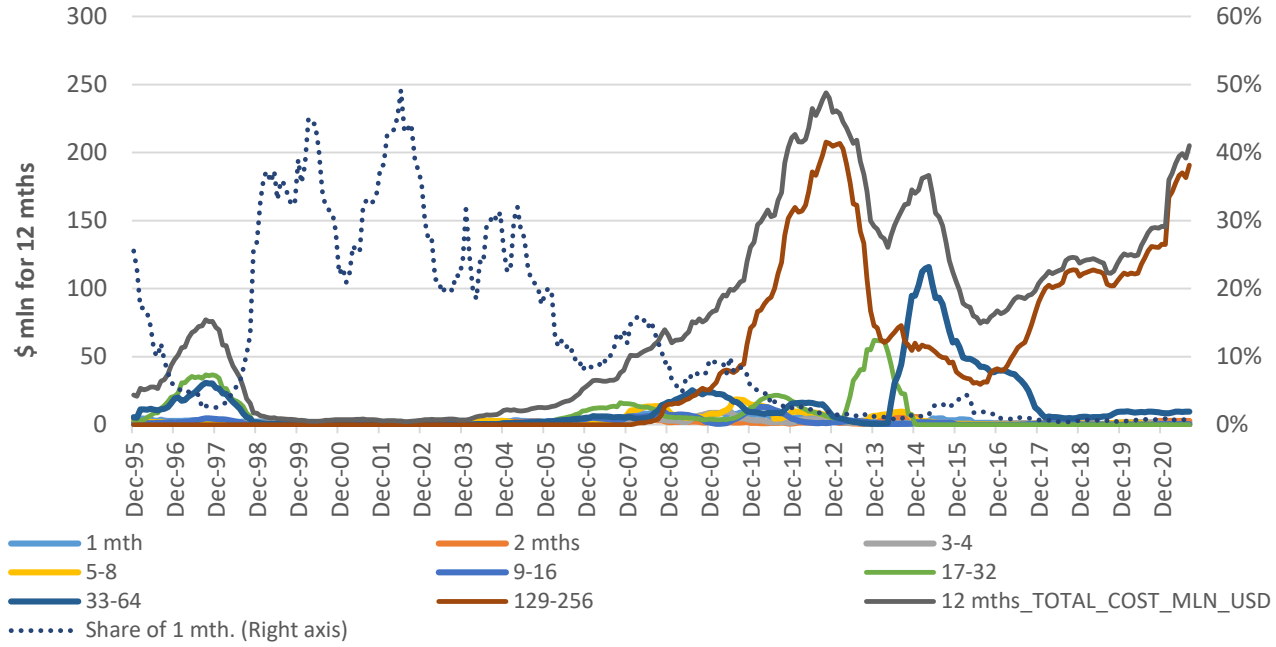
With reduction in imports of TV sets in Kazakhstan, the breaks increased and the share of 1-month runs went up (1997-1998). With the growth of imports of TV sets, breaks declined and the share of 1-month runs – the price calibration level – went down (1995-1997, beginning from 2002).

Since 2017, the share of 1-month runs has been less than 1%. In addition, since 2017, the share of runs lasting less than 9 months has been very low, within 2.1%-3.8%.

The bulk of TV set imports is made up of continuous long runs, and high levels of breaks have been recorded during the periods of low import volumes, where supplies have been volatile.

As a result, the level of price calibration at breaks decreased, as evidenced by the reduction in the share of 1-month runs. It is associated with the growth of continuous supplies and the improvement in the quality of statistics after revision of the FEACN codings.

Figure 5. Value imports of TV sets in Kazakhstan broken down by continuous observations of the length of runs in the 12-month rolling period



Source: computations by authors based on the data from the SRC MF RK and ASPR BNS RK

Thus, the following factors can be singled out, indicating that the methodology used in this study for constructing a price index based on the calculation of monthly chain price changes using the Fisher formula, with the price calibration at the points of breaks and at points of extreme price outliers is an affordable solution, which produces adequate results.

First, the presence of breaks in the data series, changes in the content of individual commodity sub-items on certain codes without data discontinuity but with possible extreme price outliers as well as natural gaps in the data series due to the rhythm of supplies, make it difficult to determine change points for constructing chain indices and lead to distortion of the results in the analysis and their incorrect interpretation.

The abovementioned shortcomings in the foreign trade data are related to the following reasons:

1) frequent updating of the FEACN international classifier, which led to the appearance of two-sided classification brackets in transitional keys between new and old FEACN codes, with the preservation in most cases of the digital values of codes when their content changes. Commodity sub-items could be combined into one code or, conversely, one commodity sub-item could be specified by several codes at the same level of the commodity nomenclature (see Table 3 and Figure 6);
2) termination of trading in morally obsolete goods and appearance of new goods;
3) a change in the unit of measurement of physical volume of trading of certain products.

Thus, the array of foreign trade data for the reviewed period (320 months) contains trade flows for more than 200 trading partner countries and covers classification changes for more than 25 thousand commodity sub-subitems, for some of which there have also been changes in units of measurement of physical volumes.

Second, the connection of broken data series that arose due to classification changes loses its meaning, since comparing the prices of commodity sub-subitems with the same code but with different content does not give accurate valid results.

Third, when considering the price index of a particular commodity basket, classification changes do not affect the content of the commodity basket as a whole. This enables to derive an adequate overall price index regardless of the change in the number of data series in the product basket. This procedure has been verified both at the level of individual commodity items and at a higher level of aggregation. Approbation of the tenge price indices recalculated from the dollar foreign trade prices is an additional proof of the validity and reliability of choosing this approach.

According to the 2017 UN Comtrade Conversion Methodology Notes [5], the harmonized coding and description system (HS, at the 6-digit FEACN level) is regularly updated by the World Customs Organization, taking into account the emergence of new and the disappearance of pre-existing products. According to the document, between **HS 2017** and any previous edition of HS, four types of relationship between codes are possible:

a) 1:1 – one and the same code of the preceding HS corresponds to one HS 2017 code;
b) n:1 – the result of subdividing the HS 2017 code into several codes;
c) 1:n – the HS 2017 code is the result of merger of several codes;
d) n:n – the result of subdivision and merger of several codes.

Table 3. Structure and types of relationships between HS 2017 codes and preceding HS

Types of relationship	HS 2012	HS 2007	HS 2002	HS 1996	HS 1992
1:1	4744	4418	3967	3660	3333
n:1	578	799	948	1153	1332
1:n	44	124	508	560	644
n:n	775	983	1651	2096	2554

Source*: UN Comtrade* *https://unstats.un.org/unsd/classifications/econ/*

Figure 6. The result of correlation between goods in the "live animals" section

Source*: UN Comtrade* https://unstats.un.org/unsd/classifications/econ/

4.3. Extreme Price Outliers

According to the IMF Export and Import Price Manual, the original foreign trade statistics should be cleared of "dirty" data that has non-market deviation of foreign trade prices. The authors gave the following definition to such price deviations: "Extreme price outliers are an abnormal deviation of the US dollar average prices of commodity sub-items for a month by more than 2 times (by 100%), 5 times (by 400%) or 10 times (by 900%) (or less than 2 times up to 50% of the original price, 5 times up to 20% or 10 times up to 10%), from prices for the previous month in the reviewed period. Such extreme deviations in the prices of certain products (even with a low value share in the basket) distort the overall price index.

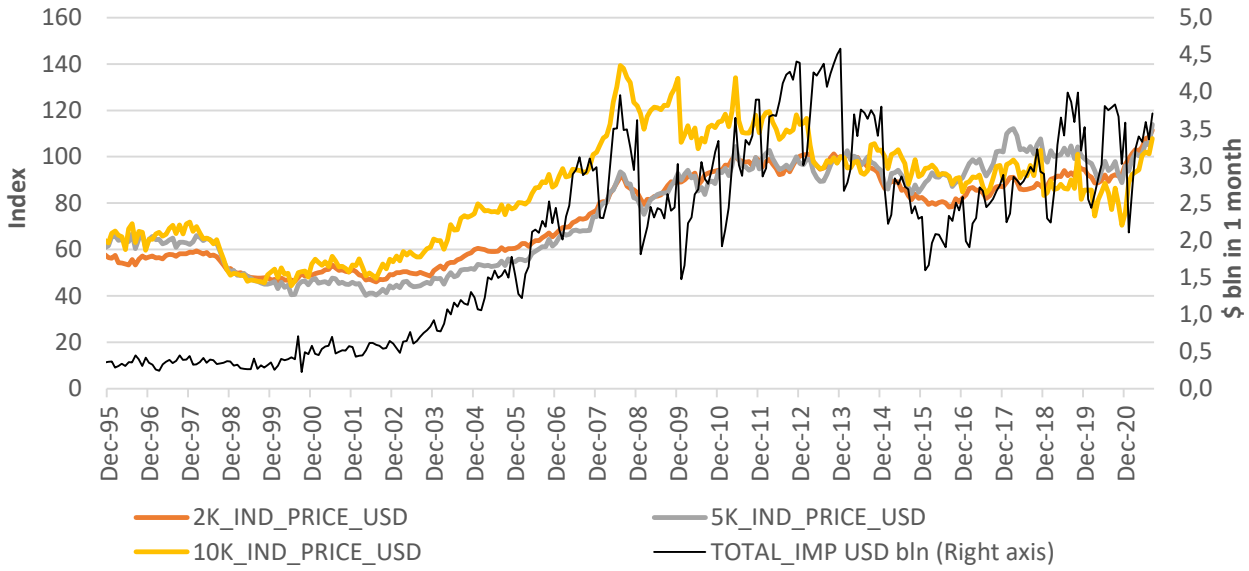
Extreme price outliers occur mainly at the points when the FEACN codes are revised, inevitably followed by occurrence of classification brackets. Thus, the initially defined FEACN code captures the trade of homogeneous goods. After the FEACN classifier has been revised, several codes are introduced instead of one code or several codes are replaced by one code.

At the same time, price surges can be traced at the points of significant changes in supply volumes – the beginning of commercial supplies. For example, in a certain period, with low, one-off physical volumes of supplies of goods, an extremely high price is observed, which has a significant price deviation from the average values. Meanwhile, the product can be supplied as a sample, and its price may include the cost of related services (research, laboratory tests, etc.). Subsequently, with commercial volumes of supplies in millions of dollars, the price of goods is reflected at the average market level. Along with this, price outliers occur due to a change in the geography of supplies, with aggregation by countries and goods at the level of the 6-digit code of the FEACN. Errors in statistical data series can also cause price outliers.

As a result, the implemented models of trade price indices enable to identify trade flows with extreme outliers of monthly dollar prices, which provide the basis for mirroring statistical data with partner countries in order to improve the data quality. The requirement of the IMF methodology to clean up "dirty" data is met by calibrating extreme outliers in foreign trade prices as "no price change". The calibration of prices within one period extinguishes multidirectional extreme spikes of prices of the reviewed commodity basket.

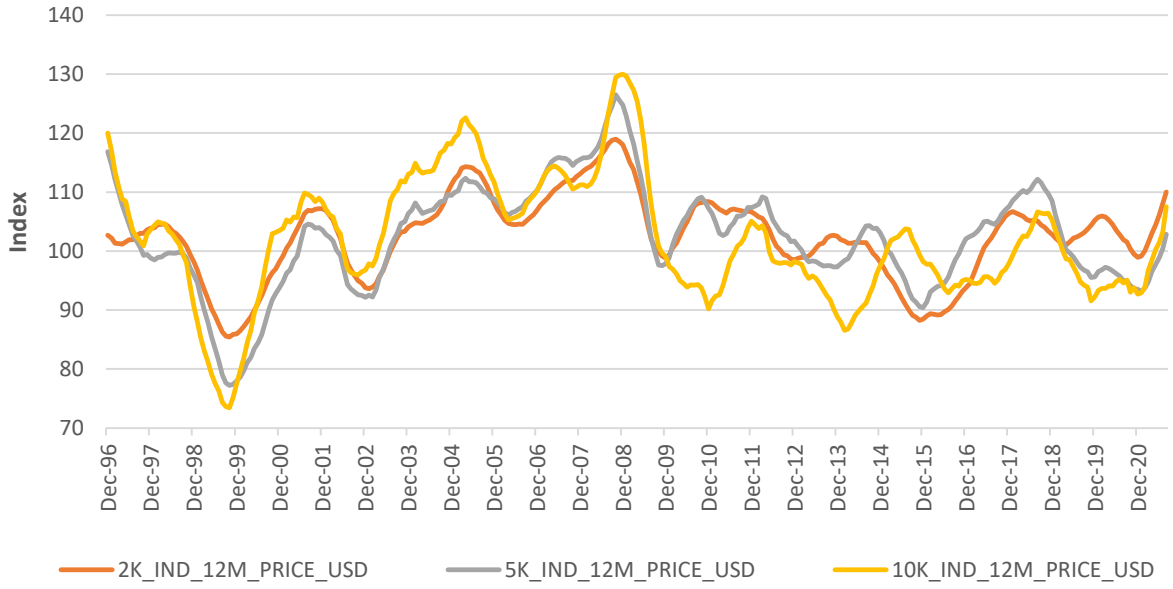
At the same time, Kazakhstan's import price indices, irrespective of the choice of calibration (2, 5 and 10-fold price outliers) have the same trends (see Figures 7 and 8).

Figure 7. Comparing import price indices of Kazakhstan realized at the level of the 6-digit code of the FEACN with the calibration of k – fold price outlier (versus the base of Dec.2013)



Source: computations by authors based on the data from the SRC MF RK and ASPR BNS RK

Figure 8. Comparing import price indices of Kazakhstan realized at the level of the 6-digit code of the FEACN with the calibration of k – fold price outlier, for a 12-month rolling period



Source: computations by authors based on the data from the SRC MF RK and ASPR BNS RK

Solving the problem of price outliers through the calibration of 2-fold surges gives more adequate price dynamics. This adequacy of the results is proved by approbation in the tenge price index and the REER dynamics (see Section 5).

As the statistics of trade flows show, thousand-fold price surges are observed in small total values with a low relative share (noise). Whereas price surges with significant total values are associated with supplies of different goods that are not comparable in quality and characteristics within the same FEACN code. For example, such goods include airplanes, towed boats, TV sets and cinemas, low-budget mobile phones and iPhones. In addition, the quality of the original statistics also suffers. As a result of price calibration, the change in value at such points is explained by a quantity factor, and not by a price factor.

The use of the Fisher monthly chain index approach takes into account the change in the structure of commodity basket, that is, the transition in the trade flow of an old product with a certain characteristic to an updated product with a new characteristic in a new price range is captured. Thus, the price index captures price changes only for comparable products and ignores price changes for non-comparable products. For example, obsolete and modified goods are not comparable. If there was an inadequate upward price outlier, and later this outlier returns to the original range, then this is most likely a statistical error. If the price outlier does not return to its former level, then the quality of goods most likely has changed. Such changes in product quality include the end of the life cycle of an old product and/or the introduction of a completely new product with new characteristics at a new price.

4.4. Choosing a model for price index construction

The statistical data on Kazakhstan's foreign trade for the reviewed period of 1995-2021 include: a) 25 thousand codes of the 10-digit code of the FEACN (including the revision) (Table 4); b) 258 partner countries (including islands); c) 30 units of measurement of physical volumes of commodity supplies.

Table 4. Indicators of Kazakhstan's imports

Indicators	5-year periods of Kazakhstan's imports					
	1996-2000	2001-2005	2006-2010	2011-2015	2016-2020	Total for the period
Cost, in USD mln	21 550	51 491	153 679	203 751	166 393	596 864
Quantity of the 4-digit code of the FEACN Commodity item, units	1 508	1 449	1 456	1 431	1 404	1 561
Quantity of the 6-digit code of the FEACN Commodity sub-item, units	6 429	5 339	5 464	5 438	5 423	7 907
Quantity of the 10-digit code of the FEACN Commodity sub-item, units	14 597	11 480	12 660	13 225	11 816	25 275

Source: computations by authors based on the data from the SRC MF RK and ASPR BNS RK

Table 5. Kazakhstan's exports indicators

Indicators	5- year periods of Kazakhstan's exports					
	1996-2000	2001-2005	2006-2010	2011-2015	2016-2020	Total for the period
Cost, in USD mln	32 425	79 155	260 625	380 877	251 331	1 004 413
Quantity of the 4-digit code of the FEACN Commodity item, units	1 345	1 248	1 276	1 299	1 309	1 502
Quantity of the 6-digit code of the FEACN Commodity sub-item, units	4 457	3 665	3 860	4 034	4 290	6 358
Quantity of the 10-digit code of the FEACN Commodity sub-item, units	8 326	6 423	7 440	7 958	7 986	17 014

Source: computations by authors based on the data from the SRC MF RK and ASPR BNS RK

As part of the study, *two models for constructing monthly indices of foreign trade prices of the Republic of Kazakhstan* at different levels of data aggregation and period coverage were implemented.

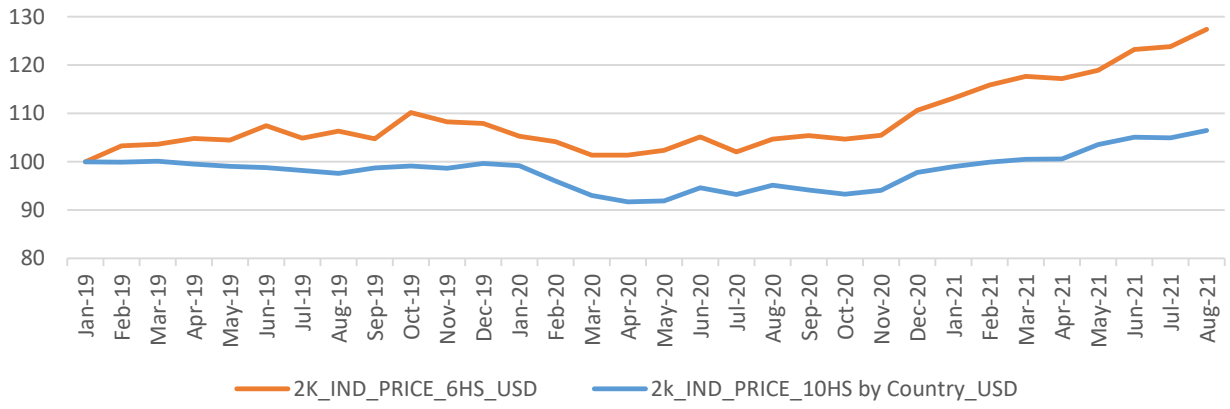
The first model was implemented at the level of 6-digit code of the FEACN of aggregated data by country covering the maximum period of monthly indicators. As examples, price indices were constructed for main commodity export and import categories (see Section 5).

The second model was implemented at the level of 10-digit code of the FEACN of disaggregated data by country. This model enables to construct: a) price indices of certain commodity items for the maximum period from 1995 through 2021; b) price indices of total imports and exports for the last three years from 2019 through 2021. As example, price indices were constructed for certain consumer goods for the period since 1995.

The choice of using the model depends on the objectives, the sample used to cover the period and the level of detail. The constructed models for calculating foreign trade price indices enable to iterate them according to the available indicators and derivative classifiers.

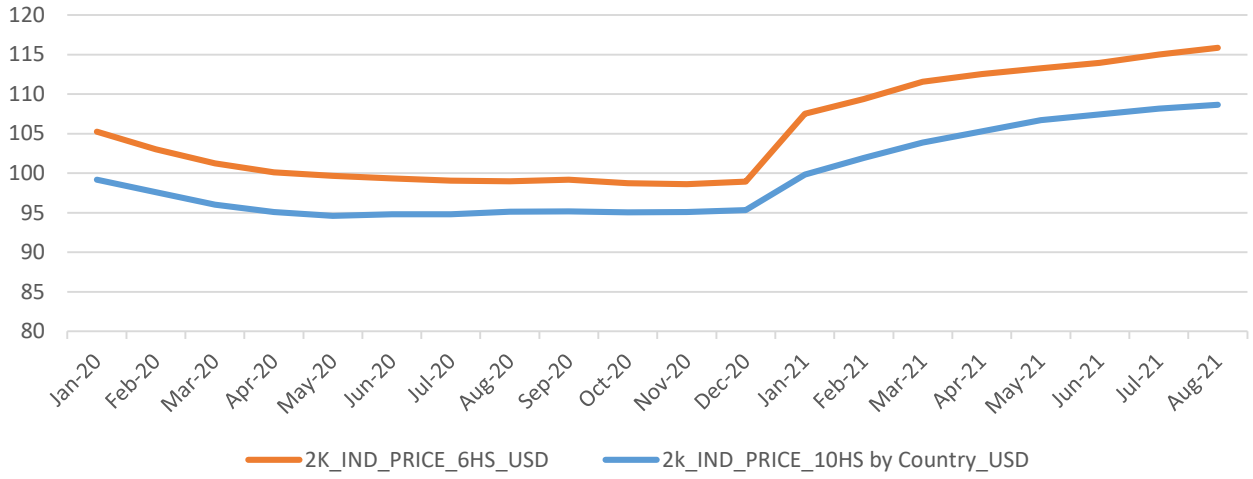
At the same time, Kazakhstan's import price indices, irrespective of the choice of model, demonstrate the same directions and fluctuations in trends at the level of 6-digit code of the FEACN (aggregated by country) or the 10-digit code of the FEACN (disaggregated by country) (see Figures 9 и 10).

