NATIONAL BANK OF KAZAKHSTAN

DECOMPOSING THE BASKET OF GOODS INTO SUPPLY- AND DEMAND-DRIVEN CATEGORIES TO ANALYZE FOOD INFLATION IN KAZAKHSTAN

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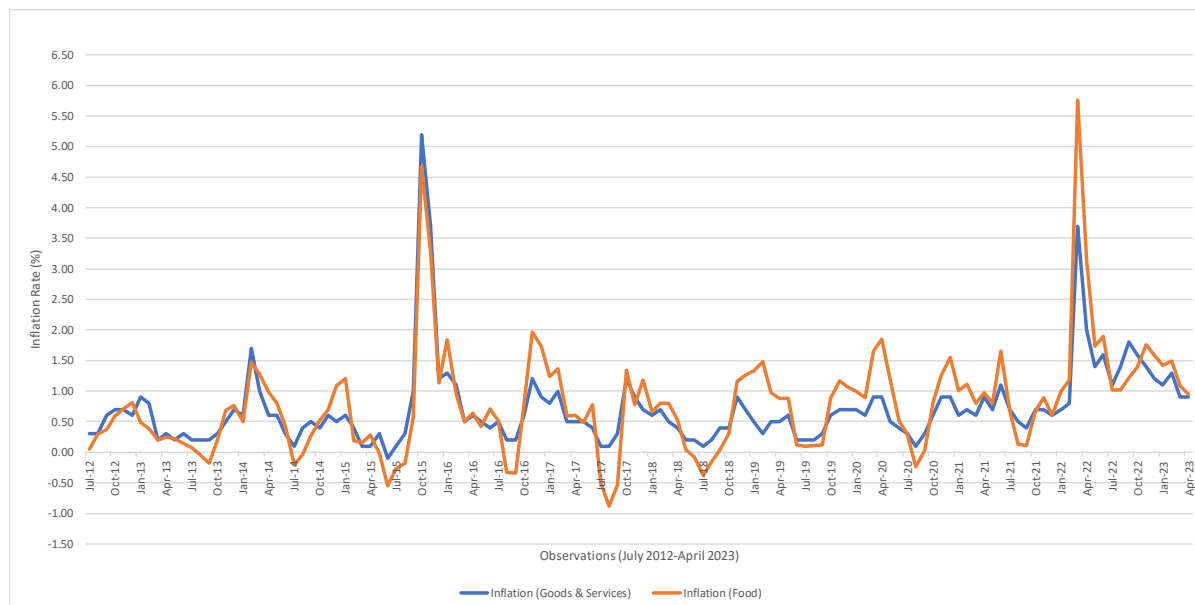# Contents

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1. Introduction

Over the past few years, inflation has been one of the most pressing topics for discussion by economists, policymakers, and the general public in Kazakhstan. As is known, inflation of goods and services in the country is divided into price changes for food products, non-food products, and services, with food inflation accounting for the largest share (i.e., about 40%) in the consumer price index (CPI). According to **Figure 1** covering the period from July 2012 to April 2023, goods and services inflation fluctuated between –0.10% and 5.20%, while food inflation varied between –0.88% and 5.76%. Except for occasional periods of economic instability causing high price volatility, such as the transition of the tenge exchange rate to a free-floating format in 2015 and the aggravation of the geopolitical situation in the West in 2022, the graph illustrates a trace of seasonality in price changes. Overall, prices tend to decline in the first half of the year and to reach their peak by the end of the year. Nevertheless, it can be observed that food inflation exceeds the inflation of goods and services in about 55% of the observations, indicating that movements in food prices pull the CPI up and down.

