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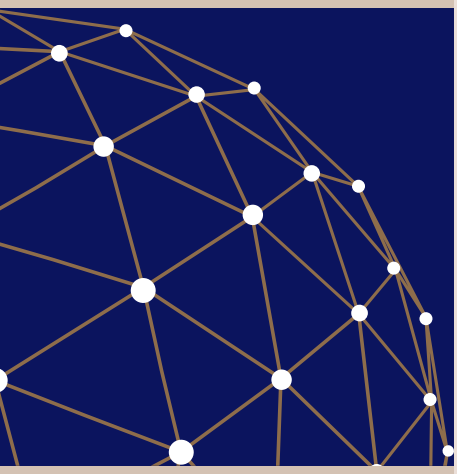

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Inflation

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Written by Mihály Hajnal, Judit Várhegyi

(Directorate Economic Forecast and Analysis, Magyar Nemzeti Bank)

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Contents

1 Introduction

Inflation is one of the most closely monitored macroeconomic variables. The purpose of this methodological booklet is to summarise the experiences gathered in the analysis of inflation and investigate other important topics related to the consumer price index.

We experience prices and price changes on a daily basis, as they constitute a part of our day-to-day lives: consequently, it is important to have a clear understanding of the concept and driving forces of inflation. The broadly accepted view holds that persistently high inflation implies undesired costs for economic agents, for instance those stemming from frequent price changes. At the global level, however, inflation has recently been low, leading to the publication of an increasing number of international analyses on deflation fears and the negative impacts of such. As a result, it is also important to examine the detrimental consequences of excessively low or even decreasing prices.

Looking at central banks around the world, price stability is the key focus of the monetary policy decisions of inflation-targeting central banks. Accordingly, the primary objective of the Hungarian central bank is to achieve and maintain price stability, as stipulated by the Act CXXXIX of 2013 on the Magyar Nemzeti Bank. With this in mind, it is particularly important to review the causes of inflation in general and understand why price stability is not synonymous with inflation of zero per cent.

The general measure of inflation is the consumer price index, which is published by the Hungarian Central Statistical Office. Measuring inflation, however, raises numerous questions, such as what kind of consumer basket price change is reflected in the dynamics, the method used for weighting individual price indices etc. There are also other price indices that serve similar purposes and provide information on price level developments. We will therefore review the main characteristics of these other price indices, in addition to topics related to the measurement of the consumer price index.

The Magyar Nemzeti Bank (MNB) uses several indicators to capture underlying inflation developments and evaluate economic processes. In the MNB's analyses and Inflation Report, we often refer to developments in these indicators, which filter out temporary shocks without any meaningful effect on the medium-term outlook. This paper summarises the key definitions related to underlying developments and the most commonly used types of such.

Inflation expectations contain valuable information for inflation-targeting central banks in several regards. They carry information for macroeconomic forecasts on the one hand, and are also informative with regards to central bank credibility on the other hand. Consequently, the last part of this paper presents the detailed characteristics of inflation expectations in Hungary and the findings of surveys conducted among households, market analysts and firms.

2 Theoretical background of inflation

One of the most important and widely discussed issues in macroeconomics is understanding the short-term dynamics of inflation. Interpreting the process is relevant from multiple perspectives, such as understanding the business cycles and taking the appropriate monetary policy actions. How monetary policy decision-makers respond to inflation exceeding the target or to a protracted disinflationary period can depend on several factors. Firstly, how strong is the correlation between prices and economic activity, and secondly, how are the expectations about economic growth which shape current pricing decisions developing. Numerous theoretical and empirical analyses have been published in recent decades in the interests of understanding inflation dynamics. In the following section, we present a brief overview of the main economic correlations linked to inflation and provide a detailed explanation of the Phillips curve, which captures the relationship between inflation and the real economy.

Prior to the emergence of monetarism, Keynesian theories focused primarily on stimulating demand while placing less emphasis on prices. According to the basic assumption of these theories, there is no price pressure as long as the economy does not reach full employment. By contrast, in his paper published in 1958, Phillips tested the correlation between unemployment and wage developments using data from England and found a stable, but reverse correlation (wages increase in the context of a tighter labour market); this marked a milestone in the development of macroeconomics. Solow and Samuelson supplemented this finding in the 1960s, applying their equations to the correlation between inflation and unemployment, instead of wages. The data confirmed the existence of the correlation, which thus became the predominant economic theory of the 1960s. In addition, the conclusion that full employment can be achieved with higher inflation, while low inflation may result in higher unemployment also provided support for economic policy decisions. However, the correlation no longer applied to the data of the 1970s,[1] and the relationship became unstable in the period of stagflation that occurred in several major economies.

[1] The real economy was significantly shaped by the spikes in oil prices, which triggered both high unemployment and inflation.

Even in the 1960s, several critiques were aimed at Phillips' original idea. Phelps (1967) and Friedman (1968) primarily questioned the exclusion of expectations. As a result, a Phillips curve supplemented with expectations emerged, which also included the assumption of adaptive[2] expectations in early publications. Consequently, inflation no longer had an impact on unemployment in the long run (in other words, the curve became vertical), as in the longer run unemployment reaches its natural level (NAIRU, non-accelerating inflation rate of unemployment), at which price dynamics remain stable (that is, the neutrality of money prevails). In the short run, however, a negative correlation remains between the two variables.

Criticisms of the concept of adaptive expectations emerged as early as the 1970s. One of the major critiques was formulated by Lucas. In his view, the behaviour of agents is not permanent and may change as a result of external causes. Empirical relationships such as the Phillips curve remain constant only if there is no change in economic policy. A potential shift also implies a change in expectations, which may alter the correlations observed earlier. This gave rise to the rational expectations theory,[3] associated with Thomas Sargent, which proposes that all economic policy interventions are ineffective. Economic agents utilise all available information in their decisions and make their decisions based on such information; hence, they adapt to the expected consequences of economic policy decisions. As a result, if agents expect the government to reduce the unemployment rate, expected inflation will immediately increase and thus impede the desired outcome. As a result, only an unexpected shock can have an economic impact.

Later critiques tended to emphasise the absence of microeconomic foundations underpinning the original relation. According to this, the relationship is not implied by the rational behaviour of individual economic agents. In reaction to this, the economic thinking of the 1970s and 1980s was fundamentally shaped by the aim of corroborating the original theory using microeconomics. A new basis for this was laid down in Fischer and

[2] Economic agents formulate their expectations based on past events.

[3] In their decisions, economic agents take into account their expectations regarding the future, therefore they are forward looking.

Gray (1977), who were the first to introduce the concept of nominal wage rigidity into economic thinking. According to this idea, wages fixed during wage negotiations remain stable for a period *n*. In reaction to the newly revealed information, the monetary authority influences real wages through the money supply – and therefore real output as well – to which agents are only able to respond in the following period. Taylor (1980) supplemented this with the finding that wage negotiations take place at different times within an economy, and furthermore past and future contracts may also impact the ones being drafted at the current time. Thus, monetary policy intervention not only impacts current wage negotiations, but also subsequent ones, and therefore effects economic output as well.

Wage and price rigidity thus became a familiar concept in economics by the early 1980s, but the microeconomic foundations of such had yet to be confirmed. The theories of Calvo (1983) and Rotemberg (1983) offered a solution, in which aggregate behaviour was partially based on microeconomic foundations. The theory posits that only some of the monopolistically competing, profit maximising firms are able to change the pricing of their products at any time. Their current pricing decisions are shaped by their future prices and marginal costs. This feature of the Calvo/Rotemberg model makes inflation a purely forward-looking variable, which serves as the basis of the new Keynesian Phillips curve. All in all, the theory's microeconomic foundations, and the fact that optimisation takes place at the level of individuals ensures the relationship between the short-term dynamics of inflation and a given variable describing real economic activity, contrary to the traditional Phillips curve.

As the marginal cost used in the models cannot be observed directly, several approaches have been proposed to measure marginal cost. Galí and Gertler (1999) use average real unit labour cost as a proxy for marginal cost (which is equivalent to the labour force's share of income). In addition, with certain assumptions, the output gap can also be used as an approximation.

