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E. V. Pavlysh,
PhD (Economics), Ass. Prof.,
A. V. Moskovets,
Donetsk National Technical University

DEPENDENCE BETWEEN THE CONSUMER PRICE INDEX AND UKRAINIAN CURRENCY EXCHANGE RATE DYNAMICS

Nowadays inflation is one of the most dangerous processes negatively influencing financial, monetary and economic systems as a whole. According to Colander, David "Inflation is a continual rise in the price level" [1, p. 149]. Among the basic negative consequences of inflation it is possible to name: increase of money supply that leads to money depreciation; price level rises on mass consumption production which leads to the fall of money purchasing value — the loss of real value in the internal medium of exchange and unit of account in the economy [2, c. 429]; monetary savings depreciation; redistribution of the national income and national wealth among the population; public reproduction disproportion, delay of the goods retail as a result of population insolvency; monetary, financial and credit, tax systems decay; instability of the economic information; weakening of foreign economic relations; increase in speculation; shadow economy strengthening; foreign currency courses increase; capital outflow from manufacture sphere into trade; state financial resources reduction; infringement of normal distribution incomes between debtors and creditors [3, p. 309 — 310].

In terms of financial crisis, defined by mass inflation and instability of the exchange rate, such problem as inflation is of current importance for Ukraine. Following the results of the first five months of the year 2010, Statistical committee of the Commonwealth of Independent States (CIS) has stated that Ukraine has the highest inflation rate among 12 countries of the CIS [4]. Moreover, according to The World Factbook's top of the countries by the annual percentage change in consumer prices compared to the previous year consumer prices, Ukraine occupies 205 place (12.3%) among 222 positions [5].

Some of the greatest economists such as J. Keynes [6], I. Fisher and R. Dornbush [7], H. Hazlitt [8], N. G. Mankiw [9], M. Friedman [10] having considered in their works the dependence between the exchange rate and inflation, found out the inflation reasons for offering

effective struggle methods against it and its negative consequences.

Thus, the research deals with an important and vast issue which demands consideration. In the given work we limit ourselves to revealing influence of the Ukrainian national currency exchange rate on inflation through the CPI indicator.

The main form of inflation is depreciation of bank notes relative to the cost of usual goods [11, p. 97 — 99]. Depreciation of money caused by inflation implies the decline of purchasing value and the decrease of national currency rate to those countries, where inflation rate is low [9, p. 81 — 88]. Inflation can be classified according to the speed of average prices rise and according to its expectancy by people.

In Ukraine, inflation develops undulatory. According to the information of the State Committee of Statistics in Ukraine [12], inflation indicators were 2100% in 1992 year; 10 256% in 1993; 501,0% in 1994; 281,7% in 1995. The data of the following years are represented on fig. 1.

From the graph, it is evident that the galloping inflation dominates. The exception makes the period from the year 2001 to 2003. The 0.6% deflation is observed in 2002. The prices grew less than by 10% in years 2001 and 2003 that testifies of moderate inflation. Such high price level in Ukraine testifies of unstable and changeable economy in the country including hryvnia as its national currency.

Measurement of inflation is a difficult, but very important task for government statisticians. However, it is of grate importance for inflation prevention and control. There is a number of widely used inflation measures [13, p. 25 — 28]:

- Producer Price Index (PPI). Earlier the PPI was called WPI. This indicator measures average changes in the prices received by domestic producers for output.
- Consumer Price Index (CPI)
- Gross Domestic Product (GDP) Price Index or

