The process of formation of inflation expectations in an information economy

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"No intelligence system can predict what government will do if it doesn't know itself."

John Kenneth Galbraith

Introduction

Before beginning our analysis of the process of inflation expectation formation, we wish to note the universal influence of key features of the modern economy on agent forecasts. The expectations channel undoubtedly is a very important part of the transmission mechanism for the conduct of monetary policy. The evolution of central bank activities and the appearance of new theoretical and practical papers demonstrate the significant role of inflation expectations.

The modern economy has been defined in a variety of ways: as a knowledge economy, as an information economy or as the new economy.[4]

In 1962, Fritz Machlup published a paper [31] on the measurement of US knowledge production and distribution. This article enhanced a wide range of research studies dedicated to investigations of principles, norms and measurements of knowledge that resulted in the appearance of a new area of the economy – the knowledge economy. Ouwersloot, Nijkamp and Rietveld (1990) [35] assumed that information and knowledge are linked in the sense that "information is the meaning assigned to data by known conventions, and knowledge is the integration of processed information". John Galbraith (1967) [20] indicated the enhanced role of knowledge in the middle of the 20th century. From his point of view, the locus of power had shifted from managers to technocrats, i.e., to a group of highly-trained experts who, collectively, have a monopoly on scarce skills and crucial knowledge and thus increasingly make the best decisions. Thus, Galbraith regarded the time-varying role of information as a basis for fundamental economic changes.

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4 Debates on the definition of the current status of the economy – as an information economy or a new economy – were held, for example, at a symposium sponsored by the Federal Reserve Bank of Kansas in Wyoming (2001) [18] with the participation of M. Woodford, J. Taylor, K. Murphy, A. Greenspan, M. King and many others.

Before 1980, the "economics of information" was mainly understood as the "economics of search" derived from Stigler's papers [39]. Stigler had modified competitive pricing theory by representing price as a random variable with a given cumulative distribution curve. Thus, he had amplified the pricing theory by integrating search activity as a necessity for price data acquisition.

The use of game theory in pricing research became the next important stage in the development of the information economy. This method of problem solving is based on analysis of the origin, duration and termination of contractual relations. Agents' incentives to negotiate are defined by the information they possess. The problem of this information asymmetry is solved by an analysis of conduct of the contracting parties and the information structure of the object to be evaluated. Thereby, problems of information economy based on interrelations of contracting parties can be solved by means of Nash's non-cooperative games [28].

The contemporary economy is also called the "new economy". The term "new economy", according to Baily [2], may incompletely reflect current activity as it is too broad and implies more frequent and deeper changes than actually take place. Nevertheless, the term "information economy", from his point of view, appears to be too narrow, as it does not fully reflect all of the changes that are inherent in the current economy, e.g., increased globalisation, more intense pressure for competition, and rapid development. This last feature of the contemporary economy is considered as a basic feature of the current economy, in this study.

One of the main tasks of monetary authorities is to provide financial stability, which primarily concerns price stability mandates. Long-term price maintenance is a prerequisite for both improvement of economic health and economic growth as a whole. Thus, for example, Charles Goodhart [22] has defined two core purposes of central banks: taking the responsibility for achieving price stability and acting as a lender of last resort, thereby maintaining the financial stability and confidence in authorities in the conduct of monetary policy [3], which directly impacts the behaviour of economic agents.

A large number of research studies dedicated to the analysis of economic agents' inflation expectations have been published recently. It is possible to identify the main research trends by conventional means, i.e., articles dedicated to the problem of inflation expectation synthesis (see, e.g., Lines and Westerhoff (2009) [27]). These works are based on the consideration of the simultaneous existence of agents in the economy characterised by different types of expectations. Some other works are based on an examination of agent expectation management. In this case, agent expectations are modelled by endogenous variables that depend particularly on monetary transparency. At the same time, the current economic structure is also of interest to many researchers, as it provides a possibility to refine the linkages among the indicators.

These research guidelines are, for example, in the ECB and Bank of Canada sphere of interest. Staff at the Bank of Canada study the extent to which the price variance from the monetary target affects agents' beliefs in the monetary authorities [9].

This research subject is also alluded to in the papers of Carboni and Ellison (2009) [8], Doepke, Dovern, Fritsche and Slacalec (2008) [17], Demertzis and Viegi (2008) [15], Andolfatto, Hendry, Moran (2007) [1], Castelnuovo, Nicoletti-Altimari and Rodriguez-Palenzuela (2003) [10], Blinder, Ehrmann, Fratzscher, De Haan and Jansen (2008) [5], and others.

The study of Van Raaij (1989) [41] appears to be of peculiar interest in the context of this research. This paper is based on the analysis of differences in the psychological and economic motives of agent expectation formation. The statement about the importance of psychological motives is contingent on inflation perception.

Thus, for example, Demertzis and Viegi (2008) [15] assumed that agents' expectations resulted not only from their own opinions but also from other economic agents' decisions. Demertzis and Hallett (2008) [13] also tested an economy with agents characterised by bounded rationality with and without information asymmetry of central bank actions. Lines and Westerhoff (2009) [27] presented a dynamic macroeconomic model in which they described the inflation rate in terms of economic agents' aggregated expectations. The authors assumed that the economy is characterised by two types of agent expectations: rational and extrapolative ones. Blinder, Ehrmann, Fratzscher, De Haan and Jansen (2008) [5] insisted on the importance of central bank transparency in the framework of irrational economic agent expectations and the presence of information asymmetry. This paper is based on an analysis of agents' cognitive psychology. The aim of the work is to classify and systematise groups of economic agents with different types of inflation expectations in the information economy and to analyse the uncertainty that occurs in the economy when the authorities redeem monetary policy promises but their action has no influence on the average inflation expectations of economic agents.

The plan for the rest of the paper is as follows. We present in the first part of the article a general description of the model that characterises the process of inflation expectation formation, including the definition of information as a source of agent expectation formation. The second part of the work presents the research on information signal perception by economic agents, their belief in this information, the estimate of the aggregated value of their consequent inflation expectations, and the effect that monetary authority activities have on agent inflation forecasts, along with an estimate of the risk of the absence of such an effect.

Model

The model of inflation expectation formation is based on the assumption that any agent in an economy possesses inflation expectations. Note that it is impossible to consider a single representative agent, due to differences in socioeconomic conditions. Both individuals and institutions are regarded as economic agents in this paper.

Economic agents maximise the objective function

$$f\left(\pi - \pi^{e}\right) \to \max , \qquad (1)$$

whose values are directly proportional to the accuracy of inflation expectations, i.e.,

$$f^{'}\left(\left|\pi - \pi^{e}\right|\right) < 0 . \qquad (2)$$

To create inflation expectations, an economic agent should use information signals, which we treat as resources. According to the new institutional economic theory, information acquisition and analysis are associated with costs. Note that information is considered in the research not in the capacity of a normal good, for example, as fixed in the work of Ouwersloot, Nijkamp and Rietveld (1990) [35], but rather in the capacity of a good that conditionally exhibits properties of various types of goods,[5] similar to a merit good [32, 33].

To investigate information perceptions, we should first define the term "information signal". This reflects some data that can be useful in compiling agent inflation forecasts.

