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Model Calculations of Short-Run Forecasts of Russian Economic Time Series
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Introduction to All the Issues

This paper presents calculations of various economic indicators for the Russian Federation in the period from October 2015 to March 2016, which were performed using time series models developed as a result of research conducted by the Gaidar Institute over the past few years[1]. A method of forecasting falls within the group of *formal* or *statistical* methods. In other words, the calculated values neither express the *opinion* nor *expert evaluation* of the researcher, rather they are calculations of future values for a specific economic indicator, which were performed using formal ARIMA models (*p*, *d*, *q*) given a prevailing trend and its, in some cases, significant changes. The presented forecasts are of inertial nature, because respective models rely upon the dynamics of the data registered prior to the moment of forecasting and depend too heavily on the trends which are typical of the time series in the period immediately preceding the time horizon to be forecast. The foregoing calculations of future values of economic indicators for the Russian Federation can be used in making decisions on economic policy, provided that the general trends, which were seen prior to forecasting for each specific indicator, remain the same, i.e. prevailing long-term trends will see no serious shocks or changes in the future.

Despite that there is a great deal of data available on the period preceding the crisis of 1998, models of forecasting were analyzed and constructed using only the time horizon which followed August 1998. This can be explained by the findings of previous studies[2] which concluded, among other key inferences, that the quality of forecasts was deteriorated in most of the cases when the data on the pre-crisis period was used. Additionally, it currently seems incorrect to use even shorter series (following the crisis of 2008), because statistical characteristics of models based on such a short time horizon are very poor.

Models for the economic indicators in question were evaluated using standard methods of time series analysis. Initially, the correlograms of the studied series and their first differences were analyzed in order to determine the maximum number of delayed values to be included into the specifications of a model. Then, the results of analyzed correlograms served as the basis for testing all the series for weak stationarity (or stationarity around the trend) using the Dickey–Fuller test. In some cases, the series were tested for stationarity around the segmented trend using Perron and Zivot–Andrews tests for endogenous structural changes.[3]

The series were broken down into weak stationary, stationary near the trend, stationary near the trend with structural change or difference stationary, and then models, which corresponded to each type (regarding the levels and including, if necessary, the trend or segmented trend or differences), were evaluated. The Akaike and Schwartz information criteria, the properties of models' residuals (lack of autocorrelation, homoscedasticity and normality) and the quality of the in-sample-forecasts based on these models were used to choose the best model. Forecast values were calculated for the best of the models constructed for each economic indicator.

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[1] See, for example, R.M. Entov, S.M. Drobyshevsky, V.P. Nosko, A.D. Yudin. *The Econometric Analysis of the Time Series of the Main Macroeconomic Indices*. Moscow, IET, 2001; R.M. Entov, V.P. Nosko, A.D. Yudin, P.A. Kadochnikov, S.S. Ponomarenko. *Problems of Forecasting of Some Macroeconomic Indices*. Moscow, IET, 2002; V. Nosko, A. Buzaev, P. Kadochnikov, S. Ponomarenko. *Analysis of the Forecasting Parameters of Structural Models and Models with the Outputs of the Polls of Industries*. Moscow, IET, 2003; M.Yu. Turuntseva and T.R. Kiblitskaya, *Qualitative Properties of Different Approaches to Forecasting of Social and Economic Indices of the Russian Federation*. Moscow, IET, 2010.

[2] Ibid.

[3] See.: Perron, P. Further Evidence on Breaking Trend Functions in Macroeconomic Variables, *Journal of Econometrics*, 1997, 80, pp. 355-385; Zivot, E. and D.W.K. Andrews. Further Evidence on the Great Crash, the Oil-Price Shock, and Unit-Root Hypothesis. *Journal of Business and Economic Statistics*, 1992, 10, pp. 251–270.

Additionally, the Bulletin presents future monthly values of the CPI, which were calculated using models developed at the Gaidar Institute, and volumes of imports/exports from/to all countries, which were calculated using structural models (SM). The forecast values based on the structural models may, in some cases, produce better results than ARIMA-models do, because structural models are constructed by adding information of the dynamics of exogenous variables. Besides, the use of structural forecasts in making aggregated forecasts (i.e. forecasts obtained as average value from several models) may help make forecast values more accurate.

The dynamics of the Consumer Price Index was modeled using theoretical assumptions arising from the monetary theory. The following was used as explanatory variables: money supply, output volume, the dynamics of the ruble-dollar exchange rate which reflects the dynamics of alternative cost of money-keeping. The model for the Consumer Price Index also included the price index in the electric power industry, because the dynamics of manufacturers' costs relies heavily on this indicator.

The baseline indicator to be noted is the real exchange rate, which can influence the value of exports and imports, and its fluctuations can result in changes to the relative value of domestically-produced and imported goods, though the influence of this indicator turns out to be insignificant in econometric models. Global prices of exported resources, particularly crude oil prices, are most significant factors which determine the dynamics of exports: a higher price leads to greater exports of goods. The level of personal income in the economy (labor costs) was used to describe the relative competitive power of Russian goods. Fictitious variables D12 and D01 – equal to one in December and January and zero in other periods – were added so that seasonal fluctuations were factored in. The dynamics of imports is effected by personal and corporate incomes whose increase triggers higher demand for all goods including imported ones. The real disposable money income reflects the personal income; the Industrial Production Index reflects the corporate income.

The forecast values of foreign exchange rates were also calculated using structural models of their dependence on global crude oil prices.

The forecast values of explanatory variables, which are required for forecasting on the basis of structural models, were calculated using ARIMA models (p, d, q).

The paper also presents calculations of the values of the Industrial Production Index, the Producer Price Index and the Total Unemployment Index, which were calculated using the results of business surveys conducted by the Gaidar Institute. Empirical studies show[4] that the use of series of business surveys as explanatory variables [5] in forecasting models can make forecasting more accurate on the average. Future values of these indicators were calculated using ADL-models (seasonal autoregressive delays were added).

The Consumer Price Index and the Producer Price Index are also projected using large datasets (factor models – FM). The construction of factor models relies basically on the evaluation of the principal components of a large dataset of socio-economic indicators (112 indicators in this case). The lags of these principal components and the lags of the explanatory variable are used as explanatory variables in these models. A quality analysis of the forecasts obtained for different configurations of the factor models was used to chose a model for the CPI, which included 9th, 12th and 13th lags of the four principal components, as well as 1st and 12th lags of the variable itself, and a model for the PPI, which included 8th, 9th and 12th lags of the four principal components, as well as 1st, 3rd and 12th lags of the variable itself.

[4] See, for example: V. Nosko, A. Buzaev, P. Kadochnikov, S. Ponomarenko. *The Analysis of Forecasting Parameters of Structural Models and Models with Business Surveys' Findings*. Moscow, IEP, 2003.

[5] Used as explanatory variables were the following series of the business surveys: the current/expected change in production, the expected changes in the solvent demand, the current/expected price changes and the expected change in employment.

All calculations were performed using the Eviews econometric package.

Industrial Production and Retail Sales

Industrial production

For making forecast for October 2015 – March 2016, the series of monthly data of the indices of industrial production released by the Federal State Statistics Service (Rosstat) from January 2002 to August 2015, as well as the series of the base indices of industrial production released by the National Research University Higher School of Economics (NRU HSE[6]) over the period from January 1999 to August 2015 were used (the value of January 1995 was equal to 100%). The forecast values of the series were calculated on the basis of ARIMA-class models. The forecast values of the Rosstat and the NRU HSE indices of industrial production are calculated using business surveys (BS) as well. The obtained results are shown in Table 1.

Table 1

Calculations of forecast values of indices of industrial production[7] (%)

	Index of industrial production				IIP for mining		IIP for manufacturing		IIP for utilities (electricity, water, and gas)		IIP for food products		IIP for coke and petroleum		IIP for primary metals and fabricated metal products		IIP for machinery	
	Rosstat		NRU HSE															
	ARIMA	BS	ARIMA	BS	Rosstat	NRU HSE	Rosstat	NRU HSE	Rosstat	NRU HSE	Rosstat	NRU HSE	Rosstat	NRU HSE	Rosstat	NRU HSE	Rosstat	NRU HSE
Expected growth on the respective month of the previous year																		
October 2015	-4.7	-3.8	-3.0	-3.1	-0.9	0.0	-11.0	-5.6	-3.4	-3.6	3.2	2.3	2.0	0.7	-4.3	-4.6	-24.6	-13.6
November 2015	-3.5	-1.4	-1.6	-0.9	-1.8	-0.1	-9.8	-4.9	-2.9	-1.8	5.3	3.3	2.5	0.1	-4.7	-5.3	-13.3	-4.2
December 2015	-4.6	-3.5	-2.6	-2.5	-1.8	-0.9	-13.2	-7.0	1.5	1.4	6.6	4.9	2.1	0.0	-4.8	-6.5	-16.3	-12.9
January 2016	-0.5	-3.4	-2.5	-2.4	-1.8	-2.8	-11.1	-5.4	0.7	2.2	3.7	1.4	1.2	-1.6	-6.5	-2.7	-19.8	-7.9
February 2016	-0.6	-2.5	-0.8	-1.4	-0.3	-1.0	-10.4	-5.1	2.4	7.0	3.6	2.1	1.9	-0.8	-2.3	1.0	-9.9	-2.8
March 2016	-0.8	-2.6	-1.5	-1.1	0.6	-1.4	-9.4	-3.3	1.9	5.1	4.4	4.0	2.6	1.9	1.6	1.6	-8.4	-4.9
For reference: actual growth in 2014–2015 on the respective month of 2013-2014																		
October 2014	2.9		0.9		1.9	0.1	3.6	0.8	2.8	3.3	3.5	2.7	6.7	3.8	0.3	5.6	-9.6	-6.8
November 2014	-0.4		0.5		2.5	1.0	-3.0	-1.9	7.0	9.2	-1.8	-0.6	4.9	3.8	1.0	6.9	-17.0	-20.5
December 2014	3.9		1.8		3.0	1.4	4.1	1.7	3.4	2.8	-2.1	-1.7	3.6	2.9	4.4	7.1	1.2	-4.9
January 2015	0.9		0.2		1.5	1.5	-0.1	-0.1	1.2	-1.5	3.6	3.9	2.6	3.0	3.0	6.5	-9.3	-14.3
February 2015	-1.6		-1.7		0.1	0.6	-2.8	-2.1	-1.7	-5.0	4.6	5.3	3.3	2.1	-3.7	0.8	-12.8	-14.0
March 2015	-0.6		-1.6		0.4	1.4	-1.9	-3.9	0.8	-0.1	2.3	1.3	0.9	-1.5	-6.6	-1.0	-4.3	-13.0

Note: in the time spans under review, the series of the Rosstat and the NRU HSE chain indices of IIP, as well as the NRU HSE chain IIP for manufacturing are identified as stationary processes around the trend with an endogenous structural change; the series of the Rosstat and the NRU HSE chain IIPs for manufacturing, for primary metals and fabricated metal products, as well as the NRU HSE chain IIP for mining and Rosstat chain IIP for machinery and equipment are identified as stationary processes around the trend with two endogenous structural changes. The time series of other chain indices are stationary at levels.

As seen from *Table 1*, the average[8] decline of the industrial production index computed by NRU HSE over October 2015 – March 2016 amounts to 2.0% compared to the same period of the previous year on industry as a whole. The Rosstat industrial production index comes to 2.7%. As of end-2015, forecast annual decline of the Rosstat industrial production index will come to 4.1%, and the NRU HSE industrial production index – 2.6%.

[6] The indices in question are calculated by E.A. Baranov and Vladimir Bessonov.

[7] It is to be noted that for making of forecasts so-called "raw" indices (without seasonal and calendar adjustment) were used and for that reason in most models existence of the season factor is taken into account and, as a consequence, the obtained outputs reflect the seasonal dynamics of the series.

[8] The average growth of industrial production indices is understood here as the average value of the said indices for six forecast months.

Average monthly values of industrial production index for mining and quarrying of Rosstat and NRU HSE for October 2015 – March 2016 will come to -1.0% for both indices. In manufacture of coke and petroleum products, average growth is forecast at 2.0% and 0.0% for the Rosstat and the NRU HSE indices, respectively.

The average decline of the NRU HSE industrial production index for manufacturing industry in October 2015 – March 2016 in comparison with the same period last year is forecast at 5.2%, and the Rosstat index – 10.8%. Average monthly values of the Rosstat and NRU HSE industrial production index for manufacture of food products come to 4.5% and 3.0%, respectively. Average monthly values of industrial production index for basic metals and fabricated metal products in October 2015 – March 2016 computed by Rosstat and NRU HSE constitute -3.5% and -2.7%, respectively. In manufacture of machinery and equipment average decrease is forecast at 15.4% and 7.7% for the Rosstat and NRU HSE indices, respectively.

Average growth of industrial production index for electricity, gas and water supply computed by Rosstat constitutes 0.1% for October 2015 – March 2015 compared to the same period last year, the same indicator for NRU HSE index comes to 1.7%.

Decline of the indices of industrial production across types for economic activity computed by Rosstat will average (on types of activity) 3.6% in 2015 and for the NRU HSE index – 2.9%.

Retail Sales

This section (Table 2) presents forecasts of monthly retail sales made on the basis of monthly Rosstat data over January 1999 – August 2015.

As seen from *Table 2*, average projected increment of the monthly trade turnover over the period from October 2015 to March 2016 against the corresponding period of 2014–2015 amounts to about 2.0%.

Average projected decrease of the monthly real turnover constitutes 9.7% for October 2015 – March 2016 against the corresponding period of 2014–2015.

Projected increment of the nominal indicator of retail turnover will constitute 5.4% and in real terms – down 9.1% at an annualized rate.

Table 2

Calculations of forecast values of the retail sales and the real retail sales

Forecast value according to ARIMA-model		
	Retail sales, billion Rb (in brackets – growth on the respective month of the previous year, %)	**Real retail sales (as % of the respective period of the previous year)**
October 2015	2,428.7 (5.1)	89.0
November 2015	2,444.5 (4.3)	88.4
December 2015	3,113.7 (5.4)	88.3
January 2016	2,075.5 (0.6)	90.2
February 2016	2,035.5 (0.2)	92.4
March 2016	2,247.8 (1.9)	93.4
For reference: actual values in the same months of 2014		
October 2014	2,310.9	101.7
November 2014	2,343.6	101.9
December 2014	2,954.8	105.1
January 2015	2,063.7	96.4
February 2015	2,031.9	93.0

March 2015	2,206.8	91.5

Note: the series of retail sales and real retail sales over January 1999 – August 2015.

Investments in Capital Assets

Table 3 presents the outputs of calculations of forecast values of investment in capital assets in October 2015 – March 2016. The forecasts were made on the basis of time-series models using the data released by Rosstat over January 1999 – August 2015.

Table 3

Calculations of forecast values of investments in capital assets and real investments in capital assets

Forecast values according to ARIMA-model		
	Investments in capital assets, billion Rb (in brackets – growth on the respective month of the previous year, %)	**Real investments in capital assets (as % of the respective period of the previous year)**
October 2015	1,535.1 (4.5)	91.6
November 2015	1,423.1 (3.7)	91.4
December 2015	2,601.9 (6.9)	91.2
January 2016	5,03.7 (-2.6)	91.4
February 2016	6,75.8 (-0.7)	91.5
March 2016	794.3 (2.9)	91.2
For reference: actual values in the same months of 2014		
October 2014	1,468.5	99.2
November 2014	1,372.5	92.2
December 2014	2,433.3	98.9
January 2015	516.9	96.1
February 2015	680.7	95.7
March 2015	772.1	97.3

Note: the series of investments in capital assets over the period from January 1999 to August 2015 are series of DS type.

