

Monetary Inflation and its Connection with Rising Prices

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Abstract

The relevance of this issue is due to the lack of a reasonable mechanism for inflation quantifying. Therefore, the purpose of this article is to describe the scheme for the numerical evaluation of the inflation rate, based on the money estimation by labor costs. Data for analysis were taken from the Statistical yearbooks for 1997-2015. It was established that monetary inflation shows the increase in price load per unit of labor almost by 20 times. In addition, the calculations showed that the growth rate of monetary inflation is above the growth rate of prices. The authors have substantiated a direct proportion between monetary inflation and price index, and described future prospects of research in this field.

Keywords: price inflation, industrial prices, monetary inflation index, working time fund, gross domestic product (GDP), human labor costs.

JEL Classification: G02, G17, C12.

Introduction

The inflation and devaluation processes have a big impact on the economy structure (Dyatlov et al. 2016, Abdymanapov et al. 2016). Therefore, a modern monetary policy of the National Bank of Ukraine is increasingly concentrated on the inflationary processes control (Cherevyk and Miroshnyk 2016). However, there is no reasonable mechanism for inflation quantifying. This fact causes the discussions about whether inflation is an independent process, distinct from price growth, or the price growth is a process of inflation.

Thus, in the Statistical yearbooks of Ukraine, the calculations of inflation are often replaced by such a value as the index of price increase. The same position is demonstrated in some economic literature (Reed 2014, Kapetanios 2004).

In our opinion, the index of price increase is not an inflation index. It is just an indicator of price increase, which under certain conditions can be triggered by inflation. Nevertheless, a monetary factor is an index of inflation, which is measured by using the indicator of the human labor costs. That is, the direct estimate of money by labor costs is applied.

1. Methods, Materials and Results

First, let us assess the market prices by the labor costs in Ukraine in 1997 – 2000 (Table 1).

Table 1. Industrial actual (market) prices assessed by the labor costs in Ukraine in 1997-2000

№ sal ary	Value	1997	1997	1999	2000
1	2	3	4	5	6
1	The production of goods and services by manufacturers of industrial goods in actual prices, UAH mln.	77848	85590	95561	128516
2	Average number of employees in industry, total, thousands	4642	4273	4142	3932
3	The use of working time fund by industry employees on average per employee (total worked hours)	1618*	1552*	1605*	1583*
4	The fund of working time of industry employees, thousand hours; (line 2 x line 3)	7510756	6631696	6647910	6224356
5	The ratio of working hours per one astronomical hour of working time **	1,250000	1,264063	1,199103	1,214153
6	The total amount of labor spent by industry employees, thousand working hours cost (line 4 x line 5)	9388445	8382882	7971529	7557321
7	money Estimates by human labor costs (or an evaluation of industrial market prices), UAH/hour of labor costs (line 1/line 6)	8,29	10,21	11,99	17,01

Compiled with the help of sources (Statistical Yearbook, 1997 - 2011; Collected book Ukraine, 2014; Statistical bulletin, 2015)

*Note 1

** Note 2

Note 1.: We will focus on the indicators marked with (*), given in the 3rd line of the Table 1. The usage rate of working time fund by industry employees on average per employee is not provided in 1997 – 2000 statistical yearbooks of Ukraine. Nevertheless, they were provided with information about the lost work time of employees across sectors of the economy. In particular, the loss of time in the industry was as follows: 1997 — 377 hours; 1998 — 410 hours; 1999 — 431 hours; 2000 — 398 hours.

If we know the size of the total fund of working time (attendance and absenteeism) in the industrial sector in the corresponding year, then we can get the index of worked hours by reducing this figure is a loss of time. Analysis of the relationship between the fund of working time (attendance and absenteeism) and the norm of working time, which depends on the workweek length, over the years from 2001, showed that 'the fund of working time (attendance and absenteeism)' in general is often 10 – 20 hours below the standard working time in a 40- hour work week. Therefore, in 1997, the standard working time in a 40-hour working week was 2,010 hours. We reduce this figure by 15 hours (average between 10 and 20 hours) and have a roughly figure of 'fund of working time (attendance and absence)' for 1997, which equals to 1 995 hours. The index of worked hours is equal to 1,618* hours (1995 hours minus 377 hours) that is introduced in the 1996 column in the 3rd line of the Table 1.