Information signals are collected cumulatively, and at period *t,* there may be an infinite but countable number of information signals in the economy, whereby it is possible to assign a particular number $q \mid q \in N$ to each signal. Denote the set of information signals by *W* and each of its elements by *w.* In this case, an information signal can be understood as either an

[5] For example, Ricardo analyzed the value of goods based on the example of diamonds and water, each possessing different values due to their degree of scarcity.

abstract or an intensional notion, i.e., we can consider the set of information signals as a homogeneous set, or in terms of information content as a source of heterogeneity. The whole set of information signals W_t includes all of the information signals $W_t = \bigcup_i w_i$, $i \in N$ collected by period of time *t*. In addition, we should single out information signals such that two signals should not have any intensional recurrences, i.e., $w_i \cup w_j = \varnothing \quad \forall i, j \in N \mid i \neq j$. It is also necessary to separate information by substance wherever it is possible. For example, we should consider unique signals for official forecasts and monetary targets instead of a single signal both for official forecasts and inflation targets.

As a result, we can identify a perceived part of the information set *W* perceived by agent *x* as a combination of two constituent parts *q* and s_q *,* where *q* is the number of signals and s_q is a parameter that reflects the content of the *q* signal*.* In addition, s_q is associated with a vector $\vec{s}_t$ that is a linear combination of vectors (with the sum of coefficients equals unit) $\vec{s}_t^{of,N}, \vec{s}_t^{\varepsilon}$, $N \in R$, where $\vec{s}_t^{of,N}$ is a linear combination of the information vectors of the monetary authorities. In particular, $\vec{s}_t^{cb}$ is a vector that reflects central bank information signals, as defined by Blinder, Ehrmann, Fratzscher, de Haan, and Jansen [5], and $\vec{s}_t^{\varepsilon}$ is a vector that expressly or by implication reflects information on external inflation shocks.

Thus, we can say that inflation expectations are formed on the basis of information signals perceived by the economic agent. The sources of information signals include the whole range of existing communication means.

The concepts of agent expectations regarding macroeconomic indicators have been studied by economists over several decades. The concepts of rationality and adaptivity of economic agents are considered basic to theories of inflation expectation formation. According to this statement, we judge that agents in an economy are presented with both rational and adaptive inflation expectations. This assumption is in line with Lucas' interpretation that adaptive expectations theory was an isolated instance of rational expectations theory [29, 30]. This dichotomy can be explained by the differences in agent education levels. The more agents are educated, the lower the costs of information signals acquisition and processing they incur. Ceteris paribus, the more an individual is educated, the more information signals of the current period he perceives to maximise the objective function. The first problem is that statistics on economic agents' levels of education are published annually. Secondly, attempts to define the educational level of legal entities among the economic agents are a priori doomed to fail. This limits the feasibility of such a method of determining the inflation forecasts. To avoid this problem, we suggest using statistics on agent incomes, which are published frequently. This approach is based on the assumption that to achieve a high level of income under current economic conditions (i.e., in an information or in a knowledge economy) both individual and institutional units must be well qualified for data acquisition and analysis. Moreover, the greater the agent income, the greater the risk he bears in case of a wrong inflation forecast, i.e., the greater his incentives to perceive an additional unit of information. Therefore, agents with higher incomes demand relatively greater accuracy of their own inflation forecasts to maximise their objective functions, under which they, ceteris paribus, perceive relatively more signals. Accordingly (as mentioned above), it is possible to single out discrete groups of economic agents that are characterised by differential aptitudes of available data acquisition and analysis. Therefore, despite neo-classical theories, we do not find it appropriate to regard the set of economic agents as a homogenous one with the same features, and we consider it reasonable to single out economic agents with different levels of available information perception, corresponding to agent-based models inherently based on the papers of Burrell (1951) [7] and Kahneman and Tversky (1979) [23]. The macroeconomic approach of these models was explained, for example, by Axel Leijonhufvud (2006) [26] and Leigh Tesfatsion (2005) [40].

Facing uncertainty, economic agents behave in accordance with their inherent characteristics (according to their own preferences based on both individual peculiarities[6] and particular economic circumstances).

We consider it impossible to rule out an agent's ability to obtain current-term signals in an information economy. We also assume that it is reasonable to use the general government as an original source of actual or future inflation information. It is essential to note that in general, the government has especially wide access to special-purpose sources of information, and the bulk of inflation fluctuations are integrated in forecasts published by the authorities.

As mentioned above, economic agents maximise their objective function, whose values are directly proportional to the accuracy of inflation expectations, which in turn is affected by monetary authorities' fulfilment of macroeconomic indicators targets,[7] i.e., it is influenced by the degree to which authorities are following ex-ante policy. Accordingly, we define the term "belief". An individual's belief in authorities is regarded as the subjective probability of how well the actual inflation coincides with the value forecasted by authorities.

Thus, we can formally assign the criterion of belief in monetary authorities

$\left|\pi_{of}^{e_T} - \pi_T^e\right| \rightarrow o$, where (3)

$\pi_{of}^{e_T}$ is the inflation forecast officially published by the authorities in the current term *T*, and

π_T^e is average agent inflation expectations in the current term *T*.

Thus, we can assume that there is a direct dependence between the degree of adherence of authorities to declared targets and agents' levels of belief. It is essential to note that the level of agent confidence will also be directly dependent on both the coordination of inflation forecasts published by authorities and macroeconomic circumstances.

Under differences in receptivity levels, agents obtain various volumes of data to set their own levels of belief in the authorities. The higher the levels of agent receptivity, the more information they obtain to set their levels of belief in the authorities.

To define the average inflation expectations on the basis of data perceptivity and belief in this information, for convenience, we single out four main types of inflation expectations (notice that every agent in the economy has just one type of expectations).

It is not assumed in adaptive expectation theory that agents acquire current-term signals. However, as mentioned above, one cannot rule out that possibility in an information economy. Therefore, we consider these agents as characterised by *quasi-adaptive expectations:*[8]

$$\lim_{p \rightarrow 0} \pi_t^e = \pi_t^{e^{qaa}} .$$

1. Economic agents with low levels of both data perceptivity and authority belief are characterised by *adaptive expectations*:

[6] For example, particularly, under the influence of the incentives that Keynes defined as "animal spirits".

[7] Kohn and Sack (2004) [24] stated, for instance, that economic agents can feel confidence in the central bank's press releases if it has demonstrated a conscientious attitude toward its published forecasts.

