Inflation in Ukraine

The Master Research Report

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Abstract

The main objective of this paper is to define the main reasons for persistent inflation in Ukraine in 1992-1997. In this research I give a brief survey of the main theories that explain inflation and describe the inflation process in Ukraine since independence. By the statistical means, I determine the main factors that had an impact on inflation in Ukraine and then suggest some policies that could sustain the achieved stabilization.

The main message of this work: it is a loose monetary policy that causes the price level to increase in Ukraine.

Introduction

Since World War II, inflation has been developing in different ways in different countries. In the developed countries, inflation peaked after the sharp increase in the world prices for oil in the 70s – at that time inflation rate was around 14 % per annum. In the 80s inflation in these countries was steadily declining. In the countries with middle and low income per capita, inflation crested somewhat later and its rate reached about 17 and 28% respectively. [1]

In the transition economies, including Ukraine, the situation differed radically. Leaving apart the consequences of initial price liberalization on the general price level, Ukraine continued to suffer from high inflation during several years after launching the reforms.

Annual inflation in Ukraine (December to December) was 10,199 % in 1993, 401% in 1994, 182 % in 1995, 40 % in 1996[2] and 10.1 % in 1997.[i] [3] In a situation when the consolidated budget deficit as the percentage of GDP was very high: 13.8 % - in 1992, 5.1 % - in 1993, 8.9 % - in 1994, 6.6 % - in 1995, 4.9 % - in 1996 and 6.7 % - in 1997; [4] the tax department failed to provide the appropriate level of budget revenue, and the government resorted to the inflation tax.

In this research I am going to determine main factors that affected inflation in Ukraine since independence and then suggest some remedies that are called for preventing future increase in general price level.

[i] The annual inflation rate was calculated as follows. $P_t=100*((I_t/I_{t-1})-1)$, where P_t-annual inflation rate in year t, I_t-CPI in December in year t, I_{t-1}-CPI in December of preceding year.

This issue is particularly important today, when many Ukrainian officials still believe that there is undersupply of money in the economy. As an argument they mention inter-enterprise arrears. They insist that if the economy receives money injections, enterprises would go out of crisis and GDP would increase. Regarding this my work is to prove that the excessive money supply would cause an increase in the price level, not in real GDP.

In addition, though the rate of inflation was acceptable in 1997, difficulties with financing the budget deficit and any considerable outflow of foreign reserves could cause a new spiral of inflation.

In the first part of the paper I am going to examine basic theories that explain inflation. These are Monetary, Keynesian and Structural theories. In the second part I will describe the development of the inflationary process in Ukraine in 1992 - 1997. The third part is devoted to the model I will investigate. The main findings and results will be presented in the fourth part. The fifth part gives some policy recommendations and is followed by conclusions.

1. Theory

There are several explanations of causes of inflation. Particularly important ones are: the quantitative or monetary (the increase of the money supply), Keynesian (the increase in the aggregate demand) and structural (disproportion between consumer sector and the sector which produces heavy industry inputs and military goods) theories.

Monetary Theory of Inflation.

The monetarists imply that the inflation is a purely monetary phenomenon and it could arise only if the rate of money growth exceeds the rate of the real GDP growth.[5] Therefore, at any moment the rate of inflation is said to reflect the current and past monetary expansion

in the economy. Monetarists reject the non-monetarist explanation of inflation – i.e. the alteration of the level of public or private spending, changes of the fiscal policy, the influence of the shortages of food or fuel an so on - because in these cases one must increase the money relatively to the real GDP and thus, the real cause of inflation is a problem with monetary policy. Monetarists admit the influence of non - monetary factors such as the labor unions' claims of wage increase, monopoly power or the administrative price increase, the goods shortages or the war in Kuwait and so on – may affect particular prices. However, they insist that without excessive monetary growth the increase in some price, caused by these non-monetary factors, after some time will be compensated by the fall in prices for other goods and the average price level will remain the same. In any case, the necessary and sufficient reason of a general price increase is the monetary expansion in the economy.

> "Irrelevantly to the country, the cause of inflation is always the fact that for a given size of goods and services produced in the economy the money stock is too big. Inflation can persist only if the money stock steadily increases and/or the output steadily decreases."[6]

The requirement of a constant velocity is the key feature that distinguishes the monetary theory of inflation from the Keynesian one. The condition goes straight from the logic of the model that inflation appears only due to excessive money growth. In case that velocity was not constant (its rate of change was not zero), it would be an additional independent cause of inflation. It follows, therefore, that velocity is at least near constant under the monetarist theory.

Keynesian Model of Inflation

The Keynesian model says that inflation could arise from anything that forces the aggregate demand to increase at a faster rate than the aggregate supply. The question about

responsible body (the Central Bank or another force) is an empirical question (subject to statistical testing) and not the conclusion of the model.