The calculation mechanism for subsequent years is the same.

In 1998, the standard working time in a 40-hour working week was 1977 hours. We reduce this figure by 15 hours, and have a value of 'the fund of working time (attendance and absenteeism)' for 1998, which is numerically equal to 1,962 hours. The index of worked hours equals to 1552* hours (1,962 hours minus 410 hours), that is introduced in the 1998 column in the 3rd line of the Table 1.

In 1999, the standard working time in a 40-hour working week stood at 2,051 hours. We reduce this figure by 15 hours, and have a value of 'the fund of working time (attendance and absenteeism)' in 1999,

which is numerically equal to 2,036 hours. The index of worked hours is equal to 1,605* hours (2,036 hours minus 431 hours), which is introduced into the 1999 column in the 3rd line of the Table 1.

Finally, in 2000, the standard working time in a 40-hour working week was 1996 hours. We reduce this figure by 15 hours, and have a value of 'the fund of working time (attendance and absenteeism)' — 1,981 hours. The index of worked hours is equal to 1,583* hours (1981 hours minus 398 hours), which is introduced into the 1999 column in the 3rd line of the Table 1.

Note 2.: The ratio of the number of working hours per astronomical hour of working time (the price coefficient) shows the number of work hours (that is, the cost of labor), which consists in one astronomical work hour of the employee. The actual preparatory material for the understanding and calculation of such coefficient exists already for more than half a century.

From the 70s of XX century, the number of athlete work in sports is measured by the total pulse rate. The total pulse rate determines the amount of pulse beats of the person during the time of athletic work. The heart rate of 60 to 80 beats per minute is taken as a starting point. The index pulse, for example, — '80 beats per minute' — means 80 pulse beats (heart rate), which are equal to one astronomical minute. Such mechanism of measuring the amount of work can be applied to human work in the industry. Moreover, we have accumulated actual material regarding studies of the association of work and heartbeat.

Specific types of labor have been distributed into groups depending on the load, using the frequency of the pulse as an indicator. In 1963 in England, Brown and Growden have researched industrial employees associated with the Slough Industrial Health Service and have published the following data in the 'Slough Scales' — the dependence of heart rate (in beats per minute) from the workload: light work — 60-100, moderate — 100-125, hard — 125-150, very hard — 150-175 beats per minute (Blanchard, Cerutti and Summers, 2015). A group of scientists from France, Switzerland and Belgium have developed the classification of works according to the frequency of the heartbeats in 1967: very light work — 75, light — 75-100, moderate — 100-125, hard — 125-150, very hard — 150-175, extremely hard work — more than 175 beats per minute (Galí, 2015).

Therefore, if we take the number of beats of the pulse for the base of the indicator light works in 80 beats./min, moderate work would have a ratio ranging from 1.25 (100 beats./min.: 80 beats./min.) to 1.56 (125 beats./min.: 80 beats./min.), hard work — from 1.57 (125 beats./min.: 80 beats/min) to 1.87 (150 beats./min.: 80 beats/min), very hard ranging from 1.88 (150 beats./min.: 80 beats/min) to 2.19 (175 beats./min.: 80 beats./min.) and so on. These are the conversion coefficients of actual working time to working hours cost.

The conducted researches give the chance to take the coefficient of the number of working hours per astronomical hour of working time in the amount of 1.25 (table 1, line 5) for 1996. Of course, this ratio should be calculated on the basis of field measurements in the workplace, but such measurements could be taken in the near future. Let us calculate the coefficients of cost based on available statistical data for 1998 and subsequent years, up to 2015. Of course, the actual data for this calculation had never been collected, but statistics provide an indicator of the usage of working time fund by industry employees on average per employee (total worked out) in astronomical hours (line 3 in table 1 and line 6 table 3, 4, 5, 6). If we multiply this figure by a factor value, you will have a value of labor costs (i.e. labor cost) spent in one year by one average working industry.