Figure 1. Comparison of Goods & Services Inflation and Food Inflation (month-on-month)

Note: Authors' calculations based on data from the NBK and Bureau of National Statistics

When trying to understand the dynamics behind these movements, one can assume that food inflation in Kazakhstan is mainly driven by supply-side factors due to reasons such as

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the country's dependence on food imports, fluctuations in the free-floating exchange rate, and volatility in global commodity prices. For instance, the role of the Russian Federation as one of Kazakhstan's major import trading partners has been growing since the establishment of the Eurasian Economic Union and the Eurasian Customs Union. Thus, over the period 2010–2020, the average annual volume of Russian imports to Kazakhstan doubled from US$ 6.6 billion to US$ 13.2 billion (Tuleuov, 2021). Such structural changes in international trade have resulted in the share of Russian food products in the Kazakhstani market increasing almost twofold and amounting to about 50% as of 2022. Meanwhile, against the background of the escalating geopolitical situation in the Eastern Europe, the Kazakhstani tenge depreciated by 82.3% in relation to the Russian ruble between March and June 2022. At the same time, 2022 saw disruptions in local and global logistics supply chains, rising global inflation, and worsening trade relations in a number of countries. One could well conclude that the combination of these factors explains why the overall inflation rate in the economy hit a record 21.3% in February 2023, with food inflation peaking at 25.3% (*Bureau of National Statistics*, 2023).

However, in order to properly address fluctuations in food inflation, it is important to use econometric analysis to ascertain whether price changes primarily reflected demand or supply factors, or perhaps exogenous shocks, and to assess how these factors contributed to the inflation rate. Therefore, this analytical note studies the extent to which supply- and demand-related factors have driven food inflation in Kazakhstan between 2012 and 2023. The objective is to determine the channels through which each category of goods in the consumer basket contributes to food inflation. As a result, this will help gain a better understanding of the potential impact of different monetary policy measures in Kazakhstan. Taking this into consideration, the study finds that although more than two-thirds of the categories are primarily demand-driven and nearly one-third of the categories are supply-driven, supply factors help explain over 40% of the variation in food inflation. In the meantime, demand-side factors account for only more than one-third of inflation levels, despite the fact that demand factors are present in nearly half of the observations. Policymakers can utilize these findings to examine whether monetary or fiscal policy affects the economy differently when inflation is high because of supply and/or demand forces. These insights can also be used to separate the impact of supply and demand on inflation from shocks in productivity level, exchange rates, government spending, etc.

2. Data and Methodology

The study uses (1) monthly price data showing month-on-month changes to better gauge short-term inflation trends and (2) monthly quantity data showing year-over-year changes to minimize noise in the time series. The data are for 31 categories of food products from the basket of goods, including alcoholic beverages and tobacco products but excluding fruits and vegetables due to their high seasonality and insufficient data. Each category is an aggregate of several food items (see **Table 1** in Appendix). The data cover the period from January 2011 to April 2023.

To conduct the analysis, the study utilizes a vector autoregressive (VAR) model. The model is run (1) for each category's price variable, price lags obtained from lag-order selection statistics, and its quantity variable to generate predicted values for price; and (2) for each category's quantity variable, quantity lags, and its price variable to generate predicted

values for quantity. The model is adjusted for autocorrelation using Prais-Winsten and Cochrane-Orcutt transformations and for heteroskedasticity using Huber-White robust standard errors.

To determine whether a category is supply- and/or demand-driven, the study relies on the methodologies proposed by Adam Shapiro and Robert Calvert Jump & Karsten Kohler. Based on the microeconomics principle, there is a positive relationship between the shift of the demand curve along the upward-sloping supply curve and the price of a good and its quantity demanded. This means that an increase in demand leads to an increase in both the price and the quantity. On the other hand, the shift of the supply curve along the downward-sloping demand curve causes the price and the quantity of a good to change in opposite directions. This signifies that a reduction in supply causes a decrease in the quantity but an increase in the price (Shapiro, 2022). Moreover, it should be noted that a simultaneous shift of the supply and demand curves in the same direction results in either a decrease or an increase in equilibrium quantity but an ambiguous change in equilibrium price. Meanwhile, a simultaneous shift of both curves in the opposite direction leads to either a decrease or an increase in equilibrium price but an ambiguous change in equilibrium quantity. With these theories in mind, comparing the signs of the price and quantity residuals[3] can be used to label a particular category as supply-driven or demand-driven. So, if both residuals have the same sign in a given observation, the category is labeled as demand-driven in that month. If residuals have opposite signs, the category is labeled as supply-driven in the given month (Calvert Jump & Kohler, 2022). If the difference between the observed price (and/or quantity) value in the current period and the past period is zero, the category in that month is labeled as "ambiguous."