[8] In other words, if agents are characterised by quasi-adaptive inflation expectations, i.e., they perceive some current-term signals but, for whatever reasons, do not trust this information, then they are actually characterised as having classical adaptive expectations. Thus, expectations specified according to adaptive expectations theory are a special case of the quasi-adaptive expectations defined in the present work.

$$\lim_{\substack{p\to 0\\ s\to 0}} \pi_t^{e^{qaa}} = \pi_t^{e^{a\partial}}$$, where

p– level of data perceptivity of agent *x*, $p \in [0;1]$,

s– level of belief in perceived information signals of agent *x*, $s \in [0;1]$ (for more details see below), i.e.,

$$\lim_{\substack{p\to 0\\ s\to 0}} \pi_t^{e^{qaa}} = \pi_{t-1}^{e} + \beta(\pi_{t-1} - \pi_{t-1}^{e}) \,. \tag{4}$$

2. The expectations of agents with low levels of signal perceptivity and high levels of belief in this information tend towards the official inflation forecasts published by the authorities.

$$\lim_{\substack{p\to 0\\ s\to 1}} \pi_t^{e^{qaa}} = \pi_{of\,t}^{e} \,. \tag{5}$$

Note that agents with a high level of information perceptivity, i.e., receiving and analysing more data on economic circumstances, are characterised by more sensitive confidence in authorities' actions than agents with quasi-adaptive expectations. As mentioned above, the forecasts of these agents are said to be made under *rational expectations*[9] theory.

$$\lim_{p\to 1} \pi_t^{e} = \pi_t^{e^{rat}}$$, i.e.,

$$\lim_{p\to 1} \pi_t^{e^{rat}} = E[\pi_t \mid I_{t-1}].$$

3. In particular, the expectations of agents with high levels of signal perceptivity and belief in monetary authorities' actions are also based on inflation targets, i.e.,

$$\lim_{\substack{p\to 1\\ s\to 1}} \pi_t^{e^{rat}} = \pi_{of\,t}^{e} \,. \tag{6}$$

Assume also that rational agents with high levels of belief in monetary authorities' actions create their expectations on the basis of all available current-term information, particularly as related to inflation targets, monetary transparency level, seasonality and other relevant data.

4. Expectations of agents with high levels of signal perceptivity and low levels of belief in monetary authorities' activities per se are also in line with *rational expectations* theory, but the wider the spread between actual inflation and its official target, the greater is the possibility that agents' decisions on monetary authorities will contradict the declared conduct of monetary policy, i.e., in the agents' minds, the actual inflation is under some pressure external to the actions of the monetary authority. Thus, the share of agents characterised by rational expectations on inflation considers the risk that monetary authorities may not be able to assure that actual inflation attains its target. This is a consequence of the existence of economic agents with quasi-adaptive (including adaptive) expectations that expect worse inflation values. In this case, rational agents consciously orient their own forecasts to these

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[9] Agents with high levels of information perceptivity are also characterised by both extra facilities to acquire data and greater abilities to analyse it. That is to say, they need minimal time to process information and to integrate signals into their expectations. In other words, rational agents acquire more current-term information signals and thereby have an advantage in future inflation assessments.

agents' expectations.[10] We identify such agent forecasts as *arbitral* ones, by analogy with OTC and stock trading strategy:

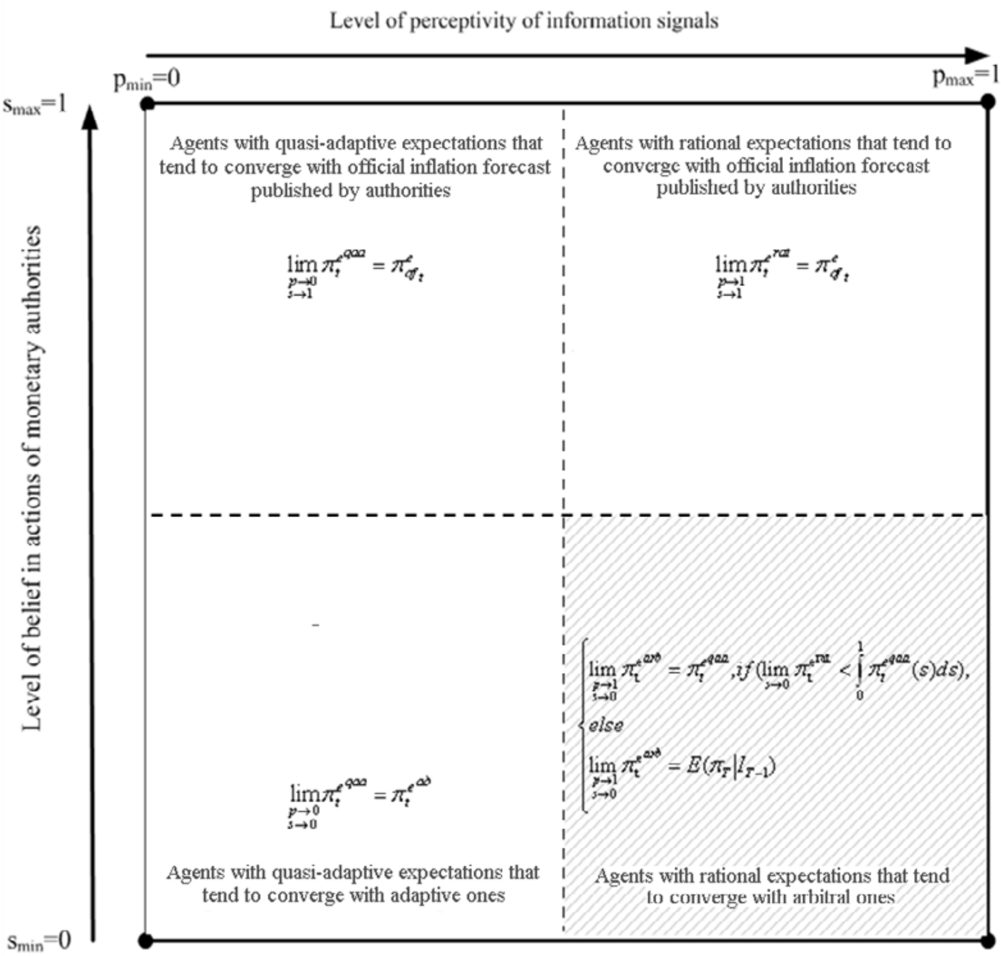
$\lim\limits_{\substack{p\to1\\ s\to0}} \pi_t^{e^{rat}} = \pi_t^{e^{arb}}$, and

$$\begin{cases} \lim\limits_{\substack{p\to1\\ s\to0}} \pi_t^{e^{arb}} = \pi_t^{e^{qaa}}, if\,(\lim\limits_{s\to0} \pi_t^{e^{rat}} < \int_0^1 \pi_t^{e^{qaa}}(s)ds), \\ else \\ \lim\limits_{\substack{p\to1\\ s\to0}} \pi_t^{e^{arb}} = E(\pi_T \mid I_{T-1}) \end{cases} \qquad (7)$$

The scheme of types of inflation expectations is represented in Figure 1.

Figure 1

Schematic representation of types of inflation expectations



Note: Multiplicity of economic agents.

[10] Notice that economic agents with arbitral inflation expectations follow a deliberate prediction strategy. This can be explained by the fact that we consider these agents as individuals defined, according to Neumann-Morgenstern theory, as risk-averse agents. According to this theory, if inflation expectations of arbitral agents are higher than average forecasts of agents with quasi-adaptive expectations, they don't resort to arbitrage and we classify them as rational agents.

1. The process of inflation expectation formation

In accordance with the concept of bounded rationality, developed by Simon in 1972 [38] (in contrast to the rational expectation hypothesis, this concept considers the limitations of the available information and of human intelligence), economic agents in this study are defined by their levels of information perception. Note that because of the bounded rationality of agents,[11] it is impossible to achieve the maximal theoretical level of information perception. Therefore, we bound the lowest level of information perception to the point that can be attributed to an agent that perceives only the public signals of the current term. We bound the maximum tolerance range to the point that can be attributed to an agent that perceives the greatest volume of information (note that this agent is not completely rational). This statement is made in accordance with the current concept of the information economy and the availability of online sources of information. Thus, such agents are considered pro tanto with the unit and zero levels of information perception.