Most recently, the earlier correlation of the Phillips curve has been supplemented with the assumption that not every agent is forward-looking, and the expectations of certain agents are based on past information; therefore, past inflation must also be taken into account (hybrid Phillips curve).

Nowadays, the most commonly used Phillips curve is:

$$\pi_t = \gamma^f E_t \pi_{t+1} + \gamma^b \pi_{t-1} + \mathrm{K} X_t + \varepsilon_t ,$$

where π_t is inflation, $E_t \pi_{t+1}$ is expected inflation, π_{t-1} is past inflation to capture persistency, and X_t is the proxy of real marginal cost, e.g. the output gap, while ε_t represents supply shocks (such as sudden spikes in oil prices). According to the theory, there is a positive correlation between the output gap and inflation.

Most recently, the literature no longer uses the Phillips curve as an independent equation, but rather embedded into a larger macroeconomic model (DSGE[4]). Generally, two independent Phillips curves are used, one for describing price dynamics and the other for describing wage dynamics, the great advantage of which is that presenting price and wage rigidities becomes easier.

Chart 1
The Phillips curve in the euro area

**Overall index excluding energy, food, alcohol and tobacco*
Source: Eurostat

[4] Dynamic stochastic general equilibrium model

3 Measuring inflation – theoretical issues

3.1 What product basket's price are we measuring?

Inflation refers to a general, sustained rise in the price level, compressed into an indicator using a certain weighting of individual price observations. This raises several questions: what price data should be included in the index, how should the average be calculated, and what weighting should be applied?

In theory, the aim is to compile a price index that accurately reflects changes in the cost of living (for instance, over time). Consequently, it theoretically shows the price changes of one consumer basket, allowing for the substitution of products in line with changes in relative prices. However, measuring this basket is hindered by numerous problems, as is briefly presented in the following section (for more detail, see Ferenczi et al 2000). In practice, the consumer price index is used for measuring price changes (see Chapter 5.1).

3.2 The difficulties of measuring the cost of living

In theory, the cost of living index derives from consumers' profit maximisation and shows the changes in expenditures necessary for maintaining a given utility level or standard of living. In other words, this is the minimal change in cost (C) necessary to reach a specific utility level (u^*), at the given base and current period prices (p^0, and p^1).

$$P\left(p^0, p^1, u^*\right) \equiv \frac{C\left(p^1, u^*\right)}{C\left(p^0, u^*\right)}$$

However, utility and consumer preferences are unobservable variables. According to the practical approach, the cost of living index is the change in the expenditure spent on a fixed consumer basket at various prices:

$$P\left(p^0, p^1, q^*\right) \equiv \frac{p^1 q^*}{p^0 q^*},$$

where q^* is the fixed (base or current period, or a combination thereof) consumer basket.

The relationship between the theoretical and the practical formula is linked by the bounds approach. The substitution bias is linked to this, according to which maintaining the old consumer basket at new prices cannot be cheaper than maintaining the old utility level. This is described using the Laspeyres formula:[5]

$$P\left(p^0,p^1,q^0\right)\geq P\left(p^0,p^1,u^0\right).$$

The aforementioned formula yields an upper bound of the estimation.[6] The source of the bias is that the consumption structure in the base period is not necessarily optimal with the relative price changes, and therefore using this may lead to an overstatement of the cost of living. Based on the theoretical model this is:

$$P\left(p^0,p^1,q^0\right)-P\left(p^0,p^1,u^0\right)\geq 0.$$

Certain conditions are necessary for creating a common price index in the case of different consumers. These include the homothety of preferences, in other words when the optimal structure of consumption is independent of the utility level. In these cases, price changes are the root cause for changes in the cost of living.

The consumer price index cannot be regarded as the cost of living index, although it does contain cost of living type elements. This is due to several reasons, attributable to the general problems involved in the measurement of the CPI.

1. The Laspeyres formula is used for calculating the CPI, in other words weights are defined according to the base period's structure of consumption, and so the CPI does not account for the substitution effect. The substitution bias may originate from several sources.

   - When consumers experience a price change in a product, they may switch to purchasing products with similar attributes. The Laspeyres index does not take into account this behaviour, substituting as it takes into account base and current period price changes under the base period's expenditure structure. This might not necessarily be optimal in the subsequent period due to changes in relative prices. This impact may

[5] It can also be described using the Paasche formula: $P(p^0, p^1, u^1)\leq(p^0, p^1, q^1)$

[6] By contrast, the Paasche index underestimates the actual cost index.

be addressed, for instance, using the Fisher index,[7] however the current period's consumption structure necessary for calculating the latter only becomes available with a significant delay. The substitution effect creates an upward bias on the CPI.

- A timing effect may also intervene. Prices are not necessarily identical on every day of the month, as certain discounts may be offered on specific dates, prompting adjustment by consumers. If the statement of the price does not account for this, it may result in a bias.
- Similarly to products, substitution bias among retail stores may also play a role, for instance when a new store opens.

2. Appearance of new products: while households are able to shape their consumption flexibly, statistics are unable to keep up with the introduction of a new product.

3. Handling changes in quality: when a product's quality improves, the consumer's utility increases, and thus maintaining the same utility level requires lower cost. Price changes stemming from changes in quality are not regarded as inflation. Disregarding this factor creates a bias affecting the index. Changes in quality are difficult to identify and quantify. Hedonic regression is one of the tools serving this purpose: it involves estimating the price of a product based on its quality attributes, which are then ignored when calculating the price index.

4. In the case of durable consumer goods, according to the theoretical concept, the price index should reflect the price of the service supplied by the product instead of the product's purchase price. This is due to the fact, that the product's "utility" stems from the service rendered by it, which is stretched out over time. However, this would only be possible in the context of smoothly functioning rental markets.

5. The CPI only measures purchased consumption. Leaving out nonpurchased consumption, i.e. goods produced by households and not introduced into the market, and social transfers in kind prevents the interpretation of the CPI as a cost of living index.

[7] The Fisher index is calculated as the geometric average of two indices with diverging bases (Laspeyres, Paasche).

4 Price stability

Low inflation which is not at zero per cent is referred to as price stability. Prices change continuously within the economy in response to the relative supply of and demand for specific goods. Inflation is when prices increase in a sustained manner for a broad group of products. The opposite of inflation is deflation, which refers to a sustained decrease in the overall price level. However, this is not synonymous with the concept of disinflation, which is a slowdown in the rate of price increases. When this occurs, prices do not decrease, but rise at a slower rate, resulting in lower inflation over time.

In the case of inflation, the purchasing power of money decreases, and high inflation is costly for economic agents. According to international practice and in accordance with the requirements of the Act CXXXIX of 2013 on the Magyar Nemzeti Bank, the primary objective of the central bank in Hungary is to achieve and maintain price stability. To achieve this objective, the central bank has applied an inflation-targeting regime since 2001 and strives to achieve a publicly announced inflation target. Since 2007, the inflation target is 3 per cent of the consumer price index (CPI) published by the Hungarian Central Statistical Office. A tolerance band of ±1 percentage point applies since March 2015. The consumer price index is the general measure of inflation.

4.1 What are the advantages of price stability?

A sustained rise in prices results in costs for economic agents due to several reasons. We separate the costs of inflation that are present irrespective of whether it was foreseeable. In other words, expected high inflation also has costs. Sustained low inflation helps to avoid such costs and fosters smooth economic operation.

Stable inflation creates a **predictable economic environment**, which facilitates agents' decision-making. Developments in the real value of revenues and expenditures can be better anticipated, which fosters long-term investments. In addition, it also increases savings, as incomes preserve their value in real terms. High or volatile inflation makes the interpretation of

investment opportunities more difficult. In the case of high inflation, investors may incorporate additional risk into the risk spreads of financial instruments in order to avoid risks related to long maturity nominal assets. By contrast, price stability reduces these risks, contributing to a smoothly functioning capital market.