Figure 9. Kazakhstan's import price indices based on two models: at the level of 6-digit code of the FEACN and 10-digit code of the FEACN by country with the calibration of the two-fold price outlier, (versus the base of Jan.2019)



Source: computations by authors based on the data from the SRC MF RK and ASPR BNS RK

Figure 10. Kazakhstan's import price indices based on two models: at the level of 6-digit code of the FEACN and 10-digit code of the FEACN by country with the calibration of the two-fold price outlier, (period-over-period)

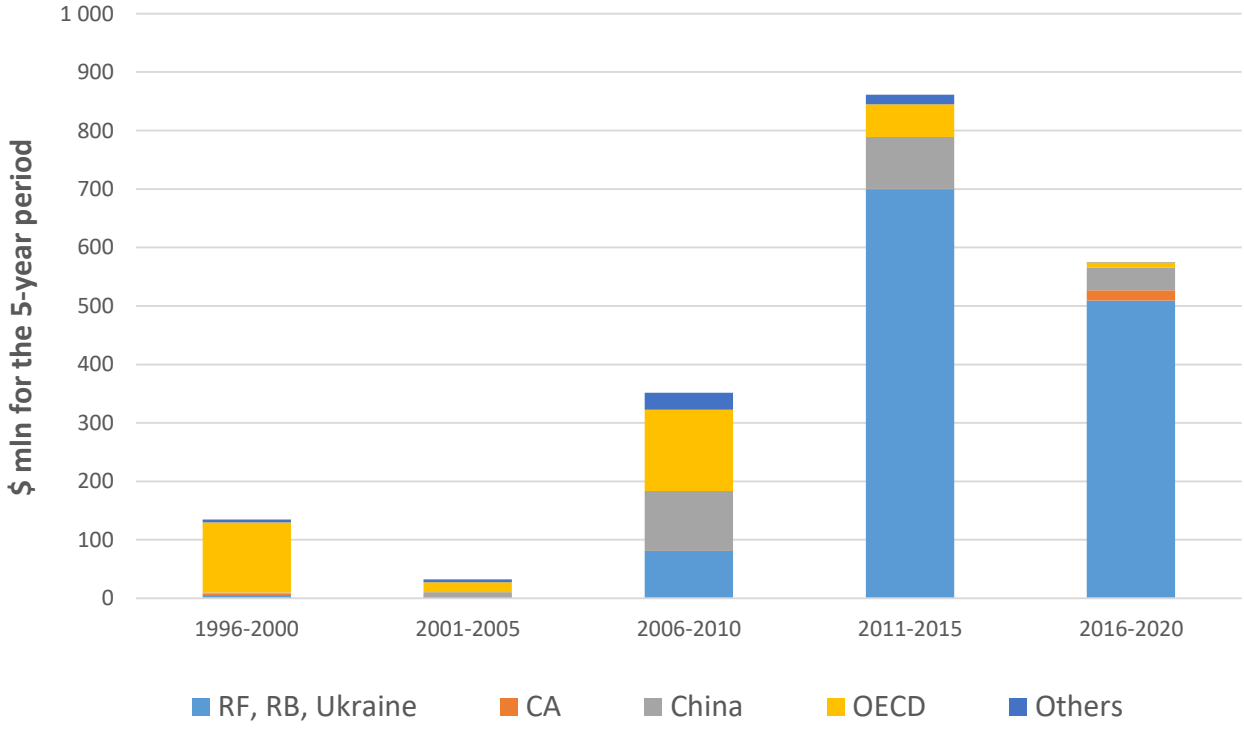


Source: computations by authors based on the data from the SRC MF RK and ASPR BNS RK

4.5. Approbation of price indices based on the example of TV sets imports to Kazakhstan

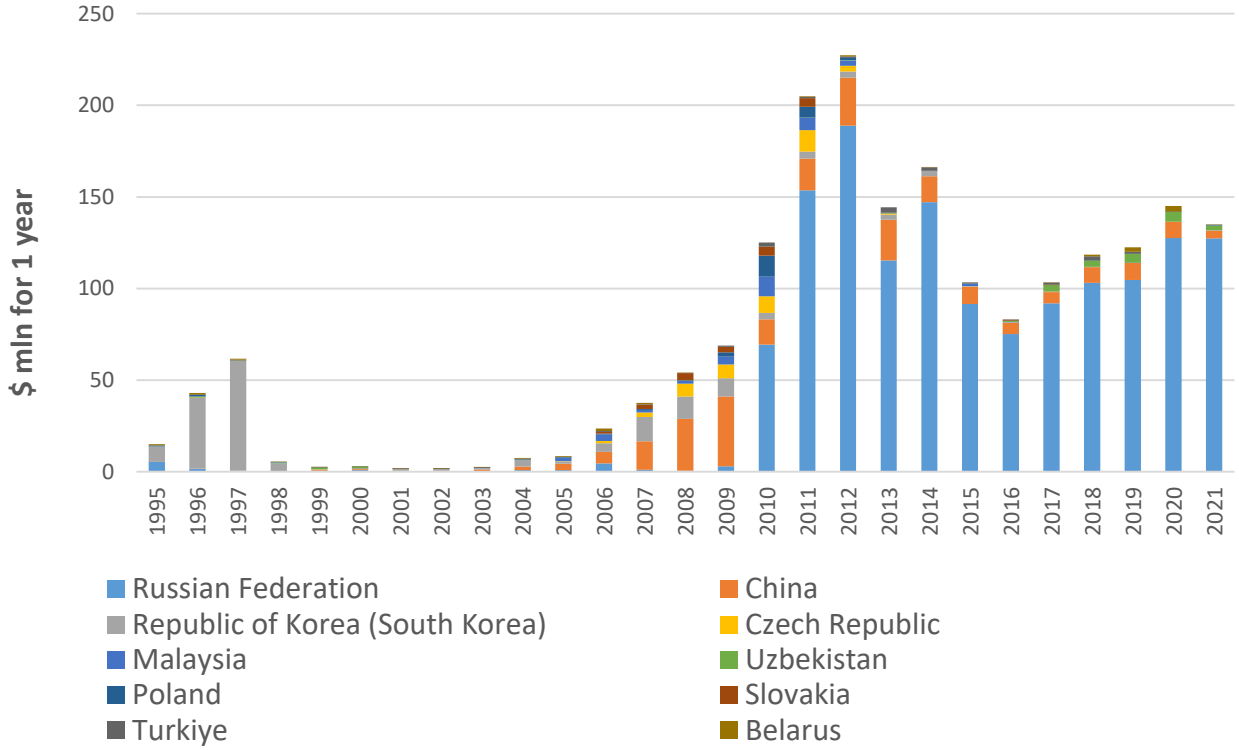
After the establishment of the Customs Union, the Russian Federation is the main supplier of TV sets to Kazakhstan. As of end-2020, Russia's share in imports of TV sets to Kazakhstan accounted for 87% and increased to 94% in 2021. (Figures 11 и 12).

Figure 11. Zones of countries-suppliers of TV sets to Kazakhstan (FEACN 852812, 852872)



Source: computations by authors based on the data from the SRC MF RK and ASPR BNS RK

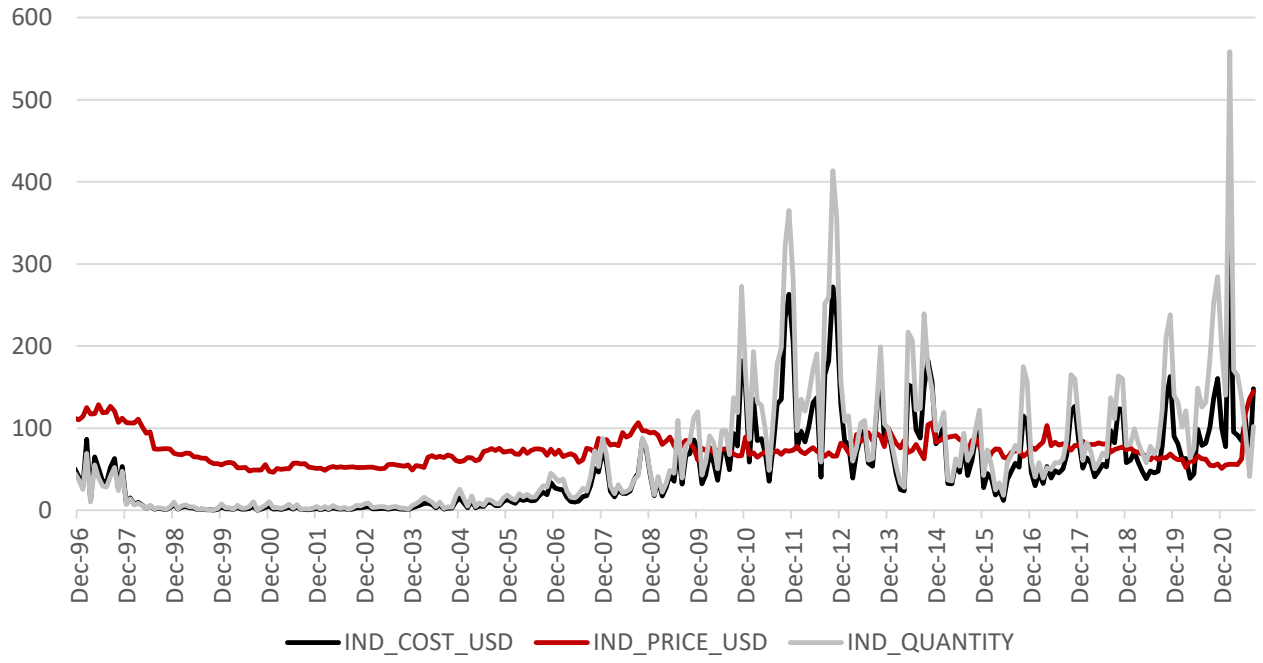
Figure 12. Top ten countries-suppliers of TV sets to Kazakhstan* (FEACN 852812, 852872)



**) information for 2021 includes January-August.*

Source: computations by authors based on the data from the SRC MF RK and ASPR BNS RK

Figure 13. Indices* of TV set imports to Kazakhstan in USD (versus the base of Dec.2013)



**) The index is constructed at the level of 10-digit code of the FEACN of disaggregated data by country, with the calibration of the two-fold outlier of monthly US dollar prices.*

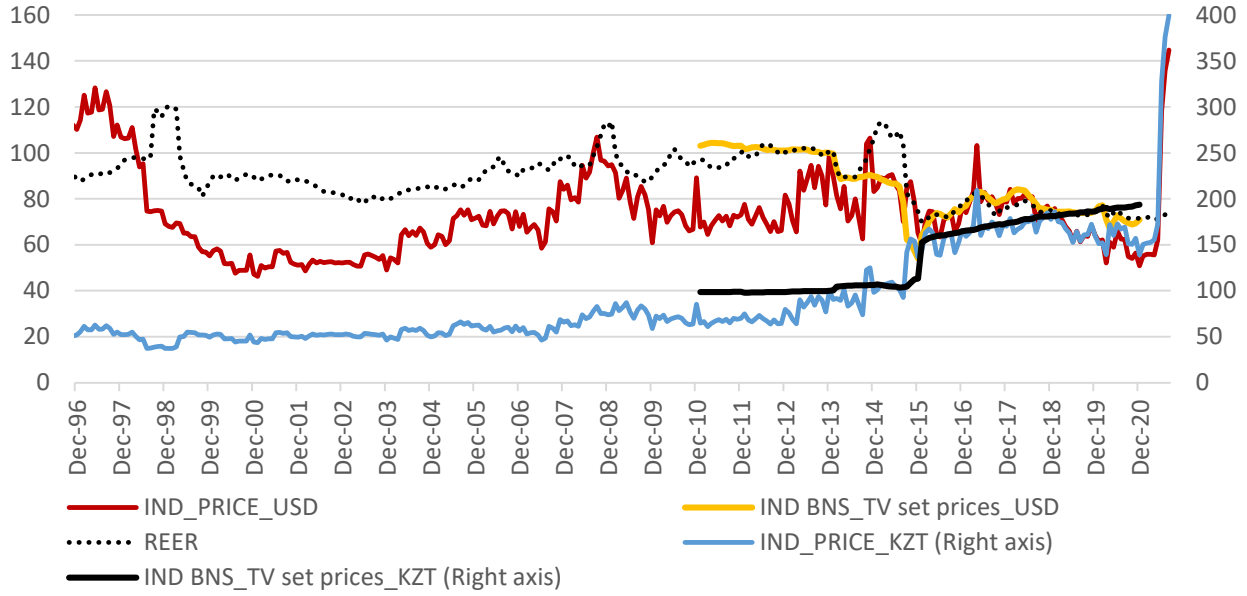
Source: computations by authors based on the data from the SRC MF RK and ASPR BNS RK

The dynamics of import price index in the US dollars and in the tenge has been the same since 2015 because of duty-free monopoly supplies of TV sets from the Russian Federation (90%). Trends

in import price indices of TV sets constructed as part of this study and trends in price indices of TV sets according to the data of the Bureau of National Statistics of the Republic of Kazakhstan (hereinafter referred to as BNS) coincide (Figure 14).

The dynamics of the index of import US dollar prices of TV sets with a certain lag outpaces the dynamics of REER, but they have the same trend. Thus, import prices of TV sets in the US dollars tend to grow and they decline mainly during periods of the overvalued exchange rate of the tenge (2008, 2015) (Figure 14).

Figure 14. Import price indices* of TV sets in Kazakhstan in USD (left axis), in the tenge (right axis) and REER and BNS data (versus the base of Dec.2013)



**) The price index is constructed at the level of 10-digit code of the FEACN of disaggregated data by country with the calibration of the two-fold outlier of monthly US dollar prices.*

Source: computations by authors based on the data from the SRC MF RK and ASPR BNS RK

The TV sets in question before 2008 were coded as 852812 at the level of 6-digit code of the FEACN in the "Customs Statistics" AWP, after the revision of the harmonized system (HS) TV sets began to be coded under the new code 852872. At the same time, before 2008, the physical volumes of supplies were presented in tons and units, depending on the disaggregation up to the 10-digit code of the FEACN, and from 2009 – in tons only (Table 6).

Table 6. Imports of TV sets in Kazakhstan

Year	Quantity			Cost, in USD mln			Estimated price, in USD		
	HS852812		HS852872	HS852812		HS852872	HS852812		HS852872
	ton	UNIT	TON				per TON	per UNIT	per TON
1995		76 373			21.7			284.6	
1996		194 650			47.9			246.0	
1997		290 602			71.4			245.7	
1998	37.2	49 498		0.7	7.9		17 502.7	158.7	
1999	21.0	20 890		0.2	3.0		11 219.0	143.7	
2000	12.5	30 874		0.2	3.6		13 624.0	117.2	
2001	8.5	12 560		0.2	2.7		27 152.9	217.9	
2002	24.1	16 780		0.6	2.6		24 215.8	156.4	
2003	34.5	22 146		0.3	3.1		9 649.3	138.3	
2004	84.6	46 857		2.1	8.3		24 870.3	177.1	
2005	317.3	71 024		4.2	8.2		13 290.2	115.8	

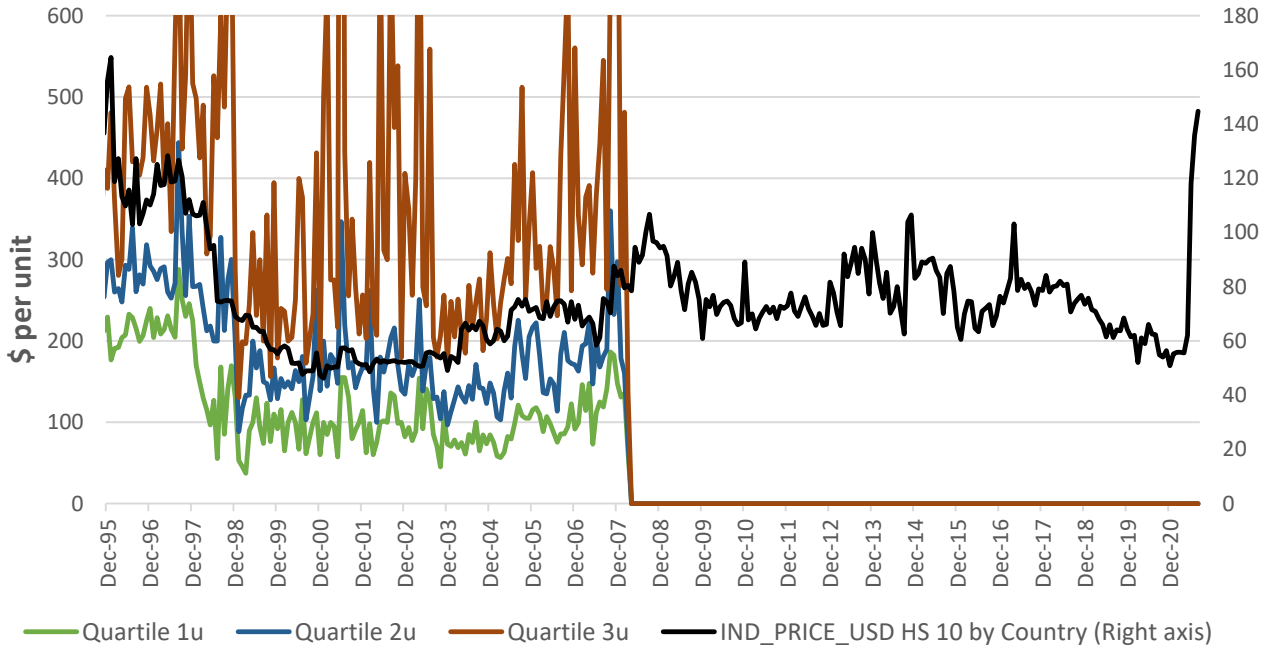
2006	646.5	107 113		13.3	14.6		20 584.1	136.5	
2007	1 517.8	56 363		34.0	12.4		22 422.1	219.9	
2008	290.6	13 190	2 225.7	6.6	3.1	56.1	22 640.1	232.1	25 191.7
2009			2 908.1			81.2			27 911.6
2010			3 768.8			130.5			34 613.5
2011			6 072.3			211.1			34 764.4
2012			6 521.2			229.5			35 196.3
2013			3 836.1			145.8			37 997.4
2014			4 575.6			170.0			37 148.6
2015			3 649.5			104.8			28 710.2
2016			2 781.0			83.7			30 079.6
2017			3 055.6			103.7			33 933.4
2018			3 720.0			118.7			31 921.6
2019			4 595.7			122.7			26 707.0
2020			6 054.8			145.8			24 085.5
2021			4 757.6			135.8			28 546.9
Grand total	**2 994.6**	**1 008 920.0**	**58 522.0**	**62.4**	**210.5**	**1 839.3**	**20 852.4**	**208.7**	

Source: computations by authors based on the data from the SRC MF RK and ASPR BNS RK

As a result, the quartiles of absolute prices per ton and per unit were calculated separately for different periods (Figures 15 и 16).

The dynamics of import prices for TV sets by quartiles and price indices calculated at the level of 10-digit code of the FEACN of data disaggregated by country are correlating (Figures 15, 16 and 17). This proves the applicability of the Fisher chain index methodology with the price calibration at points and at points of breaks and at the points of extreme price outliers.

Figure 15. The dynamics of import prices for TV sets in Kazakhstan presented in the statistics with physical volumes in units by quartiles before 2008 and the price index* (right axis)

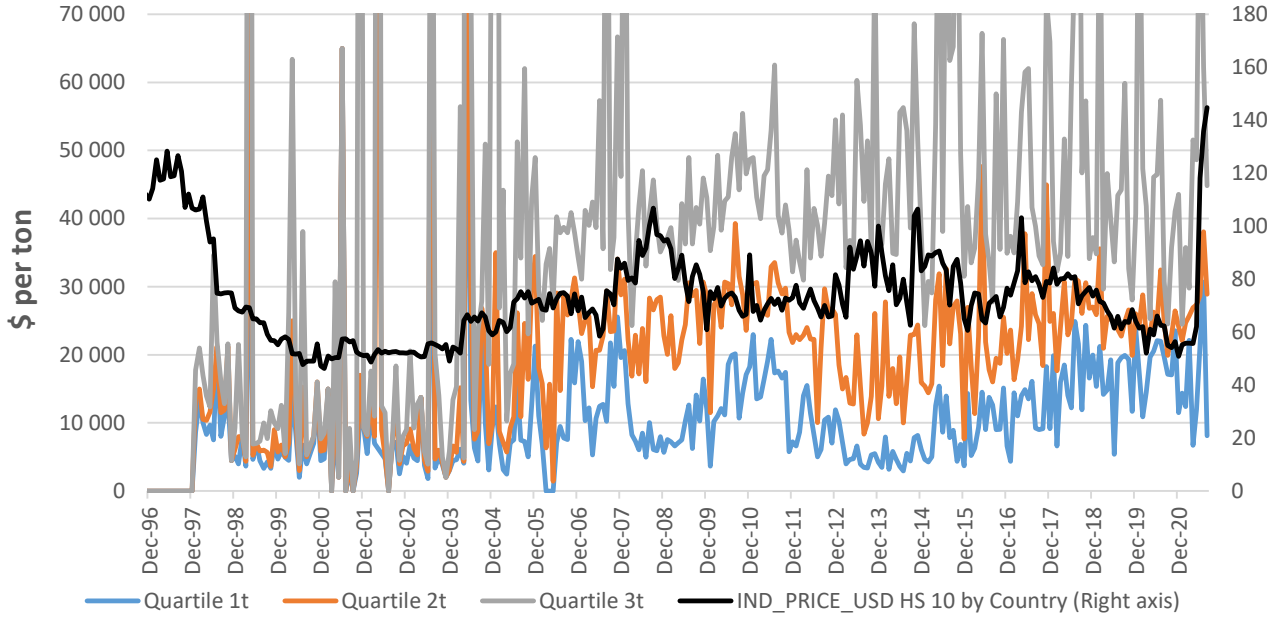


**) The price index is constructed at the level of 10-digit code of the FEACN of disaggregated data by country with the calibration of the two-fold outlier of monthly US dollar prices.*

Source: computations by authors based on the data from the SRC MF RK and ASPR BNS RK

Since 2011, the import price index of TV sets in Kazakhstan has been repeating the dynamics of the upper price range of the 3rd quartile of absolute prices as dictated by the supply of TV sets from the Russian Federation, which dominates in the Kazakh market with a share of more than 90% (Figure 16).

