Péter Gábriel, György Molnár and Judit Rariga: Measures of underlying inflation*

The primary objective of Magyar Nemzeti Bank is to achieve and maintain price stability. The central bank of Hungary defines its 3 per cent inflation target in terms of the consumer price index. However, this indicator is quite volatile, and many of its components are sensitive to temporary shocks. Consequently, the CPI also captures price changes that monetary policy should generally look through. In this context, the need has arisen to develop measures of inflation which capture medium-term underlying inflationary pressures in the economy. Most central banks, including the MNB, use several alternative measures to capture underlying inflation. These measures have increasingly become an important part of the decision-making process and communication with market participants. In respect of the domestic measures of inflation, our results can be summarised as follows. The set of underlying inflation indicators developed and used by the MNB are in line with international best practices. Movements in the various underlying measures of Hungarian inflation are significantly less volatile than those in the consumer price index, and the indicators have a robust predictive power for expected future movements in inflation. At the same time, the average value of underlying measures is different from average inflation over the long run, which makes the quantitative assessment of the indicators more difficult.

INTRODUCTION

Achieving and maintaining price stability is central to the mission of central banks in developed countries. Under an inflation targeting regime, central banks typically use the consumer price index (CPI) to define their target for inflation. However, this measure of inflation can be temporarily influenced by a number of highly volatile items, and consequently it cannot provide a sufficiently reliable picture of underlying inflationary pressure in the economy, particularly over the medium term, which is the relevant horizon for central bank decision making. In many cases, monetary policy generally need not react to such temporarily fluctuations in the price level. Moreover, since it can only influence inflation with a time lag, in the face of unforeseen and temporary shocks to the price level, monetary policy will be less effective and might cause excess volatility in real economic variables. For this reason, a more precise picture of developments in medium-term inflation, relevant from the point of view of inflation targeting, can be obtained by eliminating volatile items and the effects of policy measures which only have temporary effects on inflation. This implies the calculation of measures reflecting persistent trends in inflation. Using a less volatile indicator to capture trend inflation in central bank communications may help economic agents to better understand underlying movements in inflation and central banks to explain their decisions.

There are various methods in the literature to construct measures of underlying inflation. Ideally, such measures should meet the following criteria. First, a key requirement to be met by underlying inflation measures is smoothness: they must be less volatile than the consumer price index. Second, the long-term average value of a measure of underlying inflation is ideally equal to the average rate of inflation, which may help improve central bank communication with the general public. Third, an important requirement is that the various measures can contribute to the projections of future inflation. In addition, they should be relatively easy to calculate and should preferably not be subject to significant revision when new data comes in. This may also facilitate central bank communication.

Simple measures, excluding the prices of certain large product groups, mainly energy and food prices, are the most

* The views expressed in this article are those of the author(s) and do not necessarily reflect the offical view ot the Magyar Nemzeti Bank.

widely used measures in international practice and central banking communication, but more complex measures also play a role in the communication of several central banks. In recent years, the MNB has placed increasing emphasis on constructing measures of underlying inflation, to complement the use of the more traditional measures.[1] Consequently, these measures have been playing an increasing role in monetary policy decision-making and analysis.

The purpose of this article is to present international practice and to compare the inflation trend indicators[2] developed and used by the MNB with those in use in various other countries. First, the methods used to construct inflation measures are summarised, then we review how much central banks rely on these measures in decision-making and communications. Subsequently, the measures used by foreign central banks and the MNB are examined from a statistical point of view. Finally, we summarise our results.

TYPES OF MEASURES OF UNDERLYING INFLATION AND THEIR USE IN CENTRAL BANK PRACTICE

There are several definitions of underlying inflation in the literature: according to Eckstein (1981) it must show the trend increase in the cost of factors of production; Blinder (1997) defines trend inflation as the persistent component of inflation; while Velde (2006) defines it as the (unobserved) common component to a large number of individual price series.