Finally, to calculate the monthly supply-driven, demand-driven, and ambiguous contributions to food inflation, the rate of inflation for a given category is multiplied by its respective annual weight in the CPI's basket of goods and services.
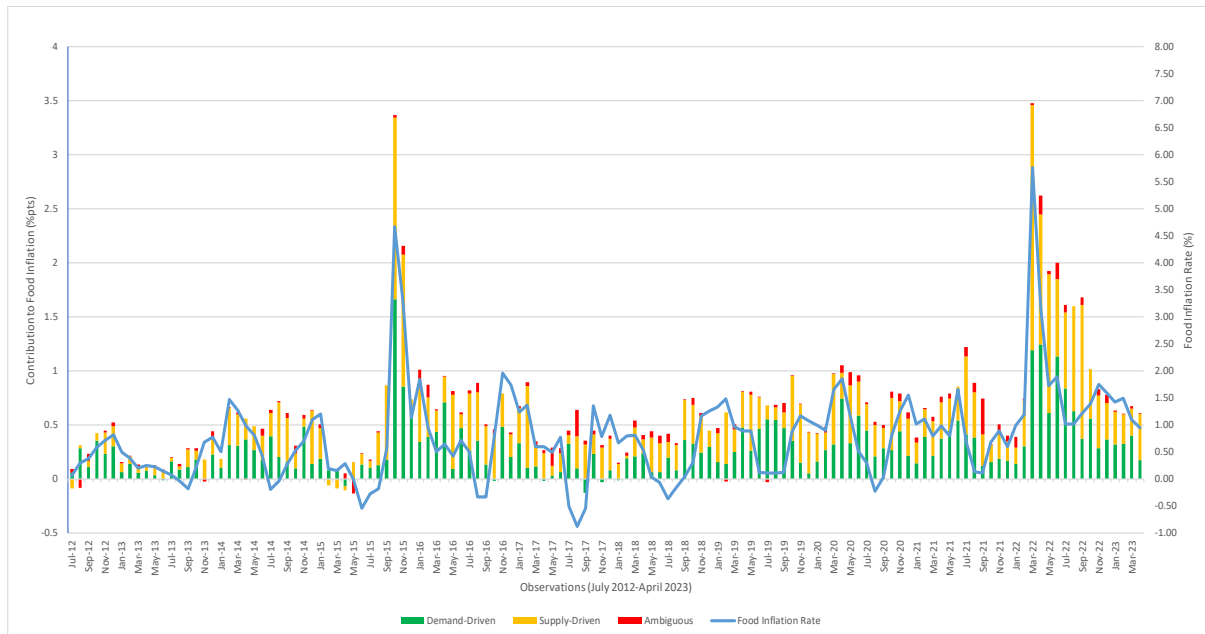
3. Results and Findings

To begin with, it should be noted that the Dickey-Fuller test for stationarity shows that the price and quantity variables of all categories are stationary except for the quantity of the category "Cigarettes and papirosa." This indicates periodic fluctuations in the variable, so the problem is solved by transforming the variable into first-differenced data. In addition, the Durbin-Watson test for autocorrelation reveals that only the quantities of categories "Processed and canned vegetables, except potatoes" and "Cigarettes and papirosa" experience serial correlation. The issue is thus addressed by applying the Prais-Winsten and Cochrane-Orcutt procedures to correct the correlation of the errors with their past values. Furthermore, 22 out of 31 price variables and 16 out of 31 quantity variables exhibit heteroscedasticity, necessitating the use of Huber-White robust standard errors to equalize the variance of the error terms.