On the basis of existing statistical data, we are not yet capable to calculate the ratio of the cost directly. Nevertheless, we can go to its numerical characteristics indirectly. We can calculate numerically not the ratio of the cost, but its change according to the previous year, namely: the index of the cost coefficient on the previous year, which essentially reflects changes in the price coefficient as well as, for example, price changes, and price index. The solving mechanism is as follows. The relationship of the price index with the index of physical volume of gross domestic product is natural. We take the year 1997 as a

reference point. Then, the index of physical volume of GDP in 1997 is equal to 100.0%, and the price index equals to 1.0. (see table 2). The product of the cost index and the rate of worked hours in direct ratio affects the physical volume of GDP if all other factors remain unchanged. Therefore, we can write that for 1997, $1618 \cdot 1,0 = 100,0 \%$, and for 1998, $1552 \cdot P_i = 97,0 \%$. If we compare these indicators with respect to each other, we will have:

$$1552 \cdot P_i / 1618 \cdot 1,0 = 0,97 / 100,0, \text{ where } P_i = 1.01125.$$

We have found not the price coefficient, but the price index (P_i) for 1998 relative to 1997, taken as 100%, or as 1.0. To calculate the value for 1998, it is necessary to multiply the IP of 1998 by the price coefficient of 1997: $1.250000 - 1.01125 = 1.264063$ (see the result in Table 2). The following calculation: for 1998, $1552 - 1.0 =$ of 100.0 %, and for 1999, $1605 - P_i = 98.1 \%$. If we compare these indicators with respect to each other, we will have:

$$1605 - P_i / 1552 - 1.0 = 0.981 / 100,0, \text{ where } P_i = 0.94861.$$

To calculate the value of the price coefficient in 2000, we need to use for 1999 multiplied by the ratio of the cost of 1999: $1.264063 - 0.94861 = 1.199103$ (by a recorded Table 2). For such mechanism, other indicators are calculated — see Table 2.

Table 2. The calculation of the price coefficient that converts astronomical hours of working time into the cost hours

Year	Indices of gross domestic product volume (in comparable prices), % to the previous year	The use of working time fund by industry employees on average per employee (all actually worked out), (see the corresponding line in Tables 1, 3, 4, 5, 6), hours	Index of the coefficient of astronomical hours of working time into cost hours in comparison with the previous year (price index) (P_i)	Coefficient of astronomical hours of working time into cost hours in comparison with the previous year (price coefficient)
1	2	3	4	5
1997	100,0	1618	1,0	1,250000
1998	97,0	1552	1,01125	1,264063
1999	98,1	1605	0,94861	1,199103
2000	99,8	1583	1,01187	1,214153
2001	105,9	1433	1,16985	1,420377
2002	109,2	1562	1,00182	1,422962
2003	105,2	1596	1,02959	1,465057
2004	109,6	1636	1,06920	1,566439
2005	112,1	1685	1,08840	1,704912
2006	102,7	1679	1,03067	1,757201
2007	107,3	1679	1,07300	1,885477
2008	107,9	1695	1,06881	2,015217
2009	102,3	1673	1,03645	2,088672
2010	85,2	1542	0,92438	1,930727
2011	104,1	1627	0,98661	1,904875
2012	105,4	1665	1,02994	1,961907
2013	100,2	1669	0,99960	1,961122
2014	100,0	1660	1,00542	1,971751
2015	89,9	1612	0,92577	1,825388

Source: Compiled with the help of sources (Statistical Yearbook, 1997 - 2011; Collected book Ukraine, 2014; Statistical bulletin, 2015)

In Tables 3, 4, 5, 6, the same calculations are presented as in Table 1, however, there is one clarification. The Statistical yearbooks of Ukraine, since 2002, have ceased to publish the indicator: 'Production of goods and services by manufacturers of industrial products in basic prices, together, millions UAH'. Now it is provided as three separate indicators, namely: 'Production of goods and services by manufacturers in the mining industry at basic prices, millions UAH' (line 1 in the tables), 'Production of goods and services by manufacturers of processing industry in basic prices, millions UAH' (line 2) and 'Production of goods and services in the field of production and distribution of electricity, gas and water at basic prices, millions UAH' (line 3). If we put these three indicators, then we will have a generalized indicator: 'Production of goods and services by manufacturers of industrial products in basic prices, together, millions UAH' (see line 4 in Tables 3, 4, 5, 6).