Results presented in *Table 3* show that the average forecast increment of the investment in capital assets (in nominal terms) over October 2015 – March 2016 against the corresponding period of 2014–2015 constitute about 2.5%.

Average projected reduction of the real investment in October 2015 – March 2016 comes to 9.3%.

Annual increment of the nominal investment index in fixed assets in 2015 will amount to 6.9%. The decrease of the share of real investment in fixed assets is forecast at 6.6%.

Foreign Trade Indices

Model calculations of forecast values of the export and export to countries outside the CIS and the import and import from countries outside the CIS were made on the basis of the models of time series and structural models evaluated on the basis of the monthly data over the period from September 1998 to Augusr 2015 on the basis of the data released by the Central Bank of Russia[9]. The results of calculations are shown in Table 4.

Forecast average growth of export, import, export outside CIS and import from the countries outside CIS for October 2015 – March 2015 against the same period 2014 will amount to -24.8%, 26.7%, 33.7% and 35.8%, respectively. Projected average surplus volume of the trade balance with all countries for October 2015 – March 2016 will constitute $ 67.3bn which corresponds to a contraction of 22.2% on the same period 2014–2015.

[9] The data on the foreign trade turnover is calculated by the CBR in accordance with the methods for making of the balance of payment in prices of the exporter-country (FOB) in billion USD.

Table 4.1

Calculations of forecast values of volumes of foreign trade turnover with countries outside the CIS

Month	Export to all countries				Import from all countries				Export to countries outside the CIS				Import from countries outside the CIS			
	Forecast values (billion USD a month)		Percentage of actual data in the respective month of the previous year		Forecast values (billion USD a month)		Percentage of actual data in the respective month of the previous year		Forecast values (billion USD a month)		Percentage of actual data in the respective month of the previous year		Forecast values (billion USD a month)		Percentage of actual data in the respective month of the previous year	
	ARIMA	SM	ARIMA	SM	ARIMA	SM	ARIMA	SM	ARIMA	SM	ARIMA	SM	ARIMA	SM	ARIMA	SM
October 2015	25.8	26.7	62	64	16.3	16.7	61	62	19.1	22.0	53	61	12.8	12.0	53	50
November 2015	25.9	27.5	70	75	19.0	15.5	82	67	18.8	22.0	60	70	13.8	11.6	68	57
December 2015	28.2	29.1	74	76	17.4	16.6	71	68	20.7	21.8	64	67	15.5	13.2	70	60
January 2016	21.9	23.9	79	86	11.5	11.2	93	90	15.4	17.7	63	72	6.9	7.5	64	69
February 2016	23.5	23.6	81	81	12.1	11.7	78	75	16.8	19.6	67	78	9.8	10.7	71	77
March 2016	26.5	27.5	81	84	14.7	12.7	85	74	20.1	22.0	71	77	13.1	10.0	85	65
For reference: actual values in respective months of 2014–2015 (billion USD)																
October 2014	41.5				26.8				36.2				24.0			
November 2014	36.8				23.1				31.5				20.5			
December 2014	38.4				24.5				32.5				22.1			
January 2015	27.7				12.4				24.4				10.8			
February 2015	29.2				15.6				25.0				13.9			
March 2015	32.6				17.3				28.4				15.4			

Note: over the period from January 1999 to August 2015, the series of export, import, export to the countries outside the CIS and import from the countries outside the CIS were identified as stationary series in the first-order differences. In all the cases, seasonal components were included in the specification of the models.

Dynamics of Prices

The Consumer Price Index and Producer Price Index

This section presents calculations of forecast values of the consumer price index and producer price index (as regards both the industry in general and some types of its activities under the National Industry Classification Standard (NICS)) made on the basis of the time-series models evaluated on the basis of the data released by Rosstat over the period from January 1999 to July 2015.[10] *Table 5 presents the results of model calculations of forecast values over October 2015 and November 2016 in accordance with ARIMA models, structural models (SM) and models computed with the help of business surveys (BS).*

Table 5

Calculations of forecast values of price indices

Month	The consumer price index (ARIMA)	The consumer price index (SM)	The consumer price index (FM)	Producer price indices: for industrial goods (ARIMA)	for industrial goods (BS)	for industrial goods (FM)	for mining and quarrying	for manufacturing	for utilities (electricity, water, and gas)	for food products	for textile and sewing industry	for wood products	for pulp and paper industry	for coke and refined petroleum	for chemical industry	for basic metals and fabricated metal	for machinery and equipment	for transport equipment manufacturing
Forecast values (% of the previous month)																		
October 2015	100.9	100.9	100.6	100.1	100.1	98.6	101.6	101.4	99.7	101.0	100.5	100.6	100.4	101.4	101.2	101.6	100.8	100.7
November 2015	101.0	100.8	100.7	100.3	100.1	98.8	101.7	100.9	100.6	101.1	100.6	100.7	100.0	101.1	101.1	102.3	101.0	100.9
December 2015	101.0	101.1	100.9	100.8	99.9	98.7	103.2	100.2	101.0	101.0	100.2	101.2	100.6	101.4	100.2	102.5	100.9	100.3
January 2016	101.8	101.4	102.2	100.9	100.3	100.0	100.9	101.0	100.5	100.8	100.7	101.4	100.6	100.8	100.9	102.1	101.5	101.1
February 2016	101.0	101.3	101.3	101.3	100.0	102.6	102.4	101.9	101.0	100.8	100.7	101.1	100.7	101.6	101.1	101.4	101.4	99.9
March 2016	100.5	101.1	101.1	101.7	100.9	102.4	102.4	101.8	101.1	100.2	100.6	100.9	100.6	102.6	101.7	100.9	100.7	100.9
Forecast values (% of December 2014/2015)																		
October 2015	111.8	111.7	111.2	114.4	112.1	113.0	135.7	117.0	104.2	111.9	111.6	108.6	115.4	123.8	118.4	116.8	112.8	116.3
November 2015	113.0	112.5	111.9	114.7	112.2	111.7	138.0	118.0	104.9	113.2	112.3	109.4	115.4	125.2	119.6	119.5	113.9	117.3
December 2015	114.2	113.7	112.9	115.6	112.1	110.2	142.4	118.3	105.9	114.3	112.5	110.6	116.1	127.0	119.9	122.5	114.9	117.6
January 2016	101.8	101.4	102.2	100.9	100.3	100.0	100.9	101.0	100.5	100.8	100.7	101.4	100.6	100.8	100.9	102.1	101.5	101.1
February 2016	102.9	102.6	103.5	102.2	100.3	102.6	103.3	102.9	101.5	101.6	101.4	102.5	101.3	102.4	102.0	103.5	102.9	100.9
March 2016	103.4	103.7	104.7	104.0	101.2	105.1	105.8	104.8	102.6	101.8	102.0	103.4	101.8	105.0	103.8	104.4	103.6	101.8
For reference: actual values in the same periods of 2014-2015 (% of December 2013/2014)																		
October 2014	107.1			105.4			100.9	107.4	103.8	110.2	103.3	102.2	102.3	112.2	108.9	108.7	106.9	103.8
November 2014	108.5			104.9			96.2	108.2	103.8	111.9	104.1	101.7	102.1	110.8	109.1	110.4	110.0	104.7
December 2014	111.3			105.7			98.4	108.5	104.6	115.2	106.0	103.1	103.1	102.0	110.6	114.6	111.8	105.9
January 2015	103.9			101.3			97.3	102.7	100.1	104.3	103.5	101.9	104.3	96.1	104.2	107.3	103.5	102.5
February 2015	106.2			103.4			97.5	106.0	99.2	107.7	107.0	105.1	106.0	98.2	108.9	113.2	106.1	104.0
March 2015	107.5			109.1			114.7	109.2	101.3	109.0	108.5	107.4	109.3	107.2	110.7	118.9	105.9	105.0

Note: over the period from January 1999 to July 2015, the series of the chain producer price index for machinery are identified as a stationary process around the trend with two endogenous structural changes. The series of other chain price indices are stationary at levels.

Forecast average monthly growth of the consumer price index in October 2014 – March 2016 will come to 1.1%. Price growth of industrial goods manufacturers for this period is forecast at an average monthly rate of 0.4%. Annual growth of the consumer price index across three models will average 13.6%. The same indicator for the producer price index is forecast at 12.6%.

For the producer price index across types of economic activity from October 2015 to March 2016, the following average monthly growth rates are forecast: in mining and quarrying 2.0%, manufacturing 1.2%, electricity, gas and water production and supply 0.6%, manufacture of food products 0.8%, manufacture of textiles and textile products 0.5%, manufacture of wood

[10] Structural models were evaluated in the period from October 1998.

and wood products 1.0%, manufacture of pulp, paper and paper products 0.5%, manufacture of coke and refined petroleum products 1.5%, manufacture of chemical products 1.0%, manufacture of basic metals and fabricated metal products 1.8%, manufacture of machinery and equipment 1.1% and manufacture of means of transport and transport equipment 0.6%.

Annual growth of the producer price index across types of economic activity will average 18.5%. By end-2015, maximum annual increment is forecasted for mining and quarrying (42.4%) and minimum index growth – for electricity, gas and water production and supply (5.9%).

The Cost of the Monthly per Capita Minimum Food Basket

This section presents calculations of forecast values of the cost of the monthly per capita minimum food basket over October 2015 – March 2016. The forecasts were made based on time series with use the Rosstat data over the period from January 2000 to July 2015. The results are shown in Table 6.

Table 6

The forecast of the cost of the monthly per capita minimum food basket

Forecast values according to ARIMA-model (Rb)	
October 2015	3,834.7
November 2015	3,910.0
December 2015	4,000.3
January 2016	4,109.9
February 2016	4,171.8
March 2016	4,188.0
For reference: actual values in the same months of 2014–2015 (billion Rb)	
October 2014	3,043.7
November 2014	3,139.4
December 2014	3,297.9
January 2015	3,592.5
February 2015	3,730.0
March 2015	3,774.3
Expected growth on the respective month of the previous year (%)	
October 2015	26.0
November 2015	24.5
December 2015	21.3
January 2016	14.4
February 2016	11.8
March 2016	11.0

Note: the series of the cost of the monthly per capita minimum food basket over the period from January 2000 to July 2015 are stationary in the first-order differences.

As can be seen from *Table 6*, cost growth of the monthly per capita minimum food basket is projected compared with the corresponding period of the previous year. Herewith, forecast cost of the monthly per capita minimum food basket constitutes nearly Rb 4,035.8. By end-2015, growth of the cost of the monthly per capita minimum food basket will constitute 21.3%.

Indices of Freight Rates

This section presents calculations of forecast values of freight rate indices on cargo carriage,[11] made on the basis of time-series models evaluated on the Rosstat data over the period from September 1998 to July 2015. Table 7 shows the results of model calculations of projected values in October 2015 – March 2016. It should be noted that

[11] The paper presents a review of the composite freight rate index on freight transport and the truckload freight rate index, as well as the pipeline rate index. The composite freight rate index is computed on the basis of the freight rate indices by individual types of transport: rail, pipeline, shipping, domestic water-borne, truckload freight and air service (for more detailed information, pls. refer, for instance, to: *Prices in Russia*. The Official Publication of Goskomstat of RF, 1998).

some of the indices under review (for instance, the pipeline rate index) are adjustable ones and for that reason their behavior is hard to describe by means of the time-series models. As a result, the future values may differ greatly from the real ones in case of the centralized increase of rates in the period of forecasting or in case of absence of such an increase in the forecasting period, but with it taking place shortly before the beginning of that period.

Table 7

Calculations of forecast values of indices of freight rates

Period	The composite freight rate index	The index of truckload freight rate	The index of pipeline rate
Forecast values according to ARIMA-models (% of the previous month)			
October 2015	100.4	100.1	100.4
November 2015	100.4	100.0	103.1
December 2015	100.4	100.0	102.6
January 2016	104.8	101.7	100.3
February 2016	100.4	100.0	100.7
March 2016	100.4	100.0	103.0
Forecast values according to ARIMA-models (% of December of the previous year)			
October 2015	117.6	102.6	125.1
November 2015	118.1	102.7	129.0
December 2015	118.5	102.7	132.4
January 2016	104.9	101.8	102.6
February 2016	105.3	101.8	103.4
March 2016	105.7	101.7	106.4
For reference: actual values in the same period of 2014–2015 (% of the previous month)			
October 2014	94.9	100.2	89.9
November 2014	100.4	101.1	100.3
December 2014	101.3	102.3	100.8
January 2015	104.0	103.4	100.5
February 2015	101.2	101.4	100.0
March 2015	99.9	98.9	99.9

Note: over the period from September 1998 to July 2015, the series of the freight rates index were identified as stationary ones; the other series were identified as stationary ones over the period from September 1998 to June 2015, too; fictitious variables for taking into account particularly dramatic fluctuations were used in respect of all the series.

According to the forecast results for October 2015 – March 2015, the composite freight rate index will be growing at an average monthly rate of 1.1%. As a result, its annual growth in 2015 will constitute 18.5%.

Truckload freight rate index will be growing by a monthly average rate of 0.3%. In 2015, annual growth of this indicator will constitute 2.7%.

Pipeline rate index will also be growing over the coming six months at an average monthly rate of 1.7%. As a result, its annual growth will constitute 32.4% in 2015.

World Prices of Natural Resources

This section presents calculations of such average monthly values of Brent crude prices (US$ per barrel), the aluminium prices (US$ per ton), the gold prices ($ per ounce), the copper prices (US$ per ton) and the nickel prices (US$ per ton) over October 2015 – March 2016 as were received on the basis of nonlinear models of time series evaluated on the basis of the IMF data over the period from January 1980 to August 2015.

Table 8

Calculations of forecast values of world prices on natural resources

Month	Brent oil ($ per barrel)	Aluminum ($ per ton)	Gold ($ per ounce)	Copper ($ per ton)	Nickel ($ per ton)
Forecast values					
October 2015	45.80	1481	1127	4726	9865
November 2015	49.21	1450	1120	4588	9734
December 2015	43.04	1439	1111	4472	9630
January 2016	47.45	1431	1121	4365	9594
February 2016	42.49	1418	1135	4266	9632
March 2016	48.54	1415	1142	4179	9735
Expected growth on the respective month of the previous year (%)					
October 2015	-47.5	-23.9	-7.8	-29.9	-37.6
November 2015	-37.3	-29.4	-4.8	-31.6	-38.4
December 2015	-30.8	-24.7	-7.6	-30.6	-39.7
January 2015	-2.0	-21.2	-10.4	-25.1	-35.4
February 2015	-26.7	-22.0	-7.6	-25.5	-33.9
March 2015	-13.0	-20.2	-3.1	-29.6	-29.2
For reference: actual values in the same period of 2014-2015					
October 2014	87.27	1946	1222	6737	15812
November 2014	78.44	2056	1176	6713	15807
December 2014	62.16	1909	1202	6446	15962
January 2015	48.42	1815	1252	5831	14849
February 2015	57.93	1818	1227	5729	14574
March 2015	55.79	1774	1179	5940	13756

Note: over the period from January 1980 to August 2015, the series of prices of crude oil, nickel, gold, copper and aluminum are series of DS type.

The average forecast crude price amounts to about $46.1 per barrel which is on average 26.2% below its year-earlier level. Aluminum prices are forecasted at about $1,439.0 per ton and their average forecasted reduction constitutes about 20% compared to the same level last year. Forecast gold prices constitute about $1,125.0 per ounce. Average forecast copper prices constitute about $4,433.0 per ton and prices of nickel prices – about $9,698 per ton. Average forecast price fall on gold constitutes about 7%, average reduction of copper prices – about 29%, average reduction of nickel prices – 36% compared to the corresponding level last year.