The key concept of the Keynesian theory of inflation is effective demand.[7] In its very simple form effective demand consists of consumption and investment. While consumption is positively related to income, investment does not depend on level of income and is largely determined by the rate of return and the state of confidence in the economy. In equilibrium, the volume of output produced should be equal to effective demand. Suppose the economy is in the equilibrium and the level of real output produced is smaller than the its full employment level. Suppose further that the effective demand increases. It may happen because of the reduction in taxation: lower taxes imply bigger disposable income and thus, higher consumption. Also, the increase in government spending goes to the consumption or investment part of the effective demand expending it. To reach a new equilibrium, the level of real output produced should increase. Therefore, the producers will employ new labor and new capital. This will continue until the economy reaches its full employment level. If at this point the effective demand still increases, the economy can not further expand production because there are no free resources for employing. However, the equilibrium condition still requires that the amount of income people would like to spend on consumer goods and services and on investment goods must be equal to the nominal output. Therefore, when economy fails to produce more to satisfy the demand, the price level should go up to maintain the economy in the equilibrium.

Therefore, Keynesians considered the increase in the effective demand as a main factor of inflation.

Structural Model of Inflation

The Scandinavian or structural model of inflation insists that inflation in a small open economy depends on the world inflation and the difference of productivity growth in the sector integrated in the world economy (mostly export and import sector) and the non-tradable sector (mostly services and government activities). [8]

I. S. Koropeñky applied this theory to the Ukrainian economy. [9] This theory could be explained by the following equation:

$$p = p_{ñ} + \alpha_m(q_c - q_m)$$

where:

p -- the overall inflation,

p_c -- inflation in the consumer sector (C),

α_m -- weights of inflation rate in the sector (M) (this sector produces heavy industry inputs and military goods) in the overall inflation,

q_c, q_m -- percent of productivity increase in sector C and M respectively.

He proposed to consider consumer sector C and sector M, which includes the producer goods and the military - industrial complex.

> "The origin of inflation has to be thought in the accumulation of demand for the output in sector C and the decrease in demand for the output of sector M. Material and human resources are not sufficiently mobile to shift immediately from sector M to sector C in order to satisfy demand for the output of the latter. As a result, prices in sector C increase, but in view of the existing conditions, prices in sector M do not decline as quickly as can be expected under free market condition. Overall inflation is an average of inflation in sector C and M weighted by their respective share of total expenditures. The C sector increases its share when economic growth occurs under free market conditions. Wages in sector C follow the increase in the price of its output, although not necessarily in the same proportion, and exceed productivity gains of the sector C workers. Workers in sector M demand relatively equal wage increases in response to the rise in inflation. Productivity is lower and, thus, inflation is higher in the sector M. The sum of the difference between productivity in two sectors weighted by the share of total expenditures on sector M's output plus the accumulated demand for the output for the C sector determines the inflation rate." [10]

Limitations of the Theories in Ukraine

The monetarist model of inflation seems to be flawed because its main assumption is constant velocity. But in Ukraine, velocity has exhibited substantial fluctuations.

Keynesian theory is less applicable to transition economies because, as Gorges de Menil stressed, they are supply-side economies, where the supply of goods is restricted by various factors such as institutional disproportions, non-efficiency of resource allocation, etc.[11] As I have mentioned above, to equilibrate the supply and effective demand when the economy operates at the full employment level, prices must go up. In Ukraine, many prices are regulated and cannot increase. Therefore, even if aggregate demand changes, the economy could not react adequately because of these restrictions.

The structural model is also inapplicable due to several reasons. First, empirical tests suggested that the model did not represent Ukrainian economy accurately and predictions could not be made on its basis, as I. Koropcky pointed out. [12] Second, this is a long-run model and thus, we can not make any conclusions about the appropriateness of this model since we have only short run data (1992 –1997). Third, the data required in this analysis (mainly the time series of productivity growth in different sectors) are difficult to get in Ukraine.

2. Inflation Experience in Ukraine

There are some reasons of why inflation in Ukraine was so severe. Yet in the former Soviet Union (FSU) economy there already were some preconditions for the outbreak of inflation. At that time, the price system was under state regulation and prices could not perform the function of equilibrating supply and demand as they do in a market economy.

These regulated prices were always below the equilibrium, mostly for political reasons. As a result there were shortages of goods.

Therefore, after liberalization and canceling the price controls, prices went up sharply, equilibrating the supply and demand on the one hand and starting the inflationary process on the other.

It is also worth saying that liberalization in Ukraine was partial. The prices for consumer goods, especially for food, were regulated administratively. It was the major explanation of the fact that between December, 1992 and January, 1993 consumer prices increased by 250 %, while wholesales prices (which were not so severely regulated) increased by 740 %.[13]

One of the adverse consequences of this incomplete price liberalization was the importing of inflation from countries in the ruble zone (at that time Ukraine was a member of this zone) where liberalization was at a higher stage. Consider, for example, Russia and Ukraine. In Russia liberalization was at higher stage: the prices for some goods were regulated in Ukraine and were determined by the market in Russia. Hence, the Russian prices for these goods were higher, because of the preceding shortages (see above). Since there circulated a single currency – the ruble – it was a good opportunity for arbitrage: to buy cheap goods in Ukraine and sell them in Russia.