In a similar way, we define the agents' levels of belief in the monetary authority's actions – those agents that completely distrust perceived information will be identified as possessing a zero level of belief, and those with absolute trust towards perceived information are identified as possessing a unit level of belief.

This simplification allows us to define the inflation expectations type of any agent in economy through linear combinations:

$$\pi_t^e(p,s)\ . \qquad (8)$$

Thereafter, to define the average inflation expectations of economic agents, we must first determine the agent unit distributions on information perception and its confidence level.

The analysis of agents' inflation expectations based on information perception and belief is presented in the first part of this work. The aim of this article is to describe the process of inflation expectation formation. Thus, we find it necessary to characterise and formalise these notions.

A. Agents' perception of information signals

Before we analyse agent information perception, it is essential to evaluate the number of incoming information signals to an agent in the economy. Assume that I_t^s [12] information signals are supplied at time t that directly or indirectly characterise the economic environment; in addition, these signals reflect both previous-period events (up to and including period [t-1]) and current changes (taking place at time t).

$$I_t^s = q_t^{of} + q_{s_t^\varepsilon}^\varepsilon\ \text{, where} \qquad (9)$$

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[11] This assertion does not contradict the concept of quasi-adaptive expectations presented in this paper since, because of the limited nature of human intelligence, every economic agent is boundedly rational (possessing both rational and quasi-adaptive expectations).

[12] It is necessary to note that each country is characterized both with its own information volume ($I_t^{s^j}, j \in N$ where *j* is a country, and s - supply) and with its own indexes reflecting information asymmetry ($\Delta_t^{i^j}$) and monetary transparency ($\delta_t^{m^j}$) characterizing the particular country. Additionally, as already mentioned above, according to Hegel's dialectical principle (the transition from quantity to quality), we can affirm that an agent's information perception increases as its total volume increases meeting its asymmetry decrease.

q_t^{of} is the number of information signals that overtly or covertly characterise the future rate of inflation predicted by monetary authorities, i.e., characterise the inflation target value.

$q_{s_t^{\varepsilon}}^{\varepsilon}$ is the number of information signals that characterise external shocks (independent of the actions of monetary authorities) that affect the inflation rate.

However, every agent in the economy at time *t* can perceive only some nuggets of information I_t^s as a consequence of information asymmetry, and I_t^a reflects the highest available volume:

$$I_t^a = f(I_t^s, \Delta_m^{i_t}) = f(q_t^{of}, q_{s_t^{\varepsilon}}^{\varepsilon}, \Delta_m^{i_t}) \text{, where} \quad (10)$$

$\Delta_m^{i_t}$ is the level of information asymmetry at time *t*.

Note that monetary transparency facilitates the decrease in the volatility of agents' inflation expectations, i.e., expectations tend to converge with official inflation forecast, and thus tend to decrease the degree of agent nervousness and to increase financial stability. In other words, more perfect monetary transparency leads to less information asymmetry between authorities and economic agents:

$\Delta_m^{i_t} = f(\Delta_t^i, \delta_t^m)$, where

Δ_t^i is the level of information asymmetry at time *t* (non-adjusted for monetary transparency), and δ_t^m is the level of monetary transparency at time *t*.

It is essential to note that, in our model, we define the monetary transparency as a whole instead of focusing on the central bank transparency, as do many research studies.[13] The index of monetary transparency reflects not only explicit policy models, the regularity of policy decision announcements, the open monetary transmission mechanism and other factors integrated into the central bank transparency index [21], but moreover, it also reveals, for example, the quantity and quality of information sources, their semantics and many other determinants.

At the same time, it is important to note that none of the monetary transparency assessments published to date can be used as the only correct one to reduce the asymmetry without applying additional adjustments. This is due, among other factors, to the lack of information on the evaluation technique (see, for example, Oxford Analytica Country Report) [43].

An economic agent perceives at time *t* only a small piece I_t^m [14] of all available information I_t^a that defines its level of information perception. Suppose that the number of apprehended information signals depends on the agent's income. Because the levels of information perception p_t and p_{t-j}[15] are generally strongly correlated with relatively small *j*, high-income agents in general are characterised by a high degree of information perception. Thus,

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[13] See for example [14, 16, 21, 36].

[14] The isolation of perceived signals I_t^m by agents from all available information I_t^a is explained by limitations of human intelligence, i.e., in philosophical terms, by the problem of ideal objects, insofar as ideal objects in combination with material objects provide the sophistication of a perpetual universe.

[15] This statement reflects an assumption that the economic agent in the short run cannot change his own level of information perception.

$$p = f(y_x; I_t^m) \in [0;1] \text{, where} \tag{11}$$

y_x – income of agent x, and p - level of information perception of agent x.

The volume of acquired information is measured by the use of signals, i.e., announcements or statistical data on the economic environment that expressly or by implication affect the future value of inflation.

Some agents (the adaptive ones) acquire and analyse only the information on the previous periods, distrusting any fresh information. Others are oriented to the most available signals disseminated by monetary authorities. The higher the level of agent signal perception, the greater the attention paid to the latest information (rational behaviour). Assume also that it is possible to determine the number of information signals such that an additional one would not substantially improve one's personal inflation forecast. Thus it is possible to limit the infinite number of information signals such that

$$I^{\max} \mid p = 1. \tag{12}$$

An economic agent acquires and analyses information and makes a decision on the basis of this analysis. Therefore, the income distribution is taken to represent the distribution of economic agents according to their capability to perceive information. The income increase per unit is much more significant for an economic agent that owns just one unit of income than for an agent that owns one thousand income units. Thus, we assume that a shift in the level of agent information perception depends on the percentage income change. For the purposes of further analysis, it is necessary to formalise the distribution function of agent incomes $B(y_x)$[16] that reflects the share of economic agents with income lower than the defined one.

Designate the density function of agent incomes by $b(y_x)$ and constrain the maximum income to y_{max}, which corresponds to the set of agents with income $y \geq y_{\max}$. This function is continuous and thus integrable. According to the above analysis, information perception and processing is associated with data acquisition costs and other problems of information asymmetry. Therefore, we use a parameter to reflect the information asymmetry adjusted for monetary transparency, $\Delta_t^i \in [0;1]$, $\delta_t^m \in [0;1]$.

Thus, two parameters affect an agent's level of information perception:

1. Relative value of income reduced to semi-elasticity:

$$\tilde{y}_x = \ln\left(\frac{y_x}{y_{\max}}\right). \tag{13}$$

2. Coefficient reflecting the relative number of information signals, adjusted for information asymmetry, monetary transparency and bounded rationality:

$$\theta = \frac{I^a}{I^{\max}} \text{, i.e.,}$$

$$\theta = \frac{I^{\delta^m \times (1 - \Delta^i)}}{I^{\max}}. \tag{14}$$

16 It is possible to use statistical data on income distributions of both households and legal entities for model verification.

The level of information perception depends on information processing as well as on monetary transparency and asymmetry per information unit:

$$p = \frac{1}{1+\left|\tilde{y}_x\right|^{\theta}} . \tag{15}$$

The density function of $\tilde{y}_x$ can be expressed in terms of the density function of agent incomes $b(y_x)$. According to (13),

$$y_x = y_{max} \times e^{\tilde{y}_x}, \text{ and} \tag{16}$$

$$dy_x = y_{max} \times e^{\tilde{y}_x} \times d\tilde{y}_x;$$

thus, inverting the order of integration, we obtain

$$\int b(y)dy = \int b(y_{max} \times e^{\tilde{y}_x}) \times y_{max}\, \tilde{y}_x\, d\tilde{y}_x. \tag{17}$$

Designate the distribution function of relative incomes in the logarithmic scale ($\tilde{y}_x$) as $\tilde{b}(\tilde{y}_x)$. Then the distribution function of information perception will be defined on the basis of the density function of relative incomes $\tilde{b}(\tilde{y}_x)$.