As of end-2015, forecasted decline of crude oil prices compared to end-2014 will constitute almost 31.0%. Similar decline of prices of aluminum, gold, copper and nickel by the year-end are forecast at 24.7%, 7.6%, 30.6% and 39.7%, respectively.

Monetary Indices

The future values of the monetary base (in the narrow definition: cash funds and the Fund of Mandatory Reserves (FMR)) and M_2 monetary aggregate over the period from October 2015 to March 2016 were received on the basis of models of time-series of respective indices calculated by the CBR[12] over the period from October 1998 to September (July – for M2 time series) 2015. Table 9 presents the results of calculations of forecast values and actual values of those indices in the same period of previous year. It is to be noted that due to the fact that the monetary base is an instrument of the CBR policy, forecasts of the monetary base on the basis of time-series models are to a certain extent notional as the future value of that index is determined to a great extent by decisions of the CBR, rather than the inherent specifics of the series.

Table 9

The forecast of M_2 and the monetary base

Period	The Monetary base	M_2

[12] The data on the specific month is given in accordance with the methods of the CBR as of the beginning of the following month.

	Billion Rb	Growth on the previous month, %	Billion Rb	Growth on the previous month, %
October 2015	8,021	-0.5	33,253	0.6
November 2015	8,202	2.3	33,449	0.6
December 2015	8,144	-0.7	34,447	3.0
January 2016	8,651	6.2	34,075	-1.1
February 2016	8,271	-4.4	34,270	0.6
March 2016	8,456	2.2	34,466	0.6
For reference: actual value in the respective months of 2014–2015 (growth on the previous month, %)				
October 2014	-0.4		-1.2	
November 2014	0.7		1.2	
December 2014	-0.9		4.8	
January 2015	11.1		-2.1	
February 2015	-12.0		0.9	
March 2015	-0.6		-0.3	

Note: over the period from October 1998 to September (July) 2015, all the time series of monetary indices were attributed to the class of series which are stationary in the first-order differences and have an explicit seasonal component.

Over October 2015 – March 2016, the forecast average monthly growth of the monetary base will constitute 0.9%, and money indicator M2 – at the average monthly rate of 0.7%. By year-end, the money base is forecast to move down by 1.0%. Projected annual growth on M2 will equal 12.5%.

International Reserves

This section presents the outputs of the statistical estimation of such future values of the international reserves of the Russian Federation[13] as were received on the basis of evaluation of the model of time series of the gold and foreign exchange reserves on the basis of the data released by the CBR over the period from October 1998 to August 2015. That index is forecast without taking into account a decrease in the amount of reserves due to foreign debt payment and for that reason the values of the volumes of the international reserves in the months where foreign debt payments are made may happen to be overestimated (or, otherwise, underestimated) as compared to the actual ones.

Subsequent to the forecast results over October 2015 – March 2016, international reserves will be falling by average monthly rate of 4.2%. In late 2015, the decline of the international reserves is forecast at 25.4%.

Table 10

The forecast of the international reserves of the Russian Federation

Period	Forecast values according to ARIMA-model	
	Billion USD	Growth on the previous month, %
October 2015	344.1	-2.4
November 2015	328.6	-4.5
December 2015	312.4	-4.9
January 2016	300.1	-4.0
February 2016	288.1	-4.0
March 2016	272.7	-5.3
For reference: actual values in the same period of 2014–2015		
	Billion USD	**Growth on the previous month. %**
October 2014	454.2	-2.3

[13] The data on the volume of the gold and foreign exchange reserves is presented as of the first day of the following month.

November 2014	428.6	-5.6
December 2014	418.9	-2.3
January 2015	385.5	-8.0
February 2015	376.2	-2.4
March 2015	360.2	-4.2

Note: over the period from October 1998 to August 2015, the series of the gold and foreign exchange reserves of the Russian Federation were identified as stationary series in difference.

Foreign Exchange Rates

The model calculations of prospective values of the foreign exchange rates (RUR per USD and USD per euro) were made on the basis of assessment of the time series models (ARIMA) and structural models (SM) of the relevant indicators released by the Central Bank of Russia as of the last date of each month over the periods from October 1998 to September 2015 and from January 1999 to September 2015[14], respectively.

USD/RUR exchange rate during the reviewed period is projected along two models in the amount of Rb 66.85 for USD. By end-2015, forecast indicator will come to Rb 66.69 for USD on average along two models.

Euro/USD exchange rate is projected at USD1.13 per 1 euro. By end-2015, this indicator is projected at USD1.12 per 1 euro on average along two models.

Table 11

Forecasts of the USD/RUR and EUR/USD exchange rates

Period	The USD/RUR exchange rate (RUR per USD)		The EUR/USD exchange rate (USD per EUR)	
	ARIMA	SM	ARIMA	SM
October 2015	67.06	66.35	1.12	1.13
November 2015	66.22	65.08	1.12	1.13
December 2015	66.77	66.60	1.12	1.12
January 2016	67.22	66.42	1.12	1.13
February 2016	67.67	67.46	1.12	1.12
March 2016	68.13	67.20	1.12	1.14
For reference: actual values in the similar period of 2014–2015				
October 2014	43.39		1.25	
November 2014	49.32		1.25	
December 2014	56.26		1.22	
January 2015	68.93		1.12	
February 2015	61.27		1.12	
March 2015	58.46		1.07	

Note: over the respective periods, the series under review were identified as integrated series of the first order with a seasonal component.

The Living Standard Indices

This section (Table 12) presents calculations of forecast values of indices of real wages, real disposable income and real income [15] as were received on the basis of the model of time series of respective indices computed by Rosstat and taken over the period from January 1999 to July 2015. The above indices depend to a certain extent on the centralized decisions on raising of wages and salaries to public sector workers, as well as those on raising of pensions, scholarships and allowances; such a situation introduces some changes in the dynamics of the indices under review. As a result, the future values of the indices of real wages and real disposable income calculated on

[14] The authors use the IMF data over the period from January 1999 to July 2015. The data over the period from August to September 2015 was obtained from the foreign exchange rate statistics website: www.oanda.com

[15] *Real cash income* is a relative index which is calculated by means of division of the index of the nominal size (which was actually formed in the period under review) of households' cash income by the CPI. *Real disposable cash income* is cash income minus mandatory payments and contributions. (See: Rossiisky Statistichesky Ezhegodnik, Moscow, Rosstat, 2004, p. 212).

the basis of the series which last observations are either considerably higher or lower than the previous ones due to such a raising may differ greatly from those which are implemented in reality.

According to the results presented in *Table 12*, in October 2015 – March 2016, the real disposable income will be on average growing by 0.2% a month. Real money income will be declining at the average monthly rate 0.5% against the corresponding period last year. The real gross payroll will be moving down by 0.9% against the corresponding period last year

By end-2015, projected decline of real disposable money income will constitute 0.9%, real money income – 3.5%, real accrued wages – 6.5%.

Table 12

The forecast of the living standard indices

Period	Real disposable money income	Real money income	Real accrued wages
Forecast values according to ARIMA-models (% of the respective month of 2014–2015)			
October 2015	98.8	97.6	86.8
November 2015	98.6	97.8	88.2
December 2015	100.1	99.6	87.0
January 2016	101.0	100.3	92.4
February 2016	100.8	100.2	91.9
March 2016	101.8	101.4	94.8
For reference: actual values in the respective period of 2014–2015 (% of the same period of 2013–2015)			
October 2014	102.1	101.8	100.6
November 2014	96.2	96.4	98.8
December 2014	93.8	93.9	96.0
January 2015	99.3	98.2	91.6
February 2015	98.4	96.9	92.6
March 2015	98.4	97.2	89.4

Note: for calculating purposes, the series of the real disposable money income, real money income and real accrued wages in the base form were used (March 1999 was adopted as a base period). Over the period from January 1999 to August 2015, those series were attributed to the class of processes which are stationary in differences and have an explicit seasonal component.

Employment and Unemployment

For the purpose of calculation of the future values of the employment (of the number the gainfully employed population) and the unemployment (the total number of the unemployed), models of the time series evaluated over the period from October 1998 to July 2015 on the basis of the monthly data released by Rosstat[16] were used. The unemployment was calculated on the basis of the models with results of the findings from business surveys[17], too.

It is to be noted that feasible logical inconsistencies[18] in forecasts of employment and unemployment which totals should be equal to the index of economically active population may arise due to the fact that each series is forecast individually and not as a difference between the forecast values of the economically active population and another index.

Table 13

Calculation of forecast values of the indices the employment and the unemployment

Month	Employment (ARIMA)	Unemployment (ARIMA)	Unemployment (BS)

[16] The index is computed in accordance with the methods of the International Labor Organization (ILO) and is given as of the month-end.

[17] The model is evaluated over the period from January 1999 to July 2015.

[18] For example, deemed as such a difference may be a simultaneous decrease both in the employment and the unemployment. However, it is to be noted that in principle such a situation is possible provided that there is a simultaneous decrease in the number of the economically active population.

	Million people	Growth on the respective month of previous year (%)	Million people	Growth on the respective month of previous year (%)	% of the index of the number of the gainfully employed population	Million people	Growth on the respective month of previous year (%)	% of the index of the number of the gainfully employed population
October 2015	71.5	-0.7	4.2	7.4	5.9	4.1	5.5	5.7
November 2015	71.3	-0.4	4.3	9.3	6.0	4.2	5.4	5.9
December 2015	70.9	-0.8	4.4	9.4	6.2	4.2	4.6	5.9
January 2016	71.1	-1.0	4.6	9.5	6.5	4.2	1.2	5.9
February 2016	70.9	-0.7	4.7	6.4	6.6	4.2	-3.8	5.9
March 2016	71.3	-0.4	4.6	1.9	6.4	4.2	-7.1	5.9
For reference: actual values in the same periods of 2014–2015 (million people)								
October 2014	72.0		3.9					
November 2014	71.6		3.9					
December 2014	71.4		4.0					
January 2015	71.8		4.2					
February 2015	71.4		4.4					
March 2015	71.6		4.5					
April 2015	71.4		4.4					

Note: over the period from October 1998 to July 2015, the series of employment is a stochastic process which is stationary around the trend. The series of unemployment is a stochastic process with the first order integration. Both indices include seasonal component.

According to ARIMA-model forecasting (*Table 13*) in October 2015 – March 2016, the number of employed in the economy will move down on average by 0.7% monthly against the corresponding period of the previous year. By end-2015, the forecast index of employed in the economy constitutes 70.9 million persons.

Average increment of total number of unemployed is projected at 4.1% per month against the corresponding period of last year. To note significant difference in forecast along two models: ARIMA model forecasts further unemployment growth meanwhile, business survey (BS) model forecasts somewhat stabilization of this indicator against last year level. The number of unemployed by end-2015 is forecast at the level of 4.3 million persons.

Annex. Diagrams of the Time Series of the Economic Indices of the Russian Federation

Fig. 1a. The Rosstat industrial production index (ARIMA-model) (% of December 2001)

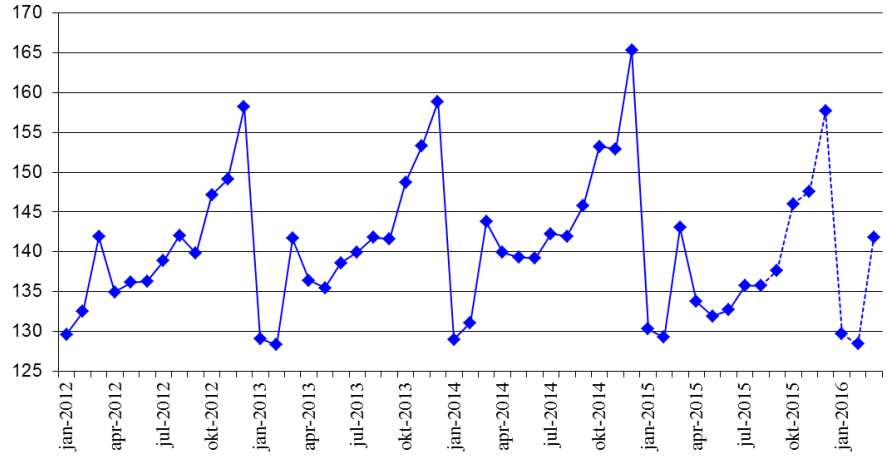


Fig. 1b. The NRU HSE industrial production index (ARIMA-model) (% of January 2005)

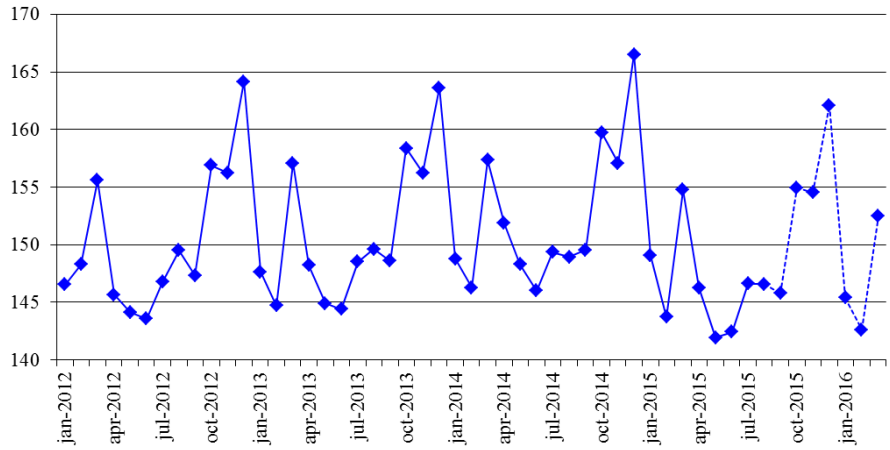


Fig. 2a. The Rosstat industrial production index for mining (% of December 2001)

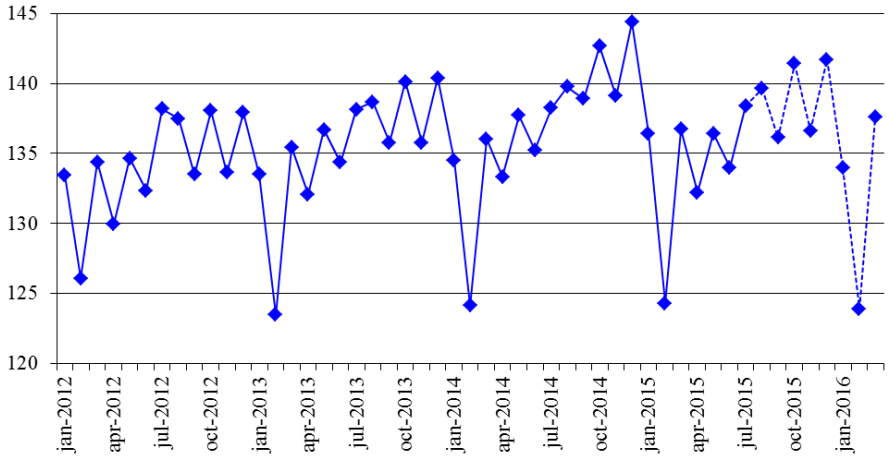


Fig. 2b. The NRU HSE industrial production index for mining (% of January 2005)