There are a number of ways to measure underlying inflation. Based on the method used, measures of inflation can be categorised into three groups. The first group generally comprises measures that exclude energy prices and food prices from the consumer price index. One great advantage of these measures is that they are easy to calculate and communicate; and therefore they are the most commonly used measure of underlying inflation. In the case of measures falling into the second group, the items to be excluded from the inflation index are chosen at the level of individual products or narrowly defined product groups. Some of these measures are calculated by removing outliers from price changes in a given month. This concept is based on the assumption that outlying price movements are presumably affected by one-off shocks, and therefore have no significance for medium-term price developments. An example for this measure is the trimmed mean. In the case of trimmed means, changes in the prices of CPI components are arranged in descending order, and the new measure is constructed by taking the average of disaggregated price changes after removing the upper and lower 10 per cent–15 per cent of the distribution of price changes in a given period. In the case of another type of measures in this group, individual components of the CPI are weighted on the basis of the volatility of product prices, or components displaying the greatest volatility are removed. The volatility-weighted measure of inflation belongs to this group. In re-weighting the items, components displaying greater volatility are assigned lower weights when calculating the measure.[3]

The third group is comprised of the results of model-based estimates. In this case, in addition to inflation, other macroeconomic variables and the theoretical relationships between the variables are used to define the underlying inflation rate. Structural VARs or factor models are commonly used to estimate these types of measure.

In practice, central banks ascribe different degrees of significance to the use of underlying inflation measures.

Table 1
Hungarian measures of underlying inflation

Core inflation excluding indirect taxes	This measure is derived by excluding the effect of changes in VAT, excise duties and other indirect taxes from the core inflation rate published by the Central Statistical Office (KSH).
Sticky price inflation	The sticky price index shows the prices of components of the consumer price index which are slow to change, and therefore are good predictors of medium-term developments in headline inflation. In calculating the index, only those groups of products of the consumer price index are used where maximum 15 per cent of the individual, shop level prices tend to change on average monthly. Administered prices have been excluded from the product groups in advance, as they are set by a government authority. The effects of indirect taxes have also been filtered out from the measure.
Demand sensitive inflation	The demand-sensitive price index excludes processed food prices from tax-adjusted core inflation as well. This may be justified by the fact that price changes of processed food are greatly dependent on typically highly volatile movements in unprocessed food prices. Consequently, the demand-sensitive price index shows the inflation of tradable goods, market services, and alcoholic drinks and tobacco, excluding the effects of indirect taxes.

[1] See Bauer (2011), Reiff and Várhegyi (2013).
[2] This article focuses on measures capturing the medium-term outlook for inflation. For more details on measures capturing the short-term outlook for inflation, see Bauer (2011).
[3] For more details on short-run measures calculated on the basis of cross-section data, see Bauer (2011).

Some central banks primarily use the consumer price index in their communications, while others also take into account underlying inflation measures in explaining their decisions. The majority of measures of underlying inflation are estimated by excluding large product groups; however, more sophisticated methods (e.g. re-weighting of inflation items) are also commonly used. Tables A1 and A2 in the Appendix provide a brief summary of the methods used in calculating underlying measures of inflation. Table 1 presents an outline of the measures of underlying inflation used by the MNB.

The inflation targets of the *European Central Bank (ECB)* and the *Bank of England* are specified in terms of the headline consumer price index, and they do not put much emphasis on developments in underlying inflation. Although the ECB also calculates measures excluding food and energy prices, the Harmonised Index of Consumer Prices is dominant in the ECB's monetary policy decisions. The Bank of England ceased publishing underlying inflation measures in the years prior to the crisis, motivated by the thought that stripping out energy prices from the inflation measure did not give a true picture of developments in inflation when oil prices exhibited a rising trend as a result of globalisation (Wynne, 2008).

Most of the examined central banks, however, use multiple measures of underlying inflation and publish these regularly in their inflation reports. In its Monetary Policy Reports, *Sveriges Riksbank* regularly publishes inflation measures. The most often cited of these excludes households' mortgage interest expenditure, in addition to indirect taxes. *Norges Bank* publishes inflation measures which exclude indirect taxes and energy prices. In their monetary policy reports, Norges Bank and Sveriges Riksbank also publish forecasts of underlying inflation measures. *Narodowy Bank Polski* calculates measures of underlying inflation excluding food, energy and regulated prices, in a similar way as the Magyar Nemzeti Bank does. All three central banks also produce statistical measures of inflation.