Given that $\left|\tilde{y}_x\right| = (\frac{1}{p}-1)^{\frac{1}{\theta}}$, and for any $y_x \le y_{max}$ we have $\tilde{y}_x \le 0$, it follows that

$$\tilde{y}_x = -(\frac{1}{p}-1)^{\frac{1}{\theta}}$$, whence

$$d\tilde{y}_x = \frac{1}{\theta} \times \frac{1}{p^2} \times (\frac{1}{p}-1)^{\frac{1}{\theta}-1} dp .$$

Inverting the order of integration in (17), we obtain

$$\int \tilde{b}(\tilde{y}_x)d\tilde{y}_x = \int \tilde{b}(-(\frac{1}{p}-1)^{\frac{1}{\theta}}) \times \frac{1}{\theta} \times \frac{1}{p^2} \times (\frac{1}{p}-1)^{\frac{1}{\theta}-1} dp . \tag{18}$$

Designate the distribution function of information perception by G:

$$G = \int_0^p \tilde{b}(-(\frac{1}{v}-1)^{\frac{1}{\theta}}) \times \frac{1}{\theta} \times \frac{1}{v^2}(\frac{1}{v}-1)^{\frac{1}{\theta}-1} dv . \tag{19}$$

The function G is equally distributed among levels of belief s.

B. Belief in perceived information

Note that the belief levels of agents with different levels of information perception are different. Those agents who perceive information relatively deeply are able to acquire and analyse extra signals, but their belief level varies.

The level of belief of the agent with level of information perception p is defined as

$$s_{|p} = (1-p) \times s_{|p=0} + p \times s_{|p=1} \text{, where} \tag{20}$$

$s_{|p=0}$ - belief level of the agent with zero information perception, and

$s_{|p=1}$ - belief level of the agent whose level of information perception is unity.

According to this analysis, we examine the process of formation of belief in the authority's actions for agents with zero and unit levels of information perception.

As mentioned above, economic agents rely on the previous period spreads between the actual inflation and its official targets in setting their own beliefs in perceived information. However, agents with zero level of information perception consider public authorities as a common source of information. Thus, for every period *t,* it is possible to determine the divergence:

$$\chi_t = \pi_t - \pi_{of}^{e_t} . \tag{21}$$

For agents with weak information perception, the compact divergence χ reflects their willingness to trust the authorities (see [3]). However, economic agents assign different levels of relevance to events of various periods for at least two reasons. First, economic agents tend to give higher priority to recent events and lower priority to past ones. Second, if a certain government returns to power at intervals, then the events of those periods would be considered to have higher importance than events at other times. Thus, for example, if the US Democratic Party comes to power, then economic agents probably will give greater weight to the events of other periods of Democratic control. Therefore, to recognise the changing relevance of information over time, we introduce a coefficient $\lambda_{t,T}$ characterising changes in the significance of events occurring in a period *t* to set the belief level in the current period *T*.

To simplify the analysis, suppose that $\lambda_{t,T}$ does not depend either on *t* or on *T,* i.e., $\lambda_{t,t+1} = \lambda$. In this case, λ reflects the extent to which event relevance decreases up to period *t* (inclusively) transferring to period *t+1.*[17] Agents with low level of signal perceptivity are characterised by fewer opportunities to acquire and analyse information. Thus, it is difficult for them to keep data in mind for long periods of time. Therefore, it is logical to suppose that the information forgetfulness coefficient should vary for agents with different levels of information perception, i.e., $\lambda = \lambda(p)$.

Assume $\lambda(0) = \lambda_0$; then the set of deviations $\{\chi_t\}$ reduces to the set deviations $\left\{\chi_t * \frac{\lambda^{T-t}}{\sum \lambda^{T-t}}\right\}$ that takes into consideration the changing relevance of information over time. Let

$$\eta_t = \chi_t * \frac{\lambda^{T-t}}{\sum \lambda^{T-t}} \quad \text{for every t.} \tag{22}$$

[17] The use of this coefficient, for example, can explain the results of the Romer & Romer investigation (2000) [36]. They statistically substantiated that, over a period of several decades, forecasts published by Fed staff were more refined than inflation expectations of economic agents.

Thus, the set of deviations $\{\chi_t\}$ gives rise to the set of deviations $\{\eta_t\}$ that takes into consideration the changing relevance of information for every time *t*.

In this case, the belief level of agents with information perception equal to unity is evaluated on the basis of the set $\{\eta_t\}$. The spread between actual inflation and the official target is affected by various factors. Therefore, the current-term spread can be considered as a random variable with unknown distribution law. Therefore, the definition of the distribution is conceptually impossible under the additive and multiplicative influence that various factors (which can vary according to the country in question) have on divergences. In the general case, it seems fair to suppose that deviations are distributed as finite numbers of linear combinations of generalised hyperbolic distributions, where the linear factors are $\beta_1, \beta_2, \ldots, \beta_n \mid \sum_{i=1}^{n} \beta_i = 1$, i.e., a linear combination of distribution functions should also be a distribution function. We can determine the mean deviation value on the basis of data on the spreads between the actual inflation and its official target:

$$m_0 \mid_{p=0} = E\eta_T = \frac{\sum_{t=1}^{T-1} \eta_t}{t-1}, \tag{23}$$

and the unbiased estimated variance of the deviations:

$$\sigma_{0^2} \mid_{p=0} = V\eta_T = \frac{t}{t-1} \times \left(\frac{\sum_{t=1}^{T-1} \eta_t^2}{t-1} - \left(\frac{\sum_{t=1}^{T-1} \eta_t}{t-1} \right)^2 \right). \tag{24}$$

We assume in this case that agents do not recognise the distribution function of the differences between the actual inflation rate and the target. This follows for at least two reasons. First, in this instance, confidence is evaluated on the basis of the coincidence between the actual inflation and the official forecast, including the coordination of the authority's actions and excluding the possible influence of a statistically significant characterisation of spread behaviour. Second, the fitting of generalised hyperbolic distributions is a rather complex process that requires special software, and consequently, agents with even relatively low costs of information acquisition and analysis have some problems with the estimates of the distribution parameters. Nevertheless, economic agents align their forecasts on the basis of their own impressions on the authority's adherence to declared targets and price level forecasts. The subjective expectation of deviations by every agent is affected by various endogenous (a consequence of individual peculiarities) and exogenous factors. The latter include the average deviation (the mean, see [23]) and degree of fluctuation instability (the variance, see [24]). The endogenous peculiarities under a random selection of agents are chance factors. Therefore, considering a particular agent, we assume that the expected deviation is a normally distributed random variable with mean m_0 and variance σ_{0^2}.

$$\eta^e \sim \frac{1}{\sqrt{2\pi}\sigma_0} \times e^{\left(-\frac{(\eta - m_0)^2}{2\sigma_{0^2}}\right)}. \tag{25}$$

Insofar as an economic system in toto consists of large numbers of agents, the distribution function of this random variable thus reflects the distribution of expected deviations. As was mentioned above, the greater the difference between actual inflation and the forecast, the lower the level of belief in the monetary authority's actions. Consequently, the distribution function of expected deviations is used as the basis for defining the belief distribution function.