Table 3. The calculation of the price coefficient that converts astronomical hours of working time into the cost hours

No	Index	2001	2002	2003	2004
Salary					
1	2	3	4	5	6
1	Production of goods and services by manufacturers in the mining industry at basic prices, millions UAH	—	23411	24386	26484
2	Production of goods and services by manufacturers of processing industry in basic prices, millions UAH	—	172759	191301	235289
3	Production of goods and services in the field of production and distribution of electricity, gas and water at basic prices, millions UAH	—	27905	28227	30360
4	Production of goods and services by manufacturers of industrial products in basic prices, together, millions UAH (line 1+ line 2+ line 3)	175532	224075	243914	292133
5	The average number of employees hired in industry, total, thousands	4061	3811	3578	3416
6	The use of working time fund by industry employees on average per employee (total worked), hours	1433	1562	1596	1636
7	The fund of working time of industry employees (astronomical clock), thousands hours (line 5 x line 6)	5819413	5952782	5710488	5588576
8	The coefficient of the working hours number per astronomical hour of working time	1,420377	1,422962	1,465057	1,566439
9	The total work amount spent by industry employees, working hours cost (line 7 x line 8)	8265760	8470583	8366190	8754163
10	Estimation of money by the cost of human labor (or evaluation of industrial market prices), UAH/hour of labor cost (line 4/line 9)	21,24	26,45	29,15	33,37

Source: Compiled with the help of sources (Statistical Yearbook, 1997 - 2011; Collected book Ukraine, 2014; Statistical bulletin, 2015)

Table 4. Evaluation of industrial actual (market) prices by the labor costs in Ukraine in 2005 — 2005

No	Index	2005	2006	2007	2008
Salary					
1	2	3	4	5	6
1	Production of goods and services by manufacturers in the mining industry at basic prices, millions UAH	31766	41149	46125	57563

2	Production of goods and services by manufacturers of processing industry in basic prices, millions UAH	325820	399039	456729	588203
3	Production of goods and services in the field of production and distribution of electricity, gas and water at basic prices, millions UAH	31961	36739	47318	60898
4	Production of goods and services by manufacturers of industrial products in basic prices, together, millions UAH (line1+ line2+ line3)	389547	476927	550172	706664
5	The average number of employees hired in industry, total, thousands	3408	3416	3362	3287
6	The use of working time fund by industry employees on average per employee (total worked), hours	1685	1679	1679	1695
7	The fund of working time of industry employees (astronomical clock), thousands hours (line 5 x line 6)	5742480	5735464	5644798	5571465
8	The coefficient of the working hours number per astronomical hour of working time **	1,704912	1,757201	1,885477	2,015217
9	The total work amount spent by industry employees, working hours cost (line 7 x line 8)	9790423	10078363	10643137	11227711
10	Estimation of money by the cost of human labor (or evaluation of industrial market prices), UAH / hour of labor cost (line 4 / line 9)	39,79	47,32	51,69	62,94

Source: Compiled with the help of sources (Statistical Yearbook, 1997 - 2011; Collected book Ukraine, 2014; Statistical bulletin, 2015)

Table 5. Evaluation of industrial actual (market) prices by the labor costs in Ukraine in 2009 — 2012

No	Index	2009	2010	2011	2012
Sal					
ary					
1	2	3	4	5	6
1	Production of goods and services by manufacturers in the mining industry at basic prices, millions UAH	91551	78492	119911	157418
2	Production of goods and services by manufacturers of processing industry in basic prices, millions UAH	751615	628232	810843	970116
3	Production of goods and services in the field of production and distribution of electricity, gas and water at basic prices, millions UAH	77688	85749	98052	129202
4	Production of goods and services by manufacturers of industrial products in basic prices, together, millions UAH (line 1+ line 2+ line 3)	920854	792473	1028806	1256736
5	The average number of employees hired in industry, total, thousands	3188	2851	2860	2828
6	The use of working time fund by industry employees on average per employee (total worked), hours	1673	1542	1627	1665
7	The fund of working time of industry employees (astronomical clock), thousands hours (line 5 x line 6)	5333524	4396242	4653220	4708620
8	The coefficient of the working hours number per astronomical hour of working time **	2,088672	1,930727	1,904875	1,961907
9	The total work amount spent by industry employees, working hours cost (line 7 x line 8)	11140020	8487943	8863802	9237875