Price stability mitigates the costs incurred by price changes. A volatile economic environment increases the frequency of price changes resulting in costs both for producers and consumers. The repricing of goods results in what is referred to as menu costs. These include changing price labels or reprinting menus, the costs of which are incurred by producers.

Meanwhile, consumers incur what is referred to as a shoe leather cost. In a higher inflation environment, keeping cash becomes costly, so agents strive to hold less cash and receive interest on their deposits. However, this requires more frequent cash withdrawals and trips to the bank or the ATM. This cost incurs a welfare loss that is hard to quantify. However, as the financial system has become more developed and network infrastructure denser, these costs are losing significance.

Changes in relative prices provide information to economic agents on the current status of supply and demand. An increase in the price of certain goods or services in a stable inflationary environment suggests higher demand or lower supply. Agents adapt automatically to the economic situation perceived: producers react by expanding production capacities and consumers seek new substitute products. This allows prices to effectively play a **coordinating role** in the allocation of resources, and changes in the aggregate price level do not prevent the interpretation of changes in relative prices. However, in high inflationary environment, when the prices of all products change, this coordinating role no longer provides information effectively. It is impossible to decide whether prices are changing due to an imbalance between supply and demand, or because the price of all products has generally changed, which ultimately does not yield effective resource utilisation.

Inflation leads to **income redistribution** between households of various income levels. Income redistribution takes place between the contracting

parties when the amounts defined in the contract are not fixed in real terms and inflation diverges from its expected rate. An example is the debtor-creditor relationship, or social benefits if they are not indexed. If inflation is higher than expected, the lent money will worth less in the future, which benefits the borrower of the loan to the creditor's detriment. This may cause a shortening of economic relationships out of fear of inflation.

High inflation often also means volatile inflation, which increases uncertainty. Frequent and unexpected changes in prices also cause additional welfare losses over and above those described above.

4.2 What causes inflation?

Prices are determined by the relative status of supply and demand. If the supply and demand equilibrium is disrupted, this is also reflected in price changes.

- If demand exceeds supply on the market, i.e. there is **excess demand**, prices will increase. In response to increased demand, producers will expand their production capacities. However, firms incur additional costs in the course of this adjustment as supply capacities are limited which ultimately cause prices to rise.

- The **increase in cost** – for instance in commodity prices – creates tension for producers. Firms may absorb the additional costs to the detriment of profit or pass the costs on to consumers by raising prices.

Price changes in certain personal items may also provide information on demand-pull or cost-push inflation pressure. Among the components of inflation, we distinguish between those for which the price change is primarily driven by cost factors (such as food and fuel prices) and those for which the price is mainly shaped by domestic demand (e.g. market services).

- In a higher inflationary environment, agents generally have higher inflation expectations, which are not anchored. In such a setting, they try to achieve higher nominal wages in view of **expected high future inflation** to try to offset decreases in their income in real terms. These higher wages push up

costs for firms, which is ultimately reflected in rising prices. This process thus becomes self-reinforcing and creates a price-wage spiral. Moreover, if inflation expectations are high, the tolerance of certain agents may increase, enabling firms to apply more pronounced price changes.

- With regard to the recent past, rising inflation due to a **higher money supply** related to quantitative easing should also be mentioned. Higher money supply increases product market demand, which ultimately increases the price level.

4.3 The economics of deflation

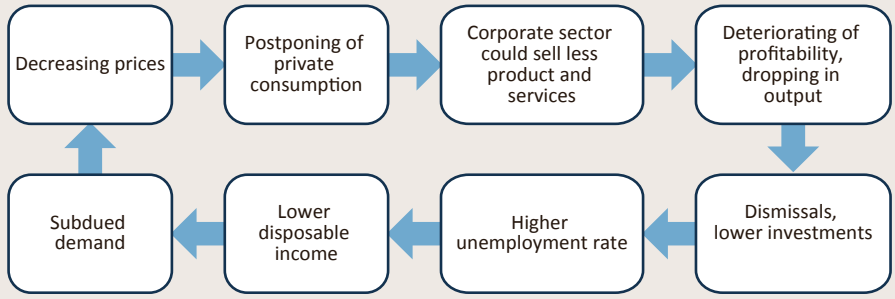
Deflation is defined as a broad-based, sustained decline in consumer prices. In other words, deflation refers to a phenomena when a broad range of consumer goods and services exhibit falling prices over a prolonged period. This decrease in prices may be driven by numerous factors: a positive cost or supply shock (e.g. falling production costs in the wake of new technology) or government measures (e.g. indirect taxes, a reduction in administered prices). In this case, we refer primarily to "good deflation", as the downward drift in prices may be accompanied by rising real incomes and expanding aggregate demand. By contrast, decreasing prices may also result from a subdued demand environment: in the literature, this is referred to as "bad deflation". In this case, a sustained, negative spiral causing the economy to contract may emerge. While in the first two cases, we saw a sustained shift in the price level, the consumer price index capturing price changes typically only takes on a negative value temporarily. However, if prices decrease in a context of a protracted recession as a result of unsatisfactory demand conditions, there is a greater likelihood of a sustained downward drift in prices resulting in real economic consequences which are difficult to counteract.

The severe real economic impacts of deflation stem from the fact that the phenomenon can easily become a self-reinforcing downward process. Anticipating a protracted decline in prices, households delay their consumption decisions en masse in the hopes of purchasing the same goods later at a lower price. Firms adapt to lower demand and weaker profitability by restricting employment, wages and investments. Slower capital accumulation

decreases the economy's potential growth rate, while lower wages and employment again decrease demand (Chart 2).

A high initial level of debt may particularly increase the likelihood of feedback. In this scenario, shrinking prices further increase borrowers' debt, already elevated in real terms, creating substantial burdens for them. Thus, the emergence of deflation is the most likely in a high-debt environment of recession. Recently, this phenomenon has affected Japan since the mid-1990s.

Chart 2
The deflationary spiral



Source: MNB

4.4 The role of monetary policy in maintaining price stability

Most central banks strive to achieve and maintain price stability as their primary objective. To fulfil this function, they use a set of monetary policy instruments to influence economic agents' decisions.

The key policy rate is a fundamental component of the central bank instruments. Monetary policy intervention is required to control inflation over the medium term. Monetary policy does not react to current inflation, but rather to inflation expected over the medium term. This is due to the fact, that transmission takes time, and a certain amount of time must pass between the decision and the effect of its impact. As a result, monetary policy may "look through" one-off upward shocks to the price level which have no impact on medium-term inflation developments. If monetary policy reacted to transitional inflationary upward drifts with interest rate hikes, the real

economic costs would be excessive, whereas inflation would have returned to a lower level even without such a response. It is therefore essential to distinguish impacts that only cause short-term fluctuations in order to provide a more accurate monetary policy judgement.

4.5 Why isn't price stability defined as zero per cent?

Although high inflation has numerous negative consequences, price stability is still not defined as zero per cent inflation. Several arguments suggest that a slight positive increase in prices is beneficial for the economy, while sustained close-to-zero inflation entails numerous risks over the long run.

We will later see that the consumer price index is complicated by several **measurement and statistical biases.**

Deflation has additional adverse impacts on the economy, and thus **avoiding deflation** also requires a low, positive inflation target.

Close to zero inflation **jeopardises the effectiveness of monetary policy** in terms of the traditional monetary instrument – the key policy rate. In the event of deflation, prices decrease and monetary policy attempts to influence economic agents' decisions by cutting the base rate. However, interest rate cuts are limited by the fact that monetary policy is unable to bring the base rate below zero. This is because negative real interest rates would push agents to hold their savings in cash, holding cash would have no cost and monetary policy could not intervene against further price decreases. However, at a zero interest rate, monetary policy can still intervene in economic processes via quantitative easing, which was one of the main tools in recent crisis management (e.g. the Fed's QE programme).

Due to downwardly rigid wages, slightly positive inflation allows more room for adjustment. If demand contracts, producers are compelled to reduce prices or wages. In a context of low inflation, nominal wages are also higher, allowing the firm more leeway for adjustment by granting lower wage raises instead of increasing unemployment. By contrast, almost zero inflation restricts economic agents' opportunities to adjust in response to a negative demand

shock through relative prices and wages. The new equilibrium emerges alongside a higher real economic sacrifice and lower employment.