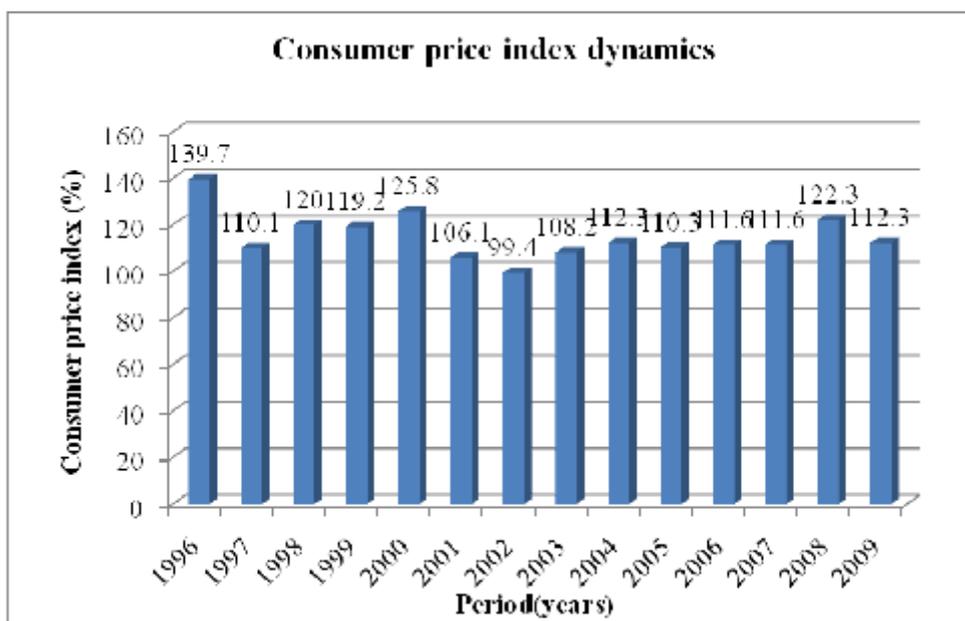


Fig. 1. Consumer price index dynamics in Ukraine in 1996 — 2009 (by December of the previous year) [14]

GDP deflator. This index measures prices of all the goods and services included in GDP.

The most widespread and the most reliable indicator for inflation measurement in the world is the consumer price index [14]. The CPI is defined by the United States Bureau of Labor Statistics as “a measure of the average change over time in the prices paid by urban consumers for a market basket of consumer goods and services” [15]. The consumer price index is one of the major macroeconomic indicators of the financial market, which is calculated by the following formula [16, p. 35]:

$$CPI = \frac{\sum_i P_1 Q_0}{\sum_i P_0 Q_0} \quad (1)$$

where i — the number of consumer goods in the market basket (the list of consumer goods and services fixed by the government), calculated according to the market prices of the base and current period;

P_1 — the cost of i -th goods at current period;

P_0 — the cost of i -th goods at base period;

Q_0 — quantity of i -th goods in a consumer’s basket in the base year.

In the article “Ukraine mostly good news” [17] Tom Mandi, Alexey Mojsseev, and Anastasiya Golovach predict the following factors which can influence the consumer price index in 2010:

- Introduction of less prudent monetary policy and monetizing of OVDP (“obligation of internal domestic

borrowing”) by NBU in order to finance the budget gap;

- Necessity to increase gas tariffs for the population and utilities;

- CPI increase caused by the rise of global commodity prices.

Now we will make an attempt to define dependence between inflation and the value of exchange rate. The CPI has been selected as one of the main indicators of inflation. Taking it into account, the model of dependence of CPI and the exchange rate of EUR/UAH will be developed, and the subsequent analysis will be represented.

In the research of economic performance connection indicators the equation of linear and curvilinear connection has been used. Attention to linear connection is determined by the limited variation of variables and by the fact that in most cases nonlinear forms of connection with time duration by means of appropriate logarithm transform into the linear form [18, p. 430]:

$$\bar{y} = a_0 + a_1 * x, \quad (2)$$

where \bar{y} is the theoretical value of resultant factor, received from the regression equation;

a_0, a_1 — coefficient (parameters) of the regression equation.