To prevent buying cheap Ukrainian goods by nonresidents, Ukraine introduced coupons, a quasi currency which circulated simultaneously with rubles. While the supply of rubles was under control of the Russian Central Bank, exclusive rights of issuing coupons were held by Ukrainian authorities. Coupons were distributed only among residents of Ukraine, and were used at retail outlets to buy cheap Ukrainian goods. Of course, these

artificial means were bound to fail, as they actually did. The problems with coupons were that Ukrainian government realized all advantages of seigniorage at that time. Therefore, very soon the supply of coupons was much bigger than it was needed to serve the economy.

In addition, there was a sharp increase in natural gas and oil prices. Since prices in the FSU were distorted and energy was very cheap, Ukraine inherited from the USSR huge energy extensive technologies. As a result, energy has a large weight in the cost structure. Therefore, when Russia, a main supplier of energy, decided to increase the price of oil, the Ukrainian price index increased sharply, producing inflation. However, now this source of inflation is exhausted since the price for energy has reached the world level.

Nevertheless, the main cause of inflation was loose monetary policy (see Table 1). Though the National Bank of Ukraine (NBU) was declared to be an independent entity, responsible for the money supply, in fact, it was subordinated to Parliament. During 1992-1993 the consolidated budget deficit was financed by NBU's direct credits to the government. Also, the government made a decision to subsidize state owned enterprises (SOE) and either persuaded NBU to do this or financed the enterprises from the budget. These subsidies were most substantial to the agricultural sector during sowing and harvesting periods and for fuel in the winters.

Table 1. Ukraine: Basic Monetary Indicators (Mln. Hryvnias, end of period).[14]

Year	CPI (average for period)		Currency in circulation		M2 in domestic currency		M2 (including time deposits in foreign currency)		NBU credits to Government		
	1990=1	Monthly % change	M. Hrn., end of period	% of change	M. Hrn., end of period	% of change	M. Hrn., end of period	% of change	M. Hrn., end of period	% of change	Actual reserve ratio (%)
1993	1696	47.1	128	2460.00	386	1578.30	481	1824	113	564.71	52
1994	16809	14.4	793	519.53	2163	460.36	3216	568.60	1244	1000.90	49
1995	80137	9.0	2623	230.77	5269	143.60	6846	112.87	4295	245.26	17
1996	14432	2.8	4041	54.06	7306	38.66	9024	31.81	5995	39.58	13
1997	167376	0.8	6132	51.74			12 453	38.00	7096	18.36	15

The resulting high inflation pressured on the liquidity of enterprises and this, in turn, was a pretext to make the NBU issue new credits to compensate SOE's losses.

> "In May [1992], the National Bank of Ukraine provided liquidity for an increase in banking system credit to enterprises of rub 345 billion (doubling the outstanding stock of such credit). And in June and July credit of some rub 300 billion was extended to recapitalize the agricultural and fuel sectors, this time at the expense of the Government but entirely financed by the National Bank of Ukraine."[15]

Several times during this period Parliament adopted minimum wage increases, which pushed the average wage up and served as another pretext for SOE to claim credits from the bank.

In addition, there were several attempts to battle with inter-enterprise arrears. These included "the creation of special temporary accounts, from which enterprises could draw credit to pay their arrears but into which they were required to pay all receipts from their debtors. Most of the arrears settled were with Russian enterprises." [16] These actions led to the creation of additional bank reserves.

This monetary policy resulted in a 71.1 %, the peak monthly inflation in June of 1993, remaining its very high levels afterwards. [17]

It should be pointed out that there were some attempts to fight inflation. As M. Zinchuk pointed out:

> "This is not to say that there was no attempt to battle inflation; there was but it was from the demand side only (allowing wage to severely decline), and somewhat from the use of fiscal policy, if one does not consider quasi fiscal operations. Wage were held back very tightly during this period, leading to the view that the Cabinet believed it could master inflation by strictly dampening consumer demand... The Kuchma administration introduced other reform measures, including price liberalization, which was extended to the greater part of the economy, excluding

natural monopolies, utilities and transportation, where considerable subsidies were maintained, and the foreign exchange market." [18]

Stabilization was evident after January 1995, when monthly inflation was expressed in a single digit. It was preceded by a substantial decrease in the budget deficit, and implicit subsidies to the SOEs and partial financing of budget deficit by more civilized means: through external financing (i.e. IMF credits) and by introducing Treasury bills in the middle of 1995.

Stabilization was a very difficult task because of inflationary expectations. After a three-year-experience of very high inflation, people cannot trust the national currency and the demand for real cash has steadily decreased. Since people still needed to make savings somehow (even in the presence of the inflation expectations) they started to buy foreign currency, mainly US dollars (the phenomenon is called dollarization).