Finally, the **high debt level** that may have emerged is also worth mentioning. The rapid and unexpected fall in inflation may entail a rise in debt in real terms, putting indebted economic agents in a difficult situation.

5 Measuring inflation from a practical perspective

5.1 Calculation of the consumer price index (CPI)

The consumer price index is the general measure of inflation. The consumer price index is designed to quantify the price changes of a basket of consumer goods and services purchased by a representative household. Used items are not included in the index. This is to ensure that the CPI is consistent with the consumer statistic used for the GDP statistic, which is fundamentally a value added indicator. Used cars are an exception among used goods, and their inclusion is based on their relative significance in the structure of expenditures. The consumer price index is based on numerous individual observations and considered to be one of the highest quality statistics. Compared to GDP, the CPI is not revised and therefore provides definitive, real-time information on price changes, facilitating economic evaluation.

5.1.1 Measurement of the consumer price index

The Hungarian Central Statistical Office (HCSO) compiles and processes the data necessary for calculating the consumer price index every month. So-called "representative items", i.e. goods or services described by key qualitative attributes (e.g. white bread, non-sliced; mineral water, sparkling, 1.5 litres in disposable plastic bottles) are defined to measure individual price changes. The prices of approximately 1,000 representative items are measured monthly; the list of representative items is reviewed annually due to the changing consumer habits. These observations are summarised for broader categories, published in two different breakdowns:

- for 140 items by detailed expenditure group, e.g. bread, pork, beef.
- Classification of goods by individual consumption purposes, or COICOP,[8] e.g. bread and cereals, meat, fruit. This includes fewer categories than the

[8] Classification of Individual Consumption According to Purpose

breakdown by expenditure. Eurostat uses this classification on its website for the purposes of international comparison.

These items are aggregated using their weights in consumption. In its flash reports, the HCSO publishes more disaggregated indices prepared based on the details for seven groups, e.g. food, household energy, and for the 12 groups used in the COICOP, e.g. food and non-alcoholic beverages.

Examining the data on a more aggregate level is also better suited for analytical and forecasting purposes. The MNB also prepares its own classification.[9]

Table 1
Inflation items according to the MNB's own classification

MNB main group	What is it influenced by?	CPI weight in 2015 (%)
Unprocessed food	price fluctuations in raw foods, weather	6.1
Processed food	raw foods, wages	13.2
Traded goods	foreign competition, foreign inflation, exchange rate	21.9
Market services	domestic supply and demand	22.1
Market energy	e.g. bottled gas, firewood	1.0
Fuel	oil prices, exchange rate	8.2
Alcohol and Tobacco	mainly changes in excise duty	9.7
Administered prices	official decisions	17.8
Total		100.0

Source: MNB

5.1.2 Weighting of the consumer price index

The weights in the consumer price index reflect the relative proportion of purchased items in individual consumption. The weights are defined based on household purchased consumption provided in the National Accounts since 2012, while before that, data from the Household Budget Survey was also taken into account. The weights are reviewed annually, and weights used in any given year reflect the consumption structure from two years earlier. The consumer price index is of the Laspeyres type, and is chain indexed.[10] The price index weighted for the base period for an *n* number of items is:

[9] https://www.mnb.hu/letoltes/en0203-mnbcsoportok.xls

[10] Chain indexation decreases the substitution bias.

$$\pi_t = \frac{\sum_{i=1}^{n} q_{i0} p_{it}}{\sum_{i=1}^{n} q_{i0} p_{i0}},$$

or alternatively,

$$\pi_t = \frac{\sum_{i=1}^{n} w_{i0} \frac{p_{it}}{p_{i0}}}{\sum_{i=1}^{n} w_{i0}},$$

where q_{i0} is the periodic quantity of the product i, p_{i0} is its base period price, while p_{it} is the product's current price observed over the period t. w_{i0} is the weight of product i within consumption expenditure ($\sum_{i=1}^{n} w_{i0} = 100$).

5.1.3 How can the data be analysed?

- Several indices serving different purposes can be calculated from the fixed base or level series: The most common indicator shows the price change that takes place over the course of 12 months (annual index), where the monthly (quarterly) index is compared to the same month (quarter) on a year-on-year basis. This has the advantage of forming a generally smooth time series and stripping out most seasonal patterns[11] from the indicator. However, its disadvantage is that it only captures current price changes with a delay, and its value for the period under review is also shaped by a base effect.[12]

- Indices with short bases provide more information on price changes during the month in question, by comparing prices for the month (quarter) under review to those of the previous month (quarter). However this is influenced by the seasonal effect, so seasonal adjustment is applied to control for these effects in order to calculate the index, so that further analyses can be performed. This type of index reflects current price changes, but is

[11] A seasonal pattern refers to a price change of nearly identical direction and rate observed characteristic of the month (quarter) under review, for instance the repricing of services typically at the beginning of the year. For more details on the seasonal adjustment methodology, see Seasonal Adjustment Methods and Practices, HoSA Handbook, 2007 July (http://www.ksh.hu/docs/files/527167.PDF).

[12] In technical terms, the base effect is the part of the annual index change stemming from the month-on-month inflation prevailing in year-on-year terms. If the month-on-month index is elevated during the month under review, this will in and of itself cause a decrease in the annual index during the same month of the following year.

characterised by significant volatility in most cases. Seasonally adjusted indices with short bases are generally used for evaluation purposes.

- The price change compared to December of the preceding year provides information on price changes during the year under review. In December, this index is the annual index itself. It is used for the aggregation of the consumer price index. In other words, price changes for the year under review are offset with the item's weight reflecting the structure of consumption expenditure of two years earlier.

Indices with short bases and level series are the most suitable ones for forecasting purposes.

5.1.4 Sources of bias in the consumer price index

Although the consumer price index is one of the highest quality statistics, sampling may create certain biases. In the US, the Boskin Commission conducted a comprehensive study on issues related to the measurement of the consumer price index. The study found that the 3 per cent inflation measured in the first half of the 1990s overstated the change in the cost of living by nearly 1.1 percentage points (Boskin et al, 1996).

The bias stems from several factors, similar to the ones mentioned among the measurement difficulties of the cost of living index (see Chapter 3.2): weighting, handling changes in product quality, appearance of new products, omission of the substitution effect.

5.2 Other price index characteristics

In addition to the consumer price index, another regularly published indicator is the **Harmonised Index of Consumer Prices (HICP).** With the introduction of the euro, it became necessary to compare price indices, as the CPI may be used for different purposes from country to country (cost of living index, compensation index etc.) and is calculated using different methodologies and consumer baskets. The HICP is an indicator that allows comparison across countries and is calculated by national statistical offices. It is calculation is

based on a harmonised methodology.[13] The HICP is the official inflation data for monetary policy within the euro area, and the convergence criterion is also specified based on the HICP. The main differences between the CPI and the HICP are:

- Treatment of owner-occupied housing: this item is excluded from the HICP, while it is included in the CPI.
- Group of households taken into account: the HICP takes into account the expenditures of households on the economic territory, that is, including non-resident households (i.e. purchases of foreigners visiting the country), while the CPI is generally a national category, i.e. calculated based on the expenditures of resident households.
- Recognition of taxes, fees and services: The HICP takes into account prices actually paid by consumers after taxes etc., while there are several existing concepts for the CPI.
- Other factors: handling changes in product quality, inclusion of gambling, handling sales promotions, differences between disaggregate level formulas etc.

Statistical offices often adapt to the new methodology when calculating the CPI as well, which narrows the difference between the two indicators. In respect of Hungary, there is no material difference between the CPI and the HICP. Owner-occupied housing has not been included in the national CPI statistic since 2012. The difference lies in the inclusion of gambling based on the consumer basket: the CPI includes gambling, while the HICP does not. For the HICP, the change in the price of services is calculated in the month when the service can be used, while for the CPI, it is included in the index when consumers pay the new price, e.g. the settlement of energy prices.

