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Inflationary expectations in transmission mechanism of monetary policy

In the paper, the analysis of inflationary expectations is considered as a key part of transmission mechanism of monetary policy. Means of mathematical modeling determine the relations between inflationary expectations and issuing processes.
Keywords: inflation, inflationary expectation, rational expectation theory, adaptive expectations theory, emission.

Problem definition

The efficiency of monetary policy depends on how predictable movements of its leverage are. Therefore, the problem of the influence of counteract factors is sufficiently actual nowadays.

Currently, in economic literature there are three theories that interpret existence of monetary policy channels in differently. According to the traditional theory, the changes in base interest rates and the subsequent changes in the exchange rate are reflected directly and indirectly in aggregate demand. However, a number of empirical studies have shown that the models based on the demand view alone do not sufficiently explain the strength of the reaction that the economies of some countries have to changes in monetary policy instruments. In other words, to explain the effectiveness of monetary policy in full, it is necessary to find additional explaining factors which monetary policy employs to reach its final target.

According to the credit theory, incomplete information and its implications for the credit market play a specific role in the second transmission phase. Higher interest rates, according to this theory, make the problem of moral hazard and adverse choice worse. This increases the probability that a company will apply for a loan that it has no intention of paying back. As a result, after interest rates are increased, financial conditions are tighter than the traditional theory would indicate, because, along with lower demand for credits from clients, the credit supply of banks will also slow down. In reaction to the higher probability of failure, commercial banks more carefully assess their clients and reduce their balance sheets. Some authors consider the effect of the credit market on the economy to be so strong that they classify it as an independent transmission channel.

The supply theory is based on the fact that the change in interest rates directly affects the supply side of the real economy, for example, through cash flow. Higher nominal interest rates burden companies with additional costs. Purchases of inputs and production factors are more restricted because of lower cash flow when financing these purchases through credit. According to this theory, increasing the nominal rates has a similar effect on the real economy as a negative shock in productivity. If the economy is dependent on credit even for financing wages, there could be a downward shift in the demand curve for labour due to higher nominal interest. The supply theory is, therefore, used to explain situations in which – contrary to the

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demand model's intuition – price growth was observed after increasing interest rates. With this growth, companies temporarily offset the decline in their cash flows.

The purpose of the article is examination of inflationary expectation which is included transmission mechanism of monetary policy, and determination of relations between inflationary expectations and issuing processes.

Main part

According to the source the MPTC (monetary policy transmission channels) has three phases. The first phase of transmission describes the primary effect of changes to monetary policy instruments (interest rates and the target) on the financial sector and the economy. The second phase of transmission – the financial sector interacts with supply and demand on the goods market. The third phase of transmission expresses the link between the real economy and inflation.

Let's limit the given research with the help of the key component, in our view, second phase of MPTC – inflation expectations.

Inflation expectations can be one of the fastest and most powerful transmission channels. While in most models the economic players know the loss function of their central bank, including the inflation target values, in the real world, this information is not directly available to them. Moreover, whether inflation expectations work in favor of the central bank or whether the central bank must fight against them depends on the credibility of the central bank, the transparency of its decisions and the character of economic shocks. If inflation expectations are unstable – for example, resulting from political instability or an international financial crisis – they do not function as an economic stabilizer. In periods of rising inflation, inflation expectations can be accelerated, and this in itself tends to speed up inflation.

Announcing the explicit final target of monetary policy is an important instrument for influencing inflation expectations. As was mentioned earlier, more than half of the central banks now use an explicit inflation target as an instrument for anchoring inflation expectations more efficiently by increasing the accessibility of information on the central bank's loss function. However, it is clear that announcing the inflation target is only the first step. The public will not automatically expect inflation value to be the same as the inflation target. Nevertheless, this relatively new transmission mechanism phenomenon should be emphasized, because the central bank has two instruments as its disposal for lowering inflation – it can increase the traditionally stressed operational instrument (base interest rates) or use a «new» type of instrument and intentionally strengthen the credibility of the inflation target.

How does the inflation expectations channel work? Let's say that the central bank announces the explicit inflation target whose value is lower than the currently observed inflation value. In this way, the expectations of the public can be changed. Public of course does not modify its expectations totally in line with the announced target because it can expect some inflation surprise from the central bank, but it adjusts its expectations on future inflation slightly downward. Just this initial change in expectations itself causes monetary policy to tighten, because – if all other variables remain unchanged – real short rates will increase *ex ante.* In addition, there is a direct effect on prices. In a low-inflation environment, all economic players raise prices in a more cautious manner than in an economy with higher inflation, so that rash decisions do not undermine the competitiveness of their products. Of course, the opposite situation could occur producing unfavorable developments. For example, a political crisis could threaten the credibility of the inflation target so much that inflation expectations would begin to accelerate at a fast pace. In an extreme case, the economy could be hit with hyperinflation. Hyperinflation is a very clear example in which the expectations

channel overpowers all other transmission channels.