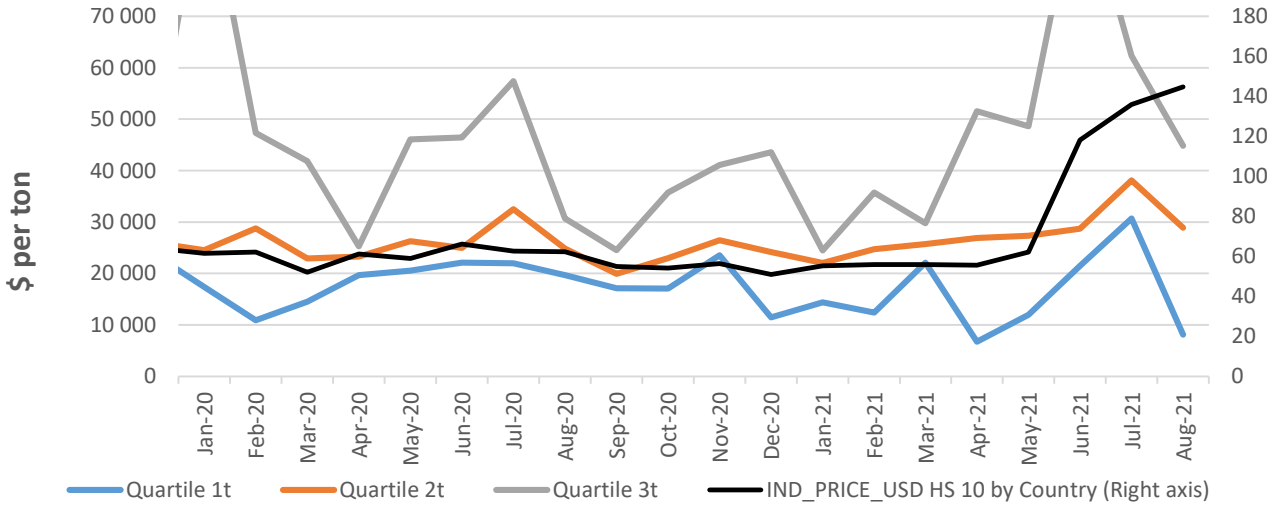
Figure 16. The dynamics of import prices for TV sets in Kazakhstan presented in the statistics with physical volumes in tons by quartiles and the price index* (right axis)



**) The price index is constructed at the level of 10-digit code of the FEACN of disaggregated data by country with the calibration of the two-fold outlier of monthly US dollar prices.*

Source: computations by authors based on the data from the SRC MF RK and ASPR BNS RK

Figure 17. The dynamics of import prices for TV sets in Kazakhstan presented in the statistics with physical volumes in tons by quartiles and the price index* (right axis) for the period of 2020-2021



**) The price index is constructed at the level of 10-digit code of the FEACN of disaggregated data by country with the calibration of the two-fold outlier of monthly US dollar prices.*

Source: computations by authors based on the data from the SRC MF RK and ASPR BNS RK

The input statistical data of Kazakhstan on imports of TV sets to Kazakhstan from the Russian Federation in absolute prices demonstrate an extreme price outlier (Figure 18 and Table 7). As part of the implemented methodology, when calculating the price index, such outliers are calibrated and brought into a separate category for mirror comparison of statistical data with partner countries.

Figure 18. Imports of TV sets to Kazakhstan, including from Russia, at the level of 10-digit code of the FEACN 8228722001 and their price

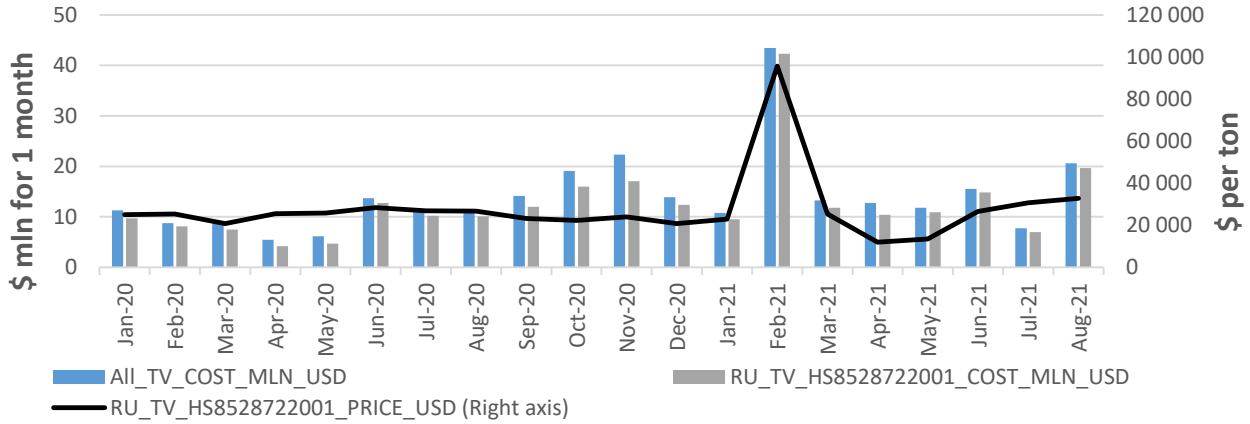
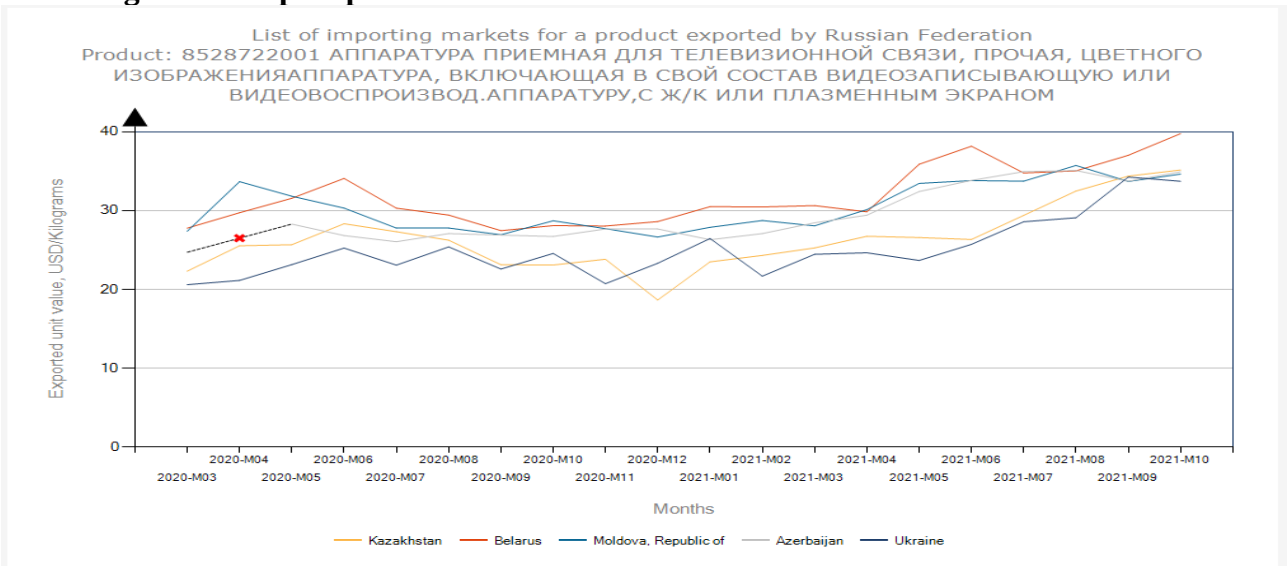


Table 7. Import price of TV sets supplied to Kazakhstan from Russia under the FEACN 8228722001

Item	Feb.2021	Apr.2021	Aug.2021
USD per ton	95 698	11 936	32 765
USD per kg	96	12	33
Average weight of a TV set, kg	20	20	20
USD per unit	1914	239	655
KZT per unit	823 003	102 650	281 779
Price characteristics	Price deviations		Within the average market prices for the last 4 years

Thus, comparison with the Russian data on TV set exports showed the discrepancy of Kazakhstan's statistical data in February 2021 (Figure 19).

Figure 19. Export prices for TV sets from Russia



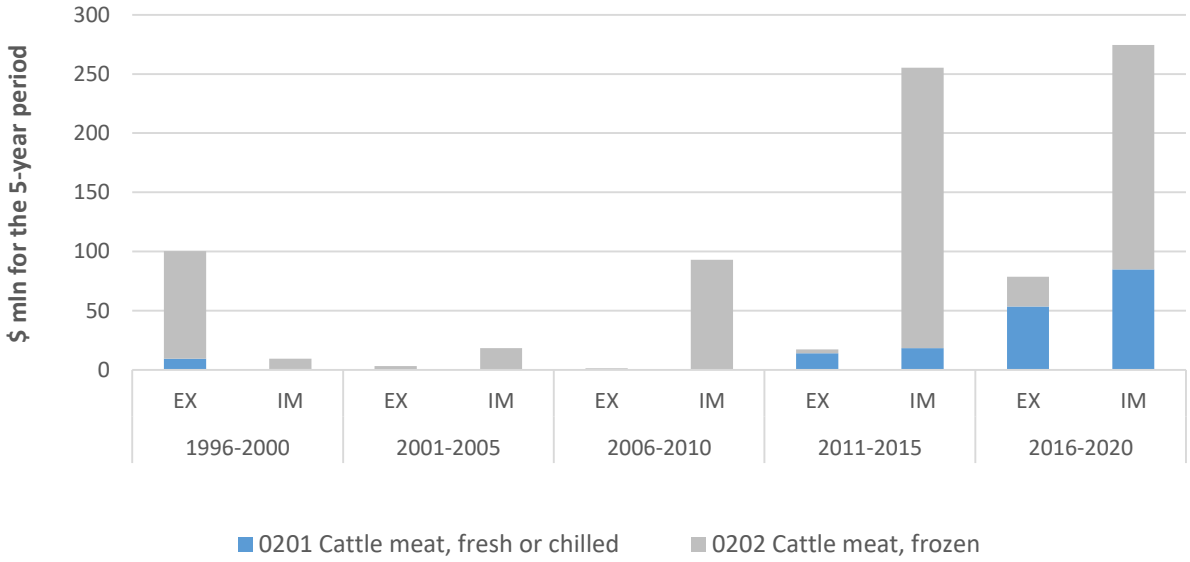
Source: ITC, calculations based on Federal Customs Service of Russia statistics. https://www.trademap.org/

Summarizing the conducted approbation of the price index based on the example of analyzing TV set imports to Kazakhstan, taking into account the calculation of quartiles of absolute prices and comparisons of the price index with the BNS data, a conclusion can be made that application of the methodology for calculating the price index using the Fisher chain formula with the price calibration at the points of breaks and at points of extreme price outliers, gives the explicable price index dynamics.

4.6. Approbation of Price Index based on the Example of Frozen Beef Imports to Kazakhstan

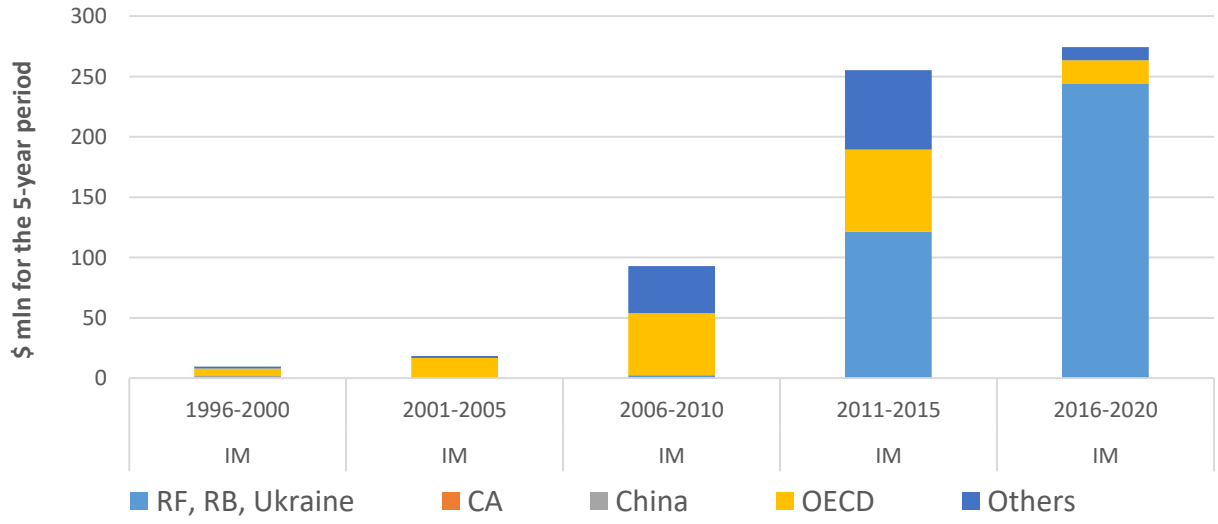
Over the past 20 years, Kazakhstan has been a net importer of beef, while the volume of beef exports from Kazakhstan for 2001-2020 did not reach the level of 1996-2000. Mostly frozen beef is imported (70%), and chilled meat (70%) is exported (see Figure 20). The main suppliers of meat to the Republic of Kazakhstan until 2010 were the OECD countries (Poland, Australia) and Latin America (Argentina, Brazil), and since 2011, such CIS countries as Belarus, Ukraine, and Russia have gained the lead as suppliers (Figures 21 and 22).

Figure 20. Turnover of beef in Kazakhstan



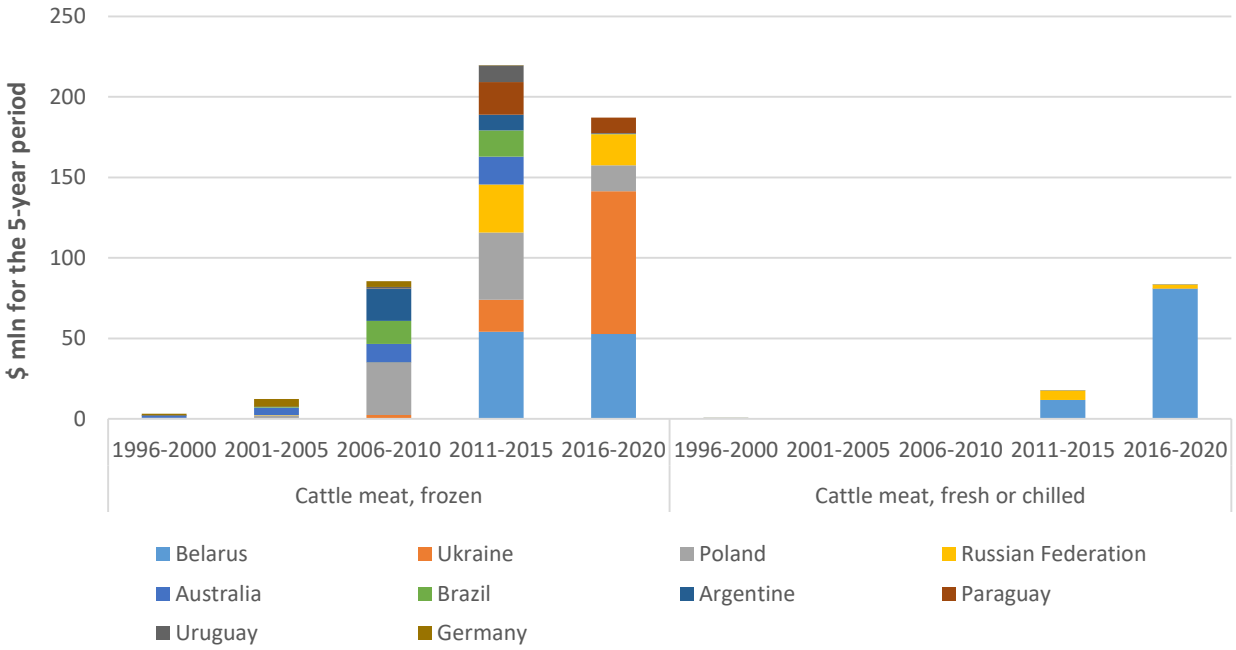
Source: computations by authors based on the data from the SRC MF RK and ASPR BNS RK

Figure 21. Zones/countries supplying beef to Kazakhstan (FEACN 0201 chilled and FEACN 0202 frozen)



Source: computations by authors based on the data from the SRC MF RK and ASPR BNS RK

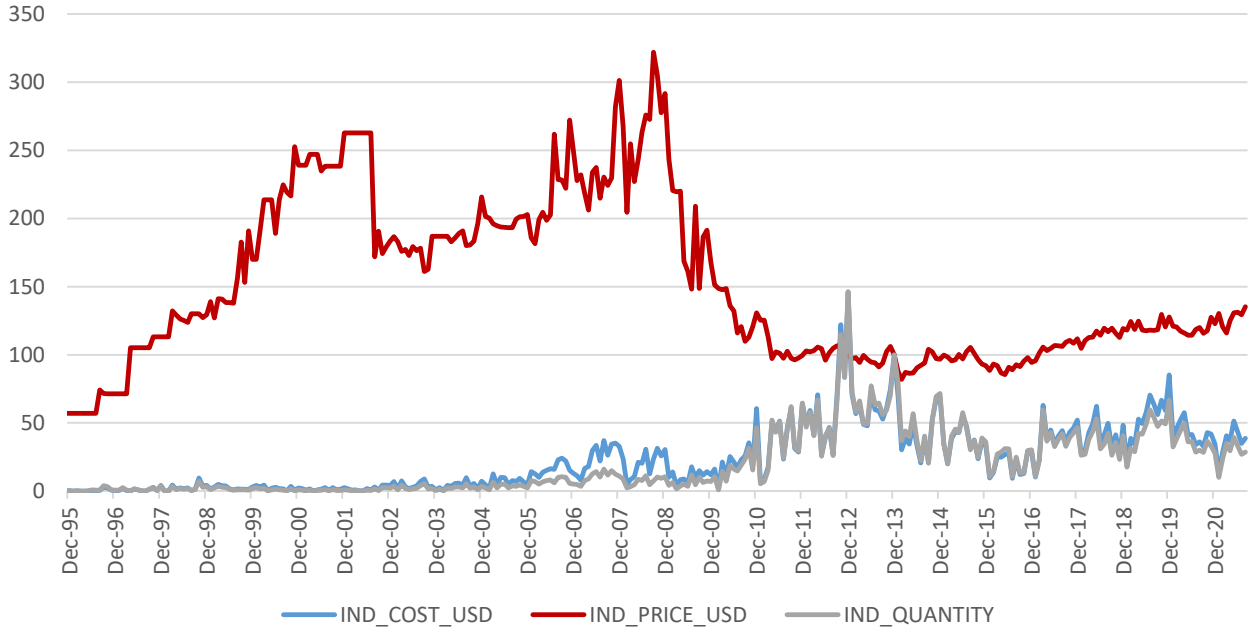
Figure 22. Top ten countries supplying beef to Kazakhstan



Source: computations by authors based on the data from the SRC MF RK and ASPR BNS RK

Import cost indices and indices of physical volumes of frozen beef supplies have the same trend. The maximum volume of supplies fell on the period of 2010-2014, when the tenge exchange rate was fixed. After the exchange rate of the tenge began to float freely, the volumes of physical supplies of imports started to decline, while prices began to rise (Figures 23 and 24).

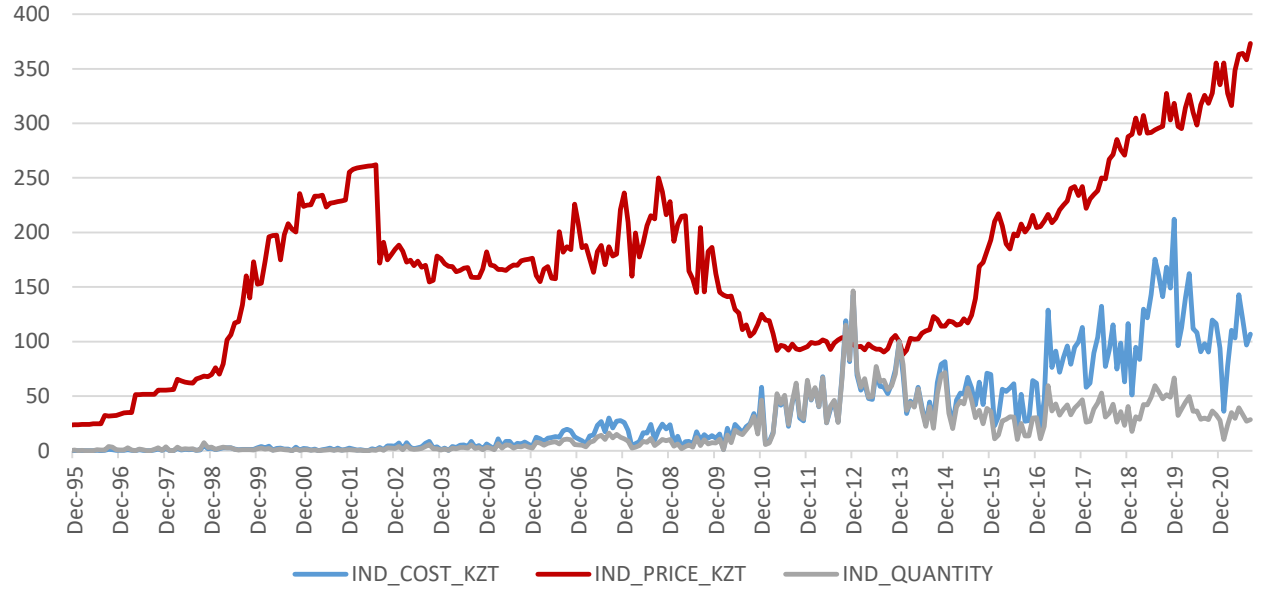
Figure 23. Indices* of imports of frozen beef to Kazakhstan, in USD (versus the base of Dec.2013)



**) The price index is constructed at the level of 10-digit code of the FEACN of disaggregated data by country with the calibration of the two-fold outlier of monthly US dollar prices.*

Source: computations by authors based on the data from the SRC MF RK and ASPR BNS RK

Figure 24. Indices* of imports of frozen beef to Kazakhstan, in the tenge (versus the base of Dec.2013)



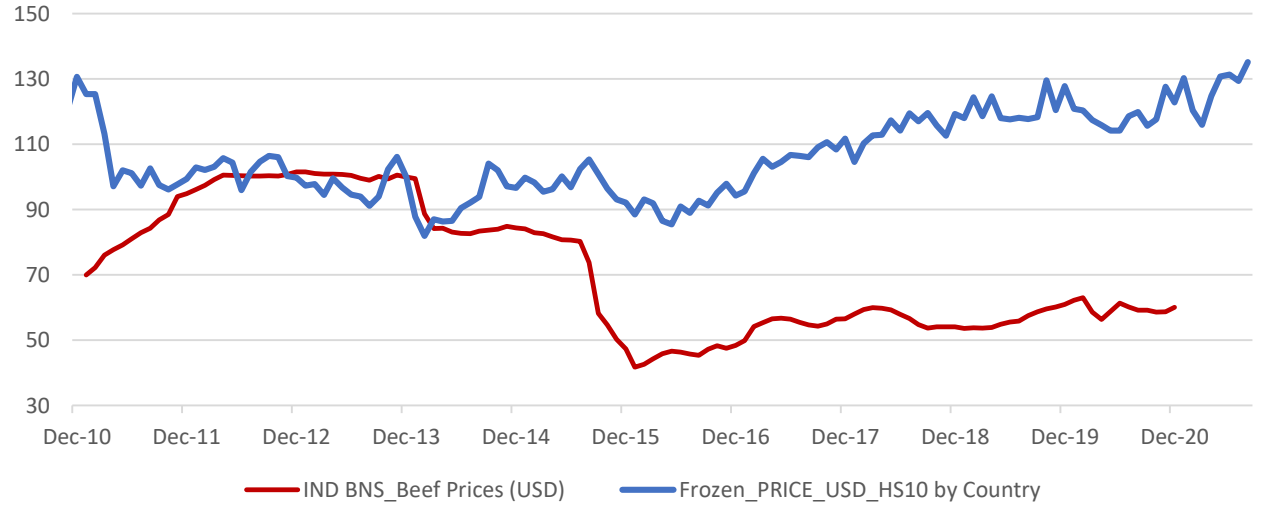
**) The price index is constructed at the level of 10-digit code of the FEACN of disaggregated data by country with the calibration of the two-fold outlier of monthly US dollar prices.*

Source: computations by authors based on the data from the SRC MF RK and ASPR BNS RK

In order to test the effectiveness of the constructed price index, the import price index of frozen beef was compared with domestic prices for beef in general according to the BNS data for the 2010-2020 period, where the bulks of supply are observed. Thus, domestic prices for beef according to the BNS data were converted into the US dollars, and the BNS price index was constructed. Indices show the same direction and trend fluctuations (Figure 25).