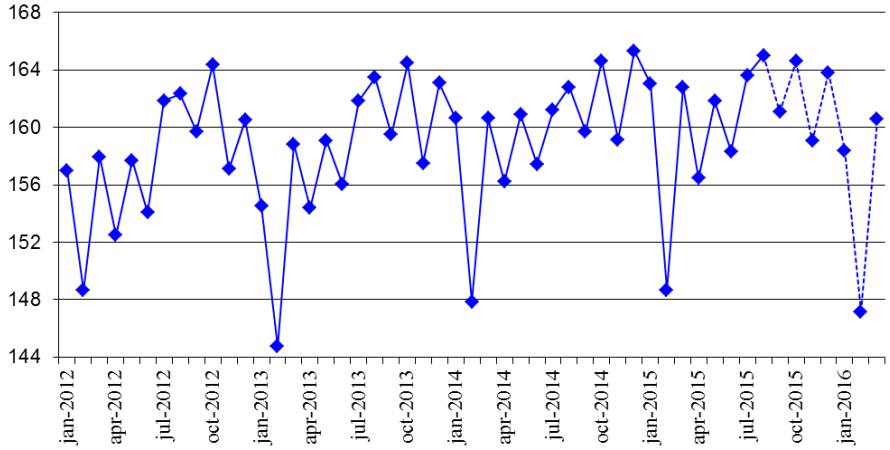


Fig. 3a. The Rosstat industrial production index for manufacturing (% of December 2001)

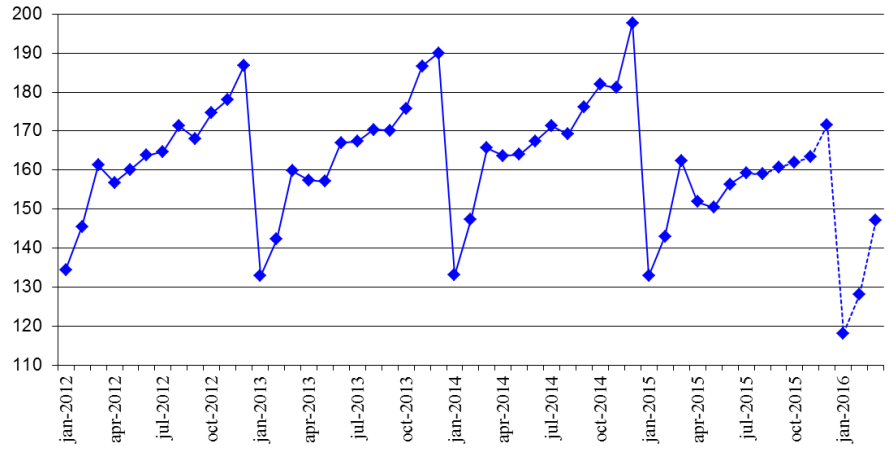


Fig. 3b. The NRU HSE industrial production index for manufacturing (% of January 2005)

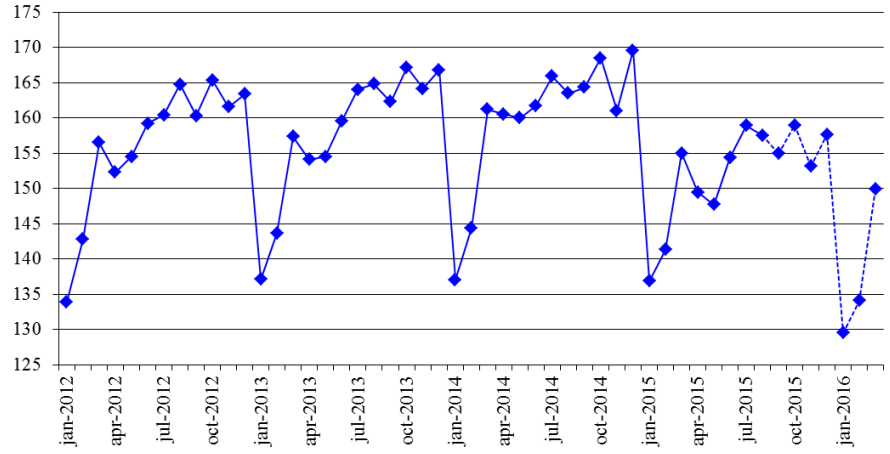


Fig. 4a. The Rosstat industrial production index for utilities (electricity, water, and gas)
(as a percentage of that in December 2001)

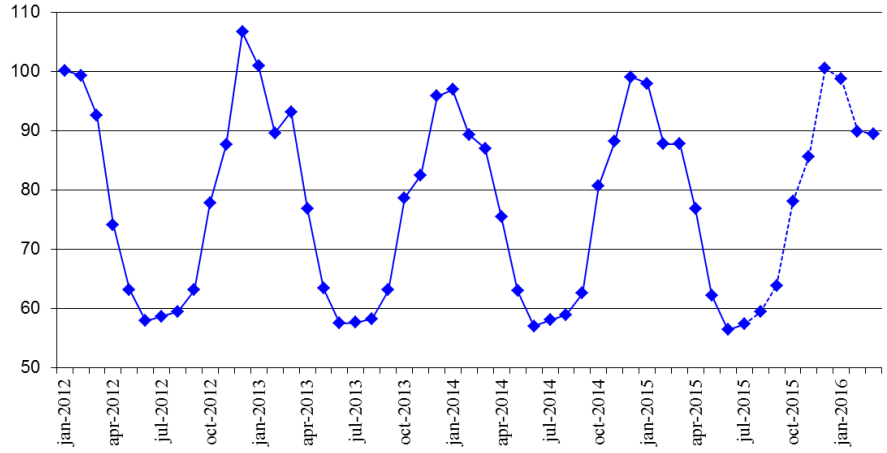


Fig. 4b. The NRU HSE industrial production index for utilities (electricity, water, and gas)
(as a percentage of that in January 2005)

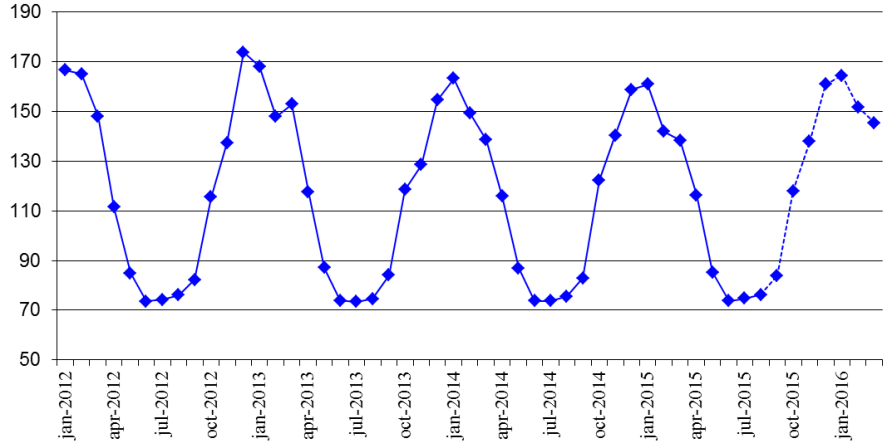


Fig. 5a. The Rosstat industrial production index for food products
(as a percentage of that in December 2001)

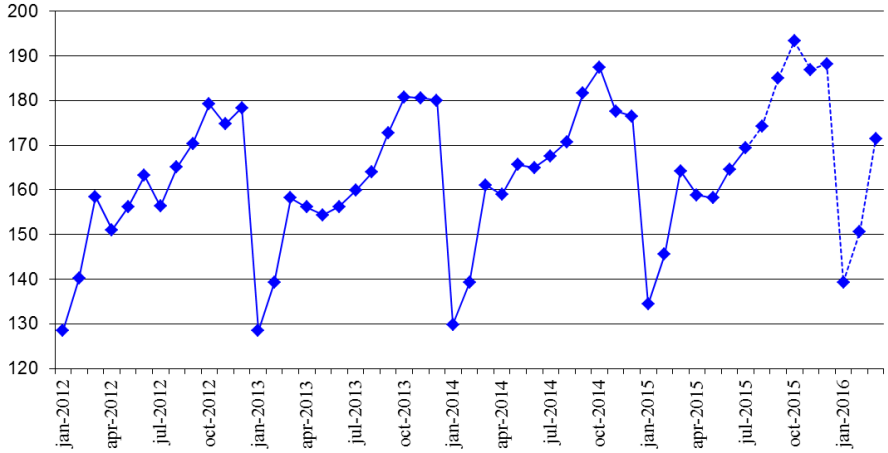


Fig. 5b. The NRU HSE industrial production index for food products
(as a percentage of that in January 2005)

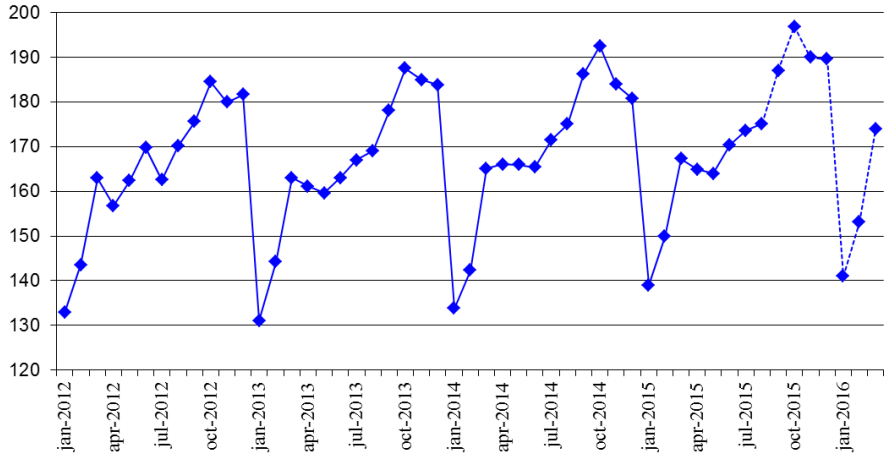


Fig. 6a. The Rosstat industrial production index for coke and petroleum
(as a percentage of that in December 2001)

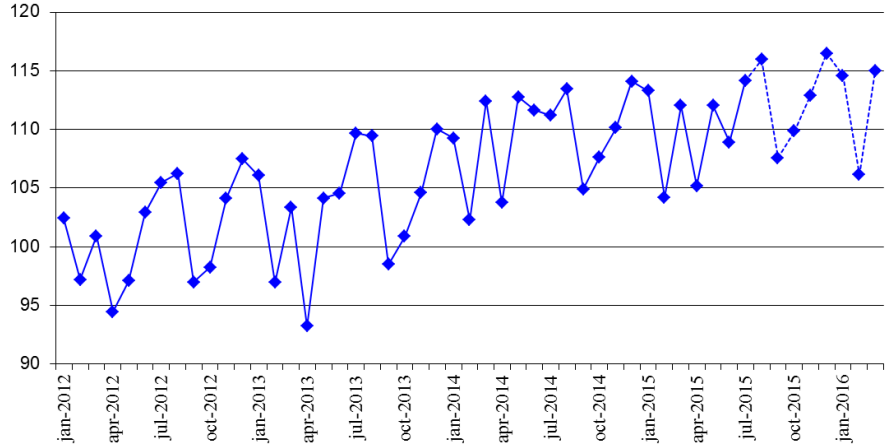


Fig. 6b. The NRU HSE industrial production index for petroleum and coke
(as a percentage of that in January 2005)

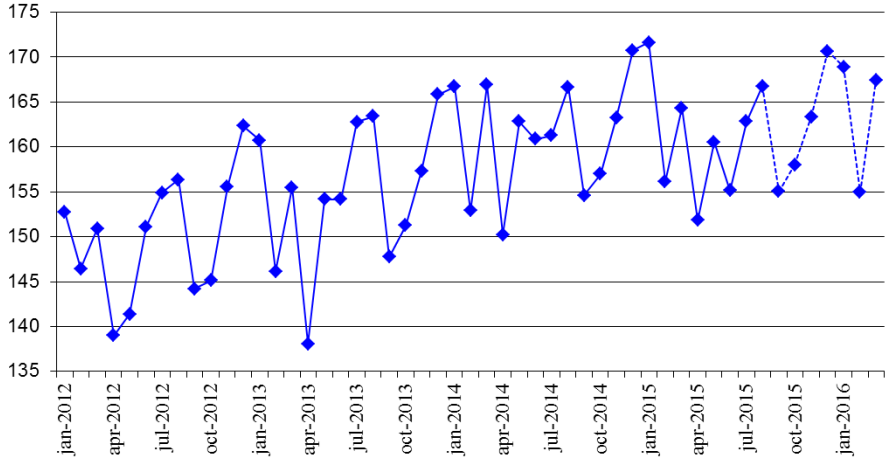


Fig.7a. The Rosstat industrial production index for primary metals and fabricated metal products (as a percentage of that in December 2001)

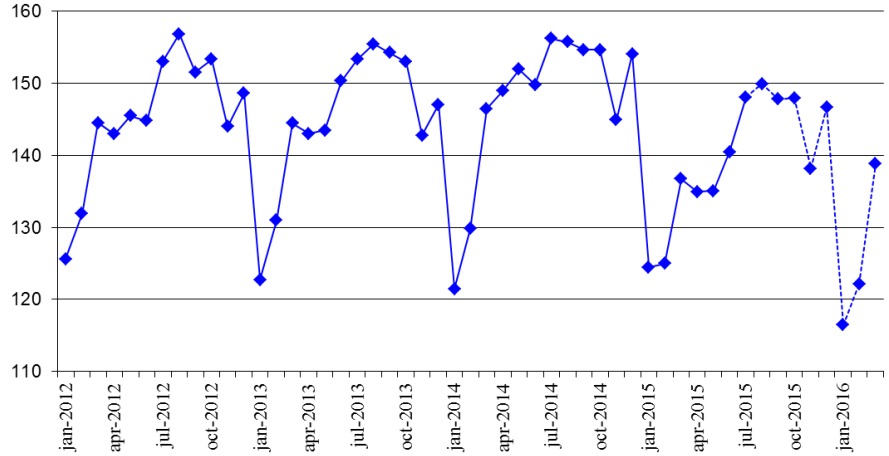


Fig. 7b. The NRU HSE industrial production index for primary metals and fabricated metal products (as a percentage of that in January 2005)

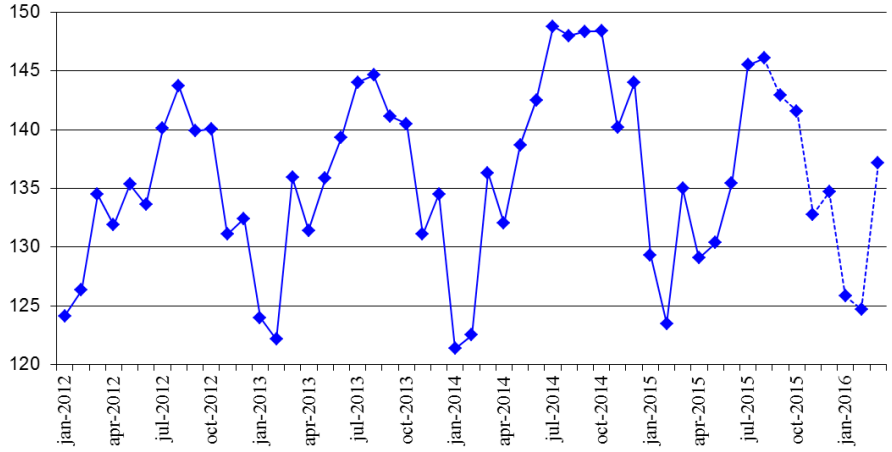


Fig. 8a. The Rosstat industrial production index for machinery (as a percentage of that in December 2001)