According to the model results, on average, supply factors contributed approximately 0.33 percentage points to monthly food inflation, accounting for about 42% of the price changes in food products. Demand factors made an almost comparable contribution of about 0.29 percentage points, which was responsible for roughly 36% of the elevated/deflated

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[3] Residual is the difference between the observed value and the predicted value.

inflation levels. Ambiguous factors, in turn, explained 5% of the food inflation rate, contributing about 0.04 percentage points. The remaining difference of 17% is assumed to be approximately attributed to changes in the prices of fruits and vegetables that were excluded from the analysis. As can be observed in **Figure 2**, the trend in food inflation rate generally and intuitively follows the trend in total contributions but with some lag. Nevertheless, the changes in pattern of categorical contributions over time demonstrate an interesting dynamic. That is, the contribution of demand-driven factors to food inflation tends to decrease during periods of the declining inflation rate, while the contribution of supply-driven factors tends to increase and prevail during periods of economic shocks and rising inflation.
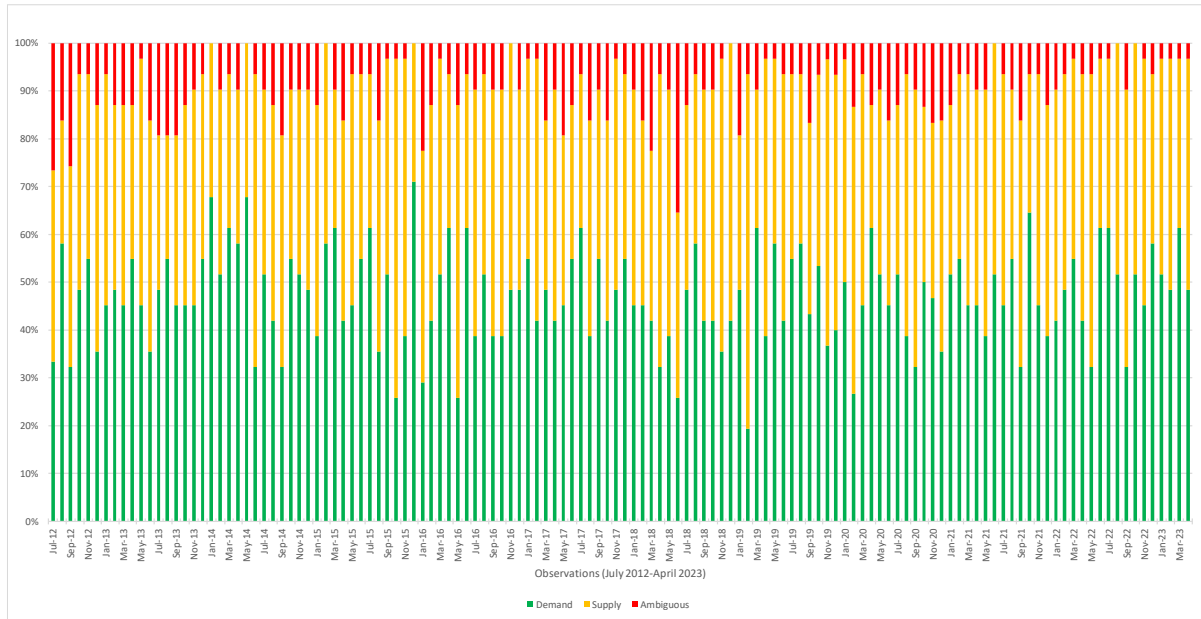
Figure 2. Monthly Contributions to Inflation of "Demand-Driven," "Supply-Driven," and "Ambiguous" Categories of Goods