Despite the fact that annual inflation was 10.1 % in 1997, until now there is a big threat of the new burst of inflation: there are still wage arrears for workers of budget financed organizations. So, if the government decides to pay all this internal debt, it would need an increase in the money supply, and, thus, in inflation if output does not tend to grow.

3. Brief Statement of the Model

The model I am going to investigate is based on the equation of exchange, which is an identity relating the volume of output at current prices to the stock of money times the turnover rate of the average unit of currency.

$$M*V= P*Y \quad [19], \qquad (1)$$

where:

M -- quantity of money,

V -- velocity of money,

P -- general price index,

Y-- real GDP.

From this identity we could infer that price level depends on the supply of money and the level of real GDP:

$$P = f(M, Y) \tag{2}$$

I do not include velocity as an explanatory variable at the right-hand side of the equation because velocity can be treated as a residual (it is a variable that is completely determined by the other three variables: P, Y, and M.)

Taking the natural logarithm on both sides of (2) and rearranging terms we obtain the following long-run relationship among the price level, the money supply and the real GDP:

$$p^* = a_0 + a_1 m + a_2 y + u, \tag{3}$$

In this equation lower case letters stand for natural logarithm of corresponding variables, u is the random disturbance term. Note that I expect that $\alpha_1>0$ and $\alpha_2<0$.

Variable p* is a hypothetical long-run price level needed to equilibrate the economy. The question is how the economy moves to this long-run equilibrium. I assume that in every period some fraction of the difference between hypothetical long-run and actual price levels is eliminated:

$$\begin{matrix} p - p_{-1} = l\,(p^* - p_{-1}), \\ 0 < l < 1 \end{matrix}, \tag{4}$$

From (4)

$$p = (1 - l)\,p_{-1} + l\,p^*, \tag{5}$$

Combining (3) and (5) we get:

$$p = l a_0 + l a_1 m + l a_2 y + (1 - l) p_{-1} + l u, \quad (6)$$

or

$$p = b_0 + b_1 m + b_2 y + b_3 p_{-1} + e, \quad (7)$$

Equation (7) is the short-run relationship among the variables and called the partial adjustment model. [20]

To estimate the model, I will use the following methodology:

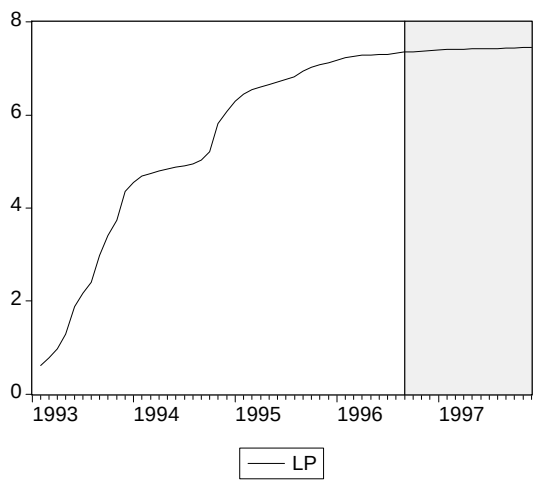
- Use unit root tests to determine whether the time series are stationary.
- Estimate the short-run regression (equation (7))
- Derive the long-run coefficients from the ones obtained in the preceding stage.

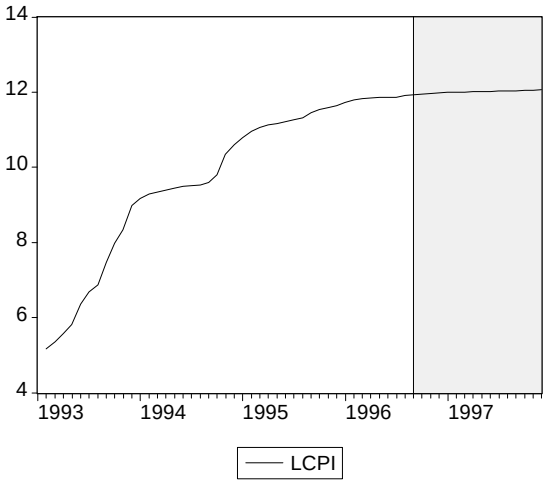
In my research I use monthly data from January 1993 to December 1997 from various issues of Ukrainian Economic Trend (see Appendix 4).