[13] http://ec.europa.eu/eurostat/statistics-explained/index.php/HICP_methodology

Chart 3
Developments in the CPI and the HICP in Hungary

Source: HCSO

The **GDP deflator** measures the price change of all newly produced goods and services within a country, but does not include the price changes of imported goods. It covers a far broader group of products than the CPI, and factors in more than just consumption. Its "product basket" is not fixed, it takes into account changes in consumer habits and is therefore not affected by any bias arising from substitution effect.

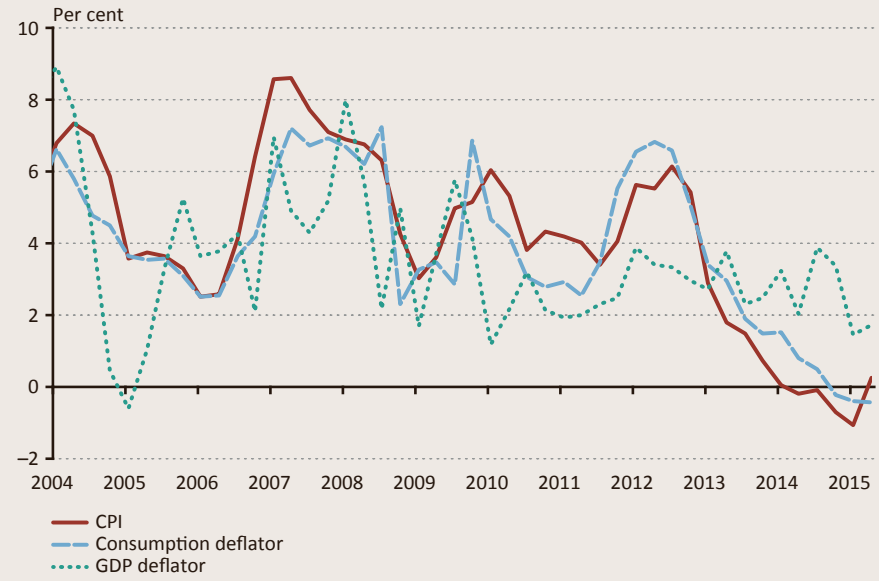
Although the GDP deflator is a more flexible indicator, the CPI provides a more accurate reflection of changes in the cost of living.

The **consumption deflator** measures the price change in household consumption. The consumption deflator and the CPI both reflect changes in prices, but the two concepts differ in several regards.

- The consumption deflator measures the price change in consumption for the period under review, and therefore the structure of expenditure reflects consumption expenditures during the period under review, while the CPI is weighted according to the base period.

- The CPI basket is fixed for one year, while the structure of expenditures changes on a quarterly basis in the case of the deflator.
- The CPI reflects purchased consumption, while the deflator includes self-produced consumption and Financial Intermediation Services Indirectly Measured (FISIM).
- The CPI is generated at a monthly frequency, while the consumption deflator is only available less frequently, on a quarterly basis.
- The CPI is not revised retrospectively, while the consumption deflator may change significantly retrospectively.
- Price changes in the goods included in the CPI can be observed directly, while for consumption, certain sub-items, such as self-produced consumption can only be estimated.

Chart 4
Deflators and the CPI



Source: HCSO, MNB

5.3 Inflation perceived by households

The inflation perceived by individuals may differ from official inflation, a phenomenon addressed by theoretical studies (calculations performed on Hungarian data are summarised in Box 1). In summary, the deviation in perceived inflation may stem from several factors:

- The consumer baskets of individuals vary. A lower-income household purchases mainly basic necessities, while higher-income households purchase more services.
- We allocate a higher weight to goods purchased more frequently. So for instance food – which is purchased on a weekly basis and often exposed to the price fluctuations of raw food – is given greater emphasis in perceived inflation. By contrast, durable consumer goods (such as washing machines and television) are purchased less frequently, and their price decreases continuously in the wake of technological progress. Durables are represented by smaller weights in current perception.
- Price increases tend to stick more in our memories, while we tend to realise price decreases to a much lesser degree. Significant and transparent price changes are often overweighted.
- In terms of perception, we often look back on longer periods, thus taking into account price changes of several years instead of just the past one year.
- If a product's price rises, it is often the quality improvement which yields the changes in prices (e.g. the inclusion of new technical elements in cars), so we are looking at a different product. Attempts are made to control for this impact in the consumer price index.
- News conveyed by the media may also distort household perceptions/ expectations (Lamla and Lein 2008).

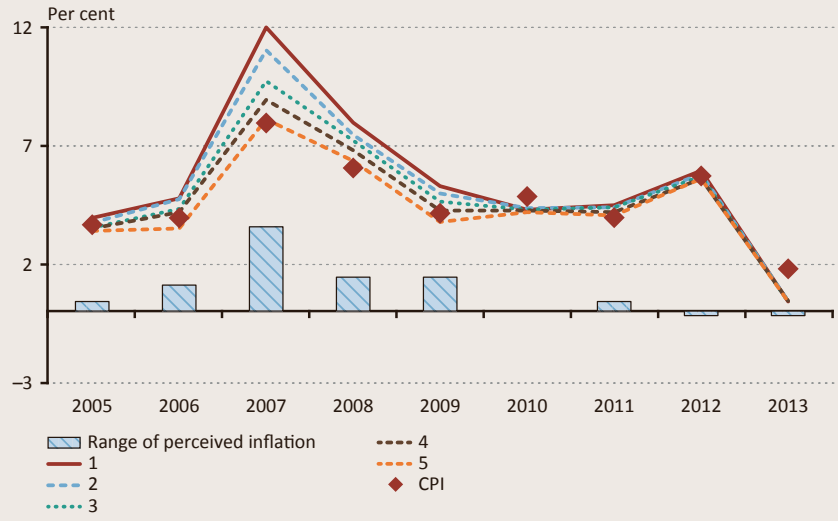
Box 1
Inflation perceived by households

Consumer public opinion polls shows that the population's perception of inflation varies by household. They tend to perceive higher inflation than the officially published price index. This stems from the above-mentioned observation problems and the varying structure of consumption by households. Differences resulting from varying consumer baskets can be examined based on the micro data of the Household Budget Survey. The inflation perceived by households can be calculated as the product of the price index of COICOP expenditure categories and the consumption structure of individual households.

Based on the results, the inflation perceived by individual households is significantly shaped by the diverging composition of consumer baskets. The greater the difference between consumer baskets, the greater the deviation in perceived inflation in the case of a price shock. In addition, perceived inflation also has a substantial impact on changes in relative prices.

According to income category, administered prices and food have a higher weight among low income households. For higher income households, the weight of these

Chart 5
Perceived inflation by quintile (%)



Source: MNB calculation

items decreases, while fuel consumption increases. As a result, the price shocks affecting these product groups have a large impact on households' perception, and also account for the differences in perceived inflation between low and high income households.

Based on historical data, decreases in the consumer price index were accompanied by lower volatility, which may have contributed to narrowing the differences between the inflation perceived by various social groups.

6 Underlying inflation trend indicators

6.1 The significance and role of such indicators in monetary policy

Inflation-targeting central banks conduct forward-looking monetary policy, meaning that decision-makers do not react to currently incoming data, but to expected future developments. This is because monetary policy can only have a delayed impact, due to the time requirement of the transmission mechanism. Offsetting transitional shocks affecting inflation, without a meaningful impact on the medium-term inflation outlook, would come at the price of real economic sacrifices which are unnecessary from the perspective of maintaining price stability.

Accordingly, central banks take current data into account only to that extent that they contain relevant information about expected future developments. In case of the consumer price index, current actual data may reflect the impact of numerous temporary factors or reflect relative price changes that have no meaningful impact on the medium-term inflation outlook. These components of the price index can be ignored when assessing the actual inflationary pressure and the underlying inflation trend within the economy. To measure these underlying inflation trends, central banks calculate various underlying inflation indicators based on official consumer price index statistics.[14]

One of the most commonly used indicators is core inflation, which filters out volatile energy and food prices. The indicator is based on the assumption that fuel and (unprocessed) food prices may shift significantly within brief periods, often in opposite directions. These shifts are often caused by supply shocks (including producer cartel price decisions, extreme weather etc.) that are not directly related to underlying economic developments, and may even change their sign over brief time periods.