10	Estimation of money by the cost of human labor (or evaluation of industrial market prices), UAH/hour of labor cost (line 4/line 9)	82,66	93,36	116,07	136,04
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Source: Compiled with the help of sources (Statistical Yearbook, 1997 - 2011; Collected book Ukraine, 2014; Statistical bulletin, 2015)

Table 6. Evaluation of industrial actual (market) prices by the labor costs in Ukraine in 2013 – 2015

No	Index	2013	2014	2015
1	2	3	4	5
1	Production of goods and services by manufacturers in the mining industry at basic prices, millions UAH	153036	155870	157305
2	Production of goods and services by manufacturers of processing industry in basic prices, millions UAH	947924	904052	926157
3	Production of goods and services in the field of production and distribution of electricity, gas and water at basic prices, millions UAH	144578	140522 +22417	148553
4	Production of goods and services by manufacturers of industrial products in basic prices, together, millions UAH (line 1+ line 2+ line 3)	1245538	1222861	1099352***
5	The average number of employees hired in industry, total, thousands	2804	2673	2297
6	The use of working time fund by industry employees on average per employee (total worked), hours	1669	1660	1612
7	The fund of working time of industry employees (astronomical clock), thousands hours (line 5 x line 6)	4679876	4437180	3702764
8	The coefficient of the working hours number per astronomical hour of working time **	1,961122	1,971751	1,825388
9	The total work amount spent by industry employees, working hours cost (line 7 x line 8)	9177808	8749014	6758981
10	Estimation of money by the cost of human labor (or evaluation of industrial market prices), UAH/hour of labor cost (line 4/line 9)	135,71	139,77	162,65

Source: Compiled with the help of sources (Statistical Yearbook, 1997 - 2011; Collected book Ukraine, 2014; Statistical bulletin, 2015)

*** Product index of industry is 89.9% before the previous year, then: 1222861 thousand UAH × 0,899 = 1099352 thousand UAH.

Summing up the results of calculating the valuation of industrial prices (column 2 in Table 7), we can calculate annual indices of the monetary inflation of industrial goods (column 3 in Table 7) and compare them with the official (published by government statistics) price index for the same industrial products (column 4 in Table 7).

Table 7. The index calculation of monetary inflation of industrial goods

Year	Evaluation of industrial prices by the human labor costs (or the value estimation of money that formed the actual (market) prices of industrial products), UAH / labor costs hour	The index of monetary inflation of money that was involved in the formation process of prices on industrial products (annual), % to the previous year (calculated by the authors)	The manufacturers price index of industrial products — annual, % to the previous year (official statistics); [Statistical yearbooks of Ukraine]
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1	2	3	4
1997	8,29	100,00	100,0
1998	10,21	123,16	105,0
1999	11,99	117,43	135,3
2000	17,01	141,87	115,7
2001	21,24	124,87	120,8
2002	26,45	124,53	108,7
2003	29,15	110,21	103,0
2004	33,37	114,48	107,6
2005	39,79	119,24	120,5
2006	47,32	118,92	109,5
2007	51,69	109,23	114,1
2008	62,94	121,76	123,3
2009	82,66	131,33	123,0
2010	93,36	112,94	114,3
2011	116,07	124,33	118,7
2012	136,04	117,21	114,2
2013	135,71	99,76	100,3
2014	139,77	102,99	99,9
2015	162,65	116,37	117,1
In total from 1997 to 2015	—	1961,96	992,91