Therefore, we estimate that the subjective probabilities of deviation lie within the determined interval [a;b]:

$$p(a < \eta_T < b) = \int_a^b \frac{1}{\sqrt{2\pi}\sigma} \times e^{(-\frac{(\eta - m)^2}{2\sigma^2})} d\eta . \qquad (26)$$

If $p=0$ and both a and b are close to к m_0, and if, in addition, the probability of the deviation lying within the determined interval is high, then the economic agents will trust the authorities.

We define the belief function based on the distribution function. It is defined on the basis of the probability distribution $p(a < \eta_T < b)$.

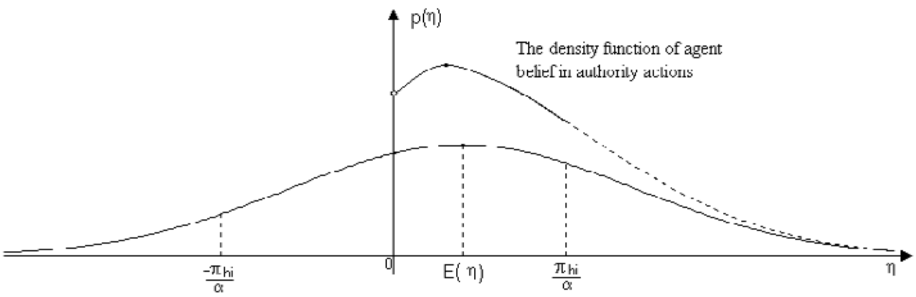
It is essential to note that under hyperinflation, in spite of the fulfilment of macroeconomic indicators targets, agents will have zero levels of belief. That is, the weakened belief in the authority's actions in the conduct of monetary policy correlates with the intersection of the hyperinflation threshold. Hence, for every critical η_{hi} such that at $\forall \eta > \eta_{hi}$, the level of belief in the authority's actions equals zero, $\eta_{hi} = \frac{\pi_{hi}}{\alpha}$, where α is the coefficient characterising the sensitivity of the agent's level of belief in the authority's actions.[18]

Therefore, the belief function is set on the basis of density function, which is defined on interval $\left[0; \frac{\pi_{hi}}{\alpha}\right]$ and is expressed as

$$\begin{cases} F = \int_0^\eta \frac{1}{\sqrt{2\pi}\sigma_0} \times e^{(-\frac{(\nu - m_0)^2}{2\sigma_0^2})} d\nu + \int_0^\eta \frac{1}{\sqrt{2\pi}\sigma_0} \times e^{(-\frac{(\nu + m_0)^2}{2\sigma_0^2})} d\nu, & \text{at } \eta \in [0; \frac{\pi_{hi}}{\alpha}) \\ F = \int_\eta^{+\infty} \frac{1}{\sqrt{2\pi}\sigma_0} \times e^{(-\frac{(\nu - m_0)^2}{2\sigma_0^2})} d\nu + \int_\eta^{+\infty} \frac{1}{\sqrt{2\pi}\sigma_0} \times e^{(-\frac{(\nu + m_0)^2}{2\sigma_0^2})} d\nu, & \text{at } \eta \in [\frac{\pi_{hi}}{\alpha}; +\infty) . \end{cases} \qquad (27)$$

Figure 2

Distribution function of agent belief in monetary authority actions.
(Reflects differences between actual inflation and official forecasts.)



Note: The coordinate of the punctured point on ordinate axis shows the value for agents with zero belief in monetary authority actions, which is determined, ceteris paribus, by the alpha value (the higher the alpha, the higher this point).

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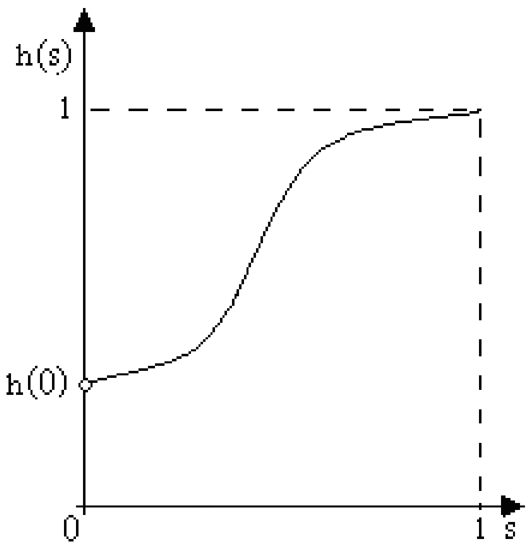
[18] The coefficient α also reflects agent nervousness, velocity of money and currency issue.

We should turn to the measure of belief $s\,|_{s\in[0;1]}=\dfrac{\pi_{hi}-\alpha\eta}{\pi_{hi}}$ to consider the distribution function of the agent belief. Therefore, if α is significantly greater than unity, then in response to a slight increase in the expected spread between actual and predicted inflation, the confidence in authority activities can decrease drastically. This thus confirms the above statement that "the wider the spread, the weaker the belief". Thus, by inverting the order of integration, we obtain

$$\begin{cases} H_0 = \int\limits_0^s \frac{\pi_{hi}}{\alpha\sqrt{2\pi}\sigma_0} \times e^{\left(-\frac{\left(\frac{\pi_{hi}}{\alpha}\right)^2 (1-\nu-\frac{m_0}{\pi_{hi}/\alpha})^2}{2\sigma_0^2}\right)} d\nu + \int\limits_0^s \frac{\pi_{hi}}{\alpha\sqrt{2\pi}\sigma_0} \times e^{\left(-\frac{\left(\frac{\pi_{hi}}{\alpha}\right)^2 (1-\nu+\frac{m_0}{\pi_{hi}/\alpha})^2}{2\sigma_0^2}\right)} d\nu, at\ \ s \in (0;1] \\ H_0 = 1 - H_{0|s\in(0;1]}, at\ \ s = 0 \end{cases} \quad (28)$$

Figure 3

Distribution function of spreads between actual inflation and official forecasts.



We have thus defined the distribution function of beliefs for agents with zero level of information perception.

The distribution function of beliefs for agents with unit level of information perception is defined analogously with the one exception that another approach is used to estimate divergences. These economic agents qualitatively distinguish all kinds of signals emanating from the authorities. Therefore, they can use different weighted coefficients to set their level of belief. In other words, they will rely on that source of information whose previous-period signals strongly correspond with actual rates of inflation. The sum of the squared deviations from actual inflation in response to this kind of signal can be used as a measure of its accuracy.

We should emphasise the significance of the coordinated actions by the authority, which is revealed by the coincidence of forecasts. This in and of itself cannot produce a strong belief in the authority's actions, but it can produce a certain multiplicative effect by sending a signal to agents that monetary actions are concerted.