Now we will make an attempt to build a single-factor regression equation of dependence between consumer Price Index (CPI) and EUR/UAH exchange rate (in obedience to information of the National bank of Ukraine [19] and Committee of statistics of Ukraine [12]). We can assume that change of exchange rate is reflected in the

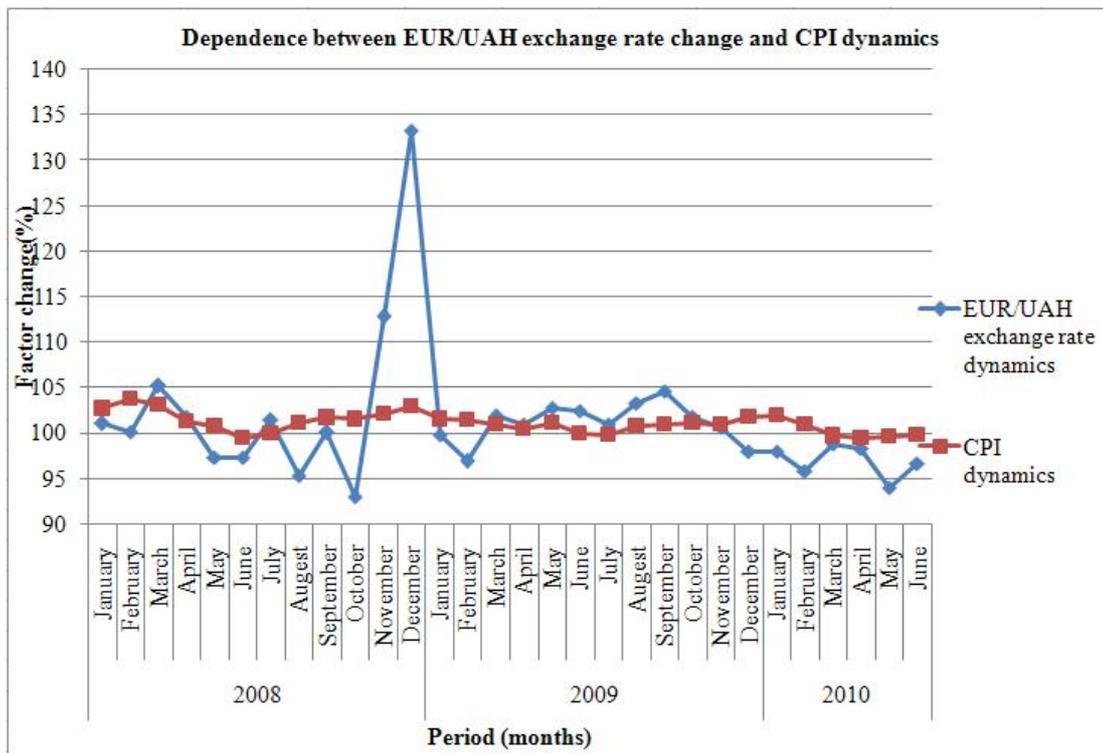


Fig. 2. Dependence between EUR/UAH exchange rate change and CPI dynamics

change of the consumer price index with a month delay. The selection of initial data contains information of 30 random data that determine the dynamics of exchange rate change and dynamics of CPI. Exchange rate will be selected as the factorial indicator, change of CPI part — as a resultant one. Initial data are represented in Annex A.

Comparison of parallel rows in Annex A shows that with growth of factorial indicator, resultant indicator increases as well. It is possible to assume that there is a direct dependence between X and Y. The graphic method has been used for clarification of connection forms (Fig. 2).

Analyzing the graph, it is possible to assume that the increase of Y factor happens in compliance with X factor increase. It means that current dependence is represented by linear connection that can be expressed in regression equation (formula 2).

We find the parameters of equation by the followings formulas:

$$a_1 = \frac{\sum (y - y_a)(x - x_a)}{\sum (x - x_a)^2} \quad (3)$$

$$a_0 = y_a - a_1 * x_a \quad (4)$$

where x_a and y_a are mean values of both factors accordingly [18, c. 430]:

The conducted calculations defined that parameter of this equation is equal to:

$$a_1 = 0.063155,$$

$$a_0 = 94.68958.$$

Equation of regression has the following form:

$$\bar{y} = 94.68958 + 0.063155 * x, \quad (5)$$

According to the graph, the average quantity of points is more close to a trend line that demonstrates average dependence between exchange rate dynamics and the consumer price index.

Regression equation received by calculations characterizes dependence of CPI dynamics and dynamics of the exchange rate. The calculated values of \bar{y} found in accordance with this equation are depicted in Annex B. Accuracy of calculated parameters can be tested by comparing the sums $\sum y = \sum \bar{y}$. In our case these sums are equal.