In general, according to the BNS resource use balance, the domestic meat consumption in the Republic of Kazakhstan is secured by the local production (over 90%), and beef import prices do not significantly affect domestic prices. A more significant influence is the turnover of livestock of cattle – the source of red meat.

Figure 25. Import price index* of frozen beef imported to Kazakhstan, in USD, and domestic price index, in USD (versus the base of Dec.2013)

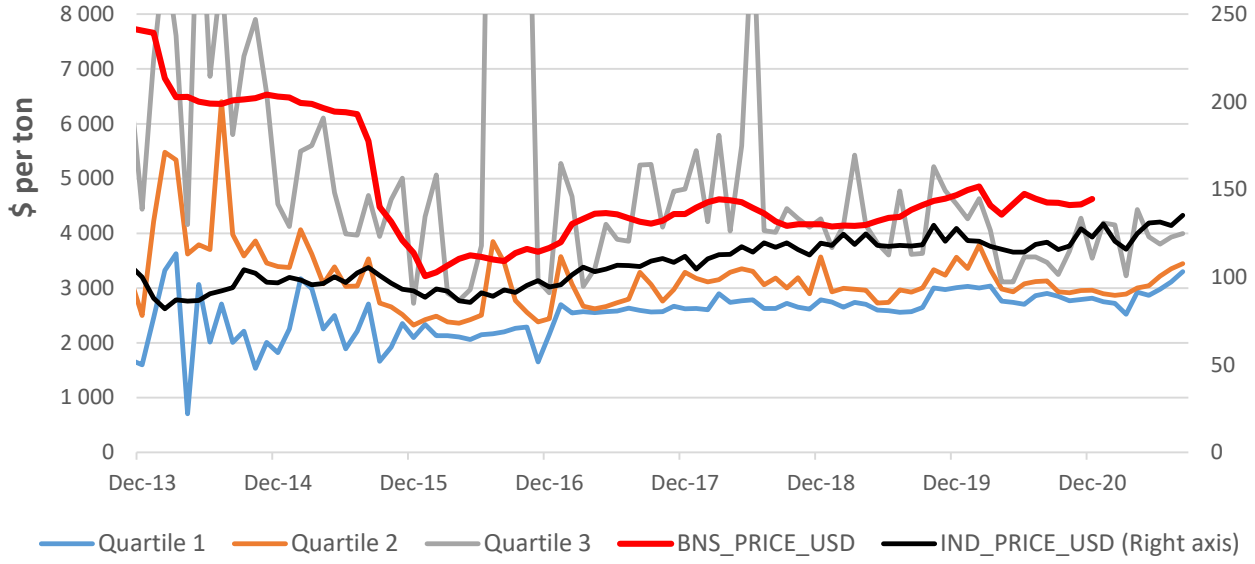


**) The price index is constructed at the level of 10-digit FEACN of disaggregated data by countries with the calibration of the two-fold outlier of monthly US dollar prices.*

Source: computations by authors based on the data from the SRC MF RK and ASPR BNS RK

During the periods of stable supply, the dynamics of import prices for frozen beef by quartiles and domestic price dynamics of frozen beef, as well as price indices calculated at the level of 10-digit code of the FEACN of disaggregated data by country, correlate with each other (Figure 26). This proves the effectiveness of the Fisher chain index methodology.

Figure 26. Dynamics of import prices for frozen beef by quartiles, the BNS data and the price index* (right axis) in the period of 2013-2021

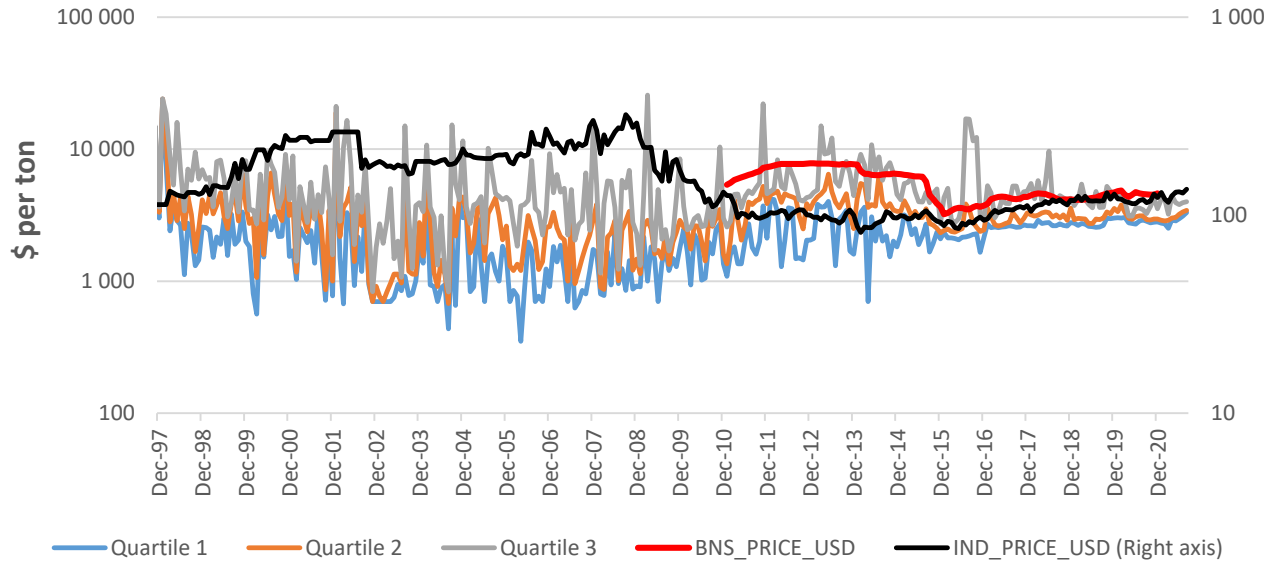


**) The price index is constructed at the level of 10-digit code of the FEACN of disaggregated data by countries with the calibration of the two-fold outlier of monthly US dollar prices.*

Source: computations by authors based on the data from the SRC MF RK and ASPR BNS RK

Imports of frozen beef in commercial volumes began in 2010. During the periods of low volumes of import flows before 2010, because of irregular supplies, the dynamics of price index is unstable (Figure 27), and the dynamics of the cost of imports is more explained by the index of physical volumes of supplies (see Figure 23).

Figure 27. Dynamics of import prices for frozen beef by quartiles, dynamics of domestic prices for frozen beef and the price index * (right axis), logarithmic scale



**) The price index is constructed at the level of 10-digit code of the FEACN of disaggregated data by country with the calibration of the two-fold outlier of monthly US dollar prices.*

Source: computations by authors based on the data from the SRC MF RK and ASPR BNS RK

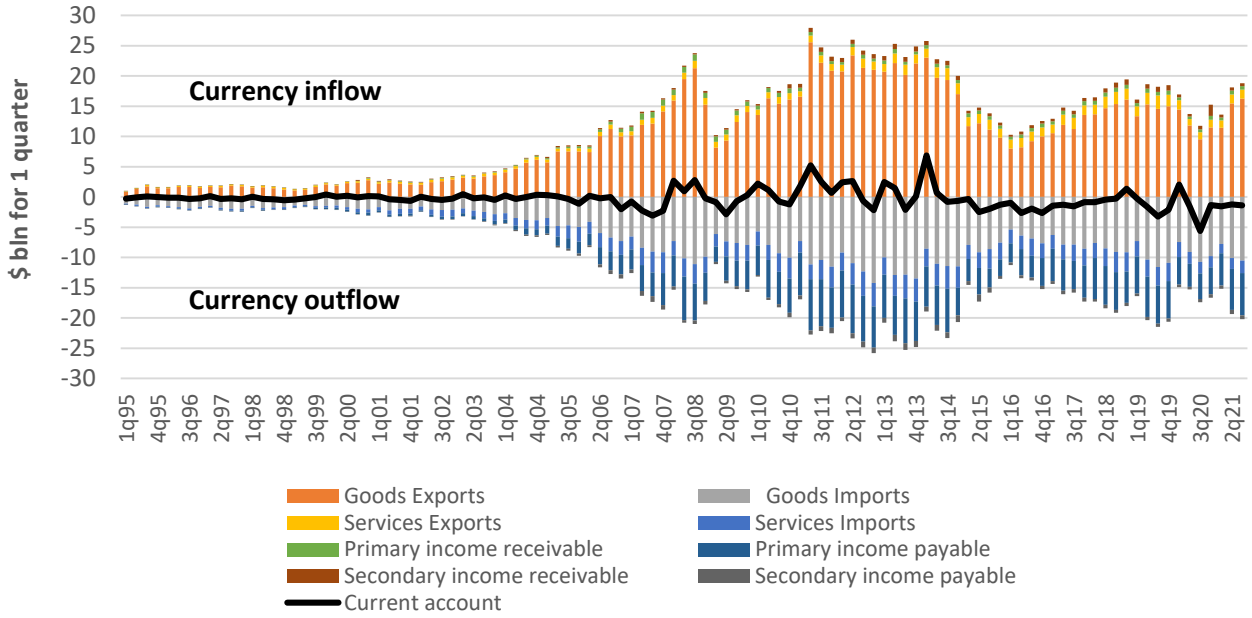
As a result, when considering a wide commodity basket in the trade flow, due to a low share of total values of individual commodity items with irregular supplies, their unstable price index is offset in the general price index. This is due to the use of methodology for calculation of the price index using the Fisher chain formula with the price calibration at the points of breaks and at the points of extreme price outliers.

5. Analysis of Foreign Trade Price Indices

5.1. Analysis of the Current Account on the Balance of Payments of Kazakhstan

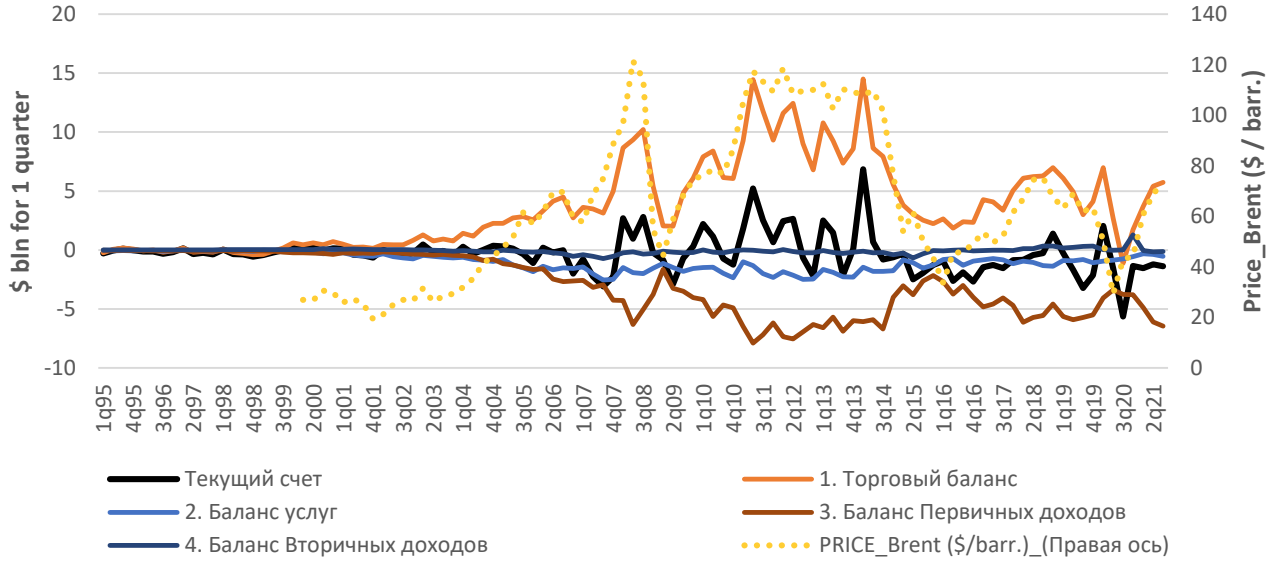
The trend of the current account on the balance of payments of Kazakhstan is largely determined by the dynamics of trade balance (see Figure 28 and 29). For its part, the dynamics of trade balance depends on the total value of primary exports, oil and exchange traded commodities. Foreign exchange export proceeds stimulate the extent of imports. At the same time, fluctuations in the dynamics of exports and imports are cyclical.

Figure 28. Current Account on the Balance of Payments of Kazakhstan by Main Items



Source: NBRK, computations by authors based on the data from the SRC MF RK and ASPR BNS RK

Figure 29. Balance of Main Items of the Current Account on the Balance of Payments of Kazakhstan

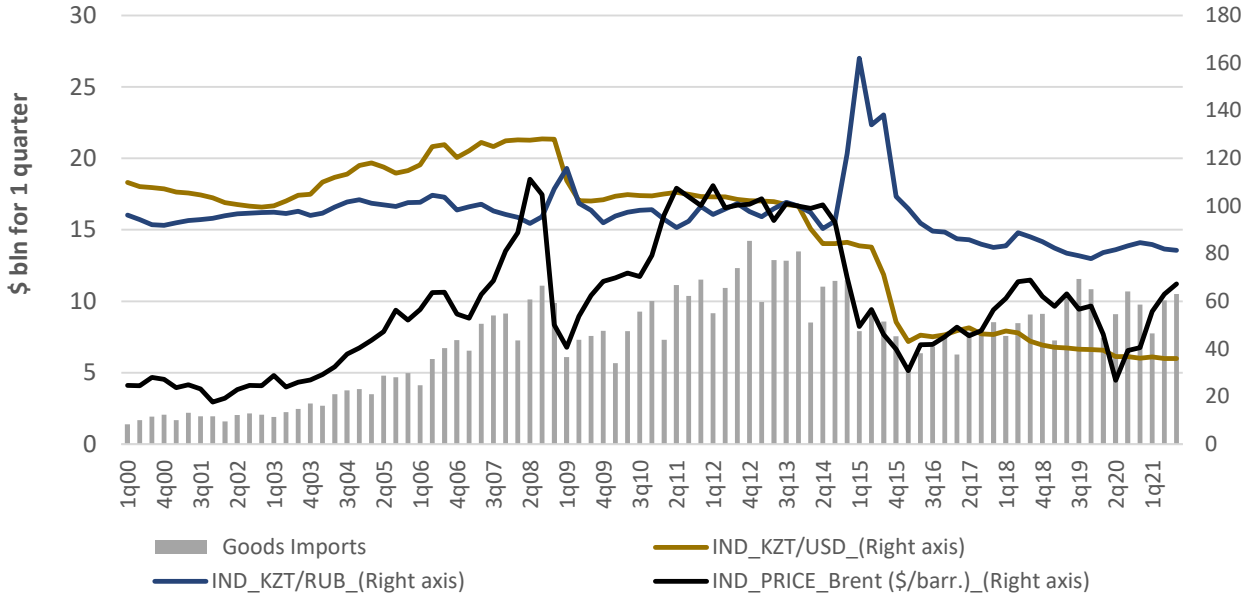


Source: NBRK, computations by authors based on the data from the SRC MF RK and ASPR BNS RK

The dynamics of import volumes of capital goods and interim products depends on import purchases as part of implementation of oil and infrastructure projects. Import purchases are initiated during the periods when the tenge exchange rate appreciates and stabilizes.

Nonetheless, the exchange rate, being determined by fundamental factors, by the demand and supply of foreign exchange where the oil price plays the main role, has an indirect effect on the total value of imports via import prices at the moment (Figure 30).

Figure 30. Kazakhstan's imports, indices of the tenge exchange rate and of oil prices (right axis) (versus the base of the 4th quarter of 2013)

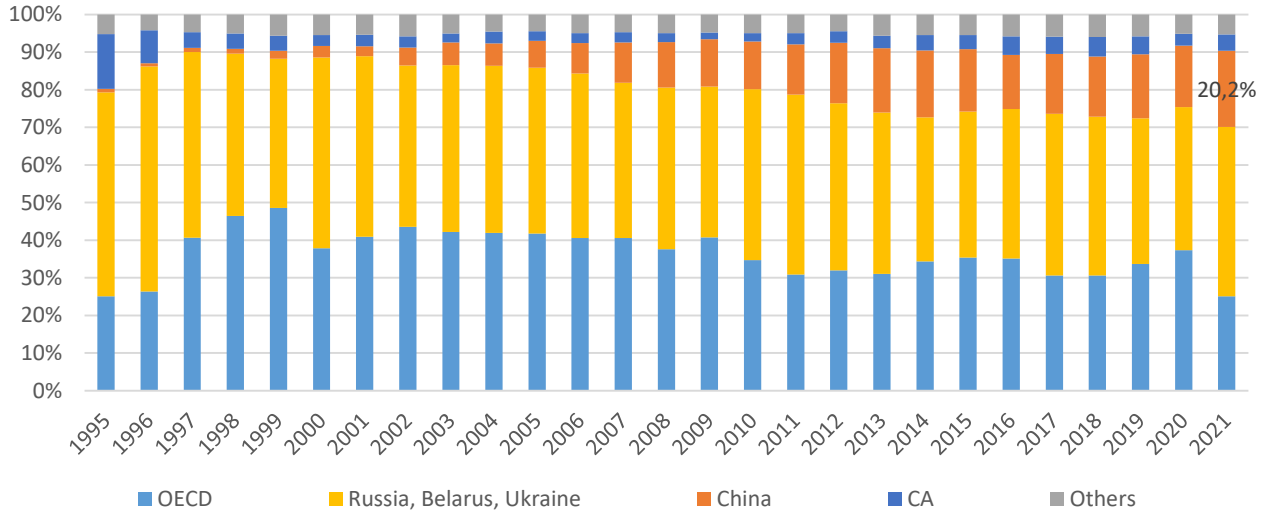


Source: computations by authors based on the data from the SRC MF RK and ASPR BNS RK

The physical supplies of diversified imports, consisting of more than 90% of processed goods, are sensitive to exchange rate fluctuations. The physical volumes of finished goods of non-primary exports are also sensitive to the exchange rate; the strengthening of the tenge reduces their price competitiveness.

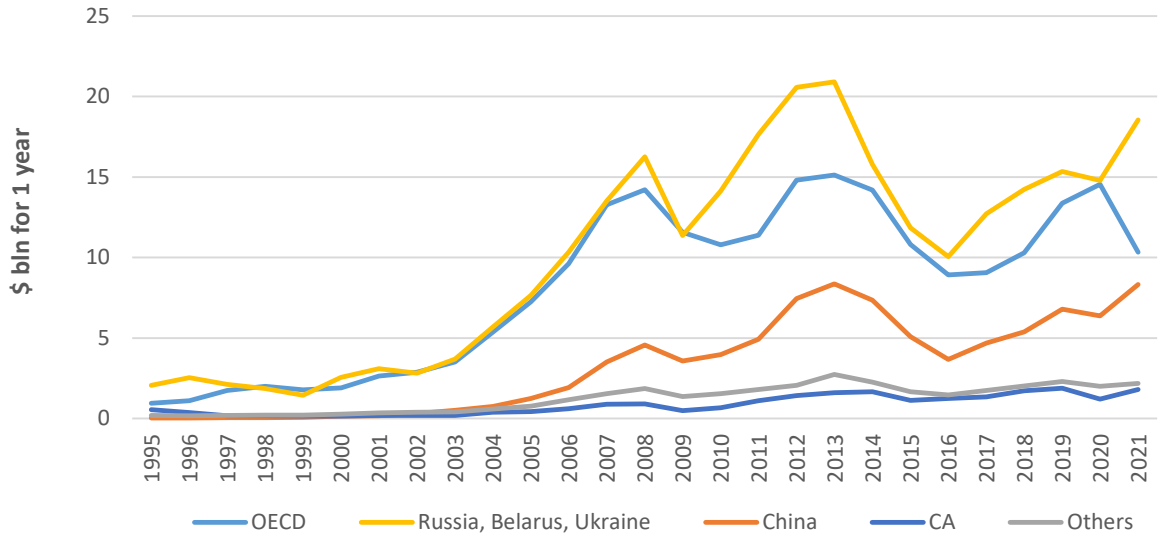
The exchange rate, while influencing import prices, leads not only to changes in the volume of imports, but also to changes in the quality of the import commodity basket. Expensive goods from one supplier are replaced by affordable goods from other suppliers. In the long run, this is reflected in the redistribution of shares of countries-suppliers of goods (Figures 31 and 32). Logistics and accessibility to Kazakhstan's market, tariff and non-tariff barriers also affect the volumes of imports.