The *US Federal Reserve (Fed)* actively refers to the trend inflation measure excluding volatile components in conducting its monetary policy. The measure used by the Fed (core personal consumption expenditure inflation) excludes food and energy components. Similarly to the Scandinavian central banks, the Fed also produces a forecast for the underlying inflation measure. At the *Bank of Canada,* underlying measures also play an important role. Although the inflation target of the Bank of Canada is also expressed in terms of the consumer price index, movements in the core inflation measure are taken into account in monetary policy decision-making. In addition to the traditional/standard measures, i.e. those excluding energy and food prices as well as the effects of changes in indirect taxes, another measure (CPIX) used by the Bank of Canada attempts to make up for the shortcomings of the traditional measures arising from the fact that not all of the food components excluded are volatile (e.g. the price of food purchased from restaurants), and thus the traditional measure may disregard components important in terms of trend inflation. Of the 182 goods and services in the consumer price index, the CPIX excludes the eight most volatile components for which historical data are available on a comparable basis[4] (fruits, vegetables, gasoline, diesel fuel, natural gas, tobacco, mortgage interest costs, and intercity transportation). The examples of the Czech National Bank and Norges Bank are presented in detail in Box.

Inflation measures relevant for monetary policy in the Czech Republic and Norway

Czech Republic

It may be useful to highlight the example of the *Czech National Bank,* which until the end of 2001 defined its inflation target in terms of 'net inflation' (consumer price index excluding regulated prices and changes in indirect taxes), instead of the consumer price index. The reason for this was that in the 1990s the level of regulated prices was significantly below the level considered justified by the government, but the Bank did not have information on the schedule of regulated price increases. Regulated price inflation had become more predictable by the 2000s. This made it possible to use the consumer price index to set the inflation target, a more common measure of inflation, with a greater impact on economic agents' decisions. This in turn makes its use by the central bank as a target variable easier to explain to the outside world, which facilitates central bank communication. Although since 2002 the inflation target has been defined in terms of the consumer price index, changes in taxes are still removed from the measure relevant to monetary policy decision-making.

[4] Over the period from 1986 to 1998.

Chart 1
Measures of underlying inflation: Česká národní banka

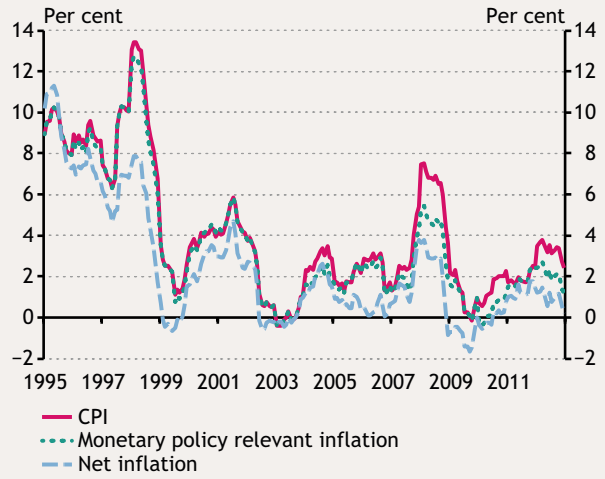
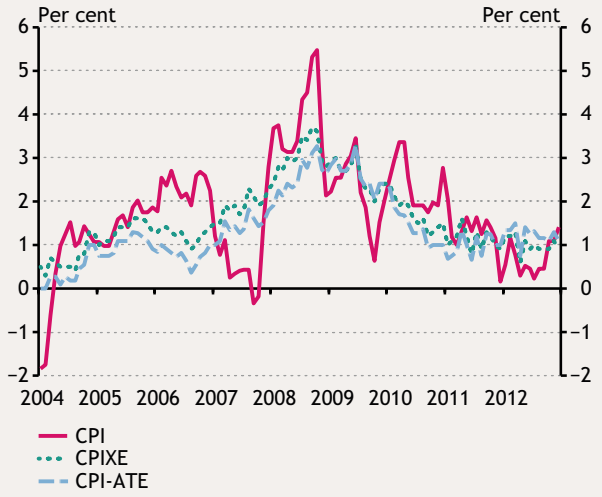


Chart 2
Measures of underlying inflation: Norges Bank



Norway

Using underlying inflation measures to explain monetary policy actions is easiest when the measure of underlying inflation and the headline consumer price index do not, on average, deviate from each other over the longer term. In this case, the deviation between the trend measure and the inflation target can be a good predictor of medium-term movements in inflation and can be used easily in communications. In practice, however, the averages of the two measures may deviate from each other even over the longer term. The CPIXE, a measure used by *Norges Bank*, seeks to address this problem. In contrast to the measure previously used by the Bank (CPI-ATE), only one-off changes are removed from this measure, whereas trend changes in the volatile items (mainly energy prices) remain included.[5] As a result, the difference between the expected values of inflation and the underlying measure has ceased to exist.