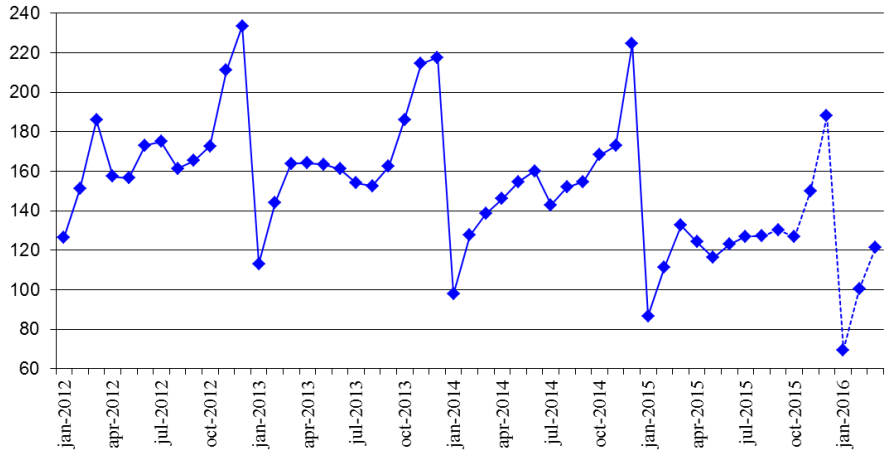


Fig. 8b. The NRU HSE industrial production index for machinery
(as a percentage of that in January 2005)

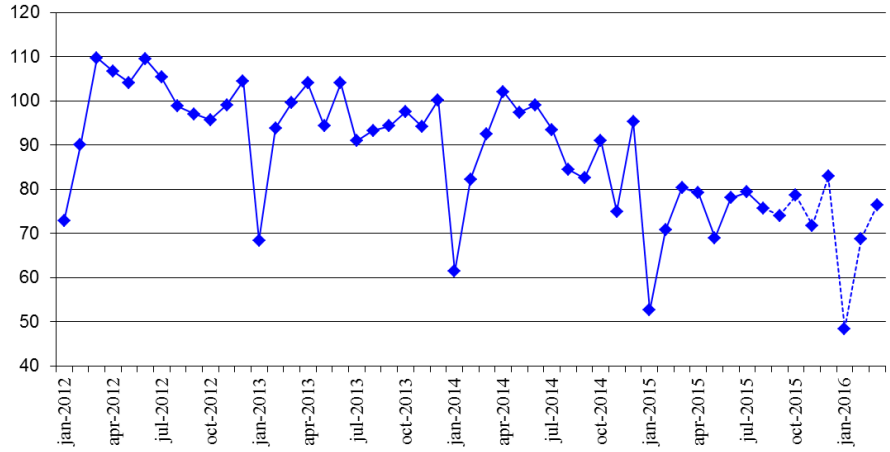


Fig. 9. The volume of retail sales (billion Rb)

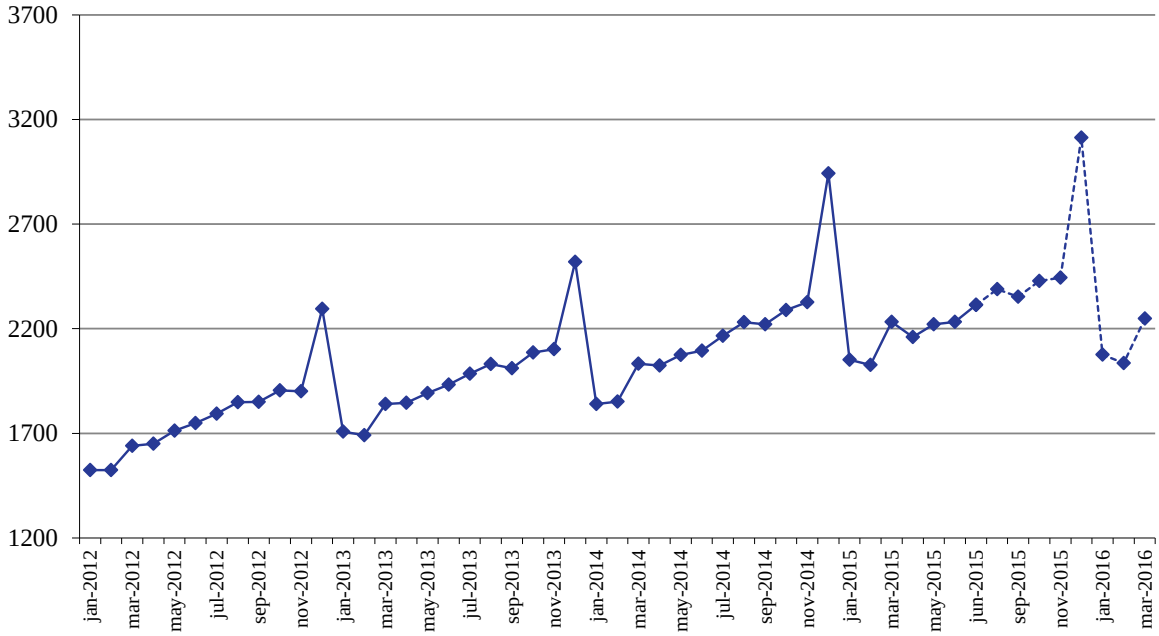


Fig. 9a. The real volume of retail sales (as a percentage of that in the same period of the previous year)

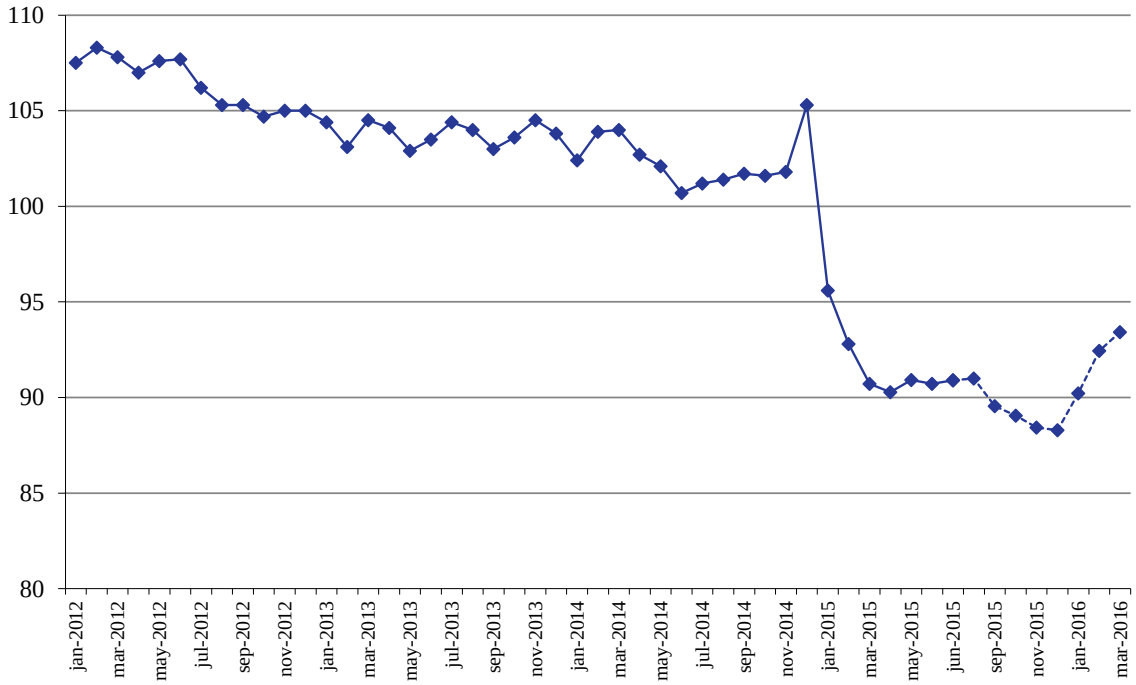


Fig. 10. Investments in capital assets (billion Rb)

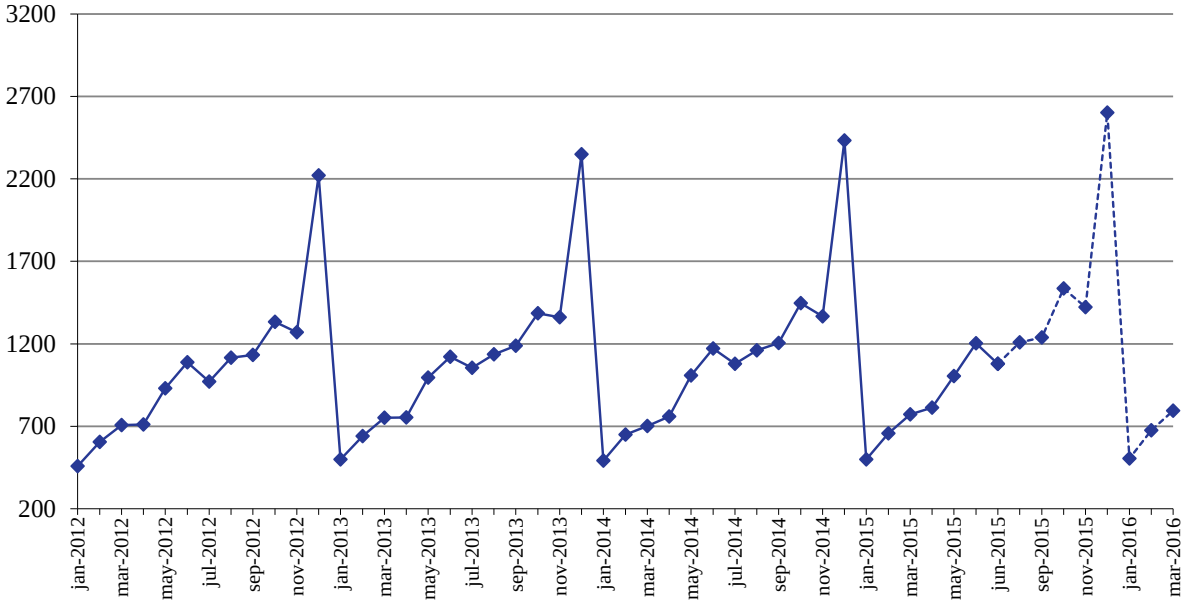


Fig. 10a. Real investments in capital assets
(as a percentage of those in the same period of the previous year)

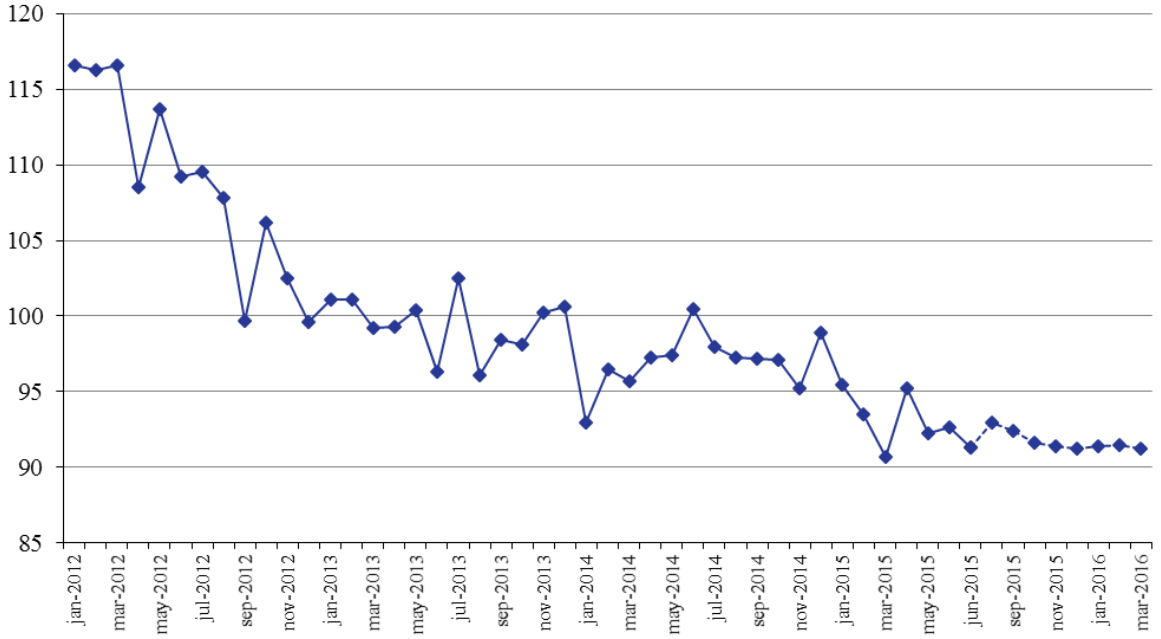


Fig.11. Export to all countries (billion USD)

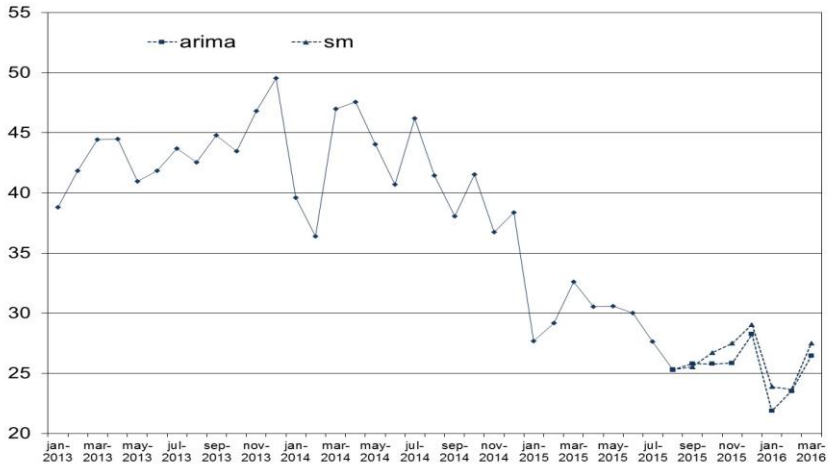


Fig. 12. Export to countries outside the CIS (billion USD)

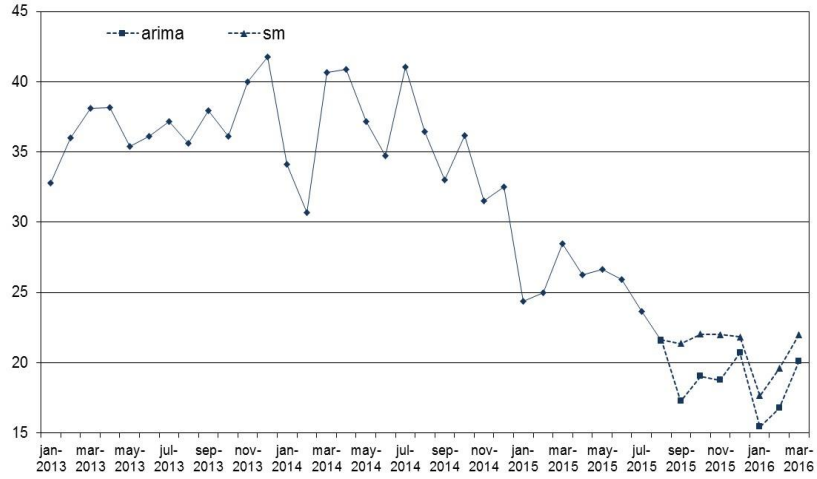


Fig. 13. Import from all countries (billion USD)