Figure 31. The share of China in Kazakhstan's imports over 20 years increased from 3% to 20%



Source: computations by authors based on the data from the SRC MF RK and ASPR BNS RK

Figure 32. Dynamics of Kazakhstan's imports by zones (countries)



Source: computations by authors based on the data from the SRC MF RK and ASPR BNS RK

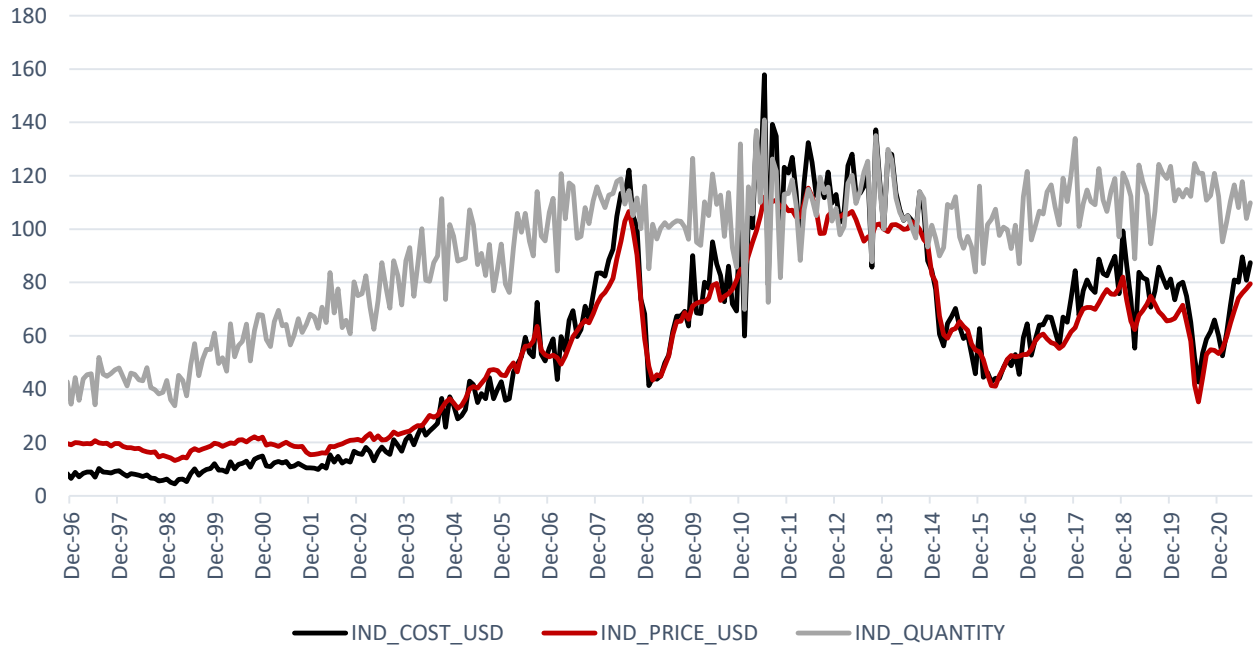
Thus, the market-based floating exchange rate serves as a stabilizing factor that indirectly influences the current account dynamics.

The analysis of export and import prices by major commodity groups and countries is described in the sub-sections below.

5.2. Analysis of Kazakhstan's Export Prices

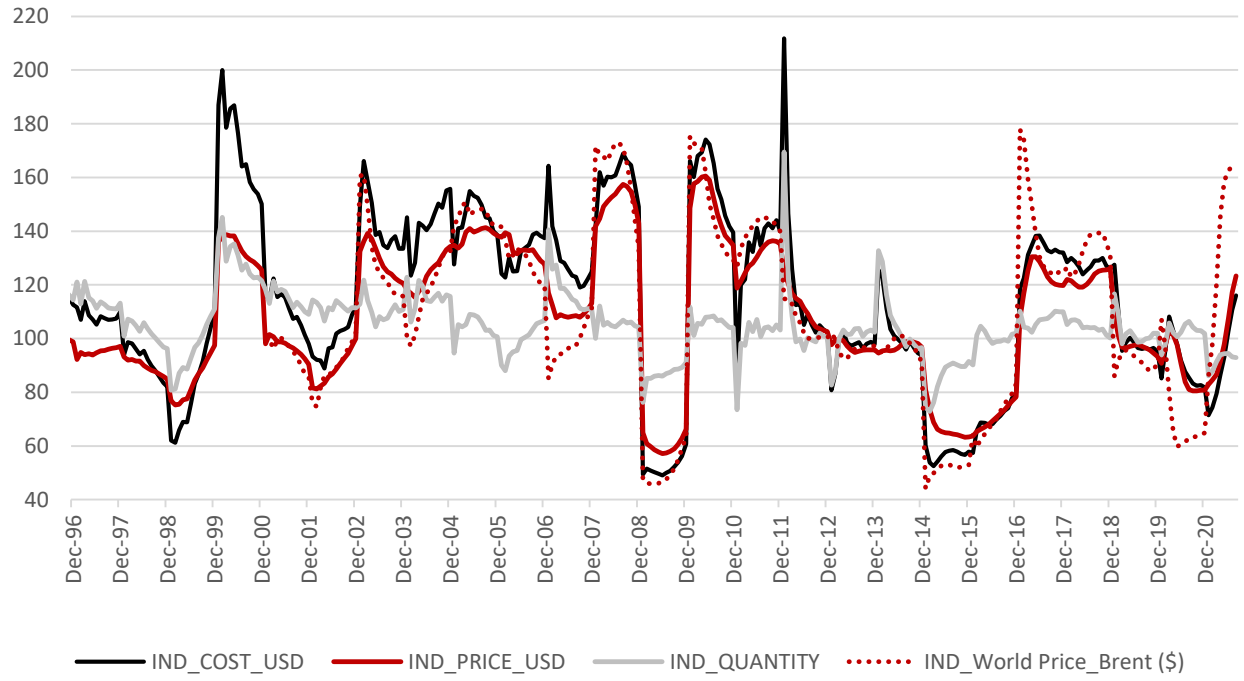
The cost of Kazakhstan's exports is largely dependent on the pricing factor rather than on the volumes of physical supplies. Due to a low diversification of exports, the index of physical volume of exports is more stable (see Figure 33). Volatility of oil prices affects the dynamics of export prices, and the export value index of Kazakhstan correlates with world oil prices (Figure 34). There is a lag with a 1-3 months interval between indices of oil export customs fees of Kazakhstan and world oil prices (Figure 35).

Figure 33. Kazakhstan's export indices (versus the base of Dec.2013)



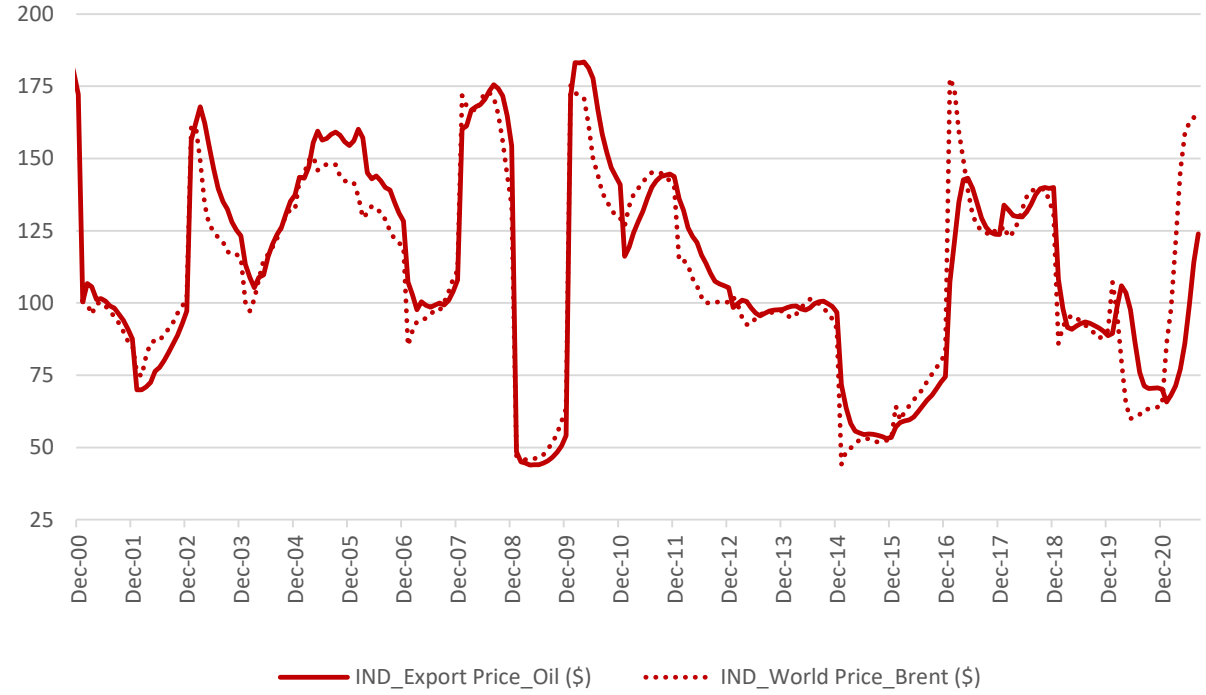
Source: computations by authors based on the data from the SRC MF RK and ASPR BNS RK

Figure 34. Kazakhstan's export indices and world oil price indices (period-over-period)



Source: computations by authors based on the data from the SRC MF RK and ASPR BNS RK

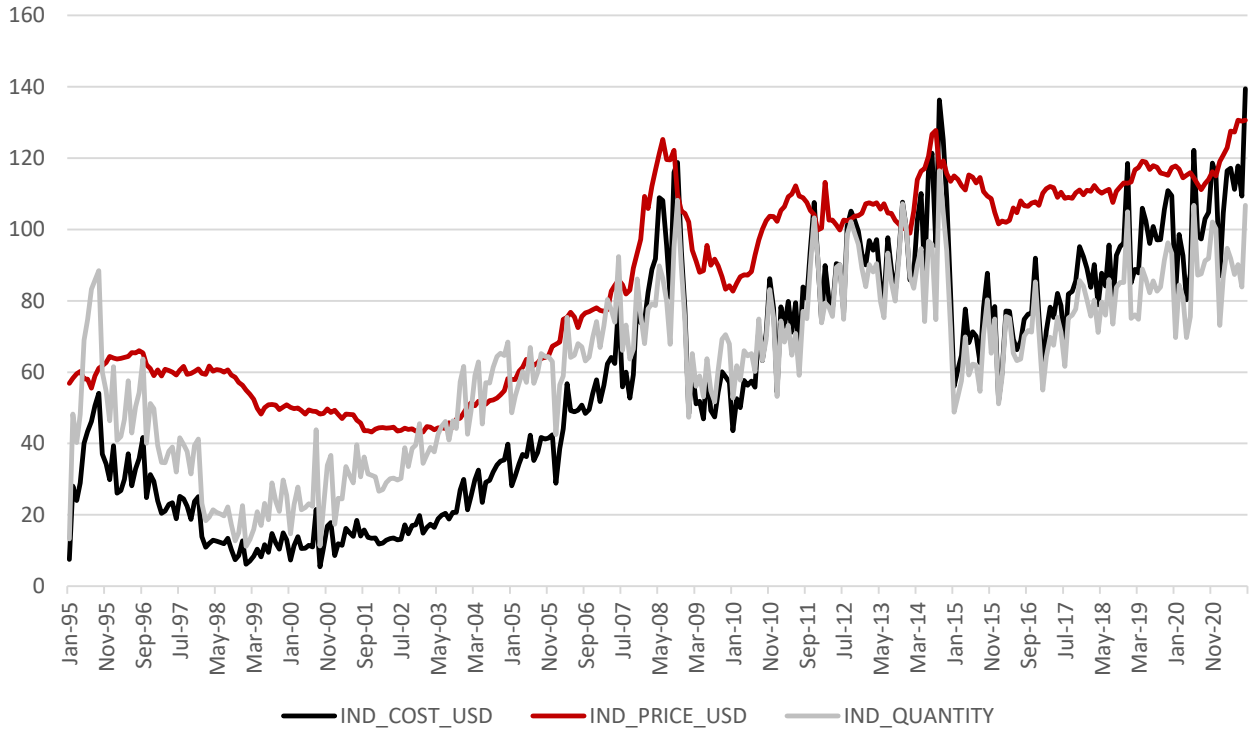
Figure 35. Kazakhstan's export prices and world oil prices (period-over-period)



Source: computations by authors based on the data from the SRC MF RK and ASPR BNS RK

The export value of finished goods is more correlated with the volume of physical supplies, while the export price of finished goods is less volatile. However, due to a low share of finished goods (8%) in the structure of exports, the impact on the final price factor of Kazakhstan's total exports is insignificant.

Figure 36. Export indices of finished products (versus the base of Dec.2013)

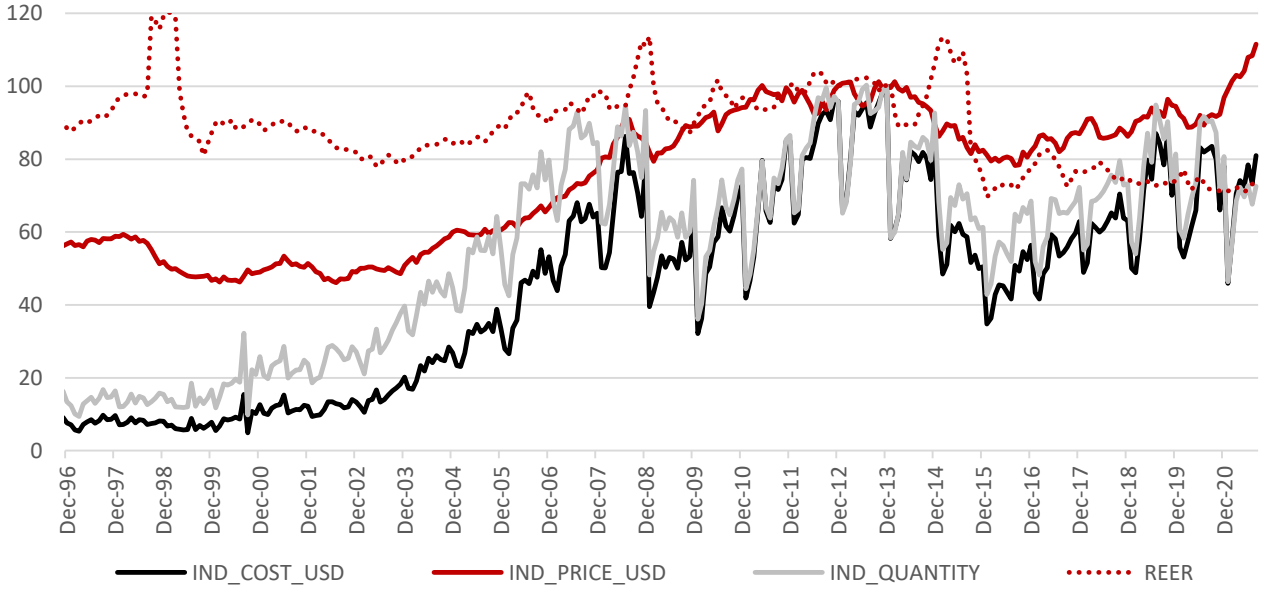


Source: computations by authors based on the data from the SRC MF RK and ASPR BNS RK

5.3. Analysis of Kazakhstan's Import Prices

The cost of Kazakhstan's imports depends more on the volume of physical supplies rather than on import prices. Import price indices are less volatile, which is explained by a high diversification of the import structure (Figure 37). Import prices in the US dollars tend to grow, and they decline mainly during the periods of overvalued exchange rate of the tenge (in 1998-1999, 2008, 2015).

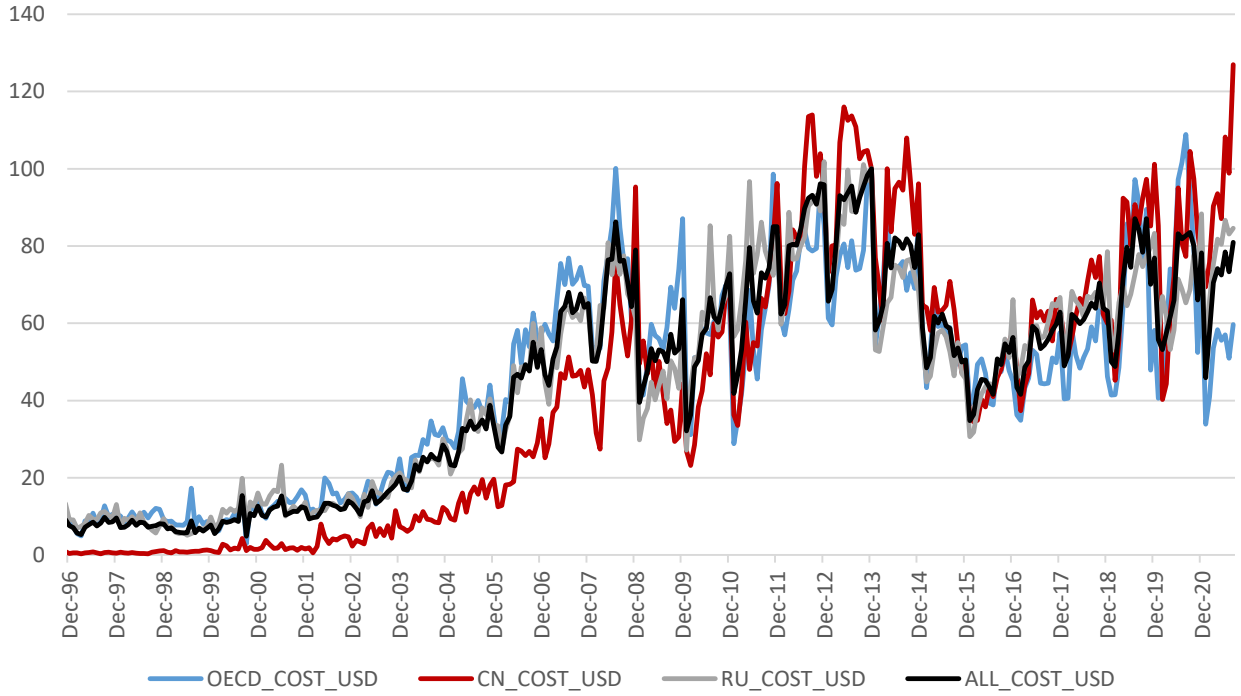
Figure 37. Kazakhstan's indices of REER and imports (versus the base of Dec. 2013)



Source: computations by authors based on the data from the SRC MF RK and ASPR BNS RK

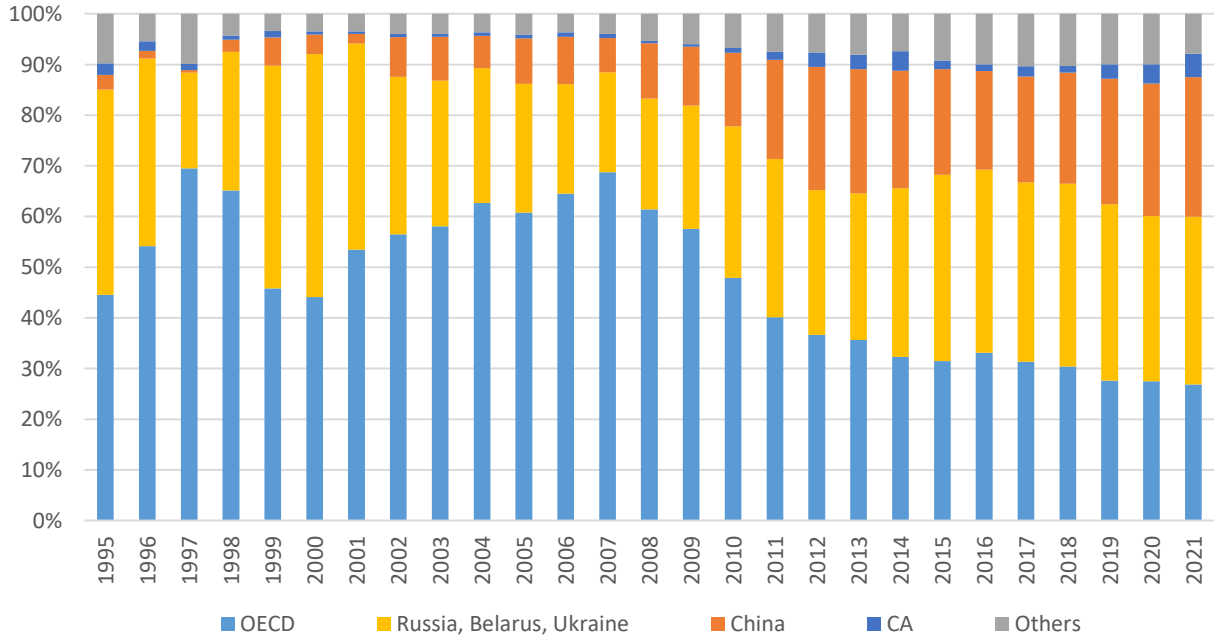
The dynamics of import value index showed that there is a change in the structure of supplying countries (Figure 38). Against the growing imports of consumer non-food products from China, imports of such goods from the countries of the Organization for Economic Cooperation and Development (OECD) are declining; along with that, there is still a high share of imports from Russia (Figure 39 and 40).