[14] For an analysis on the underlying inflation indicators used by central banks, see Gábriel et al (2013).

The characteristic of underlying inflation indicators filtered on a statistical basis is that they filter out items based on the statistical attribute characterising the period under review, rather than stripping out predefined product groups. These may be indicators separating out either the items exhibiting the highest and lowest price changes during the month under review, or the items undergoing the most frequent repricing.

In addition, indicators taking into consideration other variables besides inflation and using theoretical correlations have also become widespread. These types of indicators are generally created using a structural vector autoregressive model (VAR) or factor model.

In cases where the consumer price index is distorted by government tax measures, several central banks (e.g. the Czech National Bank) use inflation indicators excluding indirect taxes (such as sales and excise taxes) as an operative target or for communication purposes (see Box 2 for more on adjustments for the effects of indirect taxes). In terms of indirect taxes, the source of the shock triggering price changes can be clearly identified, and trend changes can be ruled out in case of one-off tax measures, so the likelihood of price level change pass-through to corporate cost structures is low, as is the probability of second-round effects. In the event of frequent changes in indirect taxes, price indices excluding taxes provide a good reference point for decision-makers thanks to the above characteristics. However, it is important to note that filtering out the impact of indirect taxes involves some uncertainty, as the part of the tax change passed on to consumers ultimately depends on the pricing decision of firms in the current demand environment.

Box 2
Estimating the impact of indirect tax changes

Changes in indirect taxes cause temporary changes in inflation, and the likelihood of the pass-through of price level changes through corporate cost structure is rather low. Tax changes make it difficult to interpret current inflation developments, so it is recommended to adjust time series excluding the effects of such. VAT is a classic example of an indirect tax change.

VAT increases can be filtered out using two different methods. On the one hand, the so-called technical effect of the tax change can be filtered out. The technical effect is the gross price change emerging in the wake of a VAT rate change, assuming constant net prices. However, VAT may be passed on to different degrees based on the prevailing state of the economy. If demand is particularly weak, hikes in VAT are unlikely to pass-through entirely into consumer prices, i.e. net prices decrease. In this case, excluding technical effect yields a significant decline in the price index that would not reflect actual underlying trends. We therefore conduct estimates on the rate of the VAT effect in an attempt to capture the actual pass-through.[15] The estimated VAT effect thus reflects the price change actually occurring in the wake of the tax change.

The basic method is the following: using software which is also applied for seasonal adjustment, we estimate the price change expected at the time of the VAT change given the seasonality and trend characterising the time series, without the tax change. The difference between the actual price change and the estimated price change is the estimated VAT effect.

Filtering VAT affects a broad range of products, so the estimate can be performed at various levels of aggregation, such as the overall inflation rate, main groups, or items. Estimates on a more disaggregated level have the advantage of addressing the impact of different VAT rates, the accuracy and credibility of the estimation can be better verified and they capture more precisely the seasonalities and trends characterising different groups.

However, the drawback of this is that more volatile individual time series may render the estimates more uncertain. For this reason, the VAT effect is worth estimating on several levels to obtain a robust picture.

It is important to note that this method includes several uncertainties. It may capture other factors besides the VAT effect, as the VAT effect may pass through only over the course of several months (although experience shows that most of the VAT effect is

[15] Changes in administered prices and fuels can be assumed to be fully passed on.

reflected in prices after one month). However, to fine tune the results, the estimation should be performed again as more data becomes available after the month of the VAT change.

Changes in excise tax only affect a narrow range of products, and the date of the tax change can be easily identified. In this case, the price change can be observed more easily at the item level, and the expected impact of the tax change can be calculated based on the statutory requirements. Based on the rate of tax change and earlier experiences, the pass-through of changes in excise tax into consumer prices is more easily identifiable.

6.2 Underlying inflation trends for Hungary

The MNB employs several indicators to capture underlying inflation trends. One difficulty in selecting the adequate underlying indicator is that inflation in Hungary has been affected by a series of price level shocks in recent years, most of them exerting an upward impact. In this case, excluding the items affected by price level shocks triggering price increases may distort underlying inflation indicators.

As a result, these indicators were still lower over a longer period compared to the consumer price index.[16] In order to assess the differences between the consumer price index and certain underlying indicators, it is essential to analyse the current economic environment.

The most commonly used indicator is core inflation adjusted for the effects of indirect taxes. We use the core inflation published by the HCSO as the basis of our calculation. Core inflation is determined by excluding unprocessed food, energy and administered prices from the consumer price index. The estimated impact of changes in VAT, excise taxes and other indirect

[16] Ideally, the long-term average of underlying trend indicators and the consumer price index are identical. In this case, the discrepancy between the two indicators may provide a reliable forecast of expected inflation. But if the long-term average of the trend measure and inflation differ, lasting price changes may have also been stripped out. In this case, it is difficult to interpret the indicator, which may nevertheless yield relevant information (for instance on dynamics).

taxes[17] is then separated out from core inflation. Nevertheless, one often cited criticism is that core inflation adjusted for the effect of taxes is quite volatile. This may be due to the fact that it contains the product group of processed foods, which may be sensitive to price shocks affecting foods. As a result, other underlying indicators have been designed. Among these, we distinguish between statistical indicators reflecting short-term inflationary pressures and those capturing more permanent inflationary pressures. We expect these underlying indicators to be smooth, with little need for revision, and to have some forward-looking characteristics. For more, see Bauer (2011).

6.2.1 Short-term inflationary pressure indicators

To capture short-term inflationary pressure, we use indicators computed on the basis of a statistical approach, described and evaluated in more detail in Bauer's (2011) study. Among these, we distinguish between the indicators that filter out items with extreme price changes at a given moment in time (trimmed mean, median, weighted median), and so in contrast to core inflation, the range of omitted items changes from one month to the next. In addition, the entire consumer basket can be taken into account, but applying different weightings (Marshall-Edgeworth index). The indicators are generated based on a detailed and itemised breakdown of the CPI, following adjustment for indirect taxes. Administered prices were excluded during the estimation, as they depend on authority decisions.

To calculate the **trimmed mean**, items are arranged in ascending order, and those items exhibiting the largest and the smallest price change are excluded. The trimmed mean gives a robust estimate of the expected value, in contrast to outliers. The indicator monitored by the MNB removes the lowest 25 per cent of items and highest 32 per cent of items of the distribution. This combination ensures the best forecasting capacity for the indicator.[18]

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[17] Inflation adjusted for taxes calculated by the MNB stems from the fact that the indirect tax effect estimated by the MNB differs from the technical effect applied by the HCSO in determining the CPI with unchanged tax content in terms of both the tax measures taken into account and their quantification. In the indirect tax as well, we strip out the financial transaction duty and the impact of the retail price margin increase of tobacco, as these are more akin to tax changes.

[18] Filtering may also be symmetrical, removing the same proportion of items from the bottom and the top of the distribution.

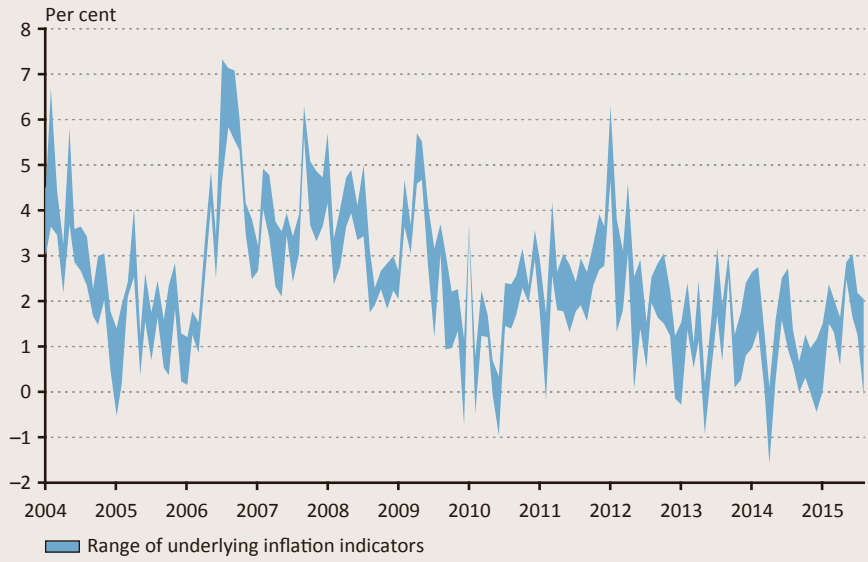
When calculating the **unweighted median**, we consider the median value of items at every point in time, thereby making it insensitive to outliers and serving as a reliable indicator of central tendency in the case of skewed distribution.