The authors of an external study assessing the performance of Norges Bank every year ('Norges Bank Watch', published by the Norwegian School of Management) consider that the price index (CPI-ATE) used by the Bank earlier was a better indicator of underlying inflation. The background to this criticism is that the oil price forecast used in the analyses and the trend rise in energy prices may be subject to significant revision.

EMPIRICAL ANALYSIS OF INFLATION MEASURES BASED ON INTERNATIONAL DATA

Statistical considerations

Level difference between inflation and the underlying inflation measure

Ideally, the longer-term average of the underlying measure is equal to the average rate of inflation. In this case, the difference between the trend measure and the inflation target can be an unbiased predictor of medium-term movements in inflation, greatly facilitating the use of the measure in external communications. If there is a significant difference between the averages of an underlying measure and inflation over the longer term, then not only one-off, but also persistent price changes have been stripped out in calculating the measure. A biased measure can also provide useful information, but it is more difficult to interpret the value of the measure, and therefore it should be used with greater care in external communications. If the difference is explained by tax changes, then that difference poses a relatively small challenge for communications. If, however, after taking account of tax changes, the difference remains significant, then it may be more difficult for the outside world to interpret the measure. In such cases, the central bank may try to publish a different value from the inflation

[5] Trend energy prices and temporary components are captured using the Hodrick–Prescott-filter.

Table 2
Differences in levels between inflation and the underlying measure
(percentage points)

	Hungary	Czech Republic	EA	Canada	Poland	Norway	Sweden	USA
CPI	5.2	2.7	2.1	1.9	3.0	1.7	1.4	2.3
Key underlying measure	2.5	2.0	1.7	1.8	1.7	1.6	1.5	1.9
Alternative measure	3.1	0.9		1.4		1.4	1.3	
Difference:								
(CPI – Key underlying measure)	**2.7**	**0.7**	0.4	0.1	**1.3**	0.1	–0.2	**0.4**
(CPI – Alternative measure)	**2.1**	**1.7**		**0.5**		**0.3**	0.1	

Note: Estimation is carried out over the 2004 january to 2012 december period. Differences significant at the 5% level are indicated by bold letters.
Key underlying measure: Hungary: Demand sensitive inflation; Czech Republic: CPI adjusted for first-round effects of indirect taxes; EA: HICP excluding unprocessed food and energy; Canada: CPI net of 8 most volatile CPI components and effect of changes in indirect taxes; Poland: CPI net of food and energy prices; Norway: CPI adjusted for tax changes and excluding temporary fluctuations in energy prices; Sweden: CPI with a fixed mortgage rate; USA: PCE excluding food and energy.
Alternative measure: Hungary: Sticky price inflation; Czech Republic: CPI net of administered prices and first round effects of indirect taxes; Canada: CPI excluding food, energy and the effect of indirect taxes; Norway: CPI adjusted for tax changes and excluding energy products; Sweden: CPI with fixed mortgage rate and excluding energy prices.

target, against which the value of the underlying measures could be compared, or it may place the emphasis in its communications on the dynamics of the indicator rather than the specific value for the underlying measure.

In order to assess this statistical feature, the significance of the differences between annual average indices was tested (see Table 2) in selected countries using an inflation targeting regime, the euro area and the US. In the cases of Canada, Norway and Sweden, the expected values of the most frequently cited underlying measures in central bank communications equal those of headline inflation. Measures used in the euro area and the US exhibit a slight bias, whereas the expected values across the countries in Central and Eastern Europe differ to a significant degree. (Differences that are statistically significant at the 5 per cent level are marked in bold.) As regards Hungary, the average rate of headline inflation during the period under review stands at 5.2 per cent. The average rate of the key underlying measure of inflation is 2.5 per cent, compared