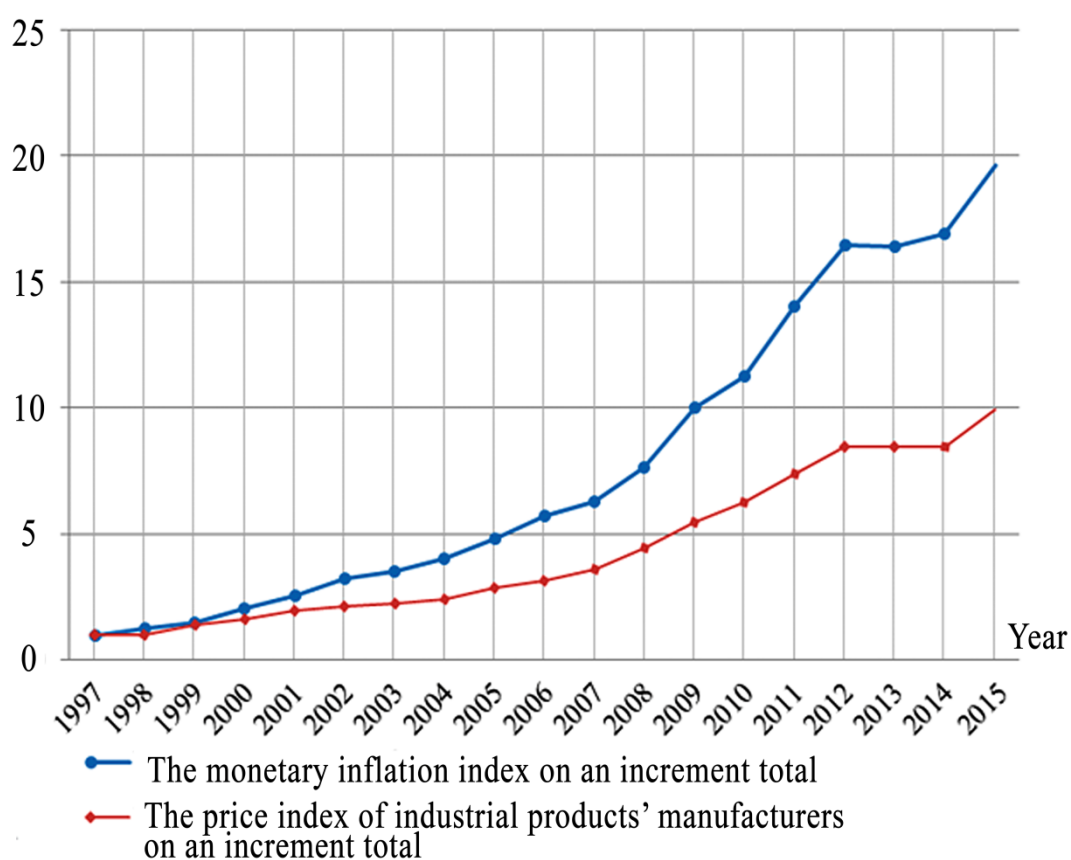


Figure 1. Comparison graph of growth rate of the monetary inflation indices and price indices for industrial products

Conclusion

This article considers the inflation processes concerning prices for industrial products during the years 1997 – 2015.

Since 1997, the monetary inflation shows the increase in price load per unit of labor almost by 20 times (19.65), (column 2, Table 7). During the same period, the market prices of manufactured products raised only by 10 times (9.93).

It is established that the growth rate of monetary inflation is higher than the rate of rising prices. In addition, there is a direct proportion between monetary inflation and price index.

The growth of the monetary inflation index is observed applied to the price index, namely, — first the monetary index increases, and after this, a growth in the price index is recorded. For example, the index of monetary inflation in 1998 was 1.2316, and the price index in the same year was 1,05, in other words, in 1998, the monetary inflation grew by 23%, and the price level grew only by 5%. Next year, monetary inflation rose by 17%, and the price level increased by more than 35%. We explain this price leap in 1998 by a leap of monetary inflation in the previous year and an 'additive' monetary inflation leap in the current year.

The look-ahead tendency of growth of the monetary inflation index towards the price index has leading term (period of time) from 1 year to half a year, — this may explain the prices leap in 1999 by 35%.

If the growth of monetary inflation stops, price growth stops in the same time period, without any lag in time, and it affects the stabilization of prices in the next period up to a year.

The relation and interaction of monetary inflation indicators and growth of prices (price index, price level) requires further investigation. In particular, it is possible to perform similar calculations relative to the consumer price index, index of sale prices of agricultural enterprises, the price index for construction-assembly works, tariff index for mail services and communication, the index of freight tariffs, price index of investment in capital assets, in order to identify the relation or its absence between monetary inflation and the rise and fall of prices.

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