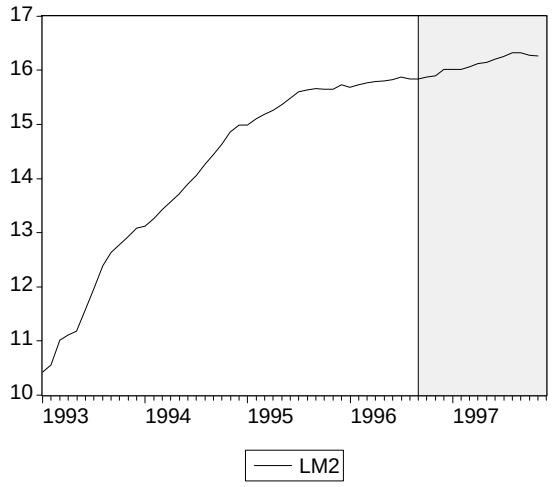
4. Estimating Procedure and Main Results

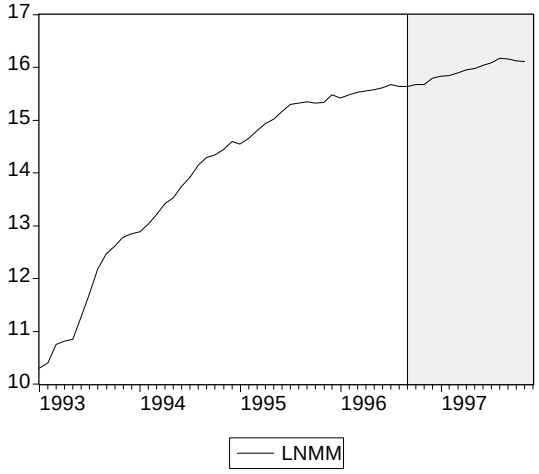
Usually it is difficult to decide what money aggregate to choose, since theory does not tell us what money aggregate is preferred. Also, there is a question what price index better represents the inflation rate in the whole economy. Therefore, I decided to consider four cases: the relationships between CPI and M2, CPI and domestic money (M2 without foreign deposits), GDP-deflator (P) and M2, GDP-deflator and domestic money.

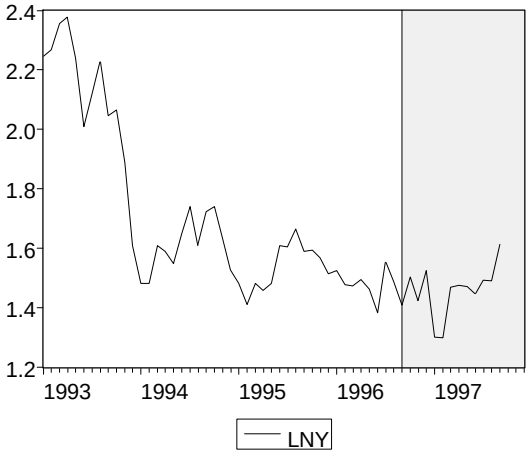
For better understanding what happened in Ukraine I represent all the time series in graphs (see bellow).











The shaded area on these graphs represents the period with new currency (a hryvnia) in circulation. This reform was fully compensatory: in September 1996, all stock of the old currency (a karbovanets) was exchanged with hryvnia at the constant ratio 100,000 karbovanetses for 1 hryvnia. It is widely agreed that the reform was very successful and further confirmed the credibility to the national currency.

Augmented Dickey - Fuller Unit Root Test suggested that the time series I am going to investigate are stationary (see Appendix 1) However, one may not believe that it is true since Ukraine went through different phases: from hyperinflation to a very low inflation. Nevertheless, the stationarity was present on the major of the period that I am going to investigate. This may explain the outcome of the unit root tests and serve as an apology for not considering the problem of non-stationarity in the rest of the research.

First of all I determine the relationship between consumer price inflation and domestic money using ordinary least square (OLS) method of estimation.

$$LCPI = -0.51*LNY + 0.31*LNMM + 0.66*LCPI(-1)$$

$$t = \quad (-3.1) \qquad (4.6) \qquad (9.6)$$

$$\text{adj. } R2 = 0.997, \quad \text{DW-stat.} = 0.897$$

where: LCPI is natural logarithm of consumer price index, LNY is natural logarithm of real GDP, LNMM is natural logarithm of M2 without foreign deposits.

In this regression adjusted R2 approaches unity which is evidence of high goodness of fit. It means that 99.7 % of the fluctuation in the CPI is explained by the real GDP, the money supply and previous CPI. Also, the coefficients have the ‘correct’ signs predicted by the theory and are statistically significant. Nevertheless, the Durbin - Watson (DW) statistics is significantly bellow the critical level, which may be the evidence of positive

autocorrelation. This is not surprising, as time series often suffer from this problem: business cycles cause macroeconomic indicators to go up steadily until some events have occurred and then go down. In the presence of autocorrelation, the main problem with ordinary least square estimation is that estimated standard errors of the coefficients are underestimated. In other words, the t-statistics of the coefficients may be too high. This leads to acceptance of false hypotheses. However, as D. Gujaraty noted, the DW d-test is not appropriate if there is a lagged depended variable in the RHS. [21] In this case I should use DW h-test:

$$h = (1 - \frac{1}{2}d)\sqrt{\frac{n}{1 - n[\mathrm{var}(b_3)]}},$$

where n is a sample size. [22]

Since, in this case

$$h = (1 - \frac{1}{2}(0.897))\sqrt{\frac{55}{1 - 55(0.06874)^2}} \approx 4.75 \succ 1.96$$

I infer positive autocorrelation in this regression. [i]

To deal with this problem I assume that the residuals of this regression are generated by Moving Average Process of the first order MA (1):

$$u_t = \rho u_{t-1} + e_t, \qquad (8)$$

where $|\rho|<1$ and e_t is an error term that satisfies all of OLS assumptions.