Thus, agents with information perception equal to unity set their own level of belief in the authority's actions on the basis of the following deviations:

$$\gamma_t = (\pi_t - (\sum_{n=1}^{N}\left(\frac{q_t^{of,N}}{\sum_{n=1}^{N}\left(q_t^{of,N}\right)} \times \frac{\sum_{k=1}^{t-1}(\pi_t^{\tau} - \pi_t)^2}{\sum_{n=1}^{N}\left(\sum_{k=1}^{t-1}(\pi_t^{of,N} - \pi_t)^2\right)} \times \pi_t^{of,N}\right)) \times \\ \times (1 + \ln(\frac{\sum_{n=1}^{N}\left(\sum_{k=1}^{t-1}(\pi_t^{of,N} - \pi_t)^2\right) + \frac{1}{N} \times \sum_{n=1}^{N}\sum_{k=1}^{t}(\pi_t^{of,N} - \pi_t^{of,(N-1)})^2}{\sum_{n=1}^{N}\left(\sum_{k=1}^{t-1}(\pi_t^{of,N} - \pi_t)^2\right)})) \quad , \ N \in R. \tag{29}$$

These deviations are then adjusted by the coefficient λ, and we consider the set of adjusted deviations $\{\varphi_t\}$:

$$\varphi_t = \gamma_t * \frac{\lambda^{T-t}}{\sum \lambda^{T-t}} . \tag{30}$$

We determine the deviation mean value on the basis of data on spreads between actual and forecast inflation for agents with high level of information perception:

$$m_1 |_{p=1} = E\varphi_T = \frac{\sum_{t=1}^{T-1}\varphi_t}{t-1}, \tag{31}$$

and the unbiased estimated variance of deviations:

$$\sigma_1^2 |_{p=1} = V\varphi_T = \frac{t}{t-1} \times \left(\frac{\sum_{t=1}^{T-1}\varphi_t^2}{t-1} - \left(\frac{\sum_{t=1}^{T-1}\varphi_t}{t-1} \right) \right)^2 . \tag{32}$$

We define the distribution function of the beliefs of agents with unit level of information perception on the basis of hypotheses on the normalcy of the expected deviation of data distribution, as described above:

$$\begin{cases} H_1 = \int_0^s \frac{\pi_{hi}}{\alpha\sqrt{2\pi}\sigma_1} \times e^{\left(-\frac{\left(\frac{\pi_{hi}}{\alpha}\right)^2 (1-\nu-\frac{m_1}{\pi_{hi}/\alpha})^2}{2\sigma_1^2}\right)} d\nu + \int_0^s \frac{\pi_{hi}}{\alpha\sqrt{2\pi}\sigma_1} \times e^{\left(-\frac{\left(\frac{\pi_{hi}}{\alpha}\right)^2 (1-\nu+\frac{m_1}{\pi_{hi}/\alpha})^2}{2\sigma_1^2}\right)} d\nu, \ s \in (0;1] \\ H_1 = 1 - H_{1|s\in(0;1]}, \ s = 0 \end{cases} . \tag{33}$$

The belief distribution function of agent *x* with level of information perception equal to *p* is defined as a linear combination of H_0 and H_1:

$$H_e = (1-p) \times H_0 + p \times H_1 . \tag{34}$$

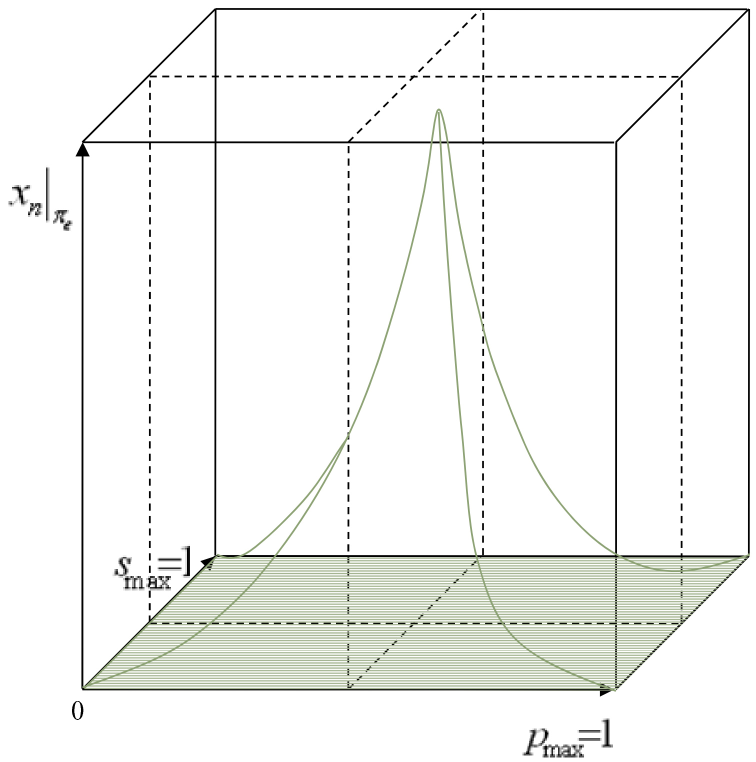
C. Average inflation expectations

We do not consider merely one representative agent in this research. Therefore, various economic agents are characterised by divergent inflation expectations. However, it is feasible to calculate the integral of the agent inflation expectations in the economy. Therefore, it is necessary to weight the inflation expectations of economic agents by their numbers. For this purpose, we define the density function of agent inflation expectations (F_H^G) based on the signal perception and confidence in this information. This distribution function is the combination of the belief *G(s,p)* and the information perception *H(p)* distribution functions that are defined above:

$$F_H^G = \int_0^p H \times G(v)dv \ . \quad (35)$$

Figure 4

Graphic representation of density function of agents' inflation expectations, reflecting signal perception and belief in the information.



Note: The peak is associated with the weighted average of expected rates of inflation (weighted by number of agents). Thus it enables one to define the predominant type of agents' inflation expectations.

This figure reflects a simplified interpretation of our research results, by means of which the predominant type of inflation expectations can be represented graphically, thus making it possible to evaluate the risks inherent in it.

Then, the average inflation expectation of economic agents is equal to the weighted (in inflation expectations) average of the above function:

$$\pi_t^e = \int_0^1 \int_0^1 \pi^e(s,p) H_p G_s dpds \ . \quad (36)$$

D. Risk of arbitrage

One of the practical aspects of applying this concept is that it makes it possible to define the risk that agents with arbitral inflation expectations are present in an economy. The corresponding uncertainty in the evaluation of average inflation expectations, i.e., the potential contribution of agents with arbitral expectations to the average anticipations, is considered to be the arbitral risk. We consider this case to be one with risk, given the uncertainty surrounding the monetary authority actions at which they were to meet macroeconomic indicator targets but would not affect the average agent inflation expectations. This occurs when agents with quasi-adaptive expectations forecast higher inflation owing to a lack of information available from monetary authorities. In this case, some agents characterised by rational expectations and with access to a volume of information sufficient to define both the share of quasi-adaptive agents and their average inflation expectations forecast the same inflation value. Thus, the average inflation forecasts of economic agents depend on the presence of agents with arbitral inflation expectations in the economy. It is essential to note that as the average agent belief increases, any inflation fluctuations increase the future average rate more than it would be in the case if this group of agents were not identified.

Note that average inflation expectations are defined according to (36) and that agents are characterised by various levels of confidence in acquired information:

$\pi^{e} = k_1\pi^{qad} + k_2\pi^{\mathrm{rat}}$, where

k_j - share of agents with the proper type of inflation expectations, $j \in [1;2], j \in N$.