Note: Authors' calculations based on data from the NBK and Bureau of National Statistics
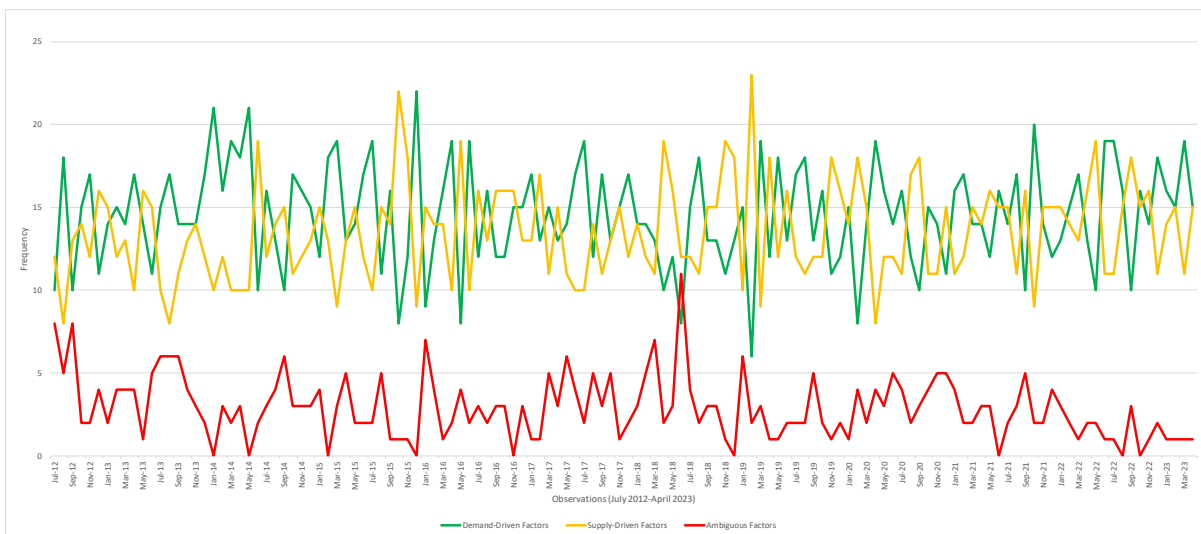
More interesting, based on **Figure 3**, on average, approximately 47% of observations face demand-side factors, 44% experience supply-side factors, and 9% face ambiguous factors. Although the types of factors appear to be independent of the time at which the series is observed, demand- and supply-driven factors have an inverse relationship with each other (see **Figure 4**). This suggests that a sharp increase in demand-side factors is associated with a sharp decrease in supply-side factors and vice versa. Regarding the ambiguous factors, they tend to follow the trend in the frequency of supply-driven factors with some lag. Such an observation possibly indicates an indirect and delayed effect of changes in supply on the creation of ambiguous inflation drivers in the categories of goods.

Figure 3. Classification of Months as "Demand-Driven," "Supply-Driven," and "Ambiguous" Based on 31 Categories of Goods

Note: Authors' calculations based on data from the NBK and Bureau of National Statistics
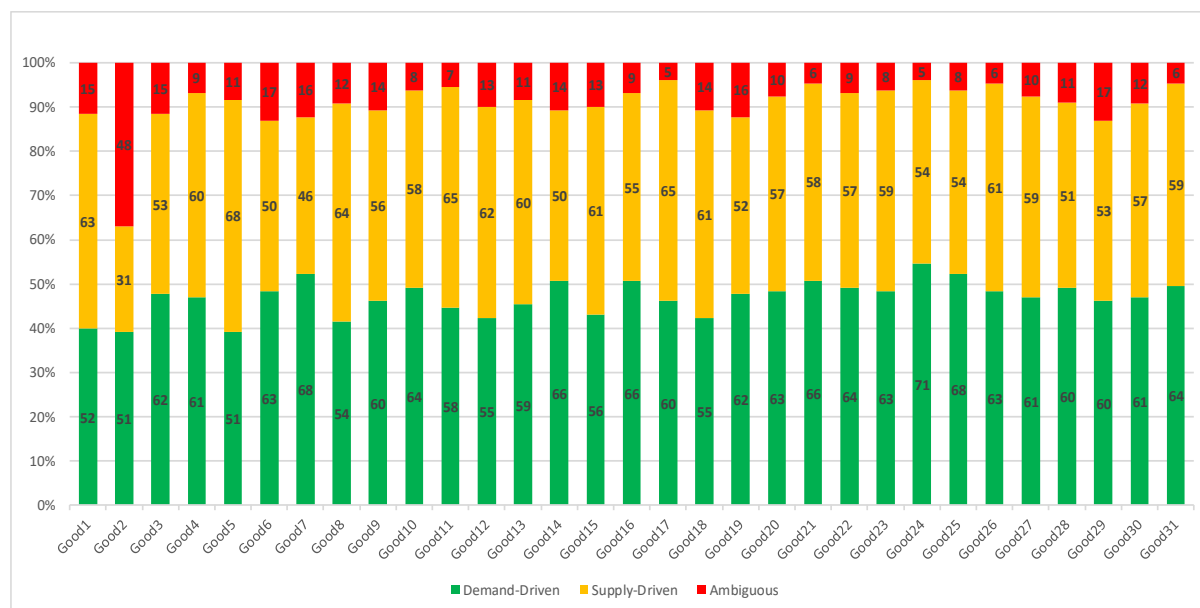
Figure 4. Frequency of "Demand-Driven," "Supply-Driven," and "Ambiguous" Categories of Goods in a Given Month