Table 3
Standard deviation of inflation and the underlying measures

	Hungary	Czech Republic	EA	Canada	Poland	Norway	Sweden	USA
CPI	1.7	1.8	0.9	0.9	1.2	1.2	1.4	1.1
Key underlying measure	1.0	1.3	0.4	0.3	0.9	0.8	0.6	0.4
Alternative measure	1.2	1.2		0.5		0.8	0.6	
Difference:								
(CPI – Key underlying measure)	–40.8%	–26.4%	–49.5%	–64.4%	–25.9%	–35.5%	–53.4%	**–63.2%**
(CPI – Alternative measure)	–26.3%	–34.7%		–47.1%		–35.9%	–59.4%	

Note: Estimation is carried out over the 2004 january to 2012 december period.
Key underlying measure: Hungary: Demand sensitive inflation; Czech Republic: CPI adjusted for first-round effects of indirect taxes; EA: HICP excluding unprocessed food and energy; Canada: CPI net of 8 most volatile CPI components and effect of changes in indirect taxes; Poland: CPI net of food and energy prices; Norway: CPI adjusted for tax changes and excluding temporary fluctuations in energy prices; Sweden: CPI with a fixed mortgage rate; USA: PCE excluding food and energy.
Alternative measure: Hungary: Sticky price inflation; Czech Republic: CPI net of administered prices and first round effects of indirect taxes; Canada: CPI excluding food, energy and the effect of indirect taxes; Norway: CPI adjusted for tax changes and excluding energy products; Sweden: CPI with fixed mortgage rate and excluding energy prices.

with that of the alternative measure, which stands at 3.1 per cent.[6] While 0.9 per cent of this notable difference could be attributed to tax changes, the size of the remaining differential still remains significant.[7] Also contributing to this discrepancy is the fact that the trend of the price indices of excluded items has been higher than that of the underlying measures, causing the latter to be a biased indicator of inflation in the longer term. This discrepancy may hinder the quantitative interpretation and use in external communications of such measures.

Volatility of measures of underlying inflation

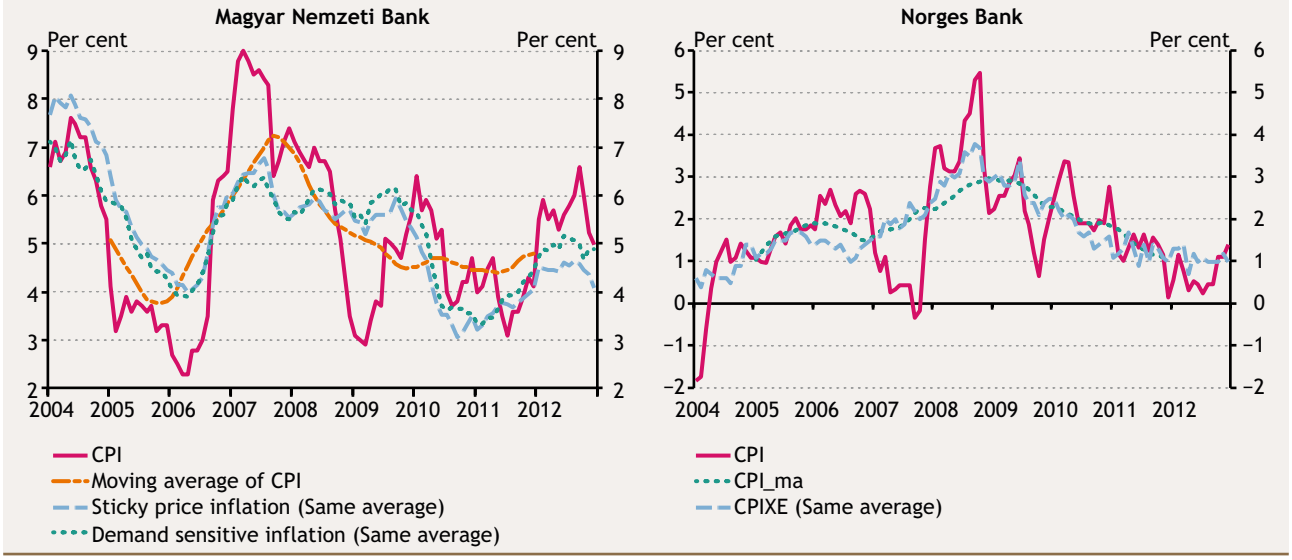
The use of underlying measures of inflation is desirable due to their ability to remove the effects of temporary shocks on inflation. Accordingly, a measure of underlying inflation should ideally have significantly lower volatility than inflation. To assess this attribute, variance is measured using the standard deviation of annual indices. On the basis of this variance, underlying measures are significantly less volatile than inflation. As far as countries in this region are concerned, the reduction in volatility is generally less pronounced. Of the Hungarian measures of trend inflation, demand-sensitive inflation tends to exhibit the largest drop in standard deviation in relative terms. With respect to domestic inflation measures, changes in taxes raised not only the level of inflation but also contributed significantly to the variance of inflation. It is therefore useful to examine the size of the decrease in the variance of underlying measures against the variance of inflation following the removal of the effect of tax changes. The differential remains relatively high (with a decrease of 32.7 per cent for the key underlying measure and 16.2 per cent for the alternative measure).