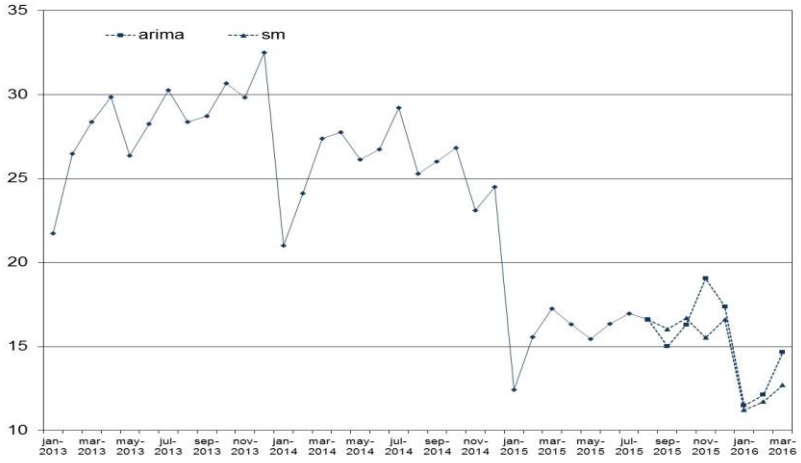


Fig. 14. Import from countries outside the CIS (billion USD)

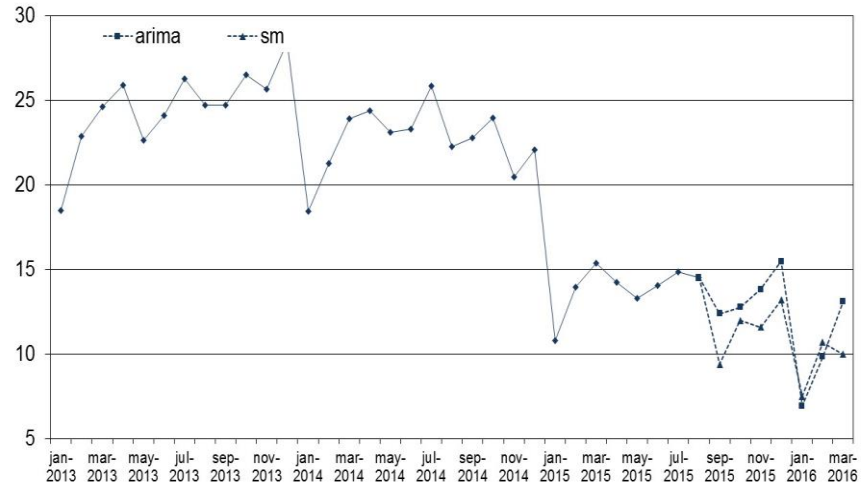


Fig. 15. The consumer price index (as a percentage of that in December of the previous year)

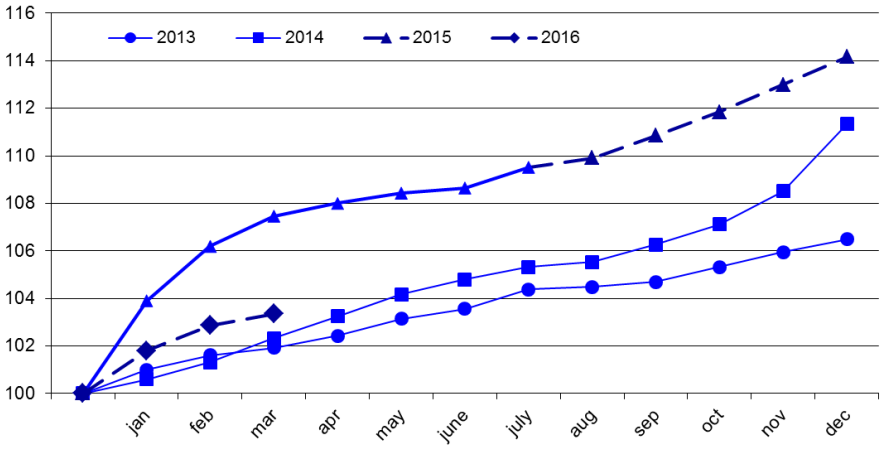


Fig. 15a. The consumer price index (as a percentage of that in December of the previous year) (SM)

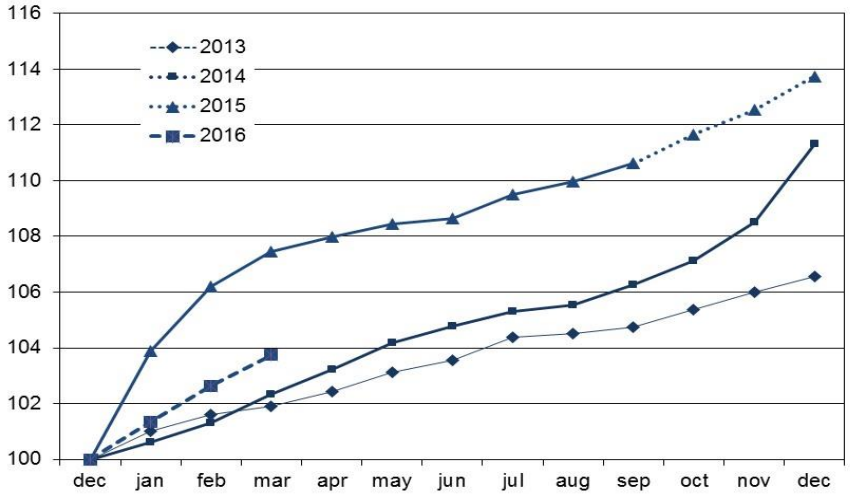


Fig.16. The producer price index for industrial goods
(as a percentage of that in December of the previous year)

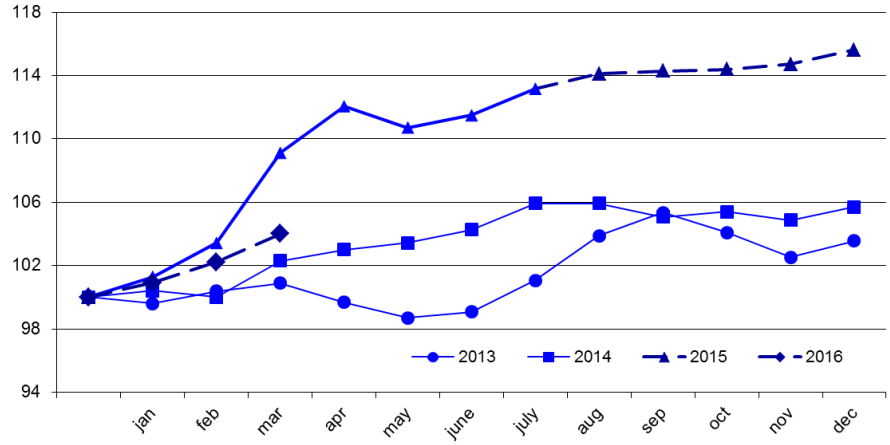


Fig. 17. The price index for mining (as a percentage of that in December of the previous year)

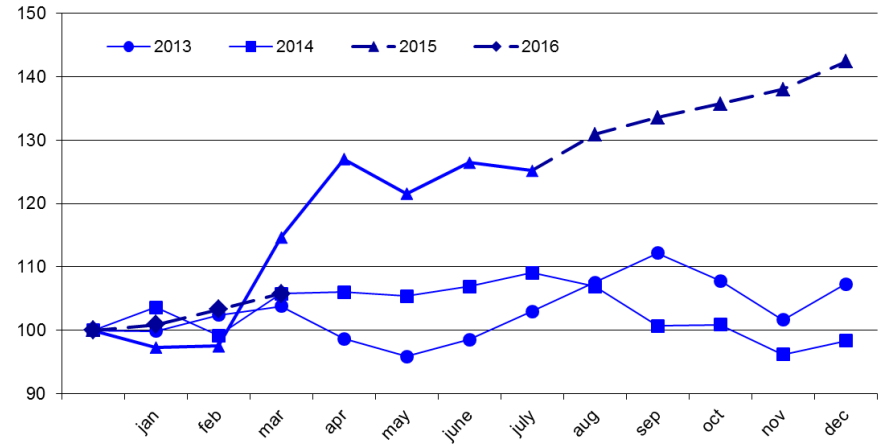


Fig. 18. The price index for manufacturing (as a percentage of that in December of the previous year)

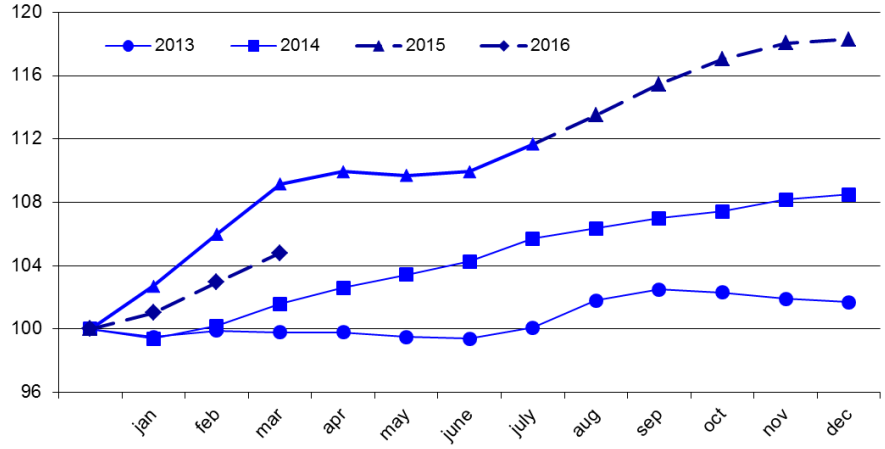


Fig. 19. The price index for utilities (electricity, water, and gas)
(as a percentage of that in December of the previous year)

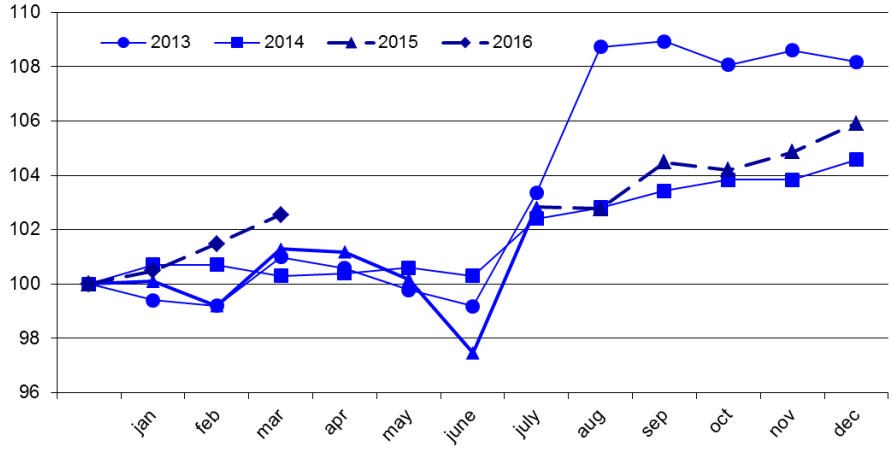


Fig. 20. The price index for food products (as a percentage of that in December of the previous year)

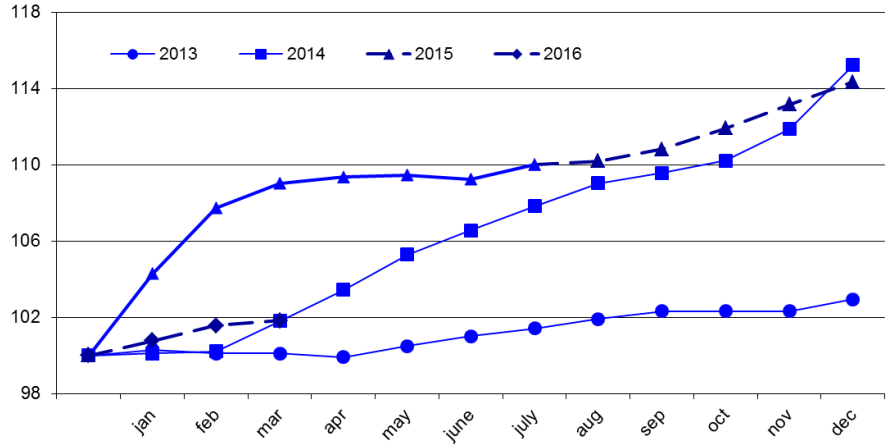


Fig. 21. The price index for the textile and sewing industry
(as a percentage of that in December of the previous year)

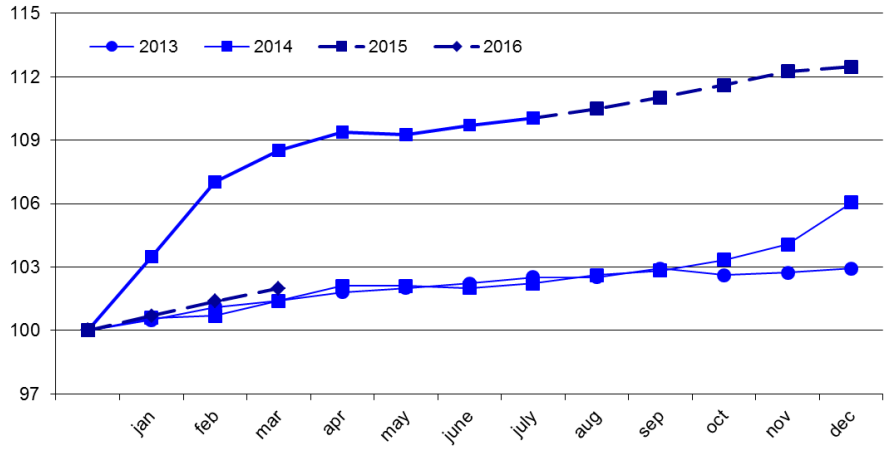
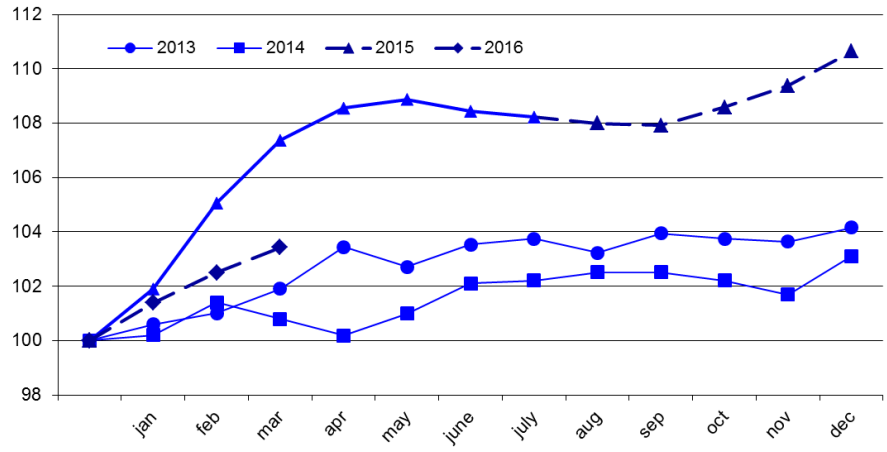


Fig. 22. The price index for wood products (as a percentage of that in December of the previous year)


112
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102
100
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2013
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2015
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Fig. 23. The price index for the pulp and paper industry
(as a percentage of that in December of the previous year)

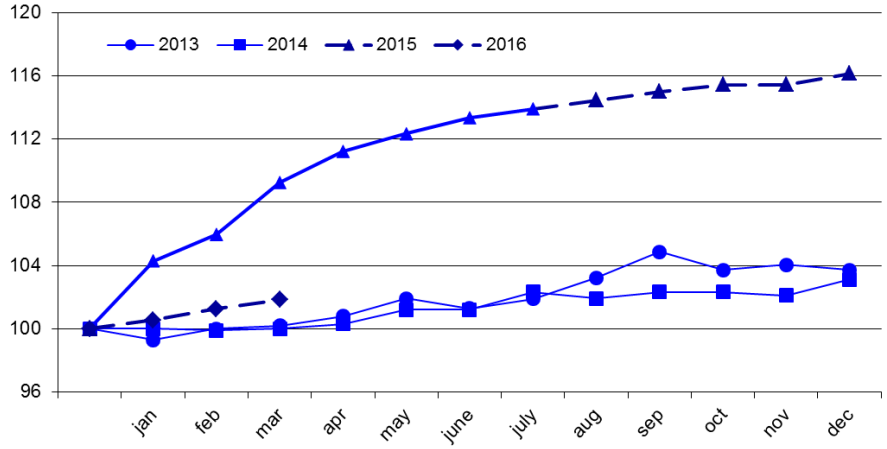

Fig. 24. The price index for coke and petroleum
(as a percentage of that in December of the previous year)