Alternatively,

$$\pi^{e} = \kappa_1 \times \pi^{ad}_{qad} + \kappa_2\pi^{of}_{qad} + \kappa_3\pi^{arb}_{\mathrm{rat}} + \kappa_4\pi^{\mathrm{of}}_{\mathrm{rat}} \text{ , where} \qquad (37)$$

κ_i - a share of agents with the proper type of inflation expectations, $i \in [1;4], i \in N$.

We evaluate the share of agents with arbitral inflation expectations at time *T*. For each kind of agent with a fixed defined level of information perception *p=p*,* the share is

$$\tilde{\kappa}_4 = \int_0^1 (1-s) \times H_{|p=const}\, ds \, . \qquad (38)$$

This value can be determined on the basis of each level of perception. Thus, it is possible to evaluate the share of agents with arbitral inflation expectations α_4 by weighting and summing up each level:

$$\kappa_4 = \int_0^1 \int_0^1 (1-s) \times p \times H_{|p=const} \times G ds dp \, . \qquad (39)$$

That is,

$$\kappa_4 = \int_0^1 \int_0^1 (1-s) \times p \times (\int_0^s \frac{\pi_{hi}}{\alpha\sqrt{2\pi}\sigma_p} \times e^{\left(-\frac{\left(\frac{\pi_{hi}}{\alpha}\right)^2 (1-\nu-\frac{m_p}{(\pi_{hi}/\alpha)})^2}{2\sigma_p^2}\right)} d\nu +$$

$$+\int_0^s \frac{\pi_{hi}}{\sqrt{2\pi}\sigma_p} \times e^{\left(-\frac{\left(\frac{\pi_{hi}}{\alpha}\right)^2 (1-\nu+\frac{m_p}{(\pi_{hi}/\alpha)})^2}{2\sigma_p^2}\right)} d\nu) \times (\int_0^p \tilde{b}(-(\frac{1}{v}-1)^{\frac{1}{\theta}}) \times \frac{1}{\theta} \times \frac{1}{v^2} \times (\frac{1}{v}-1)^{\frac{1}{\theta}-1} d\nu) ds dp \, . \qquad (40)$$

This is the contribution that agents with arbitral expectations make to the change in average expectations according to (7).

Thus, it is possible to define the significance of the influence of the arbitral formation of expectations on previous rates of inflation. It is also possible, using this model, to measure the magnitude of the risk in the current term and, thus, to establish the optimal conduct of monetary policy for achieving a given inflation target and a stable price level over the long run.

Conclusion

There is no doubt about the importance of the expectation channel of transmission in the conduct of monetary policy. Ben Bernanke,[19] for example, noted the incontestability of a significant influence of inflation expectations on its actual value and thus on achievement of price stability. This can also be seen in the ECB paper[20] on the analysis of agent expectations, which asserts that in the conduct of monetary policy, central banks need to form and to monitor expectations of economic agents on a continuing basis. Insofar as the authority actions affect the macro parameters with lags, monetary policy needs levers against agent anticipations of random processes within a framework of financial stability, in order to keep current economic risks to a minimum. In addition, expected changes in economic variables can strongly influence current agent behaviour by means of various channels of the transmission mechanism.[21] It should be noted that understanding the formation of agents' expectations makes them more manageable for monetary authorities, which in turn facilitates, for example, asset price management. The importance of this is demonstrated by Japan, which has struggled with the consequences of the collapse of the asset price bubble over the last twenty years.

Accordingly, we wish to note that to manage agents' inflation expectations, it is essential to analyse and use all sources of information. A lack of coordination on the part of the authorities can lead at least to a decreasing level of agents' belief, thus increasing the number of agents with arbitral expectations. The only way to avoid agents' distrust and thus decrease the risk of arbitrage is to publish monetary targets on a monthly basis using various information sources simultaneously to provide sufficient access to this information.

In conclusion, we would like to note that for the purposes of addressing crisis phenomena, the feasibility of defining the inflation expectations that economic agents form based on perceived data in the information economy appears to be an extremely important issue.

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Abbreviations

W	a set of information signals
w	a single element in a set of information signals
x	economic agents
q	a number of signals
s_q	a parameter that reflects the content of the signal *q*
I_t^s	supplied information signals at time *t* that directly or indirectly characterise the economic environment
I_t^a	the highest available volume of information at time *t*
I_t^m	a piece of the available information I_t^a perceived by an economic agent at time *t* that defines its level of information perception
$I^{\max}$	the maximum number of information signals perceived by an economic agent at time *t*
θ	a coefficient reflecting the relative number of information signals adjusted for information asymmetry, monetary transparency and bounded rationality
Δ_t^i	the level of information asymmetry at the time t (non-adjusted for monetary transparency)
$\Delta_m^{i_t}$	the level of information asymmetry at the time t (adjusted for monetary transparency)
δ_t^m	the level of monetary transparency at the time t
$\vec{s}_t^{\,of,N}$	a linear combination of vectors of information emanating from monetary authorities
$\vec{s}_t^{\,cb}$	a vector defined according to [5] that reflects central bank information signals
$\vec{s}_t^{\,\varepsilon}$	a vector that expressly or by implication reflects information on external inflation shocks
q_t^{of}	the number of information signals that overtly or covertly characterise the future rate of inflation predicted by monetary authorities (i.e., that characterise the target inflation rate)
$q_{s_t^{\varepsilon}}^{\varepsilon}$	the number of information signals that characterise external shocks (independent of monetary authorities' actions) affecting the inflation rate
$\pi_{of}^{e_T}$	inflation forecast published by the authorities in the current term T
π_T^e	average inflation expectations of agents in the current term T
$\pi_t^{e^{a\partial}}$	adaptive inflation expectations
$\pi_t^{e^{qa\partial}}$	quasi-adaptive inflation expectations
$\pi_t^{e^{rat}}$	rational inflation expectations

$\pi_t^{e^{arb}}$	arbitrary inflation expectations
π_{hi}	hyperinflation
α	the coefficient characterising the sensitivity of the agent's belief in the actions of the authority
p	level of information perceptivity of agent x, $p \in [0;1]$
s	level of belief in the perceived information signals of agent *x*, $s \in [0;1]$
y_x	income of agent x
$y_{\max}$	maximum agent income
$B(y_x)$	distribution function of agent incomes that reflects a share of economic agents with incomes lower than the defined one
$b(y_x)$	density function of agent incomes in b(y_x)
G	distribution function of information perception
$\{\chi_t\}$	set of deviations $\{\chi_t\}$ of actual inflation from its official forecast
$\lambda_{t,T}$	coefficient characterising changes in the significance of events occurring in period *t* to set the belief level in current period *T*
$\{\eta_t\}$	set of deviations obtained from the set of deviations $\{\chi_t\}$ considering the changing relevance of information over time for every *t*
$\{\gamma_t\}$	set of deviations of actual inflation from its official forecast, providing an indicator of the maximum number of information signals
$\{\varphi_t\}$	set of deviations obtained from the set of deviations $\{\gamma_t\}$ providing an indicator of the maximum number of information signals and considering the changing relevance of information over time for every *t*
H_e	belief distribution function of agent *x* with level of information perception equal to *p*
F_H^G	density function of agent inflation expectations reflecting signal perception and confidence in the information
κ_i	proportion of agents with *i*-type inflation expectations

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