Then I will run generalized least square regression and test whether the regression outcome suffers from autocorrelation problem: the absence of autocorrelation evidence in this regression would imply that the assumption of an MA (1) process is correct.

To determine ρ-value I do not need to run the regression (8). Since $r = \frac{\sum (u_t u_{t-1})}{\sum u_t^2}$

and DW d-statistic, $d = 2(1 - \frac{\sum (u_t u_{t-1})}{\sum u_t^2})$, ρ is determined as follows ρ = 1-d/2. [23]

In this case ρ = 0.55 and I should adjust all involved time series in the following way: subtract portion ρ of each value of a variable in the previous period from its value in the current period. Then I run a regression on the adjusted variables. Such a procedure is called generalized least square (GLS) regression.[24]

So, I obtain the regression with feasible coefficient estimates:

(LCPI-0.55*LCPI(-1))= -0.58*(LNY-0.55*LNY(-1)) + 0.36*(LNMM-0.55*LNMM(-1))+ 0.6*(LCPI(-1)-0.55*LCPI(-2))

t = (-3.9) (5.9) (9.3)

adj. R2 = 0.99, DW-stat. = 2, h = 0.0059

As one can see, in the short-run, a 1 % increase in real GDP will cause a 0.58 % decrease in consumer price level, 1 % increase in supply of M2 without foreign deposits will produce 0.36 % increase in CPI. From (6) and (7) $\lambda = 1 - \beta_3 = 1 - 0.6 = 0.4$. It means that 40 % of the discrepancy between long-run equilibrium of consumer price level and its actual level is eliminated within a month. Also, in the long-run a 1 % increase in real GDP generates a 1.45 % decrease in consumer price inflation [(-0.58) / (0.4) = -1.45, from (6) and (7)] and a 1% increase in domestic money supply leads to a 0.9 % (0.36/0.4=0.9) increase in consumer prices. It seems reasonable that long-run elasticities are greater than the short-run ones as in the short-run prices are stickier.

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[i] 1.96 is a critical value at 5 % significance level. In general, if h lies within the interval [-1.96;1.96] then the hypotheses that there is no autocorrelation could not be rejected. If h>1.96 it is the evidence of positive autocorrelation, if h<1.96 – the evidence of negative autocorrelation.

Also, I have ran similar regressions with different variables (see in Appendix 2 for details). The problem of estimation was the same – the autocorrelation – and thus, the remedy was the same. I have summarized the outcome in Table 2:

Table 2. The relationship between inflation , real GDP and money supply in Ukraine.[i]

	Dependent variables			
Indicators in the GLS regression	**CPI with MM**	**CPI with M2**	**P with MM**	**P with M2**
β_1 (SR elasticity of money)	0.36 (5.88)	0.38 (6.96)	0.18 (4.93)	0.47 (5.24)
β_2 (SR elasticity of real GDP)	-0.58 (-3.89)	-0.65 (-4.76)	-0.56 (-3.45)	-0.62 (-4.48)
R2 adj.	0.99	0.99	0.99	0.99
$\alpha_1 = \beta_1/\lambda$ (LR elasticity of money)	0.9	0.9	0.66	0.95
$\alpha_2 = \beta_1/\lambda$ (LR elasticity of real GDP)	-1,45	-1,54	-2,07	-1,26
$\lambda = (1-\beta_3)$ (speed of adjustment)	0.4 (9.33)	0.42 (9.98)	0.27 (15.40)	0.49 (6.79)
$t = \ln(0.1)/\ln(1-\lambda)$ period in which 90 % of the discrepancy is eliminated	4.50	4.20	7.31	3.42

As one can see, the results do not differ very much, especially in the first and the second cases. In general, the short-run elasticity of prices with respect to the income lies in the range from -0.56 to -0.65, with respect to money supply – from 0.18 to 0.47. The coefficient of adjustment (the λ coefficient) lies in the range from 0.27 to 0.49. This means that in every period 27 % - 49 % of the discrepancy between long-run price equilibrium and its actual level is eliminated. This coefficient is fairly large and tells us that the short run in Ukraine lasts about 7 months: 90 % of the discrepancy is eliminated for a little more than 7

[i] T - statistics are given in parentheses below the coefficients.

months if $\lambda = 0.27$ and for up to 4 months if $\lambda=0.49$.[i] The long-run elasticity of price with respect to income lies in the range from -1.26 to -2.07, with respect to money supply – from 0.66 to 0.95.

Other authors also have attempted to model inflation in Ukraine. V. Honchar in his article has made such an attempt. [25] The author investigated the relationship among consumer price index, M0 and average cash exchange rate. He ran a cointegration regression and then vector error correction and inferred that long run elasticity of consumer prices with respect to M0 lies between 0.62 and 0.91, with respect to exchange rate – in the range from 0.18 to 0.45. The speed of adjustment is equal 0.3. As one can see these results are not so far from mine.