In order to apply this formula, it is necessary to calculate, how real it is. It means, we need to check up its adequacy. Meaningfulness of coefficients of linear regression (for an aggregate with the amount of researches of about 30) is explored by Student t-criteria. It is necessary to calculate the actual values of t-criteria for both parameters [20, p. 124].

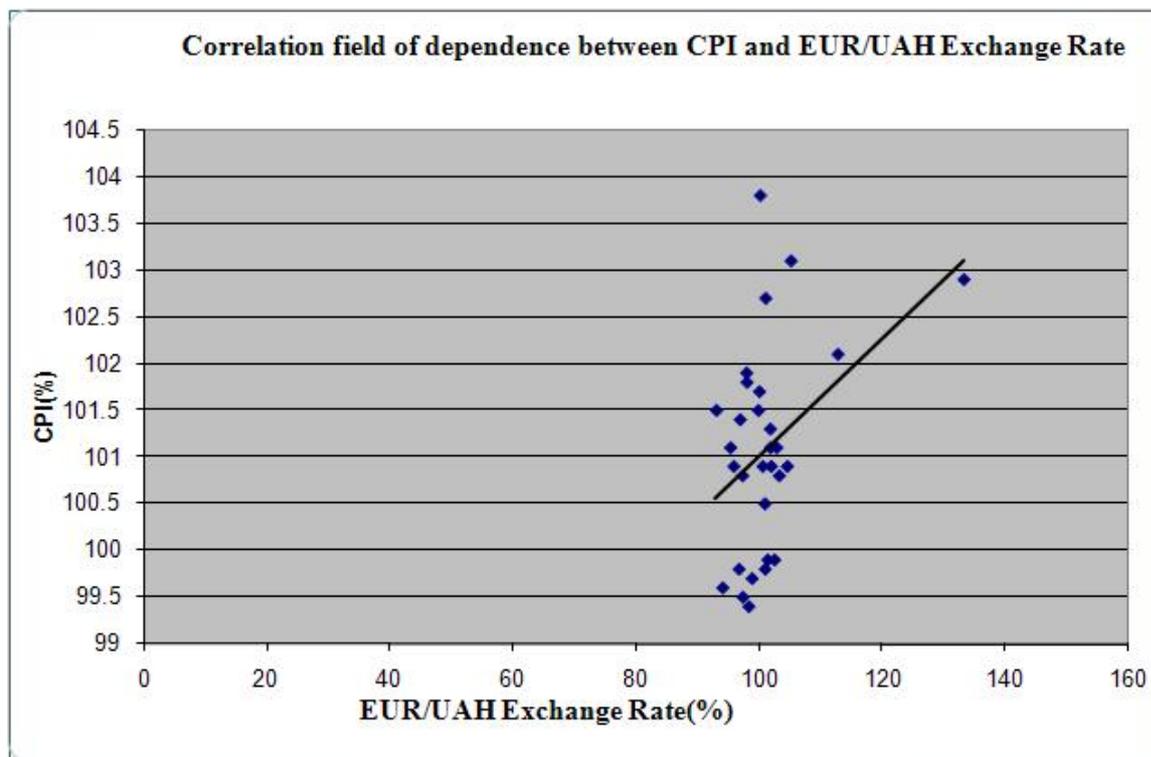


Fig. 3. Correlation field of regression equation

For parameter a_0 :

$$t_{a_0} = |a_0| \frac{\sqrt{n-2}}{S} \tag{6}$$

For parameter a_1 :

$$t_{a_1} = |a_1| \frac{\sqrt{n-2}}{S} S_x \tag{7}$$

Where: n is the selection size;

S — standard deviation from \bar{y} values that is determined by [20, c. 297]:

$$S = \sqrt{\sum (y - \bar{y})^2 / n} = 1.011013 \tag{8}$$

S_x — standard deviation of indicator X from the general mean X_a [20, c. 297].

$$S_x = \sqrt{\frac{\sum x^2}{n} - \left(\frac{\sum x}{n}\right)^2} = 7.063005 \tag{9}$$

Using these values in both criteria, we get:

$$t_{a_0} = 495.5922 ;$$

$$t_{a_1} = 2.334648.$$

The next step is to compare calculated values of Student T-criteria and critical values from Student Table taking into account the accepted level of meaningfulness $\alpha = 0,05$ and the amount of independence degrees $\nu = n - 2 = 28$. Parameters are to be significant if $t_{value} > t_{score}$. From the table we find critical values for a sample of selection size $n = 30$: $t_{score} = 2.0484$. Both calculated indexes are bigger than tabular criterion that is why it is possible to assert that parameters of regression equation are meaningful and reliable.