Note: Authors' calculations based on data from the NBK and Bureau of National Statistics

According to **Figure 5**, it is important to highlight that 71% of categories are predominantly demand-driven and 29% of categories are supply-driven. Categories of goods that experience frequent demand-driven price movements include "Processed and canned fruits and nuts," "Yogurt and fermented or squeezed milk and cream," "Flour," "Sugar," "Vinegar, sauces, and mixed condiments," and "Food salt." Categories that experience frequent supply-driven price movements include "Fruit and vegetable juices," "Butter," and "Cereal, including rice." The category whose price changes are largely explained by ambiguous factors other than supply and demand is "Meat by-products (salted, brined, dried, or smoked) (excluding pork and bovine meat)."

Figure 5. Classification of Categories of Goods as "Demand-Driven," "Supply-Driven," and "Ambiguous" over July 2012-April 2023

Note: Authors' calculations based on data from the NBK and Bureau of National Statistics

4. Conclusion

This analytical note shows that supply-driven categories of goods in Kazakhstan were responsible for about 42% of the elevated/deflated levels of food inflation in the period 2012–2023. Demand-driven categories similarly made a significant contribution to the inflation rate, explaining around 36% of food price changes. Factors that cannot be labeled as either supply or demand, on the other hand, accounted for approximately 5% of the food inflation thus playing a relatively trivial role.

All in all, these findings suggest that there are some risks to the economy due to the prevalence of contributions to food inflation from supply-related factors. As is known, monetary policy is aimed at reducing the contribution of demand-driven inflation. So, in the event of a supply shock, the economy could face surging prices and declining purchasing power, thus risking entering a period of slower growth. In addition, given the fact that the majority of food categories are explained by demand factors but that inflation pressures are mainly supply-driven, the timely effectiveness of tightening monetary policy seems less clear. Nevertheless, this should not detract from the importance of a well-timed monetary policy enactment to avoid potentially higher inflation and subsequent more aggressive interest rate hikes.

It is worth noting that inflation is a multifactorial process, which makes it impossible to single out a separate factor. The factors that shape inflation are closely interrelated. In view of this, it is necessary to take coordinated measures to control inflation processes. The National Bank needs to adhere to traditional monetary policy measures. In turn, unconventional measures (purchase of government bonds, direct financing of the economy, participation in government programs, etc.) entail an expansion of the money supply (unsecured issue), which carries increased inflation risks.

In turn, the Government needs to adhere to a countercyclical fiscal policy. Besides, the focus of policymakers should now be on identifying and understanding the specific determinants of supply factors that drive changes in food prices, such as the state of international supply chains, local production capacity, or labor productivity levels. This is necessary to try to solve the supply-related problem and deal effectively with inflation before it gets out of control.