Figure 38. Kazakhstan's import value index in the USD by zones (countries) (versus the base of Dec.2013)



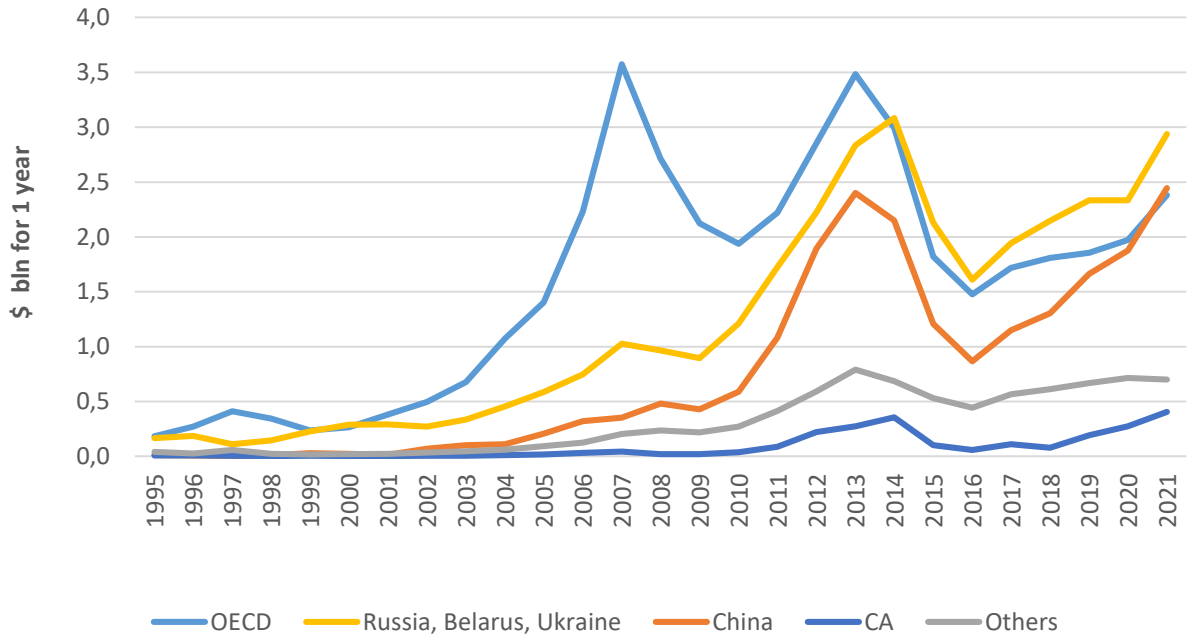
Source: computations by authors based on the data from the SRC MF RK and ASPR BNS RK

Figure 39. Imports of consumer non-food products in Kazakhstan by zones (countries)



Source: computations by authors based on the data from the SRC MF RK and ASPR BNS RK

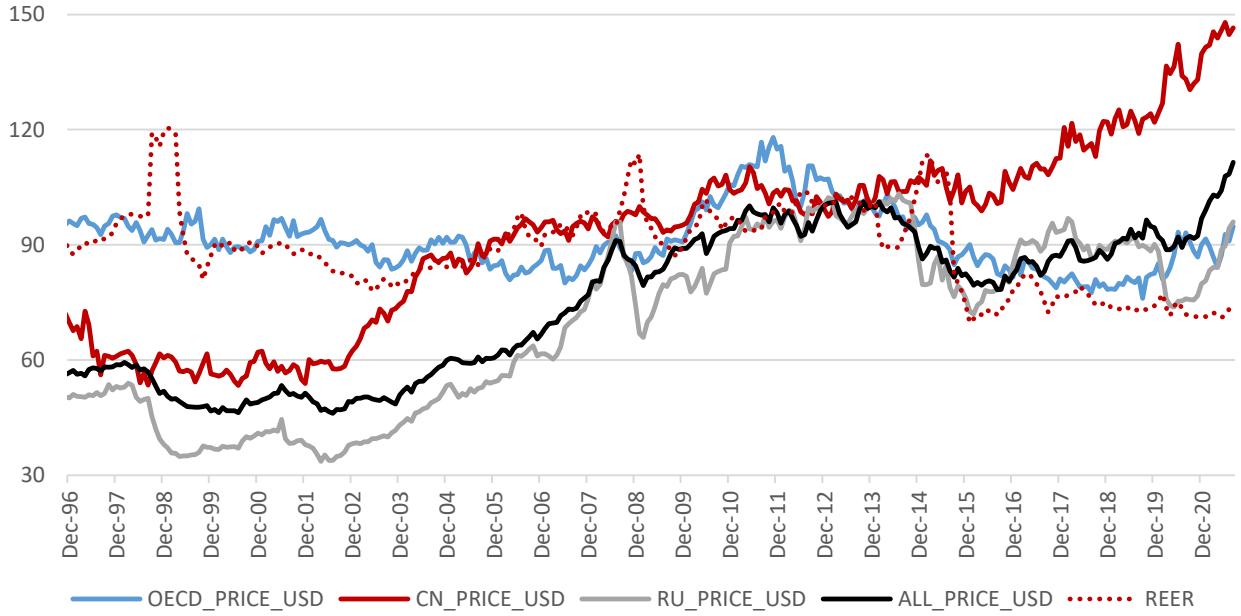
Figure 40. Dynamics of imports of consumer non-food products in Kazakhstan by zones (countries)



Source: computations by authors based on the data from the SRC MF RK and ASPR BNS RK

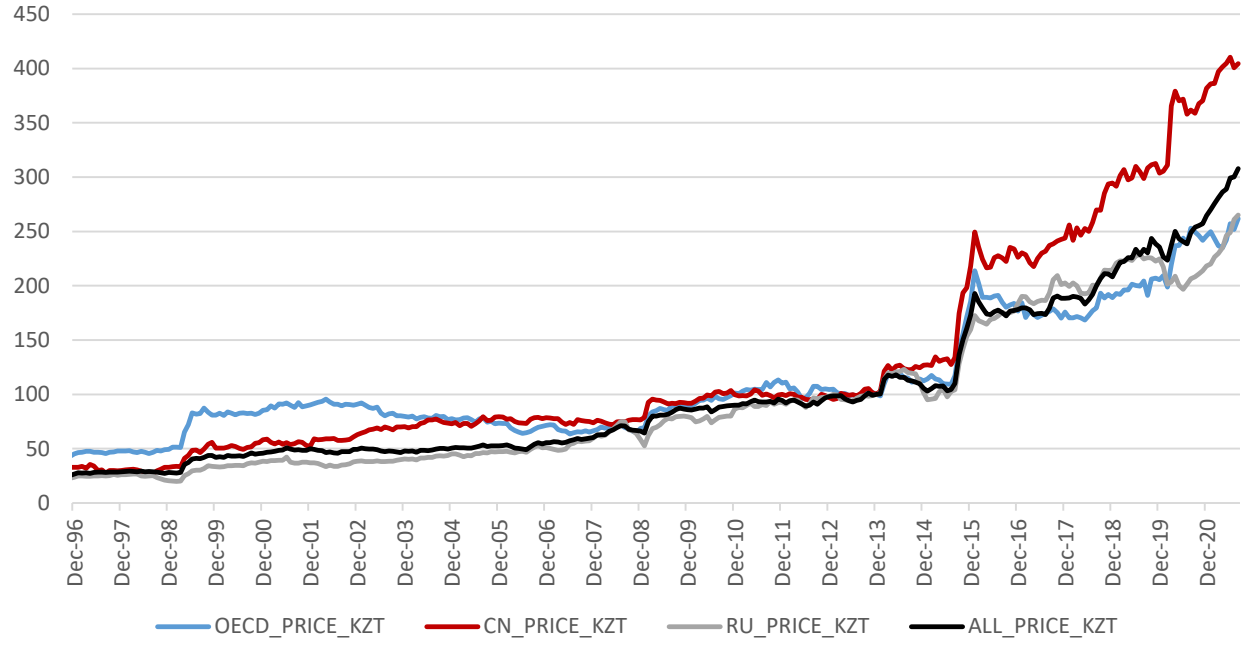
The quality of import basket from supplier countries is changing. If in the 1990s, lower quality and cheaper goods were imported from China, now more high-tech and expensive goods such as computers and mobile phones are being imported. Thus, leading companies, placing their production in China, began to supply the world with high quality and affordable goods. As a result, the import price index of goods from China increased (Figures 41 and 42), offsetting the decline in the physical volume of supplies (Figure 43).

Figure 41. Import price index in the USD by zones (countries) (versus the base of Dec.2013)



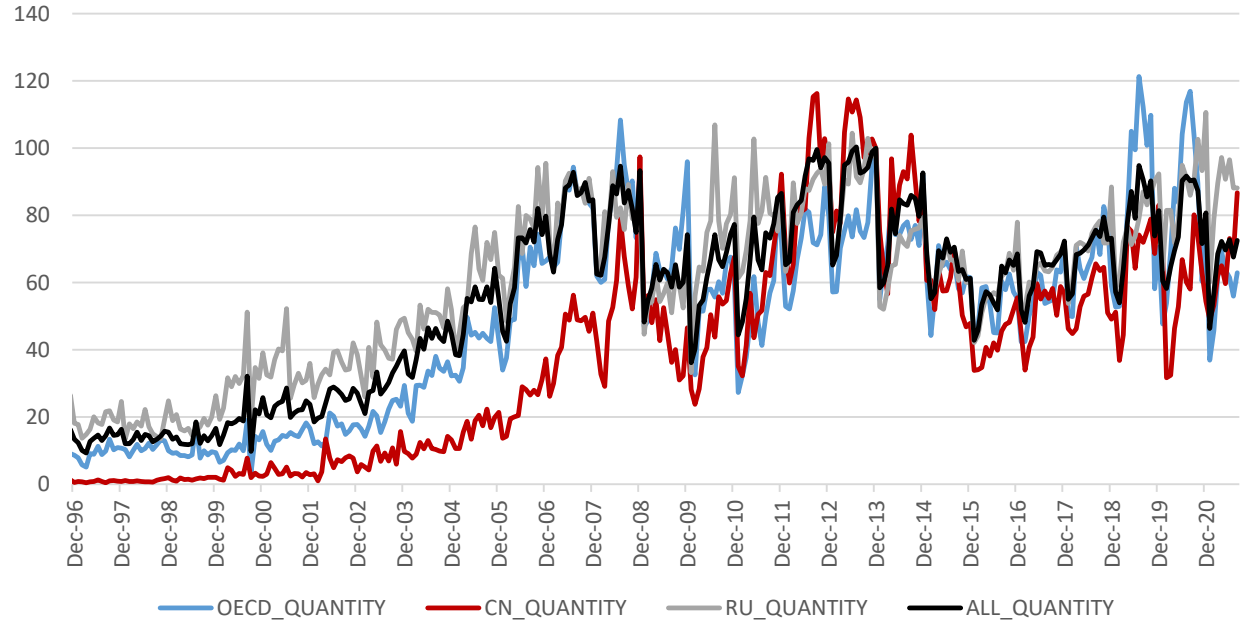
Source: computations by authors based on the data from the SRC MF RK and ASPR BNS RK

Figure 42. Import price index in the tenge by zones (countries) (versus the base of Dec. 2013)



Source: computations by authors based on the data from the SRC MF RK and ASPR BNS RK

Figure 43. Indices of physical volumes of imports by zones (countries) (versus the base of Dec. 2013)

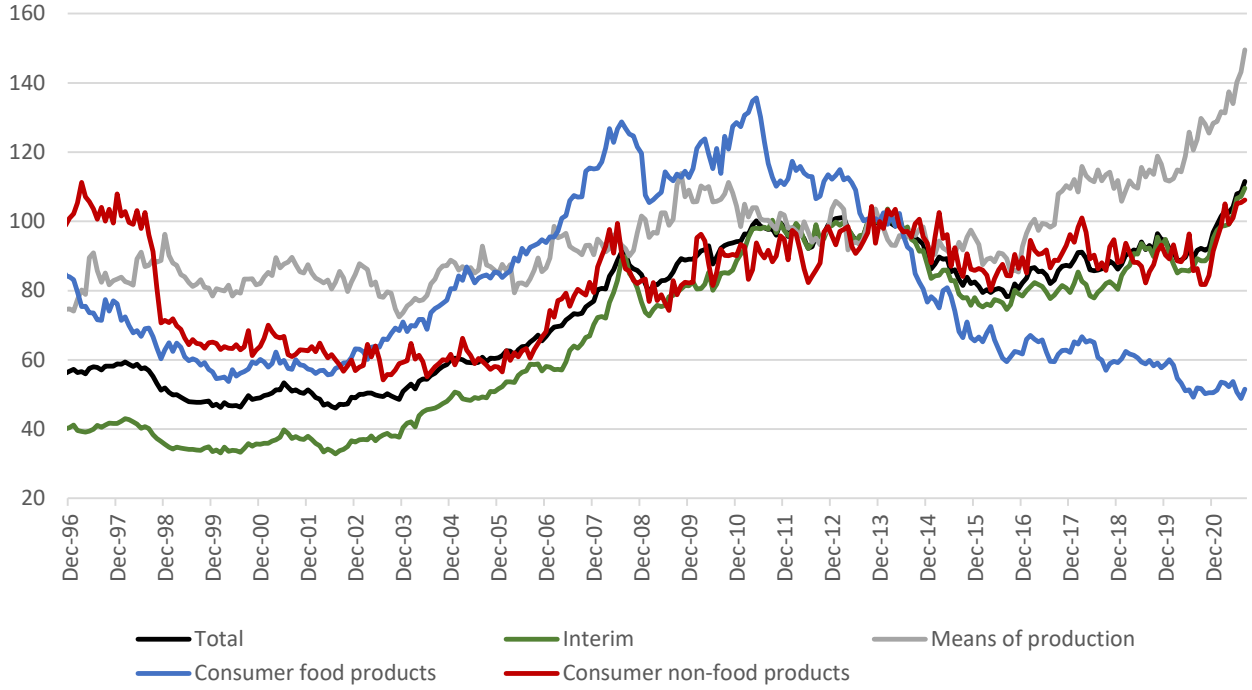


Source: computations by authors based on the data from the SRC MF RK and ASPR BNS RK

In terms of product groups, over the past 5 years, import prices have been growing in product categories that account for the bulk of imports, namely interim goods (50.4% on average for the 2016-2020 period), capital goods (23.5%) and consumer non-food products (17.8%).

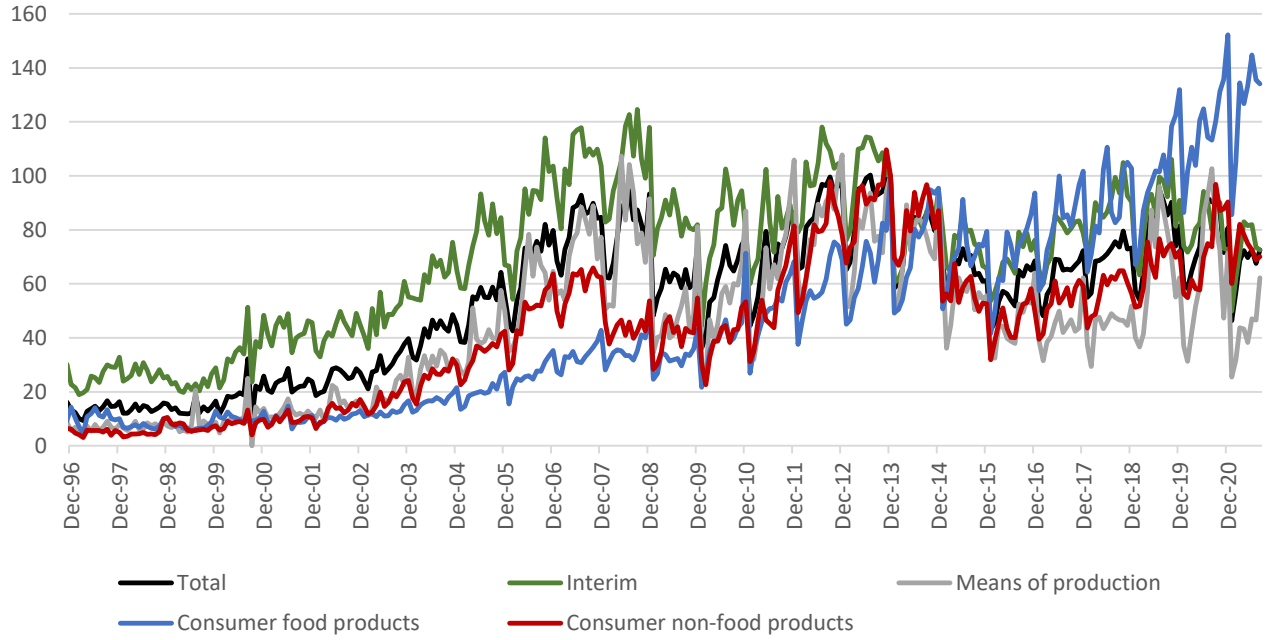
Prices for consumer food products are an exception – they showed a decline (Figure 44). However, their share is only 8.3%, the main suppliers of these goods are the CIS countries (70%). At the same time, the physical supply of consumer food products increased (Figure 45).

Figure 44. Import price index in the USD by commodity groups (versus the base of Dec.2013)



Source: computations by authors based on the data from the SRC MF RK and ASPR BNS RK

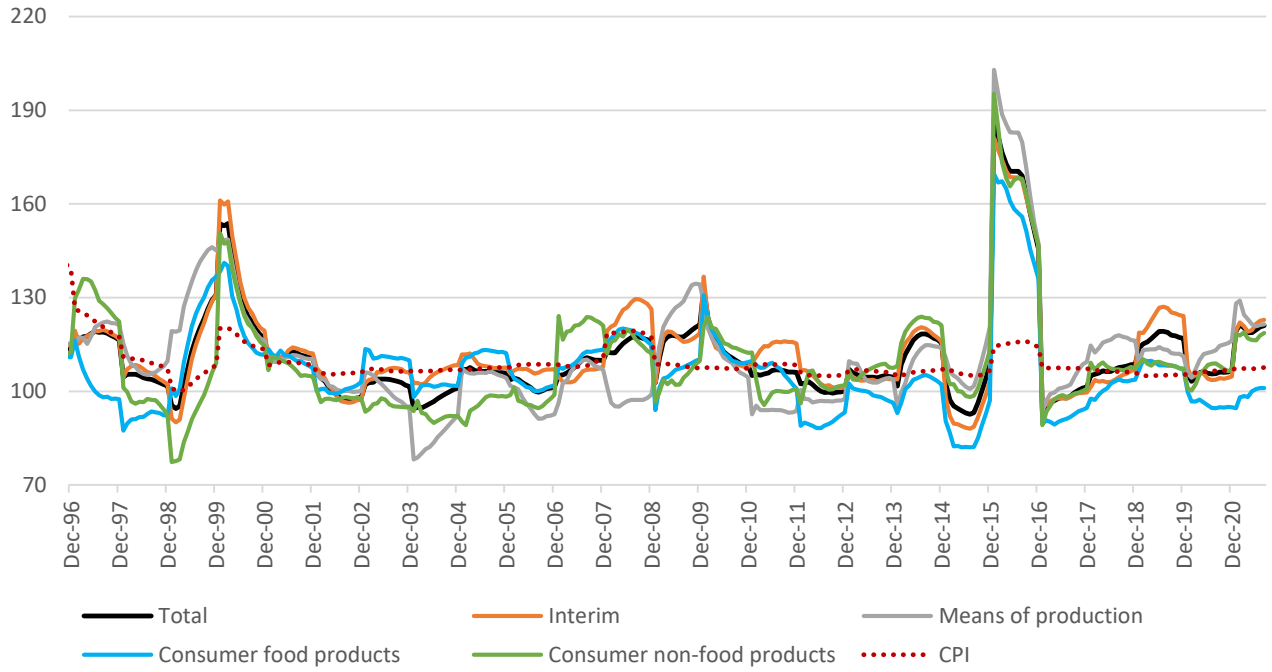
Figure 45. Index of physical imports by commodity groups (versus the base of Dec.2013)



Source: computations by authors based on the data from the SRC MF RK and ASPR BNS RK

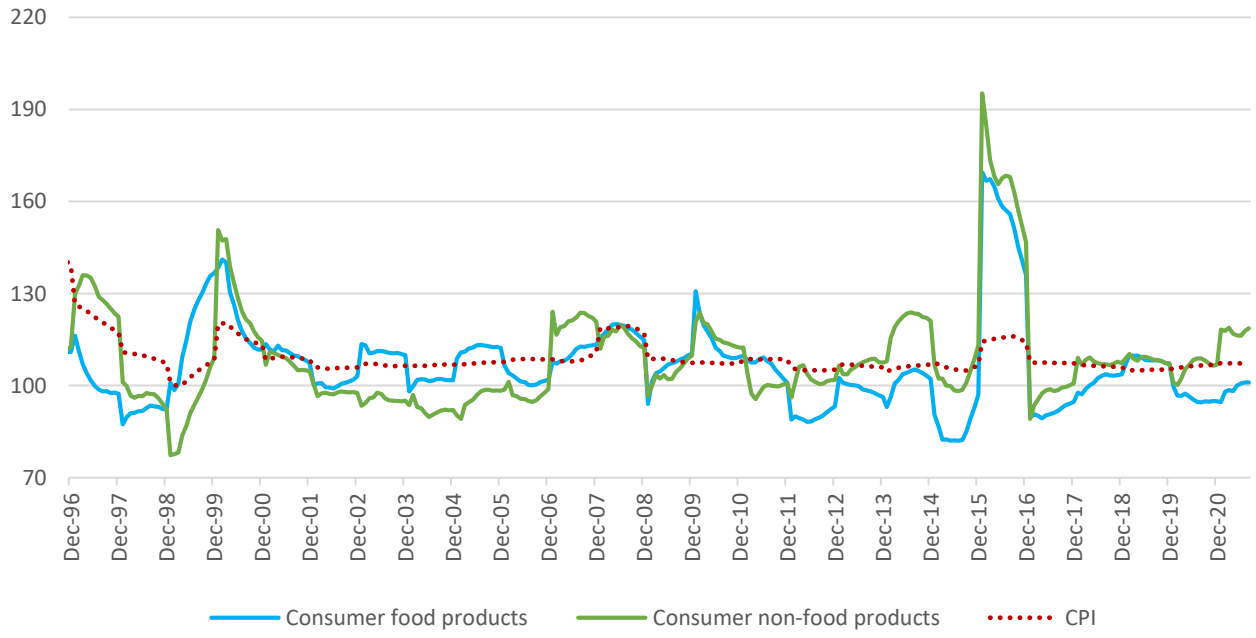
To analyze the relationship with inflation, we additionally calculated import price indices in the tenge by commodity groups. The analysis showed price leaps during the periods of devaluation. There is a higher correlation of inflation with import price indices for consumer and interim goods. To a lesser extent, inflation correlates with the means of production (Figures 46 and 47).