Verification of regressive model adequacy must be complemented with the correlation analysis. For this purpose it is necessary to define the closeness of correlation connection between variables X and Y. It can be defined by certain empiric correlation h , when d^2 (intergroup dispersion) characterizes deviation of group means from general mean $h_{\bar{y}} = \sqrt{d^2 / S^2}$. Theoretical correlation is a relative indicator which is determined as a result of comparison of standard deviation of the leveled values of resultant factor d , the one calculated by the regression equation (see formula 2) with standard deviation of empiric (actual) values of resultant factor S .

Table 1

Commodity pattern of foreign trade in Ukraine in 2005 — 2010, GDP and an import quota in 2005 — 2008 [12]

Year	Exports	Imports	GDP	Import quota
	mln. USD	mln. USD	mln. USD	%
2005	34286	36141	86142	42
2006	38367	45034	107753	42
2007	49248	60669	142719	43
2008	66967	85535	179992	48
2009	39695	45433		
2010(January- July)	27 335	30789		

In accordance with formulas of quadratic deviations calculation [20, p. 297].

$$d = \sqrt{\frac{\sum (\bar{y} - y_a)^2}{n}} \quad (10)$$

$$s = \sqrt{\frac{\sum (y - y_a)^2}{n}} \quad (11)$$

Theoretical correlation relation can be ranged from 0 to 1. The closer it is to 1, the denser is the connection between factors. Regarding the research done, the correlation relation will be equal to [20, p. 297]:

$$h = \sqrt{\frac{\sum (\bar{y} - y_a)^2}{\sum (y - y_a)^2}} = 0.403664 \quad (12)$$

The value of theoretical correlation relation received in calculations testifies the reliable presence of average connection between factors which are explored. The coefficient of determination equals 0.403664. According to this number, it is possible to draw the conclusion that 40% of general aggregate of CPI changes were predefined by variation of such factor as the change of exchange rate (Fig. 3).

Thus, the study of dependence between the exchange rate and the prices is an important task. The main issue is the influence of exchange rate dynamics on economic processes, in particular on inflation. As it is known, inflation influences on export volumes and import demand volumes in the country [21, p. 909]. We will consider export and import deliveries in Ukraine:

To reveal the importance of import for the domestic economy as a whole we have calculated import quota (relations of import value to GDP) [16, p. 315 — 317]. In the period of 2005 — 2008 import quota grew

from 42 % to 48 % (Tab. 1). It means that the Ukrainian average person spent 48 out of 100 hryvnias for the imports.

It is necessary to point out that the share of import in GDP is almost equal to the level of dependence between the exchange rate and CPI (40%). According to this information; it is possible to make a conclusion that there is a proportional dependence between these two indicators. Thus, a considerable quantity of imports needs foreign currency purchase promoted by the growth of the exchange rate. Correspondingly, the exchange rate growth makes for the import price rise because of foreign exporters who raise price levels to receive the same sum of money in their currency [11, p. 21]. As a result, import price rise leads to the consumer price index growth since the import goods are a part of a the market basket [13, p. 452].

According to the data from table 1 (In obedience to information of the State Committee of statistics in Ukraine [12]) it is obvious that import prevails considerably over export. Deficit of the trade balance has been increasing stably from year 2005. According to the quantity of imports the first place is occupied by energy resources (31.6%), and then goes inorganic chemistry (11%), and machines and equipment (7.5%) [12]. Since 60% of pricing in Ukraine depends on the cost of imported energy resources, the increase of prices on these resources is one of the major factors of economic development braking [22]. Moreover, the International Monetary Fund (IMF) approved \$ 15.15 billion loan to Ukraine on July 28 [23], as a result, the main demand of it is the increase of gas prices [24]. Therefore, an abrupt price hike for natural gas can cause inflation increase.