In the case of the **weighted median**, item weights are also taken into account when defining the median value compared to the previous indicator.

The **Edgeworth-weighted index** is a special weighted average, as items are not aggregated based on their weight within consumption, but using the reciprocal of the item's deviation. Thus volatile items are assigned a smaller weight, while smoother items are assigned a larger weight. The deviation of items may change over time, so deviation is taken into account using a moving-window. A 24-month moving window was defined for the indicator used by the MNB.

Compared to core inflation adjusted for the effect of taxes, several indicators have better characteristics, and the Edgeworth-weighted index is considered to have the best characteristics. At the same time, it is worth stressing that the combined examination of several indicators is most capable of yielding

Chart 6
Indicators capturing short-term inflation prospects



Source: MNB calculations based on HCSO data

a robust picture, so a minimum - maximum range is defined for indicators in analyses. This range also provides information on uncertainty.

6.2.2 Underlying indicators capturing medium term trends

Sticky inflation shows the price change of a slowly repricing product group and thus provides a reliable forecast of medium-term inflation developments. To calculate the indicator, we used only those partial groups of the consumer basket that exhibit no more than a 15 per cent average monthly price change observable at the individual shop level. We exclude administered prices from the groups. The impact of indirect taxes is also filtered out from the indicator.

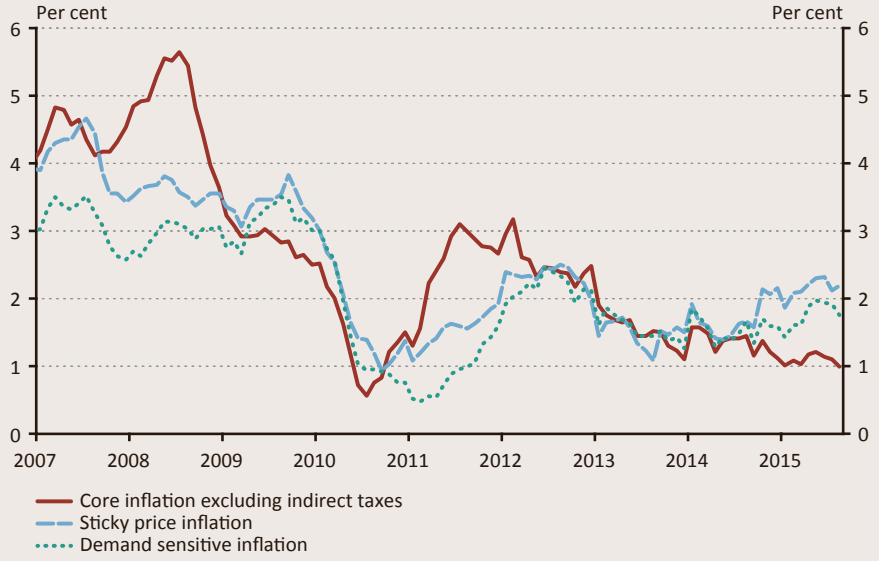
The underlying consideration behind the concept is that the inflation of products with sticky prices exhibiting infrequent price changes is rather forward-looking, and firms factor in future trends inflation in their pricing decisions; hence, this carries more information on expected future inflation.[19] The better forward-looking nature that accompanies lower repricing frequency can also be demonstrated in a theoretical model (Reiff-Várhegyi, 2013). With a price change frequency of less than 15 per cent (that is, when more than six months elapse on average between the repricing of goods), the degree of foresight is at least 60 per cent. Using this threshold value, the defined products are primarily market services and industrial goods, which reflect a more persistent part of core inflation. Products with sticky prices account for 40 per cent of the consumer basket, excluding administered products. According to surveys, the inflation of prices with rarely changing prices offers better forecasting characteristics than core inflation. Compared to statistical indicators it has the benefit of containing a fixed range of products.

Demand-sensitive inflation is calculated by excluding processed food prices from core inflation adjusted for taxes. The rationale for this is that price changes in the latter product group are highly dependent on the volatile price changes of agricultural commodity prices. Demand-sensitive inflation therefore reflects the inflation of industrial goods, market services and alcohol

[19] Two extreme examples are fuel and restaurant prices. The price of fuel changes on a weekly basis, so its price changes are less forward-looking, as prices may change the following week in the wake of market developments (oil prices, exchange rates). By contrast, restaurant prices change more rarely, every one to 1.5 years, so they must be defined taking into account expected inflation.

and tobacco products adjusted for the effect of indirect taxes. Similarly to sticky inflation, demand-sensitive inflation provides better forecasting properties in assessing medium-term inflation processes.

Chart 7
Indicators capturing medium-term inflation prospects



Source: MNB calculations based on HCSO data

7 Inflation expectations

7.1 The role of inflation expectations

Inflation expectations are crucial for inflation-targeting central banks in several aspects. They carry information for macroeconomic forecasts on the one hand, and are important for central bank credibility on the other hand. In Chapter 4.1, we explained how high inflation and high expectations have a detrimental effect. Expectations situated close to the target suggest that agents believe that in the event of shocks increasing (or decreasing) the price level, the monetary policy response will bring inflation back close to the target over the medium term, and hence agents will not increase (or decrease) their expectations. In other words, a credible inflation target stabilises expectations as a nominal anchor, which contributes to maintaining price stability.

When expectations are anchored, agents believe that monetary policy will offset the inflationary effect of economic shocks. Thus, expectations do not rise in the wake of shocks, thereby preventing inflation from accelerating in the future. Therefore, monetary policy comes at a lower real economic cost, and shocks fade away faster. Monetary policy may therefore disregard temporary, one-off price level increases without jeopardising the medium-term inflation target, whereas demand shocks require smaller monetary policy reactions to achieve the medium-term inflation target.

By contrast, unanchored expectations erode the effectiveness of monetary policy measures and increase their real economic impact. In addition, further interest rate hikes may be necessary to restrain inflation due to high expectations.

7.2 Experiences in Hungary

Our data on inflation expectations are based on individual questionnaires. Two types of surveys can be distinguished:

- Quantitative, featuring a question aimed at eliciting a specific, quantified answer on the inflation expectation. This has the benefit of immediately

generating the time series of expectations without need for further transformation. At the same time, as a drawback, quantitative values often exceed actual inflation or the central bank's inflation target. This phenomenon can also be observed in international data.

- The qualitative questionnaire (prepared monthly by the European Commission[20]) only includes questions on the expected direction of price changes, and does not require a quantified reply. This has the advantage of being easy to answer, but renders the interpretation of the survey findings more difficult. Various assumptions and transformations are necessary to obtain a quantified value, and therefore its level depends on the assumptions applied. The Carlson-Parkin procedure is often used (for its application to Hungarian data, see Gábriel 2010).

Surveys are conducted among various economic agents, and their information content may vary accordingly. Market analysts possess the most information, and often use complex models. Firms, as price-setting agents, may provide valuable information on their price-changing intentions. Households, which are decisive in terms of consumption decisions and wage bargaining, are considered as being less informed compared to the previous two groups. Surveys of market analysts and households are commonly used in international practice, while corporate surveys are less frequent. As the information content of various surveys differ, it is recommended to examine the time series of various expectations together. Household expectations are predominantly biased, and hence it is the changes in the time series and comparisons to its own historical values that yields relevant information, instead of the actual level of the time series.