Figure 46. Import price index in the tenge by commodity groups and consumer price index (period-over-period)



Source: computations by authors based on the data from the SRC MF RK and ASPR BNS RK

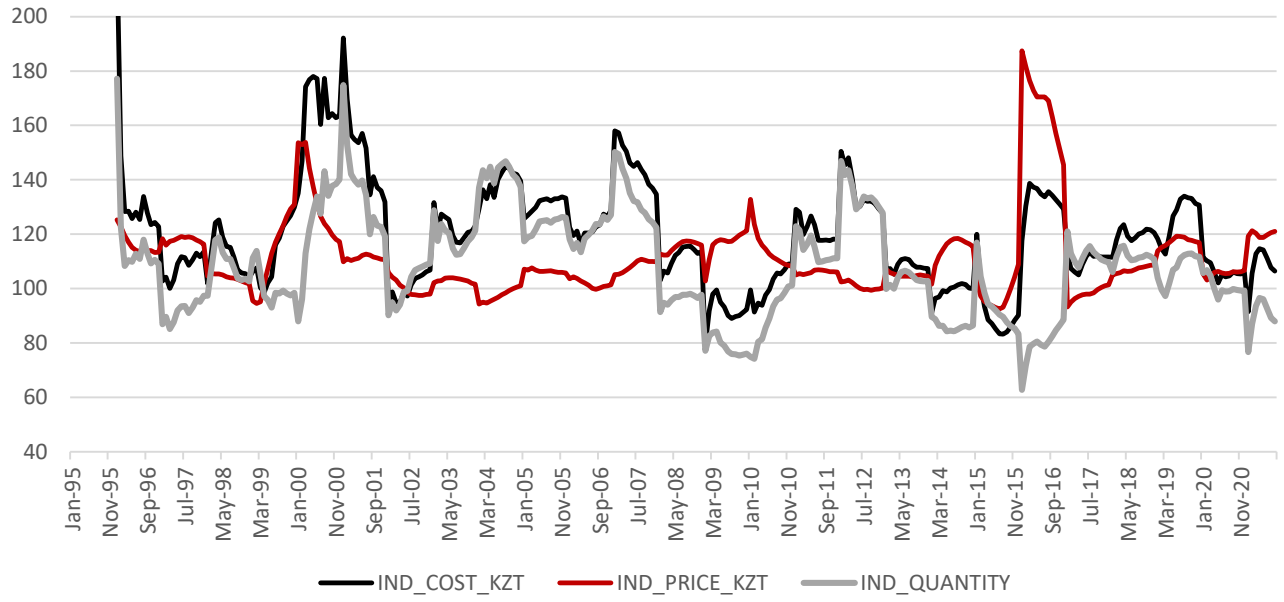
Figure 47. Import price index in the tenge by consumer goods and consumer price index (period-over-period)



Source: computations by authors based on the data from the SRC MF RK and ASPR BNS RK

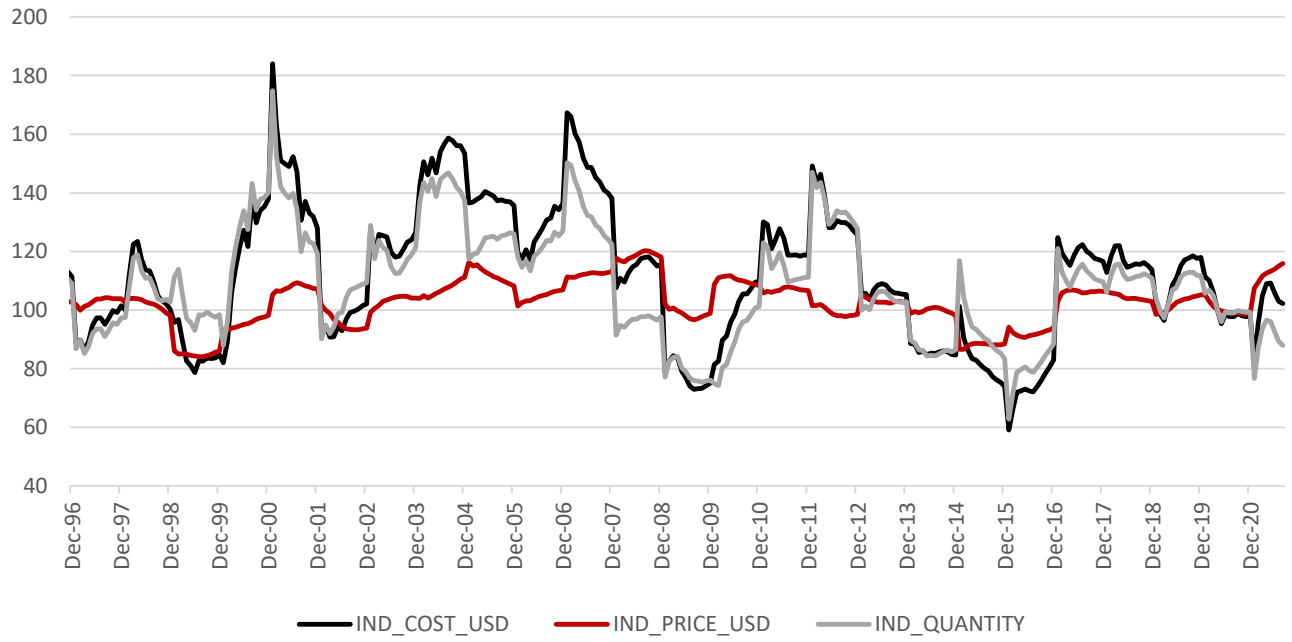
Figures 48 and 49 show import indices in the tenge and in foreign currency on the year-over-year basis. Thus, import price in the tenge in 2020 grew by 6.72% compared to 2019 whereas import prices in the US dollars declined by 1.07%.

Figure 48. Import price index in the tenge (period-over-period)



Source: computations by authors based on the data from the SRC MF RK and ASPR BNS RK

Figure 49. Import price index in the USD (period-over-period)



Source: computations by authors based on the data from the SRC MF RK and ASPR BNS RK

6. Conclusion

As part of the study, the analysis of factors affecting price volatility and leading to destabilization of foreign trade flows of goods was performed; the analysis of relationship between the current account and the exchange rate was carried out, including the assessment of elasticity of imports to the exchange rate.

Thus, the trend of the current account on the balance of payments of Kazakhstan is largely determined by the trade balance dynamics, which, in turn, is more dependent on the value of primary exports, oil prices and exchange-traded commodities. The volume of export proceeds in foreign exchange stimulate the extent of imports. At the same time, fluctuations in the dynamics of exports and imports are cyclical.

The dynamics of imports of capital goods and interim products depends on import purchases as part of implementation of oil and infrastructure projects. The initiation of import purchases occurs during the periods when the tenge appreciates and stabilizes.

Physical supplies of diversified imports, consisting of processed goods by more than 90%, are sensitive to currency fluctuations. Physical volumes of finished goods of non-primary exports are also sensitive to the exchange rate, and the strengthening of the tenge reduces their price competitiveness.

The exchange rate, while influencing import prices, leads not only to changes in the volume of imports but also to changes in the quality of import basket. Expensive goods from one supplier are replaced by affordable goods from other suppliers. In the long run, this is reflected in redistribution of the shares of countries supplying goods. Import volumes are also affected by logistics and accessibility to Kazakhstan's market, tariff and non-tariff barriers. Over the past two years, the main factors determining foreign trade of Kazakhstan and partner countries are not the fundamental factors but the sanitary and epidemiological and geopolitical situation in the world.

The analysis of import prices in the context of main commodity groups and supplying countries enabled to obtain an objective assessment of the elasticity of imports to the exchange rate. This study of volatility of export and import prices showed that the market-based floating exchange rate is a stabilizing factor that indirectly affects the current account dynamics through changes in prices for non-primary and consumer goods.

To achieve the study's objectives, analytical tools on foreign trade statistics of the Republic of Kazakhstan were designed and implemented.

At the first stage, the data was collected and compiled, and *a new flexible analytical toolkit on foreign trade of the Republic of Kazakhstan*, "Cube of Database on Kazakhstan's Foreign Trade: Ver 2.2021" *was designed*.

At the second stage, *the methodology for constructing the foreign trade price index* that is based on the key principles of the IMF Export and Import Price Index Manual (XMPI, 2009) *was elaborated and described*. The factors indicating that this methodology for constructing a price index through calculation of monthly chain price changes using the Fisher formula, with the price calibration at the points of breaks and at the points of extreme price outliers, is an affordable solution that produces adequate results.

As part of the methodological effort:

1. The level of breaks in the statistical series of foreign trade supplies was analyzed and the statistics of runs of continuous data that determine the level of confidence in the methodology for constructing a chain export and import price index were prepared;

2. Trade flows with extreme outliers in monthly US dollar prices by more or less than 2, 5 and/or 10 times have been identified. Such extreme price outliers form the basis for working on statistical data mirroring with trading partner countries and allow improving the data quality.

At the third stage, *two models for constructing Kazakhstan's monthly foreign trade price indices were implemented* at different levels of data aggregation and the period coverage. *The first model* has been implemented at the level of the 6-digit code of the FEACN, of aggregated data by country covering the maximum period of monthly indicators. *The second model* is implemented at the level of the 10-digit code of the FEACN of disaggregated data, by country. The choice of using the model depends on objectives, the sample used for the period coverage and the level of detail. The constructed models for calculating foreign trade price indices enable to iterate them according to available indicators and derivative classifiers.

The array of foreign trade data for the reviewed period of 1995-2021 contains trade flows for more than 200 trading partner countries and covers classification changes for more than 25 thousand commodity sub-sub items; there have also been changes in units of measurement of physical volumes on some of these sub-sub items.

Ultimately, in the course of the study, analytical tools for foreign trade price indices were implemented with on-the-spot administration that does not require financial costs. This toolkit enabled to assess trends in foreign trade prices.

The toolkit of the foreign trade price index, which is the purport of this study, will allow preparing analytical materials and initiate further research in this area. This will provide an opportunity to get feedback from the expert community, to test the capabilities of the toolkit based on the methodology used, and will contribute to the publication of a number of papers on the aspects of Kazakhstan's foreign trade.

Sources and Literature

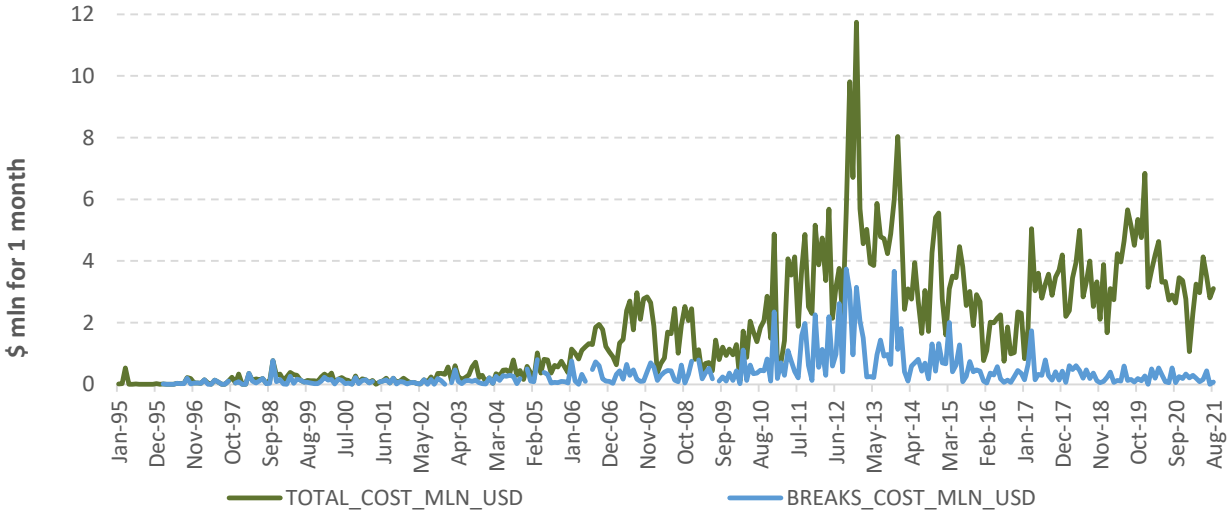
1. Classification by broad economic categories (BEC), UN Statistical Commission, 2002;
2. The IMF Export and Import Price Index Manual, (XMPI), 2009;
3. Internet resource of the State Revenues Committee of Kazakhstan's Ministry of Finance. Foreign Trade Statistics (http://kgd.gov.kz);
4. Internet resource of the Bureau of National Statistics with the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan. Mutual trade statistics (http://stat.gov.kz);
5. Conversion Methodology General Notes, UN Comtrade, 2007. https://unstats.un.org/unsd/classifications/econ/.

1. Statistics of Runs on Kazakhstan's Imports of Frozen Beef for the Period from January 1995 through August 2021

The following data is available for the period of 1995-2021 in calculating Kazakhstan's import price index for frozen beef (FEACN 0202) on a statistical flow at a maximum available disaggregated level of the 10-digit code of the FEACN by country in terms of units of measurement of physical volumes:

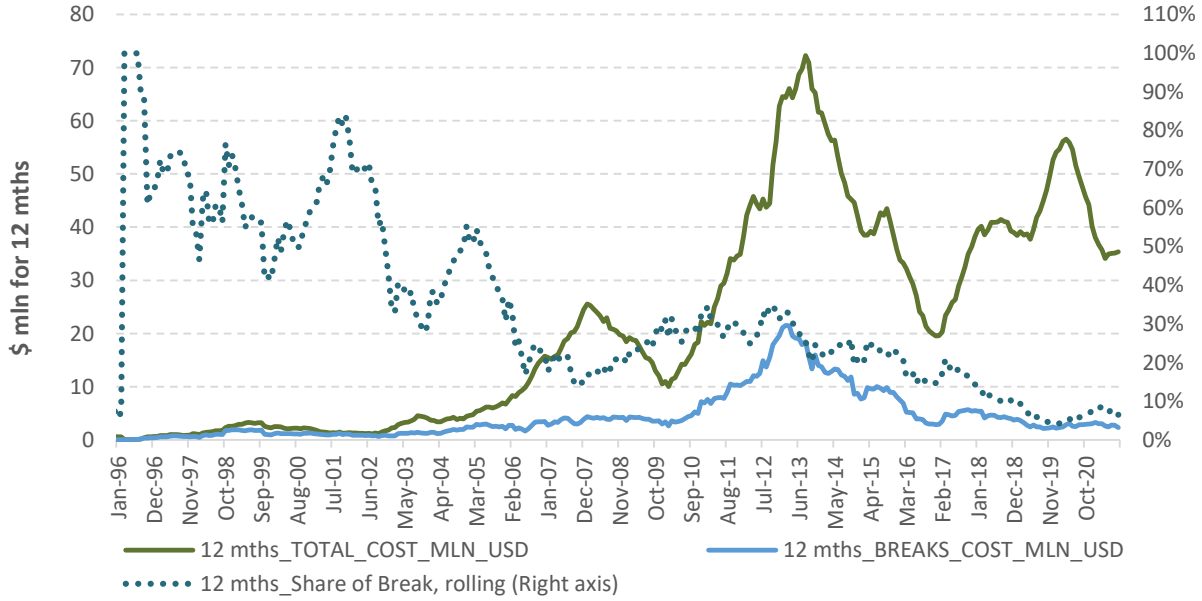
1) 358 units (structure) – the quantity of unique items under three features: CODE_TNVED, ID_COUNTRY, ID_MEASURE, obtained by aggregating the real import flow in the reviewed period. *(the coverage includes 56 codes of the 10-digit FEACN code, 48 coutries and 1 unit of measurement).*
2) 114 560 units (array) – the quantity of points for the reviewed period including the fourth feature – time obtained as follows: 358 units x 320 months (frim Jan.1995 through Aug.2021).
3) 3 418 units (actual) – the quantity of points with actual data on imports of frozen beef by all four features.

Figure 1.1. Kazakhstan's imports of frozen beef and the cost at the points of break on the left



Source: computations by authors based on the data from the SRC MF RK and ASPR BNS RK

Figure 1.2. Kazakhstan's imports of frozen beef, the cost at the points of break on the left, for a 12-month rolling period



Source: computations by authors based on the data from the SRC MF RK and ASPR BNS RK

Table 1.1. Statistics of runs on Kazakhstan's imports of frozen beef for the period of 1995-2021

Runs	Quantity of points, pieces	Cost, mln US dollars	Share of the total cost
1 mth	973	58.8	10.3%
2 mths	438	42.4	7.4%
3-4	578	79.2	13.9%
5-8	452	75.7	13.3%
9-16	293	57.5	10.1%
17-32	183	50.4	8.8%
33-64	501	206.1	36.1%
Total Kazakhstan's imports of beef	**3418**	**570.0**	**100.0%**

Source: computations by authors based on the data from the SRC MF RK and ASPR BNS RK

Figure 1.3

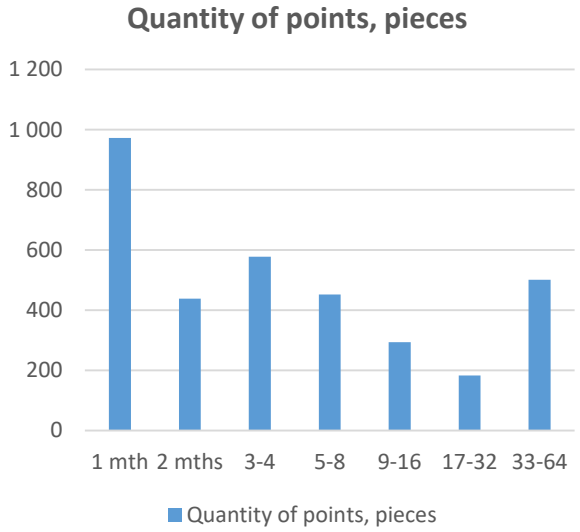
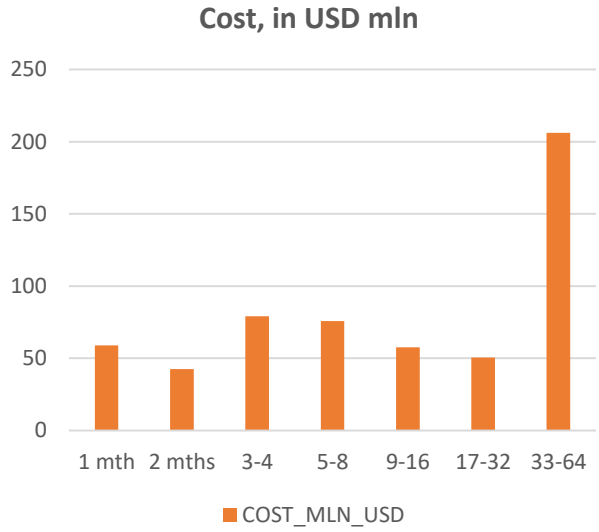
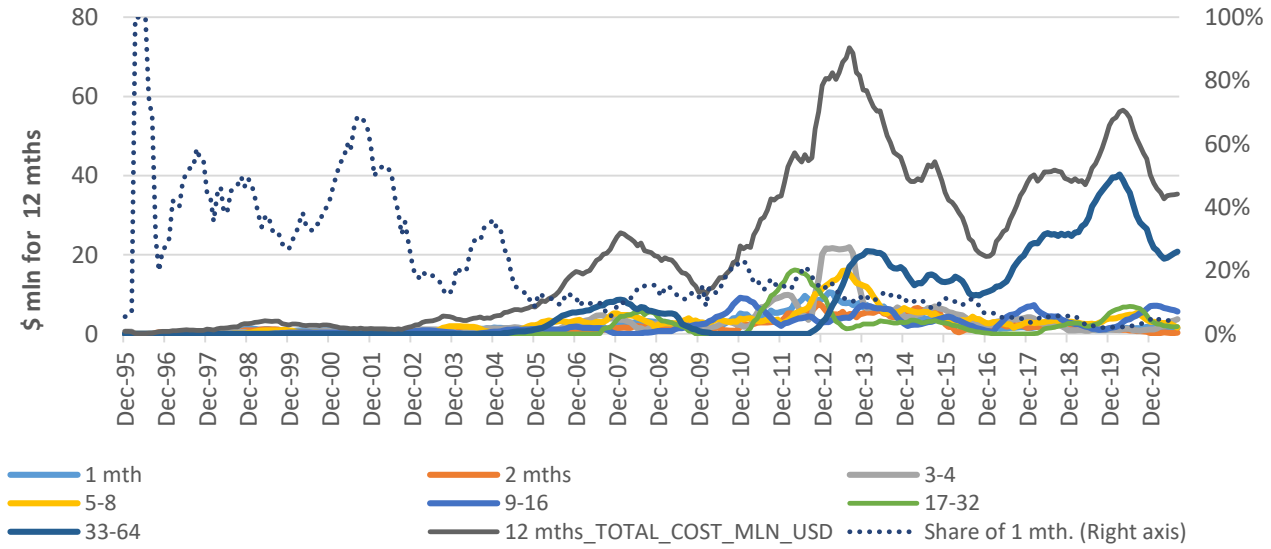


Figure 1.4



Source: computations by authors based on the data from the SRC MF RK and ASPR BNS RK

Figure 1.5. Value imports of frozen beef in Kazakhstan by ongoing observations of run lengths, for a 12-month rolling period



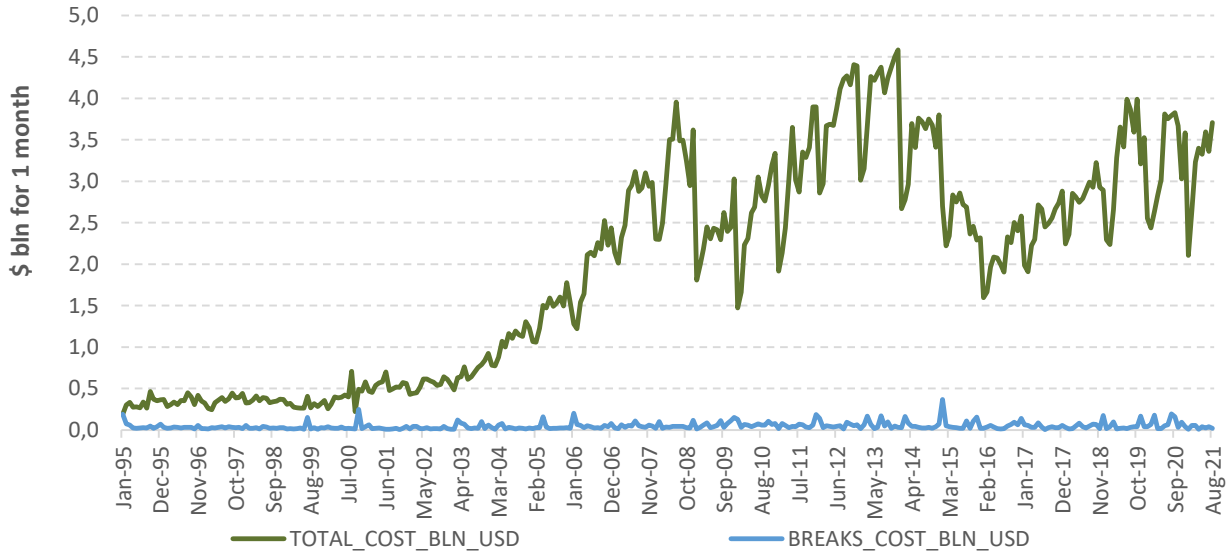
Source: computations by authors based on the data from the SRC MF RK and ASPR BNS RK

2. Statistics of Runs on Kazakhstan's Total Imports at the Level of 6-Digit Code of the FEACN for the Period from January 1995 through August 2021

The following data is available for the period of 1995-2021 in calculating Kazakhstan's total import price index on a statistical flow at the level of 6-digit code of the FEACN by units of measurement of physical volumes:

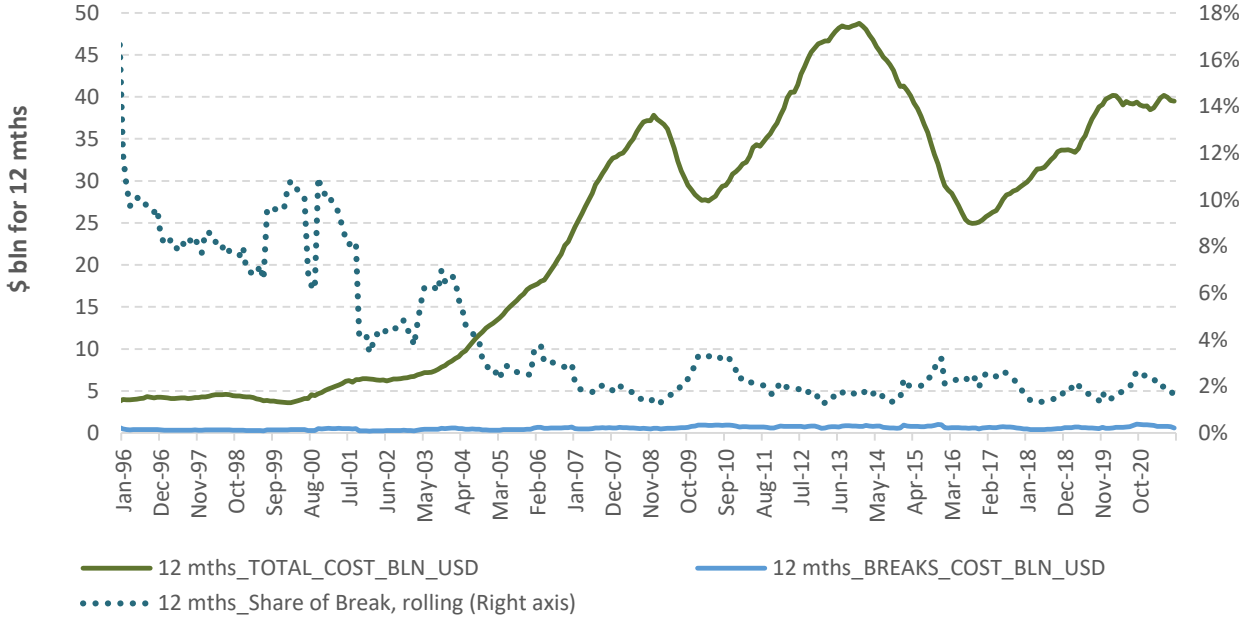
1) 8 009 units (structure) – the quantity of uinique items on: CODE_06, ID_MEASURE, obtained by aggregating the real import flow in the reviewed period. *(The coverage includes 7 085 codes of the 6-digit code of the FEACN and 24 units of measurement).*
2) 2 562 880 units (array) – the quantity of points for the reviewed period including the third feature – time, obtained as follows: 8 009 units x 320 months (from Jan.1995 through Aug.2021).
3) 1 087 747 units (actual) – the quantity of points with actual data on total Kazakhstan's imports by all three features.