Comparison of underlying measures with the moving average of inflation

Underlying measures should ideally produce a smoother series than headline inflation, and provide a reliable picture of inflationary trends. Given that the underlying trend in inflation cannot be observed, the measurement of the latter characteristic requires the setting of a benchmark. In this paper, the centred moving average[8] of the consumer price index is used as a benchmark to compare the performance of the various measures. This comparison is consistent with the definition by Bryan et al. (1997) for underlying inflation. Using the annual indices of the reviewed measures, the mean square errors (MSE) are compared with the reference value calculated from inflation.

$$\frac{\sum_{t=1}^{T}(\pi_t^i - \pi_t^{ma})^2}{T}.$$

Chart 3
Moving average of inflation and the underlying measures



[6] Offering fewer benefits from a statistical point of view and providing a less forward-looking measure of trend inflation, the core inflation rate excluding taxes is not discussed in this analysis.

[7] Recent changes in indirect taxes have not only been common in Hungary. It holds true in the international environment that there has been a shift towards consumption-type taxation, which could have contributed to the emergence of such discrepancies between the levels.

[8] A 25-month central moving average is calculated for the annual indices.

Table 4
Comparison of underlying measures and the moving average of inflation
(average square error)

	Unadjusted	Mean adjusted		Unadjusted	Mean adjusted
Hungary			**Poland**		
CPI	**1.40**	1.40	CPI	**0.42**	0.42
Key underlying measure	8.40	**0.67**	Key underlying measure	1.90	**0.24**
Alternative measure	5.70	**0.66**	**Norway**		
Czech Republic			CPI	0.85	0.85
CPI	1.63	1.63	Key underlying measure	**0.14**	**0.13**
Key underlying measure	**1.34**	**0.77**	Alternative measure	0.36	0.16
Alternative measure	4.28	0.79	**Sweden**		
EA			CPI	0.86	0.86
CPI	0.45	0.45	Key underlying measure	0.67	**0.64**
Key underlying measure	**0.32**	**0.14**	Alternative measure	**0.66**	**0.64**
Canada			**USA**		
CPI	0.57	0.57	CPI	0.97	0.97
Key underlying measure	**0.33**	**0.31**	Key underlying measure	**0.33**	**0.21**
Alternative measure	0.52	0.34			

Note: Estimation is carried out over the 2004 january to 2012 december period.
Key underlying measure: Hungary: Demand sensitive inflation; Czech Republic: CPI adjusted for first-round effects of indirect taxes; EA: HICP excluding unprocessed food and energy; Canada: CPI net of 8 most volatile CPI components and effect of changes in indirect taxes; Poland: CPI net of food and energy prices; Norway: CPI adjusted for tax changes and excluding temporary fluctuations in energy prices; Sweden: CPI with a fixed mortgage rate; USA: PCE excluding food and energy.
Alternative measure: Hungary: Sticky price inflation; Czech Republic: CPI net of administered prices and first round effects of indirect taxes; Canada: CPI excluding food, energy and the effect of indirect taxes; Norway: CPI adjusted for tax changes and excluding energy products; Sweden: CPI with fixed mortgage rate and excluding energy prices.

The problem with this analysis is that the MSE cannot only be high because of the high noise in a measure, but also because the expected value of the reviewed series differs from that of inflation. At the same time, a biased measure can also provide information on the direction of trend inflation. To adjust for this bias, an MSE adjusted for the average differential[9] was also calculated (see Chart 3).