According to macroeconomic theory, economic subjects in during formation of its inflation predictions are guided by behavior of inflation in recent past period, which is adjusted to fallacy of inflation predictions. It can be written in such way:

$$\pi_t^e = \pi_{t-1}^e + y \cdot \left(\pi_{t-1} - \pi_{t-1}^e \right) \tag{1}$$

In accordance to the given formula, inflationary expectations for the predicted period $\left(\pi_t^e \right)$ is equal to inflationary expectations in previous period $\left(\pi_{t-1}^e \right)$, and adjusted for fallacy of inflationary expectations in previous which is equal to $\left(\pi_{t-1} - \pi_{t-1}^e \right)$. In this case, fallacy is included with the help of correction coefficient (y), whose level depends on the rate of revaluation of expectations. It is concerned that inflationary expectations are fast adjusted, in such situation coefficient approaches to 1. In this condition, equation of anticipated inflation has a view:

$$\pi_t^e = \pi_{t-1} \tag{2}$$

Thus, adaptive expectations theory comes from the point that anticipated inflation is equal to inflation from the closest past period. On these conceptions is based the adaptive expectations theory

As for rational expectation theory, inflationary expectation are rational when they provide prosperity optimization. That is the opinion of the participants of business system. Such understanding doesn't let mathematically clear define the conditions of convergence of real inflation with anticipated one. According to the conception, inflationary expectations are rational only when they are equal to grounded expectation of future price movement. In this case, probabilistic predictions, those are made by economists and based on market information, allows to determine the level of anticipated inflation. Exactly such expectations have to be taken into account during the development of long-term monetary strategy. Rest upon this principle rational expectation school theorists obtained conditions when it is mathematically possible to reach the convergence of real and anticipated inflations. So than, the implementation of «neutral», to real sector of economics, money management is also possible.

For inflationary expectations and issuing process analysis will use mathematical-economical model which was given in the paper.

Taking to consideration the equation of demand for money and forming process of inflationary expectation basis equations will be gotten,

Demand for money is given in such way:

$$m = \frac{M}{P} = c \cdot \exp(-a\hat{\pi}) , \tag{3}$$

where m – real money; M – monetary aggregate; P – price index; $\hat{\pi}$ – anticipated rates of inflation;

c – constant that defines the scale of demand for money (or demand when inflationary expectations are equal to zero);

a – coefficient, that shows demand's decrease when inflationary expectations increase (a>0).

This expression is surely acting in hyperinflation conditions. The assumption that real interest rate is constant was made. By the data, the demand is equal to supply, then the expression (1) can be considered as equilibrium condition.

If expectations have rational character, than it can be considered that:

$$\frac{d\hat{\pi}}{dt} = b(\pi(t) - \hat{\pi}(t)), \qquad (4)$$

where $\pi(t); \hat{\pi}(t)$ – current level of inflation and inflationary expectations;

$b > 0$ – coefficient, that is equal to the rate of growth of inflationary expectations in surplus of expected on 1 point.

In the capacity of <u>exogenous</u> variables in the model is given price index and monetary base. For condition of inflationary expectations stability $\frac{d\hat{\pi}}{dt} = 0$ is taken the equality of anticipated and real inflations ($\pi = \hat{\pi}$), <u>endogenous</u> variables are real money.

Based on made calculations the table 1 is filled in.

Table 1 – Real money rate, depended on the volume of money supply,
price index and anticipated inflation in 2000–2009 period

Year	Monetary aggregate (M), millions uah	Price index (P), % to previous year	Anticipated inflation ($\hat{\pi}$), %	Real money (m), millions uah
2000	32252	125,8	22,4	185,35
2001	45755	112,0	28,5	234,76
2002	64870	100,8	10,7	33029
2003	95043	105,2	0,8	460,03
2004	125801	109,0	4,9	558,61
2005	194071	113,5	8,3	759,27
2006	261063	109,1	11,9	936,04
2007	396156	112,8	8,4	1259,23
2008	451316	126,2	11,3	1151,32
2009	506423	139,4	13,2	1221,43

It is known that the expression (3) surely acting in hyperinflation conditions. In its derivation was considered that real interest rate is constant. On equality condition, demand is equal to supply, hence expression (3) can be regarded as equality condition.

If it is considered that expectations have rational nature then it can be considered:

$$\frac{d\hat{\pi}}{dt} = b(\pi(t) - \hat{\pi}(t)), \qquad (5)$$

where $\pi(t); \hat{\pi}(t)$ – current level of inflation and inflationary expectations;

$b > 0$ – multiplier that is equal to the rate of growth of inflationary expectations, when inflation exceeded the growth on 1 point. Using statistic data of NBU (inflation from previous years) and computer analysis that was done, b can be found (table. 2): $\bar{b} = 2{,}97$.