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6. Appendix

Table 1. Categories of consumer goods used in the study

Good#	Category	Food Items
Good1	Meat and poultry meat	Beef - hips Beef - sirloin Beef - shoulder and breast part Beef with bones Boneless beef Pork - ham hock Pork ribs Pork - shoulder part Boneless pork Pork with bones Lamb with bones Lamb - back part with bone Horse meat with bones Zhaya Beef liver Kazy Beef tongue Chickens Chicken thighs Chicken thigh and shank Chicken breasts Chicken wings
Good2	Meat by-products (salted, brined, dried, or smoked) (excluding pork and bovine meat)	Dumplings, manty, and khinkali Ground meat Meat cutlets Meat semi-finished products in small pieces Smoked meat Smoked meat from other types of meat

Good3	Sausages and similar meat products	Boiled sausage Half-smoked sausage Sausages and wieners Raw smoked sausage
Good4	Processed and canned fish, crustaceans, and molluscs	Fresh or chilled fish Frozen fish Seafood Frozen peeled shrimp Cold smoked mackerel Salted and smoked fish (non-delicacy) Salted fish (delicacy) Pickled herring Sprats in oil Canned fish (non-delicacy) Canned fish (delicacy) Red caviar
Good5	Fruit and vegetable juices	Fruit juices Vegetable juices
Good6	Processed and canned vegetables, except potatoes	Pickled and marinated cucumbers Canned snack foods Natural, canned, and pickled vegetables Canned green peas Canned corn Pickled and marinated mushrooms Natural frozen vegetables
Good7	Processed and canned fruits and nuts	Dried fruits for compote Nuts (hazelnuts, almonds, cashews, walnuts) Peanuts Dried apricots Raisins Canned fruits
Good8	Vegetable oils	Olive oil Sunflower oil
Good9	Margarine and similar products	Margarine
Good10	Processed liquid milk and cream	Ultra-pasteurized, sterilized milk Pasteurized milk Cream
Good11	Butter	Unsalted butter Vegetable butter

Good12	Cheese and cottage cheese	Cottage cheese (5–9% fat) Curd mass Rind cheese Hard cheese Processed cheese Brine cheese
Good13	Condensed milk and cream, with or without added sugar or other sweetening agents	Condensed milk with sugar Concentrated milk without sugar
Good14	Yogurt and fermented or squeezed milk and cream	Yogurt Kefir (2.5% fat) Sour cream Ryazhenka
Good15	Ice cream and food ice	Ice cream Sherbet
Good16	Flour	Premium plain wheat flour First grade wheat flour
Good17	Cereal, including rice	Semolina Buckwheat groats Oat groats Pearl barley Millet Corn grits Cereal flakes (breakfast cereals) Polished rice
Good18	Bread; cakes and confectionery products; sweet bakery products	Rye-wheat bread Wheat bread made of premium plain wheat flour Wheat bread made of first grade wheat flour Sliced loaf Muffins Cakes Rolls and cupcakes
Good19	Breadcrumbs and cookies; long-life confectionery products	Gingerbread Sugar cookies Cakes/brownies Waffles Sushki Shortbread cookies Croutons
Good20	Pasta, noodles, couscous, and similar flour products	Vermicelli Noodles

		Macaroni Spaghetti
Good21	Sugar	Granulated sugar Refined sugar
Good22	Chocolate and confectionery products made of chocolate and sugar	Toffee Caramel Chocolate glazed candies Unglazed chocolate candies Marshmallow Chocolate Marmalade
Good23	Tea and coffee	Soluble coffee Ground coffee beans Black tea Green tea
Good24	Vinegar, sauces, and mixed condiments	Ground red pepper Ground black pepper Mayonnaise Yeast Ready-made condiments and sauces Vinegar and vinegar essence Tomato ketchup Dry broths Tomato paste Soup concentrates Other spices
Good25	Food salt	Salt
Good26	Vodka and liqueur beverages	Vodka
Good27	Cognac and cognac beverages	Ordinary and vintage cognacs
Good28	Wine (excluding cider and grape must)	Table grape wines Fortified grape wines Champagne (sparkling) wines
Good29	Beer	Alcoholic beer
Good30	Mineral waters and soft drinks	Mineral water Drinking water Non-carbonated beverages Carbonated beverages
Good31	Cigarettes and papirosa	Filtered cigarettes

		Non-filtered cigarettes