His work is a good contribution in the field of inflation investigation and prediction. However, there are few small disadvantages with his model. First of all, he did not include real GDP as an explanatory variable in the model but all available theories described above state that GDP and price level are interdependent. Also, to determine the long-run relationship among variables the author used cointegration method. The logic behind this is as follows. Econometric theory suggests that the problem of time series' non-stationarity could be solved by differencing and then running a regression on differenced variables. However, by doing so we lose the information on long run relationship among variables. To deal with this, the level variables in the error correction model enter the estimating equation in a special way: they enter cointegrated in the single entity that captures the extent to which the system is out of equilibrium. However, in our case all time series are stationary (see

[i] Suppose the discrepancy is D. Then in the first period the discrepancy would be $(1-\lambda)D$, in the second period: $(1-\lambda)^2D$ and in the t's period: $(1-\lambda)^tD$. Since when 90% of the discrepancy is eliminated what is left is 0.1D. Therefore, to determine t one should solve the equation: $(1-\lambda)^tD = 0.1*P$, or $(1-\lambda)^t = 0.1$.

Appendix 1) and hence, there is no need to run cointegrating regression. Furthermore, when running such a regression, the residuals of the cointegration equation, included in vector error correction model, are not integrated in order 0. So, the obtained result may be spurious: the inference about the regression based on the common t and F testing procedure is not valid.

The other relevent work was done by Banaian, King et al.[26] The authors also run cointegration regression and then vector error correction. As apposed to V. Honchar's cointegration techniques, all time series they included in cointegrating regression (namely inflation rate, natural logarithm of real money, log of nominal interest rate, log of real GDP) were shown to be non-stationary. Therefore, the residuals from this coitegration appears to be stationary. So, by including the residuals in the vector error correction model they avoided the problem of spurious results.

Their result was as follows: long run elasticity of inflation with respect to real money is 0.23 and with respect to real GDP is -0.87 and with respect to nominal interest rate – -1.01. The speed of adjustment (the λ - coefficient) according to their model is 0.18. In the short run inflation is affected by the lagged values of change of real money balance and the change of deposit rate as well as by the change in inflation lagged three periods. What is interesting that the impact of change in real money lagged one and three periods is positive but this variable lagged two periods – is negative. The same is true for the exchange in deposit rate: it has a positive impact on change of inflation in the next period but the negative impact on the change in inflation after two periods. Speaking about absolute value of the impact, one can see that it is greater for the deposit rate (1.5 on the average) than for real

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So, $t = \ln(0.1)/\ln(1-\lambda)$ and if $\lambda = 0.27$, $t = 7.32$, if $\lambda = 0.49$, $t = 3.42$

money (0.2 on the average). 1 % change in inflation in the last period produces 0.23 % change in the current period. Also, in the short run a significant impact is obtained by the change in administrative prices – the coefficient is 0.6.

5. Policy Issues

According to my research a reasonable monetary policy should reflect the patterns of real sector development: to have stable economy (to keep prices constant) the growth rate of money supply should go one-to-one with the growth rate of real GDP.[i] This rule suggests that the money supply in Ukraine should contract to follow the contraction in the real sector.

In fact, the money supply increased during this period. So, the money impact on the price level is twofold: if real GDP remains constant, the money supply should also remain unchanged, not increase; and when real GDP fall, the money supply should also decrease. Therefore, the significance of the coefficients of money supply and real GDP suggest that inflation in Ukraine is a purely monetary phenomenon and only a substantial deduction in the rate of growth of money supply can deal with this problem.

Despite this, many Ukrainian economists still believe that money supply must increase to support national production and insure the ability of enterprises to make payments to each other. So, they insist on further monetary expansion. Also, they argue that due to the specificity of Ukraine, it was the increase in price level that causes money supply to grow, not the reverse. They believe that money followed the price increase to ensure ability of payments among enterprises. With some statistical techniques it is easy to support or reject both hypotheses, namely: money supply does not cause GDP growth and the true causality direction is from money to inflation.

As I summarize in Appendix 3, the test on causation strongly rejects the hypothesis that inflation has any impact on the growth of the money supply. The Pairwise Granger Causality Test works as follows. Suppose we have two time series: Y and X and would like to know whether X causes Y. We regress Y on lagged X. The number of lags should be chosen so that all the impact of X on Y is captured. Then we test the null hypothesis that all coefficients jointly are equal to zero. If this hypothesis can not be rejected at appropriate level of significance then X does not Granger cause Y. To test the hypothesis we use an F-test. As one can see in Appendix 3, when we regress ln(domestic money) on ln(CPI), the F-statistic is equal to 2.09 (if 6 lags are included) and 2.6 (if 3 lags are included); when we regress ln(M2) on ln(CPI), F-statistic equal to 0.6 and 0.72 respectively. All these the F-statistics are smaller than the critical value at 5 % level of significance. Therefore we can infer that ln(CPI) does not cause either ln(M2) or ln(domestic money).