Another major factor which has essential influence on inflationary processes is the inflow of foreign loan capital. In the previous years banks applied to foreign financial institutions to provide profitable loans to the

Ukrainian population [25]. Moreover, the interest rate for the national and foreign currency should be led to the same level, cutting currency demand because of its cheap price. At the same time, the decline of the interest rate will stimulate the decline of pressure from the external debt. More than that, foreign currency import caused money supply growth in the country, thus, promoting y money depreciation and strengthening inflation. The population bought more and more imports for cheap credits in foreign currency. As a result, less currency has begun to arrive to the country, import has become more expensive, and dollar cost has jumped up. G. A. Chernichenko in his article "Inflation as economy reflection" [26] names this phenomenon as a credit inflation. The following situation in years 2005 — 2008 made the population to loose their trust in the bank system and to keep money at home.

Summing it all up, it is obvious that the exchange rate, despite different factors influencing inflation, puts powerful pressure on CPI. In this connection it is necessary to accept a number of measures on regulation and stabilization of the national course in Ukraine. In this connection the role of national currency legislation grows in determination of foreign currency.

In spite of the fact that inflation is a difficult multiple-factor phenomenon, the exchange rate has rather a big share (40%) in influencing the formation of its main indicator-consumer price index. The principal cause of the given influence is the considerable quantity of import deliveries, foreign debt, and powerful share of import in GDP formation. Besides, export and import deliveries, and GDP volumes have been considered, the import quota has been counted. As a result of the work done, the necessity of Ukrainian national currency stabilization leading to political, economic and financial security of the country has been determined.

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INITIAL DATA FOR THE REGRESSIVE MODEL BUILDING

Year, month	100 EUR/UAH official exchange rate	EUR/UAH exchange rate dynamics	CPI dynamics
2008_01	743.02	101.03	102.90
2008_02	744.08	100.14	102.70
2008_03	782.41	105.15	103.80
2008_04	796.35	101.78	103.10
2008_05	774.68	97.28	101.30
2008_06	753.67	97.29	100.80
2008_07	763.99	101.37	99.50
2008_08	728.12	95.30	99.90
2008_09	728.26	100.02	101.10
2008_10	677.24	92.99	101.70
2008_11	763.93	112.80	101.50
2008_12	1018.62	133.34	102.10
2009_01	1016.98	99.84	102.90
2009_02	985.08	96.86	101.50
2009_03	1004.18	101.94	101.40
2009_04	1013.28	100.91	100.90
2009_05	1041.92	102.83	100.50
2009_06	1067.60	102.46	101.10
2009_07	1077.80	100.96	99.90
2009_08	1112.76	103.24	99.80
2009_09	1163.50	104.56	100.80
2009_10	1184.71	101.82	100.90
2009_11	1191.37	100.56	101.10
2009_12	1167.24	97.97	100.90
2010_01	1142.95	97.92	101.80
2010_02	1095.33	95.83	101.90
2010_03	1082.19	98.80	100.90
2010_04	1063.39	98.26	99.70
2010_05	999.96	94.04	99.40
2010_06	966.83	96.69	99.60
2010_07	1005.74	104.02	99.80