Table 2 – Rate of inflationary expectations growth for 2000–2009 periods

Year	Rate of inflationary expectations growth (b)
2000	1,33
2001	0,73
2002	1,72
2003	4,63
2004	2,34
2005	6,32
2006	2,55
2007	6,98
2008	0,096
2009	1,24

Since value of inflation depends only on inflation that was in the past, the solution of the last expression:

$$\hat{\pi}(t) = b \int_{-\infty}^{t} \pi(s) \exp(b(s-t)) ds \tag{5}$$

as t – is current moment though impact of inflation from previous year is exponent diminishing with the growth of time interval. One hyperinflation that was in the past can provoke significant influences on inflationary expectations.

After analysis of relations between inflation growth and rapid growth of money aggregates (σ). $M(t) = M_0(1+\sigma)^t$. Let's put this expression to (3). After finding the logarithm and differentiation, the expression becomes:

$$\sigma - \pi = -a \frac{d\hat{\pi}}{dt} \tag{6}$$

$$\text{or } \pi = \sigma + a \frac{d\hat{\pi}}{dt} \tag{7}$$

Putting $\dfrac{d\hat{\pi}}{dt}$ from (7):

$$\sigma - \pi = -ab(\pi - \hat{\pi}) \tag{8}$$

As it was considered earlier, stability condition of inflationary expectations is $\dfrac{d\hat{\pi}}{dt} = 0$, in other words, equality of current and expected levels of inflation is $\pi = \hat{\pi}$. The character of the equality depends on the value of the product *ab*.

If *ab*<1, then equality is stable and after slight deviations from the balanced system, the system returns to the state $\pi = \hat{\pi} = \sigma$. If *ab*>1, then the equality is unstable and the deposition to $\pi < \sigma$ or $\pi > \sigma$, that leads to the growth of inflation or deflation. If *b* has significant value, the excess of expected level of inflation leads to the substantial growth of inflationary expectations ($\dfrac{d\hat{\pi}}{dt}$ increasing), that, for its turn, if the rate of growth of money aggregates is

constant, leads to increasing of inflation according to expression (5). If a considerable (increase of inflationary expectations), then it leads to substantial decrease of demand for real money, that also leads to the growth of inflation rate.

Thus, growth of inflation (hyperinflation) is possible by constant rate of growth of money aggregates due to the process, which is based on rational expectation theory.

Conclusion

The divergence of theoretical base of existence of channels of monetary policy realization doesn't conflict with each other. Vice versa, they should be considered as components of one mechanism. The supply and credit theories specify which mechanisms can change transmission mechanisms and make this policy more influential. Complimentary theories explain why the influence of monetary policy is stronger and longer.

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Т.О. Семененко, Н.М. Нілова
Інфляційні очікування як складова трансмісійного механізму

Ефективність монетарної політики залежить від прогнозованості дії окремих її важелів. Тому проблема визначення ступеня впливу протидіючих чинників є достатньо актуальною на сьогодні. В економічній літературі існують теорії, які по-різному трактують існування каналів монетарної політики. Так, згідно традиційної теорії зміни у базовій процентній ставці й наступні зміни обмінного курсу прямо й опосередковано відбиваються на сукупному попиті. Згідно кредитної теорії обмеженість інформації справляє специфічний вплив на кредитному ринку: більш високі процентні ставки створюють відчуття ризику в економічних агентів. Теорія ж пропозиції базується на тому, що зміна процентної ставки чинить прямий вплив на виробничу сферу реальної економіки. Трансмісійний механізм монетарної політики – це складний передатний процес зі своїми взаємо залежними складовими. Дане дослідження зосереджене на аналізі, як на погляд авторів, ключової складової цього механізму – інфляційних очікувань. Розбіжність теоретичних основ існування каналів реалізації монетарної політики, хоч якими різними вони можуть здатися, не суперечать один одному. Навпаки, їх треба розглядати, на наш погляд, як складові єдиного механізму. Теорія пропозиції та кредитна теорія уточнюють які механізми зміцнюють трансмісійний механізм і роблять монетарну політики більш впливовою. Комплементарні теорії пояснюють чому вплив монетарної політики сильніший і триваліший. У роботі методами математичного моделювання визначається залежність між інфляційними очікуваннями та емісією грошей.
Ключові слова: інфляція, інфляційні очікування, теорія раціональних очікувань, теорія адаптивних очікувань, емісія.

Т.А. Семененко, Н.М. Нилова
Инфляционные ожидания как составляющая трансмиссионного механизма

В статье предложен анализ инфляционных ожиданий как ключевой составляющей трансмиссионного механизма монетарной политики. Методами математического моделирования определяется зависимость инфляционных ожиданий и эмиссии денег.
Ключевые слова: инфляция, инфляционные ожидания, теория рациональных ожиданий, теория адаптивных ожиданий, эмиссия.