On the other hand, the impact of money supply on real GDP is ambiguous and depends on the chosen lag size: when I included 3 lags the hypothesis that ln of M2 does cause ln of real GDP cannot be rejected at 5 % significance level; however testing the same hypothesis with 6 lag inclusion we come to the conclusion that there is no causality given the same level of significance. But, even if there was a causal relationship, the correlation matrix suggests (Appendix 4) that the money supply has a negative impact on the GDP growth: the more money is in the economy, the slower is real growth.

Also, I would like to deal with the point that short run in Ukraine lasts up to seven months. A standard economic theory suggests that money supply does have a positive impact on the real economy at least in the short run. As the prices are sticky in the short run (long

[i] See equation (1) and assume that money velocity is constant.

term contracts with suppliers, long term wage contract, etc. prevent prices from changing), a money supply expansion lowers the interest rate. This, in turn, induces investment and since investment is a part of real GDP, GDP will go up. Hence, there is some justification for expanding the money supply. In Ukraine, after experiencing hyperinflation, people have great inflation expectations and high uncertainty. Therefore, they do not enter long term contracts, and prices adjust to the rate of money growth very quickly. So, expansionary monetary policy does not have a positive impact on the real GDP growth. It is another argument for the tight monetary policy.

I would like to point out two cautionary observations about applying my econometric results directly to monetary policy decisions:

- A regression always puts the greatest emphasis on periods when the variables have large movements. These occurred when inflation was rampant. These years provided very large R-squares. Thus we cannot be certain that the equations apply as closely to 1997 and 1998;

- In controlling the money supply, NBU also controls bank credit. A tight money policy can led to bankruptcies of commercial banks. This may weed out inefficient banks, but on occasion it may cause a financial crises and damage real GDP. Hopefully, the NBU will not use the risk to justify a continuing inflationary policy.

Another important conclusion could be drawn from the significance of the lagged coefficient. This significance indicates that economic agents in Ukraine examine the past inflation experience very carefully before making their predictions of inflation. Therefore, even if the government announces the decision of fighting against inflation and indeed restricts the money supply, prices remain at a very high level because people set their

expectations concerning inflation looking on the past experience of inflation, not believing the government proclamations. Hence, the government should begin to work on the restoring its public credibility because this is very important for the future activity.

As explained above, the big inflation pressure in Ukraine occured because of a huge budget deficit. One could argue that the influence of budget deficit on inflation was not captured by the model. But it was. It was not the budget deficit per se but the way of financing it that influenced the rate of inflation. There are three major ways to finance a budget deficit: external financing (through borrowing from the international institutions such as IMF or selling T-bills to non-residents), internal financing (through issuing T-bills) and seigniorage. Seigniorage implies that goverment expands the money supply. So, the coefficients of money supply variables in my model capture the effect of such financing of budget deficit. The external and internal borrowings do not necessarily lead to inflation. If the expansion of government expenditures influenced the real sector and caused it to grow, then the debt would be easily returned in the future, as at that time government revenues would increase (I assume that the government expenditures will not increase). If government expenditures go only to consumption not to investment (as they do in Ukraine) there are no reasons for the real GDP increase in the future. Therefore, when the time to pay the debt comes the government would have no alternative but to increase the money supply. This would lead to inflation. So, once again it is the money supply which leads to inflation in Ukraine.

There is another problem associated with circulating of T-bills. The NBU may have a dilemma: to support stable prices or a stable exchange rate. As the rate of return on Ukrainian T-bills was very high (mainly because of high risk associated with these financial

assets), non-residents started to sell foreign exchange and buy T-bills. So, the supply of foreign exchange increased. Therefore, hryvnia would appreciate. This would have a negative impact on current account and on national exporters but would keep the money supply and prices stable. On the other hand, if NBU would decided to keep the exchange and the current account constant, it should buy foreign exchange at the predetermined price. This would lead to the money supply increase and inflation.

Considering these results we can state that to stabilize the Ukrainian economy and let it grow, the government must adopt tight monetary policy. Recent evidence of price stabilization and moderate growth of money also supports the proposal.

Conclusions

The most suitable theory of inflation in Ukraine is a Monetary one.

Though partially inflation was caused by the collapse of the FSU and economic transition which were unavoidable, the main factors that produced inflation were the huge budget deficit and subsidies to the state sector.

The statistical tests suggested that almost all past experience of inflation in Ukraine was determined by the money supply, the decrease in the real GDP and inflationary expectations.

To maintain achieved stabilization, the government should continue to conduct a tight monetary policy, work on its credibility and gradually reduce the rate of return on T-bills.

The model investigated did not capture the impact of exchange rate fluctuations (that can be due to financial crisis on foreign market, speculative attacks, change in competitiveness in the foreign trade sector etc.) on the money supply in Ukraine. Therefore, additional research could extend this work in this direction.

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