CALCULATED DATA FOR THE REGRESSIVE MODEL BUILDING

	x	y	x ²	x-x _a	y-y _a	(x-x _a)* (y-y _a)	(x-x _a) ²	Y _{calculated}
Research number	EUR/UAH exchange rate dynamics	CPI dynamics						
1	101.03	102.70	10206.38	-0.11	1.62	-0.17	0.01	101.07
2	100.14	103.80	10028.55	-0.99	2.72	-2.70	0.98	101.01
3	105.15	103.10	11056.80	4.02	2.02	8.13	16.15	101.33
4	101.78	101.30	10359.51	0.65	0.22	0.14	0.42	101.12
5	97.28	100.80	9463.17	-3.85	-0.28	1.07	14.85	100.83
6	97.29	99.50	9464.94	-3.85	-1.58	6.06	14.79	100.83
7	101.37	99.90	10275.73	0.24	-1.18	-0.28	0.06	101.09
8	95.30	101.10	9083.03	-5.83	0.02	-0.14	33.97	100.71
9	100.02	101.70	10003.85	-1.11	0.62	-0.69	1.24	101.01
10	92.99	101.50	8647.93	-8.14	0.42	-3.45	66.24	100.56
11	112.80	102.10	12723.95	11.67	1.02	11.94	136.13	101.81
12	133.34	102.90	17779.41	32.21	1.82	58.72	1037.25	103.11
13	99.84	101.50	9967.83	-1.29	0.42	-0.55	1.67	100.99
14	96.86	101.40	9382.49	-4.27	0.32	-1.38	18.23	100.81
15	101.94	100.90	10391.55	0.81	-0.18	-0.14	0.65	101.13
16	100.91	100.50	10182.06	-0.23	-0.58	0.13	0.05	101.06
17	102.83	101.10	10573.28	1.69	0.02	0.04	2.87	101.18
18	102.46	99.90	10499.01	1.33	-1.18	-1.57	1.77	101.16
19	100.96	99.80	10192.00	-0.18	-1.28	0.23	0.03	101.07
20	103.24	100.80	10659.25	2.11	-0.28	-0.58	4.45	101.21
21	104.56	100.90	10932.76	3.43	-0.18	-0.61	11.74	101.29
22	101.82	101.10	10367.91	0.69	0.02	0.02	0.48	101.12
23	100.56	100.90	10112.75	-0.57	-0.18	0.10	0.33	101.04
24	97.97	101.80	9599.02	-3.16	0.72	-2.28	9.98	100.88
25	97.92	101.90	9588.13	-3.21	0.82	-2.65	10.33	100.87
26	95.83	100.90	9184.08	-5.30	-0.18	0.94	28.08	100.74
27	98.80	99.70	9761.51	-2.33	-1.38	3.21	5.44	100.93
28	98.26	99.40	9655.57	-2.87	-1.68	4.81	8.24	100.90
29	94.04	99.60	8842.60	-7.10	-1.48	10.48	50.38	100.63
30	96.69	99.80	9348.35	-4.45	-1.28	5.68	19.77	100.80
Sum	3033.99	3032.30	308333.41			94.52	1496.58	3032.30
Average	195.74	101.13				3.15	49.89	101.08

Pavlysh E. V., Moskovets A. V. Dependence between the Consumer Price Index and Ukrainian Currency Exchange Rate Dynamics

In present article the dependence between the consumer price index dynamics and Ukrainian currency exchange rate dynamics is analyzed. The essence and factors of consumer price index as the main indicator of inflation has been considered. The regressive model confirming the dependence of the consumer price index on the EUR/UAH exchange rate has been defined. Main causes of the given dependence have been revealed.

Key words: consumer price index, inflation, exchange rate.

Павлыш Е. В., Московец А. В. Взаємозв'язок між динамікою індексу споживчих цін і курсом національної валюти України

У цій роботі проаналізовано взаємозв'язок між динамікою індексу споживчих цін і динамікою курсу національної валюти України щодо євро. Розглянуто суть і чинники індексу споживчих цін як важливого

показника інфляції. Побудовано регресійну модель, яка підтверджує залежність індексу споживчих цін від валютного курсу. Виявлено основні причини цієї залежності.

Ключові слова: індекс споживчих цін, інфляція, валютний курс.

Павлыш Э. В., Московец А. В. Взаимосвязь между динамикой индекса потребительских цен и курсом национальной валюты Украины

В этой работе анализируется взаимосвязь между динамикой индекса потребительских цен и динамикой курса национальной валюты Украины по отношению к евро. Рассмотрены сущность и факторы индекса потребительских цен как важного показателя инфляции. Построена регрессионная модель, которая подтверждает зависимость индекса потребительских цен от валютного курса. Выявлены основные причины этой зависимости.

Ключевые слова: индекс потребительских цен, инфляция, валютный курс.

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