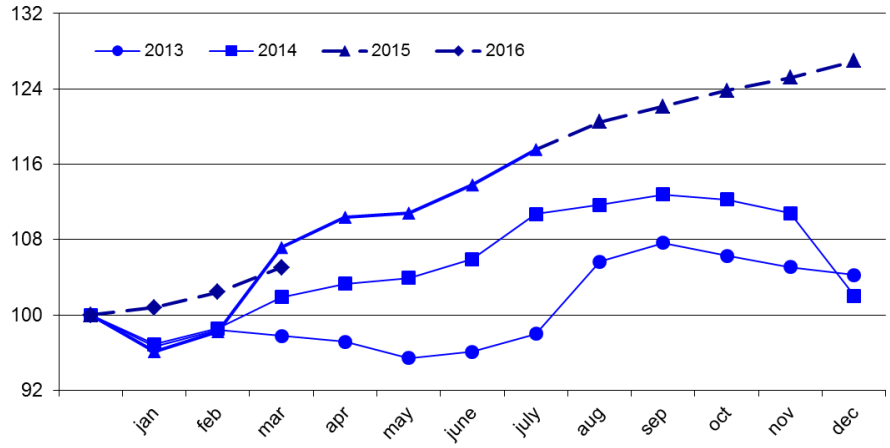

Fig. 25. The price index for the chemical industry
(as a percentage of that in December of the previous year)

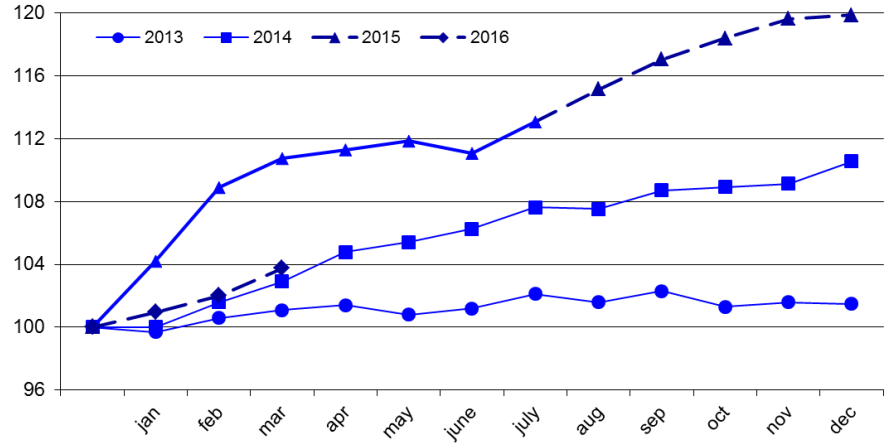

Fig.26. The price index for primary metals and fabricated metal products (as a percentage of that in December of the previous year)

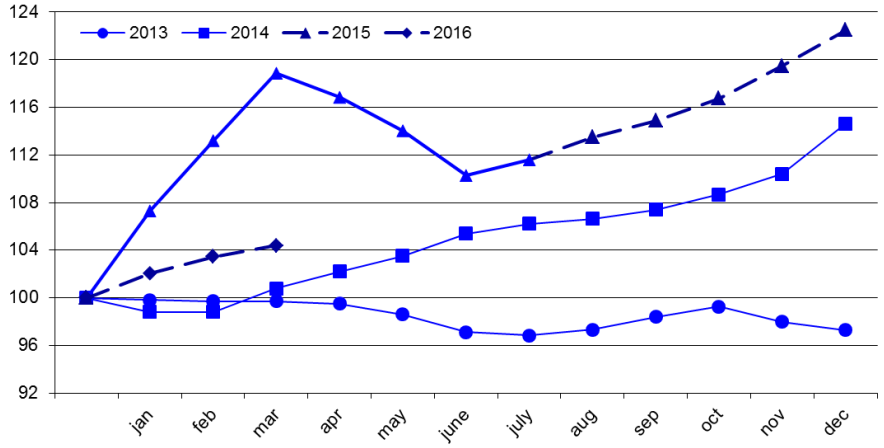

Fig.27. The price index for machinery (as a percentage of that in December of the previous year)

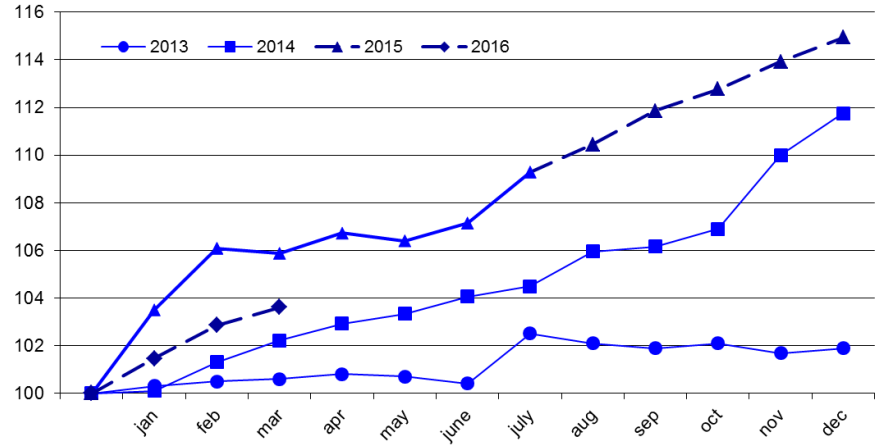

Fig.28. The price index for transport equipment manufacturing (as a percentage of that in December of the previous year)

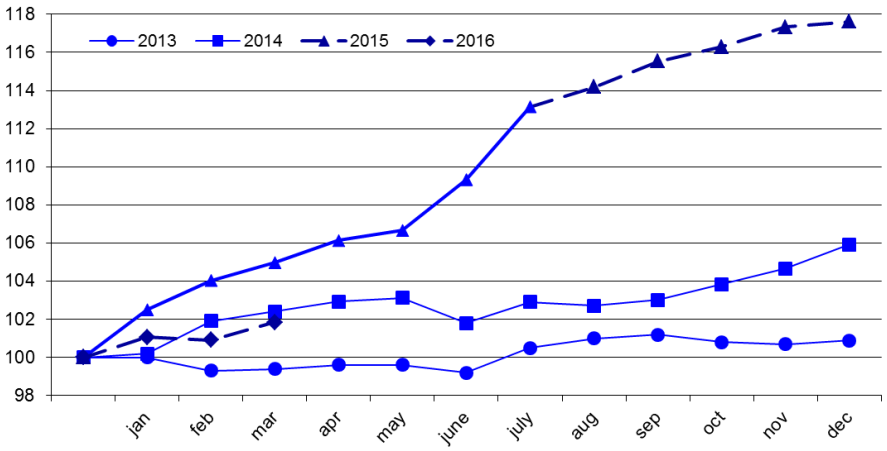

Fig. 29. The cost of the monthly per capita minimum food basket (Rb)

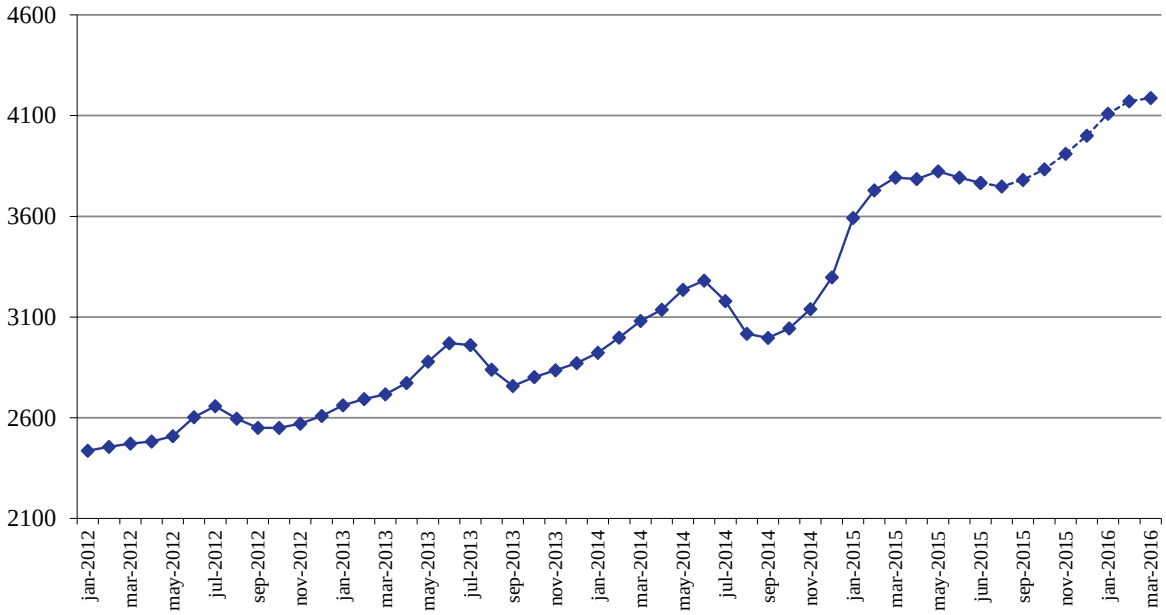

Fig. 30. The composite index of transport tariffs
(for each year, as a percentage of that in the previous month)

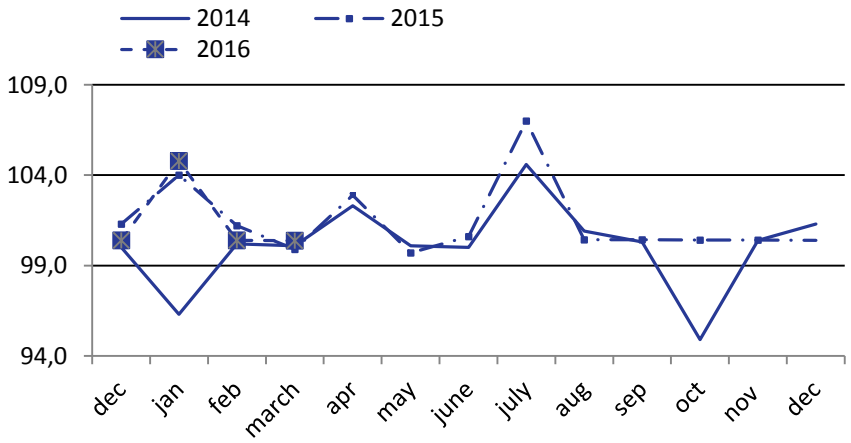

Fig. 31. The index of motor freight tariffs (for each year, as a percentage of that in the previous month)

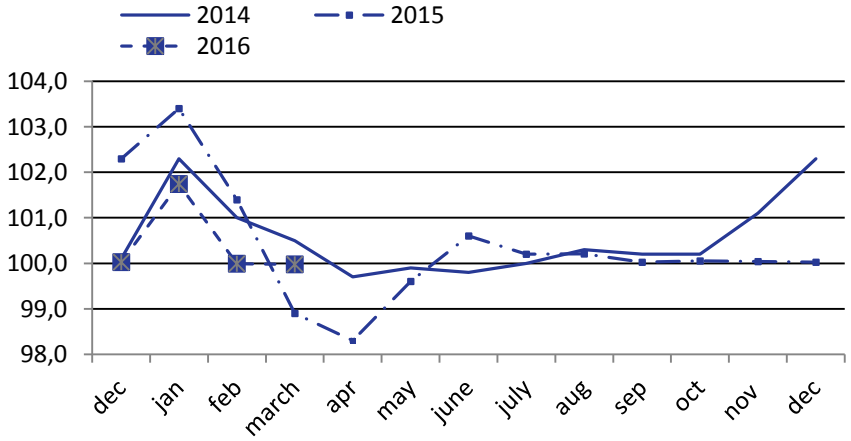

Fig. 32. The index of pipeline tariffs (for each year, as a percentage of that in the previous month)

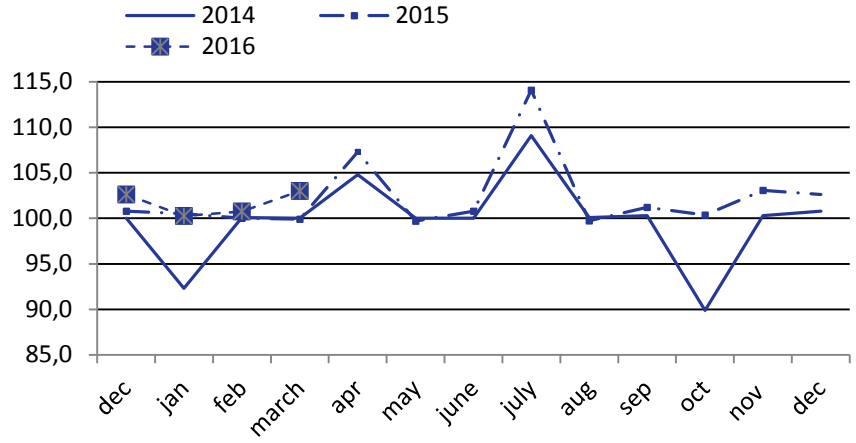

Fig. 33. The Brent oil price ($ per barrel)

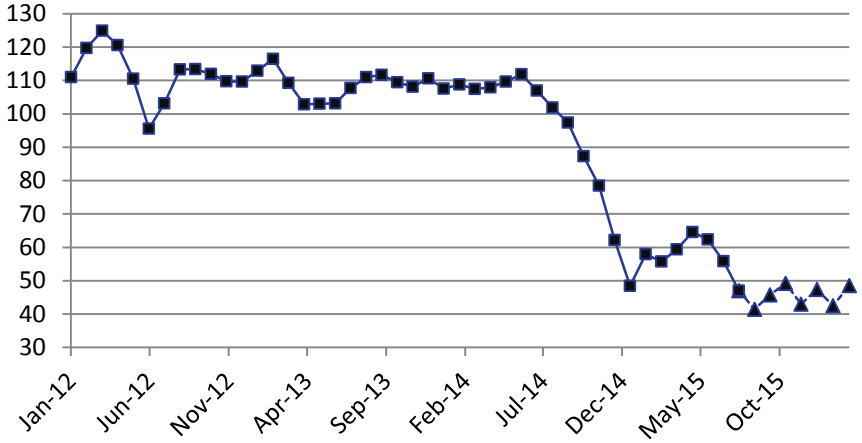

Fig. 34. The aluminum price ($ per ton)

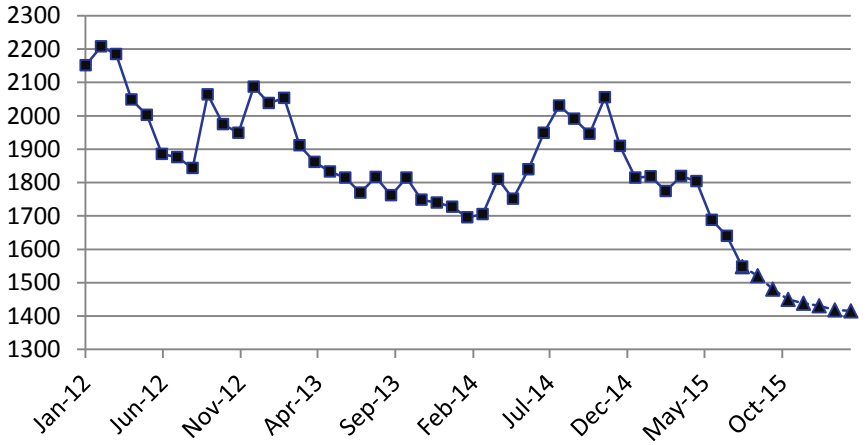

Fig. 35. The gold price ($ per ounce)