Figure 2.1. Total Kazakhstan's imports (6HS) and the cost at the points of break on the left



Source: computations by authors based on the data from the SRC MF RK and ASPR BNS RK

Figure 2.2. Kazakhstan's total imports (6HS) and the cost at the points of break on the left, for a 12-month rolling period



Source: computations by authors based on the data from the SRC MF RK and ASPR BNS RK

Table 2.1. Statistics of runs on Kazakhstan's imports for the period of 1995-2021 (6HS)

Runs	Quantity of points, thous.	Cost, bln US dollars	Share of total cost
1 mth.	69.9	6.3	1.0%
2 mths.	48.1	5.2	0.8%
3-4	62.7	7.6	1.2%
5-8	73.0	10.8	1.7%
9-16	74.1	12.0	1.9%
17-32	67.1	19.8	3.2%
33-64	79.3	25.1	4.0%
65-128	115.4	68.9	11.0%
129-256	364.0	312.0	49.8%
>256 mths.	134.2	159.1	25.4%
Kazakhstan's total imports	**1 087.7**	**626.9**	**100.0%**

Source: computations by authors based on the data from the SRC MF RK and ASPR BNS RK

Figure 2.3

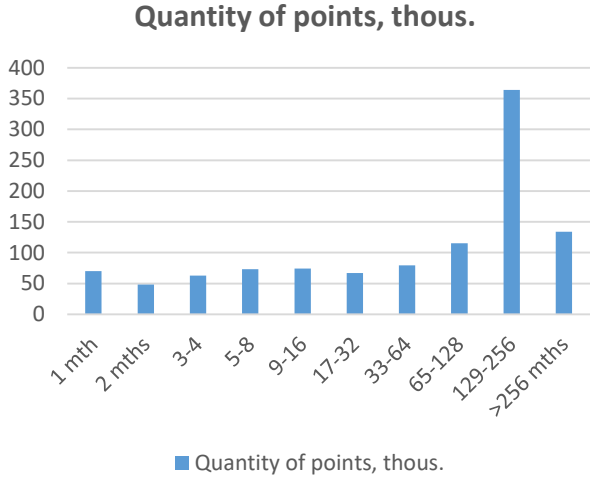
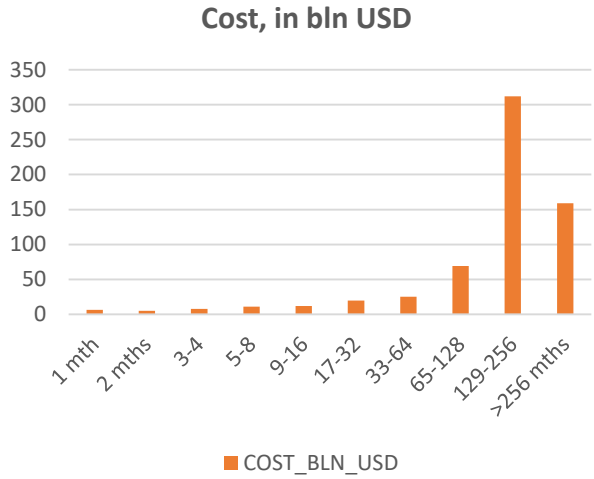
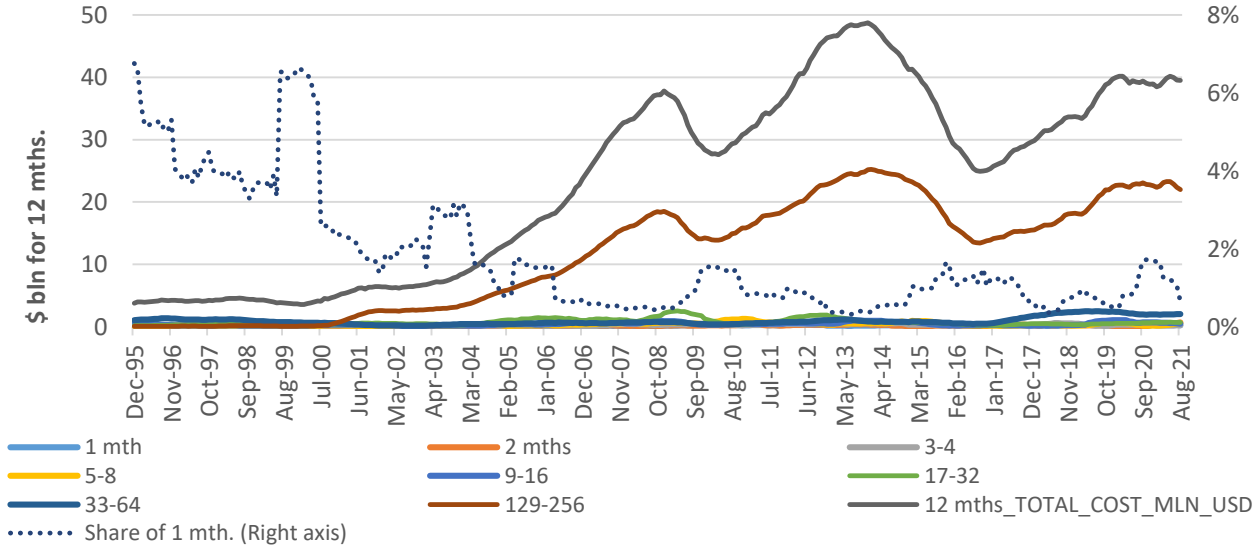


Figure 2.4



Source: computations by authors based on the data from the SRC MF RK and ASPR BNS RK

Figure 2.5. Kazakhstan's value imports (6HS) by ongoing observations on the run lengths, for a 12-month rolling period



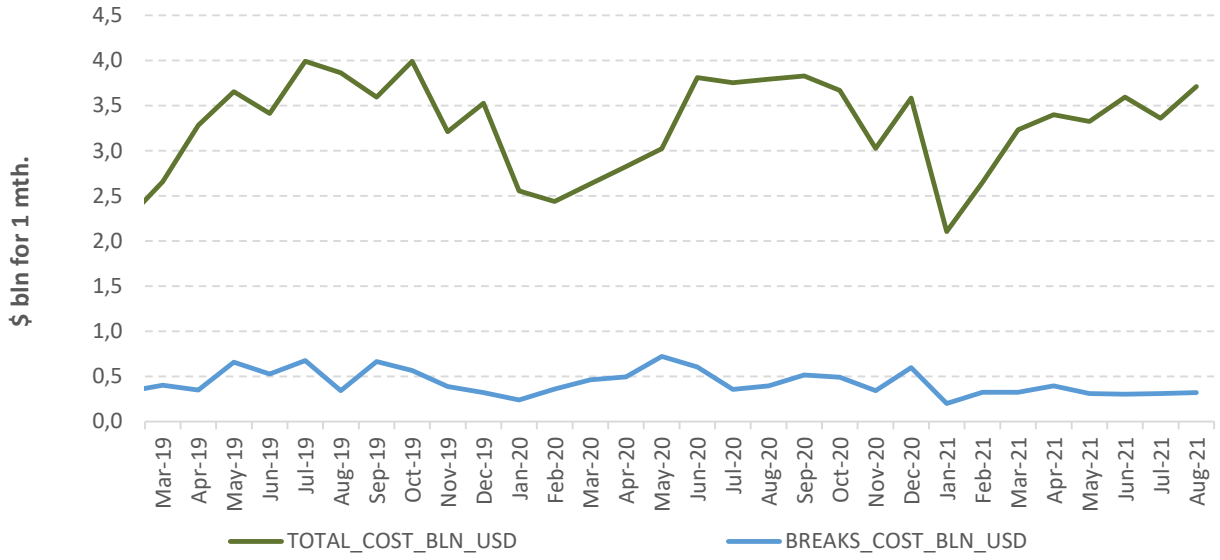
Source: computations by authors based on the data from the SRC MF RK and ASPR BNS RK

3. Statistics of Runs on Total Kazakhstan's Imports at the Level of 10-digit Code of the FEACN of Disaggregated Data by Country for the Period from January 2019 through August 2021

The following data is available for the period of 2019-2021 in calculating Kazakhstan's total import price index on a statistical flow at the maximum available disaggregated level of 10-digit FEACN by units of measurement of physical volumes:

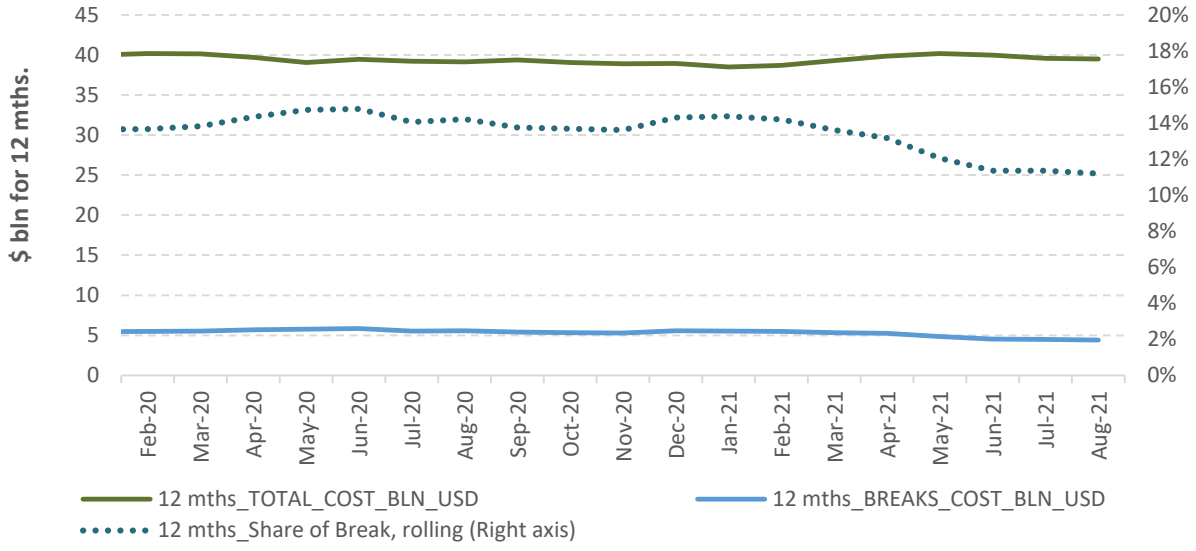
1) 113 175 units (structure) – the quantity of uinique items by three features: CODE_TNVED, ID_COUNTRY, ID_MEASURE, obtained by aggregating the real import flow in the reviewed period. *(The coverage includes 10536 codes of the 10-digit code of the FEACN, 206 countires and 20 units of measurement).*
2) 3 621 600 units (array) – the quantity of points in the reviewed period inlcuding the fourth feature – time, obtained as follows: 113 175 units x 32 months (from Jan.2019 through Aug.2021).
3) 1 029 421 units (actual) – the quantity of points with actual data on Kazakhstan's total imports by all four features.

Figure 3.1. Kazakhstan's total imports (10HS by country) and the cost at the points of break on the left



Source: computations by authors based on the data from the SRC MF RK and ASPR BNS RK

Figure 3.2. Kazakhstan's total imports (10 HS by country) and the cost at the points of break on the left, for a 12-month rolling period



Source: computations by authors based on the data from the SRC MF RK and ASPR BNS RK

Table 3.1. Statistics of runs on Kazakhstan's imports for the period of 2019-2021 (10HS by country)

Runs	Quantity of points, thous.	Cost, bln US dollars	Share of total cost
1 mth.	231.2	8.2	7.9%
2 mths.	107.7	3.8	3.7%
3-4	114.0	6.8	6.5%
5-8	118.6	9.1	8.8%
9-16	128.0	9.3	9.0%
17-32	330.0	66.8	64.2%
Kazakhstan's total imports	**1 029.4**	**104.0**	**100.0%**

Source: computations by authors based on the data from the SRC MF RK and ASPR BNS RK

Figure 3.3

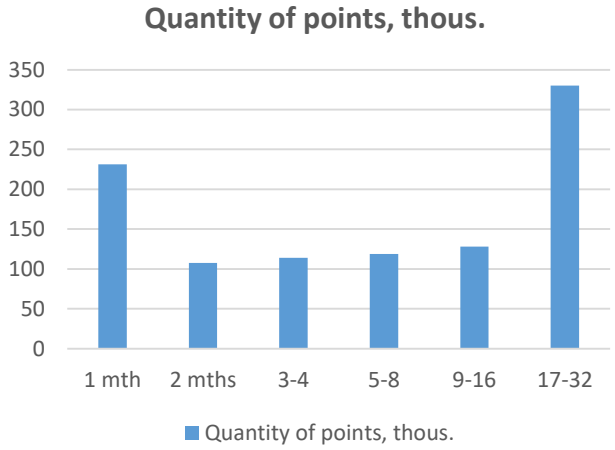
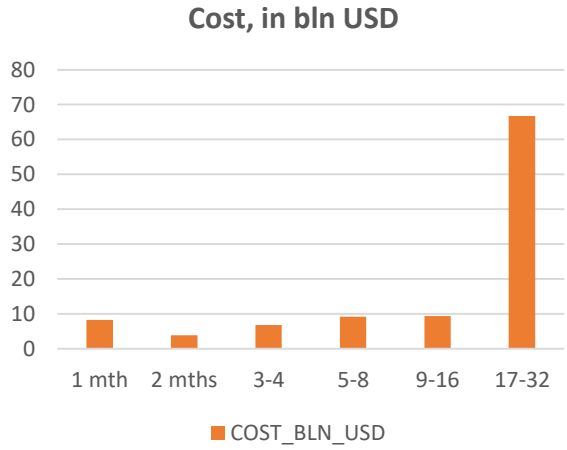
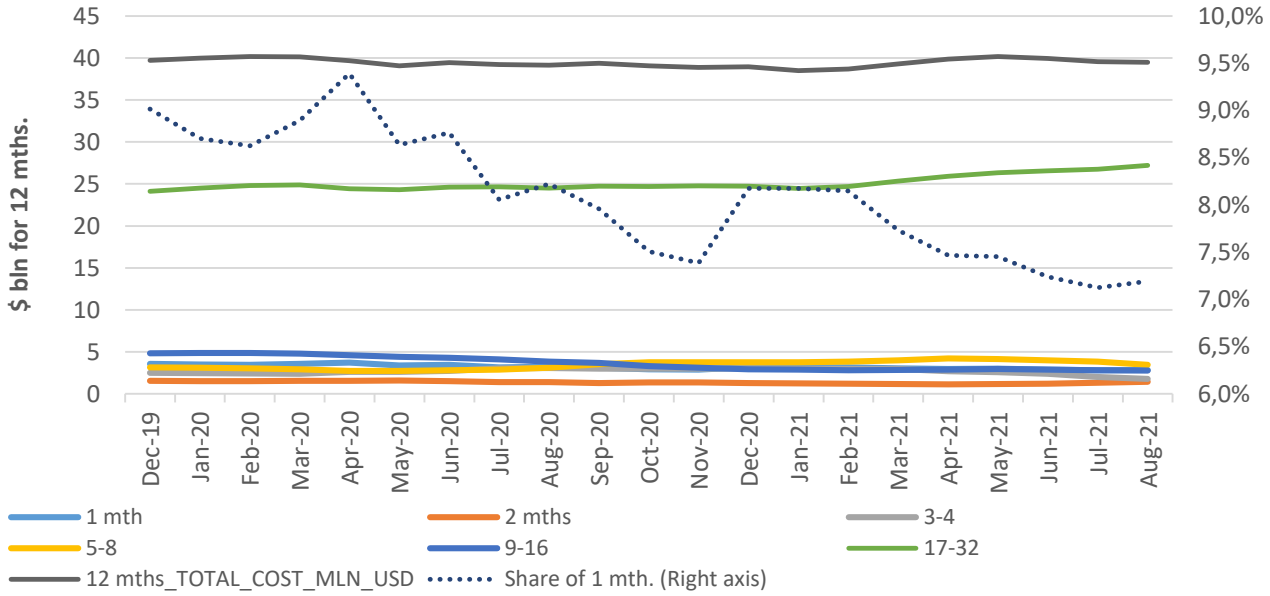


Figure 3.4



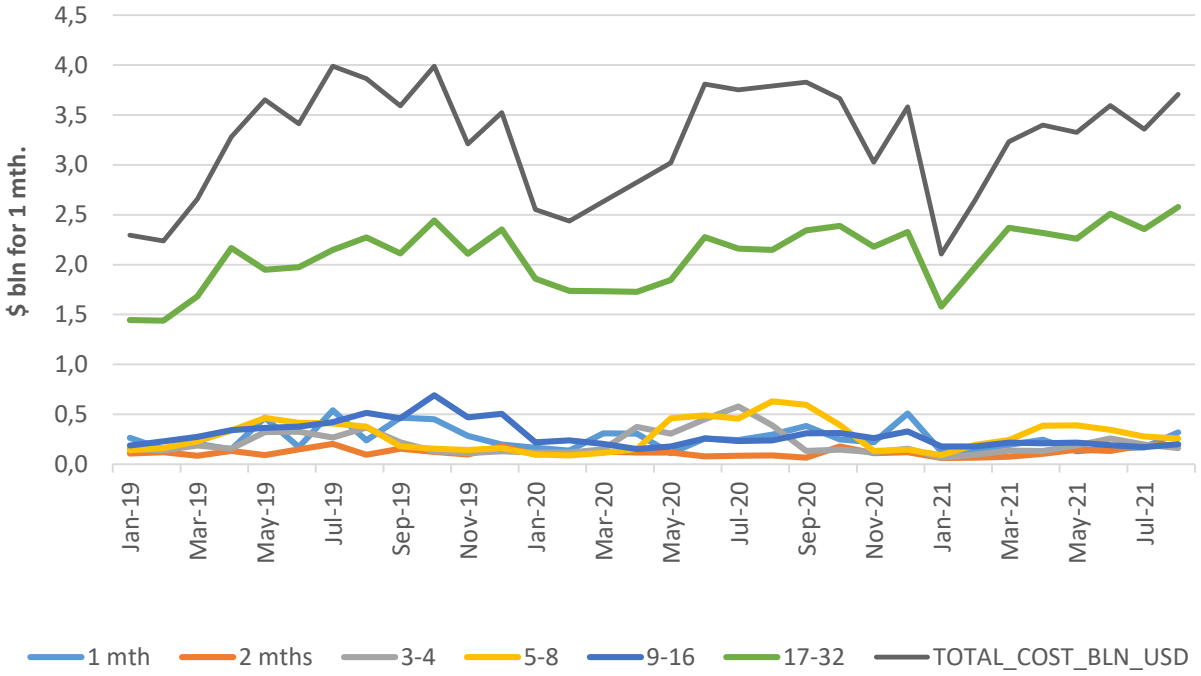
Source: computations by authors based on the data from the SRC MF RK and ASPR BNS RK

Figure 3.5. Kazakhstan's value imports (10 HS by country) by ongoing observations on the run lengths, for a 12-month rolling period



Source: computations by authors based on the data from the SRC MF RK and ASPR BNS RK

Figure 3.6. Value imports of Kazakhstan (10 HS by country) broken down by the ongoing observations of the length of runs



Source: computations by authors based on the data from the SRC MF RK and ASPR BNS RK