7.2.1 Households

Household expectations are directly reflected in wage negotiations and consumption and savings decisions:

- During wage negotiations, in the case of higher expectations they aim to receive higher nominal wages.

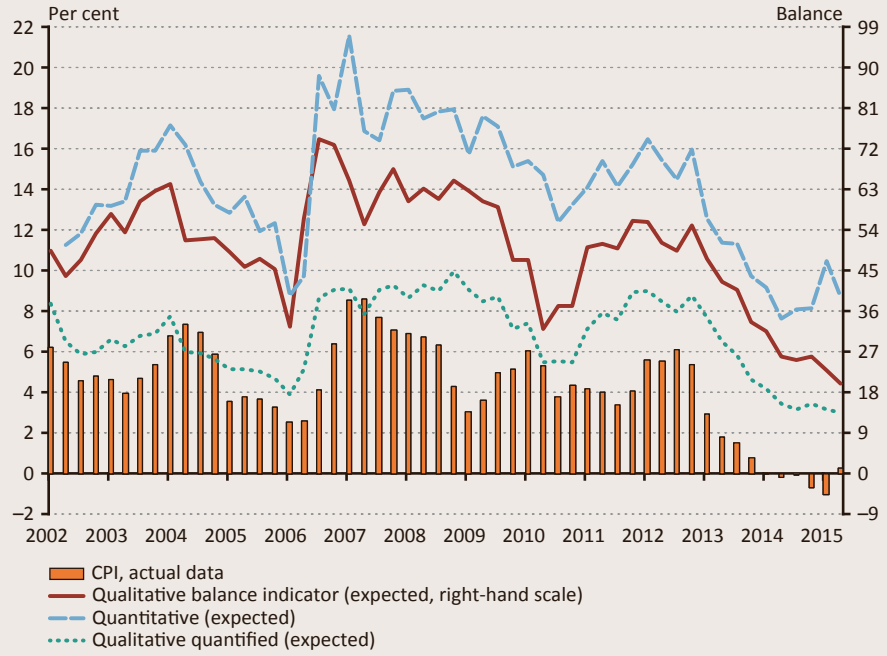
[20] Business and Consumer Surveys, http://ec.europa.eu/economy_finance/db_indicators/surveys/index_en.htm

- If expectations are higher, households bring forward their consumption, which may push prices up by boosting demand.
- In the case of higher expectations, consumers exhibit greater tolerance for price increases (making less of an effort to seek out cheaper products), which also reinforces inflationary pressure.

A widely accepted fact in the literature is that households rely on developments observed in the past when shaping their expectations (backward-looking inflation expectations), while their expectations regarding the future are shaped by their current inflation perceptions. As a result, household expectations predict future inflation inaccurately.

The levels of quantitative and qualitative inflation expectation time series for Hungary differ, but their dynamics exhibit similar movements. Expectations

Chart 8
Households' inflation expectations



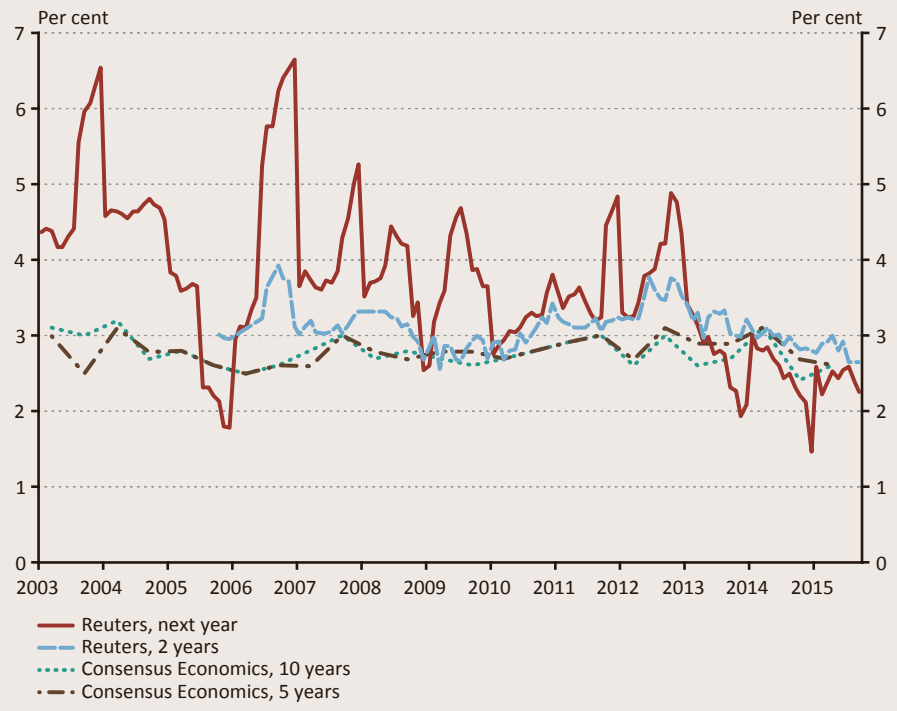
Note: The balance is the difference between the indicator calculated from the proportion of households expecting a price increase and those expecting a price decrease. The qualitative quantification is the indicator generated using the Carlson-Parkin procedure.
Source: HCSO, MNB calculation based on data from the European Commission, and the MNB

closely covary with actual inflation, and certain product groups, such as foods and administered prices, which are monitored more closely by households. As a result, if the price index of these items changes, it has a greater impact on expectations.

7.2.2 Market analysts

Market analysts have the most information and often shape their expectations using complex models. According to time series for Hungary, short-term expectations are volatile, while longer-term expectations form close to the target. The latter is a proof of the credibility of monetary policy. Using US data, El-Shagi et al (2012) examined whether market analysts provide additional information compared to central bank forecasts. Based on this study, central bank forecasts were more accurate than market forecasts. The difference

Chart 9
Developments in analyst expectations in Hungary



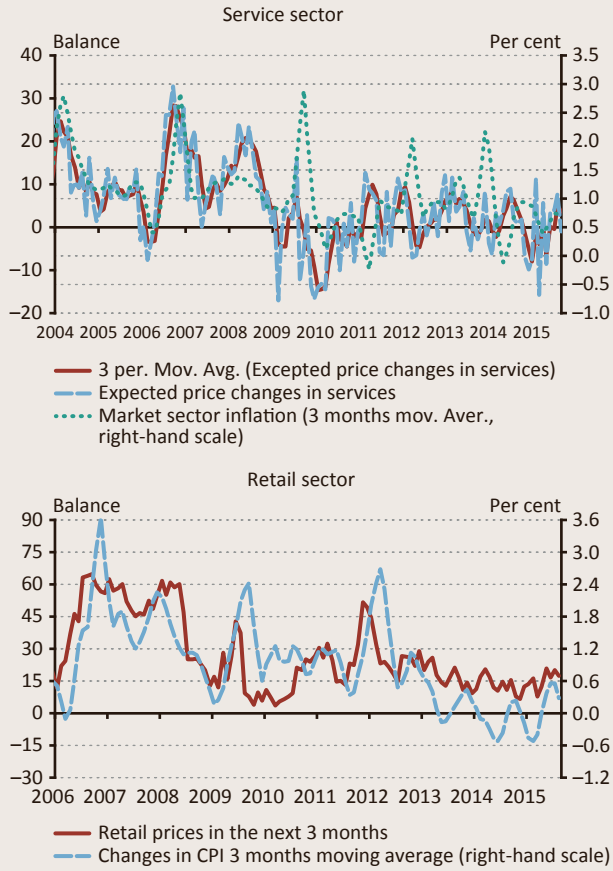
Source: Consensus Economics, Reuters

between the central bank and analysts narrowed, which could be explained by greater central bank transparency.

7.2.3 Corporations

According to international results, corporate expectations are less forward-looking. The short-term expectations surveyed by the European Commission (and GKI in Hungary) provide information looking ahead for a few months. This time series may mainly help to assess the current state of the economy.

Chart 10
Short-term inflation expectations



Source: European Commission and MNB calculation based on HCSO data

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