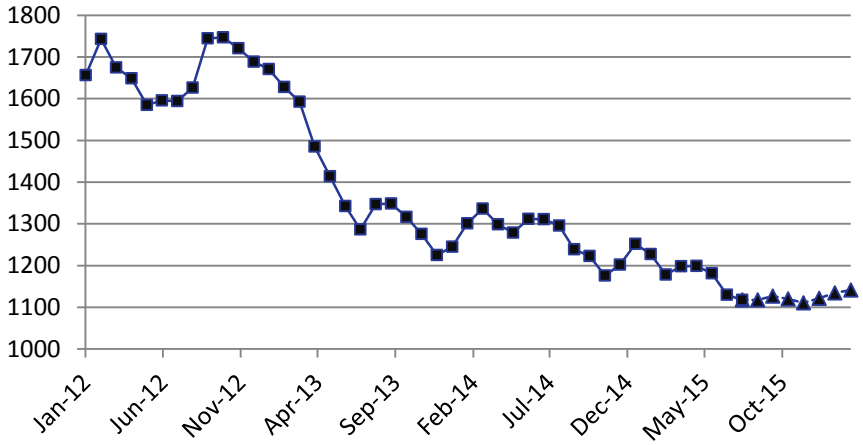

Fig. 36. The nickel price ($ per ton)

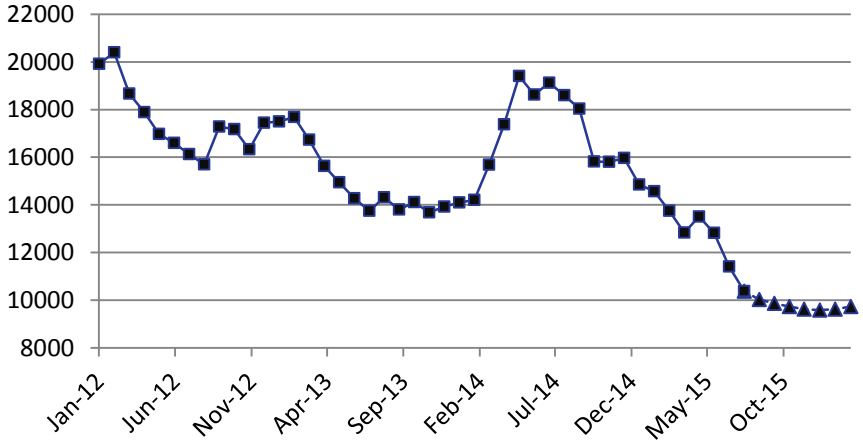

Fig. 37. The copper price ($ per ton)

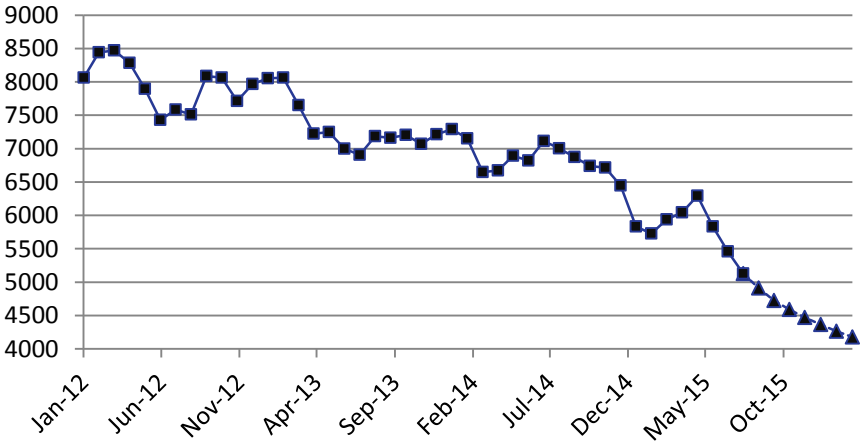

Fig. 38. The monetary base, billion Rb

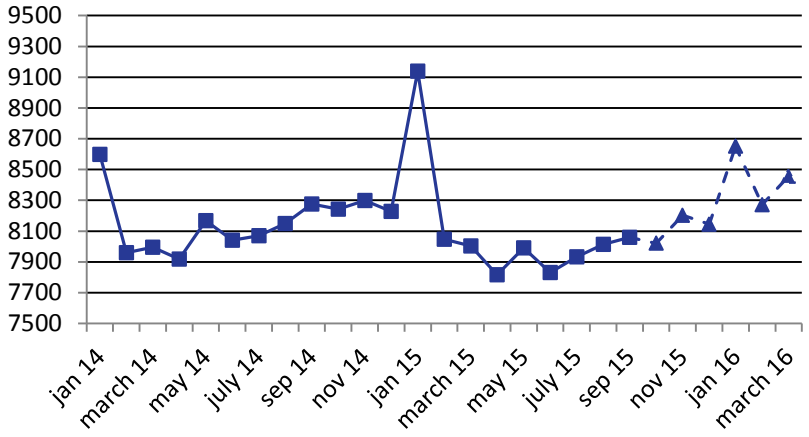

Fig. 39. M_2, billion Rb

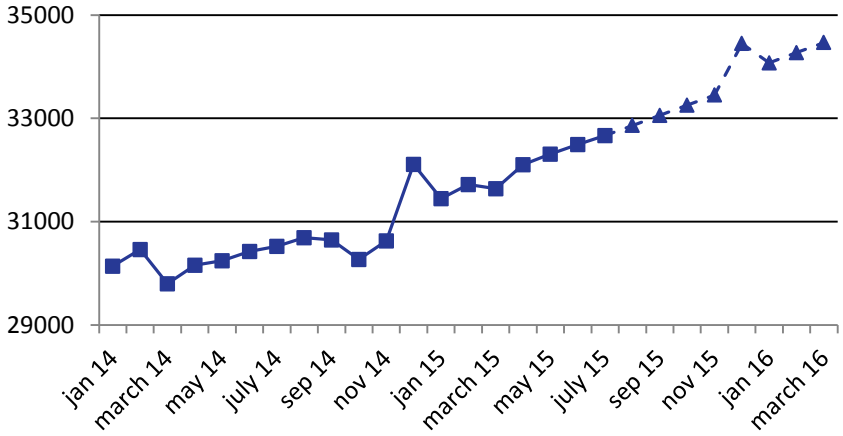

Fig. 40. The international reserves of the Russian Federation, million USD

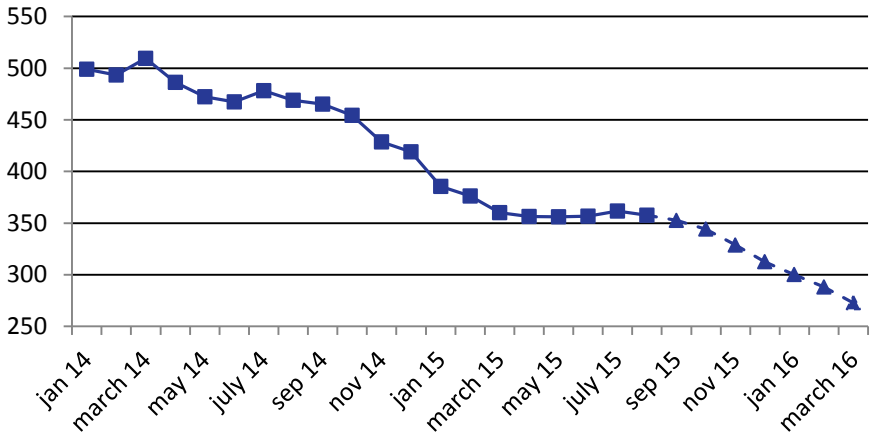

Fig. 41. The RUR/USD exchange rate

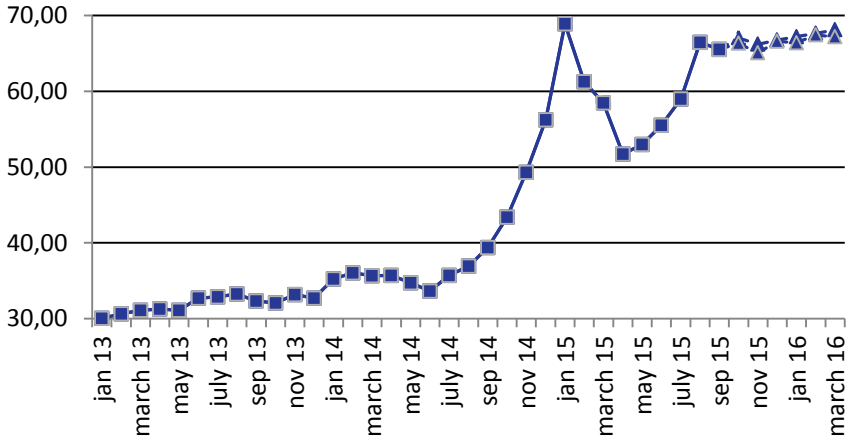

Fig. 42. The USD/EUR exchange rate

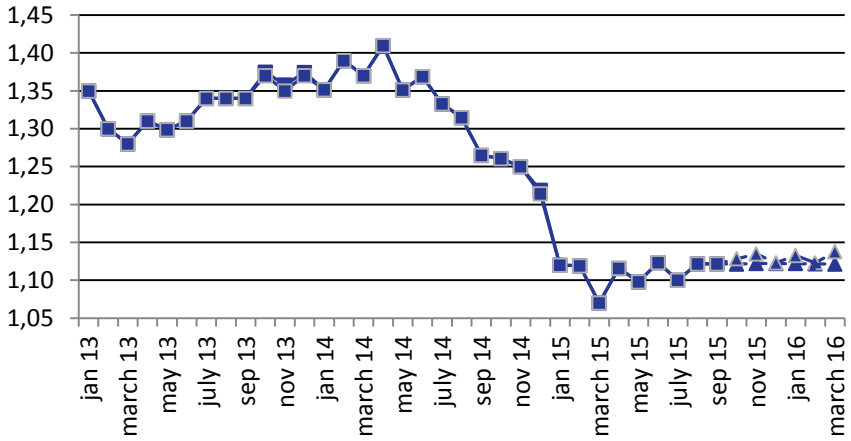

Fig. 43. Real disposable cash income (as a percentage of that in the same period of the previous year)

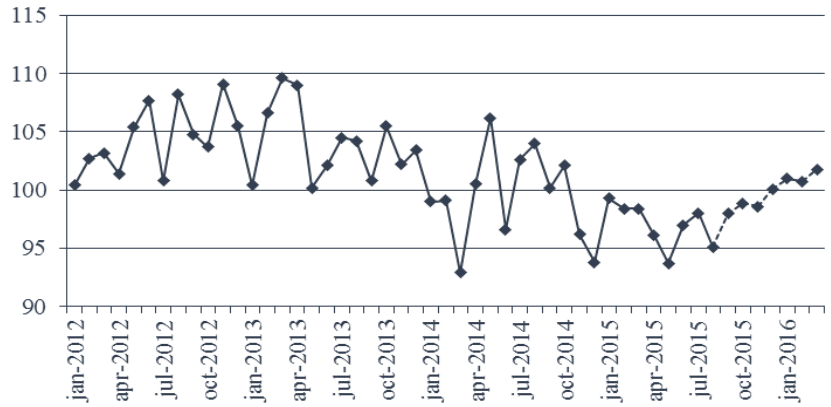

Fig. 44. Real cash income (as a percentage of that in the same period of the previous year)

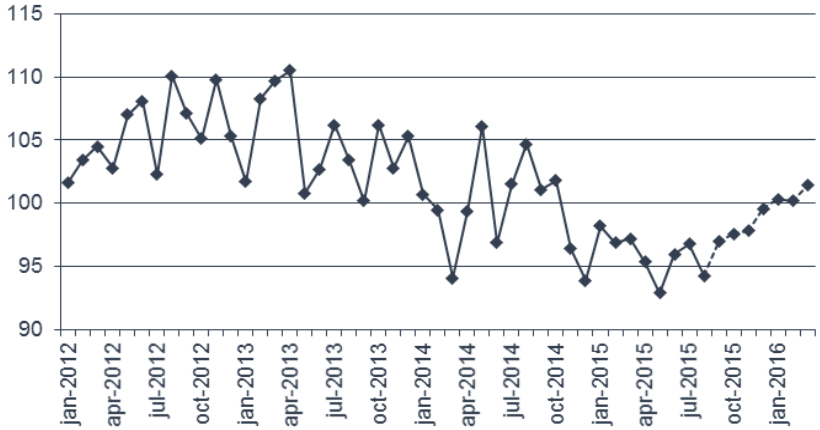

Fig. 45. Real accrued wages (as a percentage of those in the same period of the previous year)

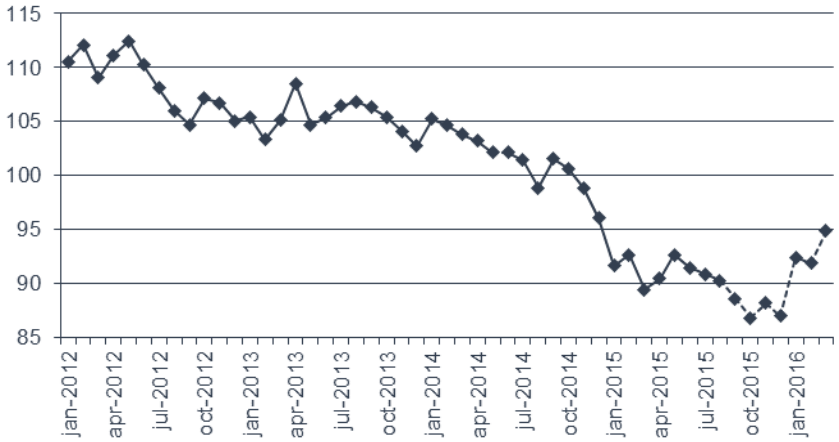

Fig. 46. Employment (million people)

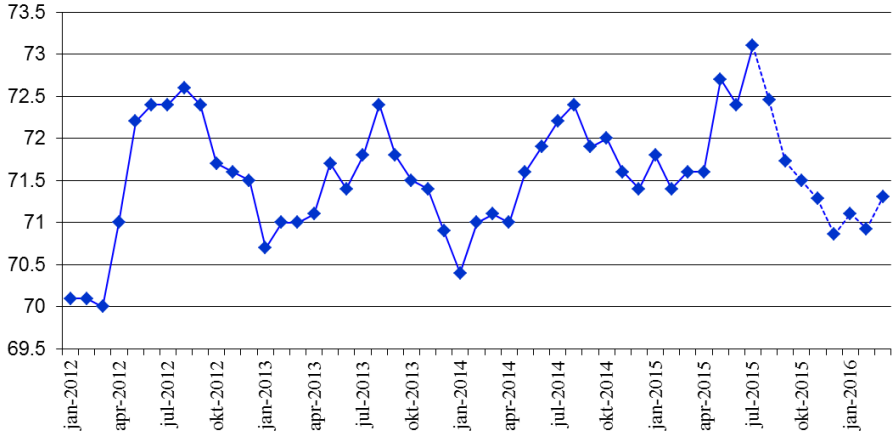

Fig. 47. Unemployment (million people)