The performance of the measures reviewed varies significantly. In the vast majority of countries, the best measures in terms of following trend inflation perform significantly better than the consumer price index. While Poland and Hungary are exceptions, the underlying measures for these countries on the basis of the MSE adjusted for mean deviation do perform better than consumer price index. Demand-sensitive inflation and sticky price inflation reflect the trend of the consumer price index relatively well.

Underlying measures are forward-looking indicators of inflation

For the purposes of monetary policy, it is a key requirement that underlying measures should be able to contribute to forecasting future inflation. Using a simple approach, the following section reviews the performance of the trend measures of inflation used by a number of central banks to forecast future rates of inflation, as well as the ability of such measures to signal future changes in inflation.

In accordance with Catte and Slok (2005), we test whether the difference between the consumer price index and the current value of the underlying measure has a significant impact on the difference between current and future (expected in 6, 12 18, 24 months) rates of inflation.[10]

[9] The expected values of the series under review are equated, followed by the calculation of the MSE.
[10] *Ex-post* estimation is used.

The following equation has been estimated:

$$\Pi_{t+k}^{CPI} - \Pi_t^{CPI} = \alpha + \beta(\Pi_t^{CPI} - \Pi_t^c) + \varepsilon_t, \quad (1)$$

where

Π_t^{CPI} represents the consumer price index,

Π_t^c stands for the trend measure, and

k refers to 6, 12, 18 or 24 months.

If the consumer price index exceeds the underlying measure of inflation due to a temporary shock, then inflation is expected to decline in the subsequent period. Consequently, the coefficient β in the regression presented above is expected to be negative and significant. Ideally, the value of the coefficient β equals –1, which implies that if inflation diverts from the underlying measure, the difference between the consumer price index and the underlying measure will completely disappear over the next *k* periods.[11] With regard to a number of central bank inflation measures in selected countries, Table 5 illustrates to what extent the gap between the consumer price index and the trend measure explains the development of inflation over various time horizons.

For the majority of the countries reviewed, the coefficients estimated are negative and significant, and lie close to the value of –1, seen as ideal. This means that underlying measures are relatively good predictors of changes in inflation. This statement also holds true for Hungary, where the values of the estimated coefficients imply that the gap between the underlying measure and the consumer price index closes at a relatively fast pace (within roughly one year). As the time horizon expands, the explanatory power

Table 5
Estimates for coefficient β and explanatory powers for selected time horizons

Underlying measure	6 months		12 months		18 months		24 months		Average R^2
	β	R^2	β	R^2	β	R^2	β	R^2	
Sweden									
CPIF	–0.474***	0.16	–1.157***	0.4	–1.653***	0.6	–1.867***	0.68	0.46
CPIF excluding energy	–0.462***	0.21	–1.077***	0.5	–1.304***	0.56	–1.325***	0.54	0.45
Norway									
CPI-ATE	–0.911***	0.43	–1.554***	0.68	–1.073***	0.37	–0.656**	0.15	0.41
CPIXE	–1.092***	0.52	–1.735***	0.76	–1.216***	0.43	–0.814	0.21	0.48
Canada									
CPIX	–0.582***	0.25	–1.172***	0.6	–1.206***	0.63	–1.202***	0.54	0.51
CPI-XFET	–0.577***	0.24	–1.024	0.45	–1.025***	0.43	–1.094***	0.39	0.38
USA									
Core PCE	–0.847***	0.31	–1.611***	0.63	–1.311***	0.51	–1.204***	0.44	0.47
Eurozone									
HICPex	–0.472*	0.12	–1.239***	0.36	–1.374***	0.39	–1.178***	0.3	0.29
Poland									
CPI net of food and energy	–0.391	0.04	–1.203***	0.21	–1.613***	0.32	–2.094***	0.47	0.26
Czech Republic									
Monetary policy relevant inflation	–1.173***	0.2	–2.841***	0.48	–3.359***	0.57	–3.174***	0.54	0.45
Net inflation	–1.081***	0.44	–1.991***	0.59	–1.869***	0.44	–1.298***	0.22	0.42
Hungary									
Demand sensitive inflation	–0.635***	0.2	–1.119***	0.31	–1.315***	0.36	–1.573***	0.49	0.34
Sticky price inflation	–0.506***	0.13	–0.911***	0.21	–1.074***	0.24	–1.371***	0.38	0.24

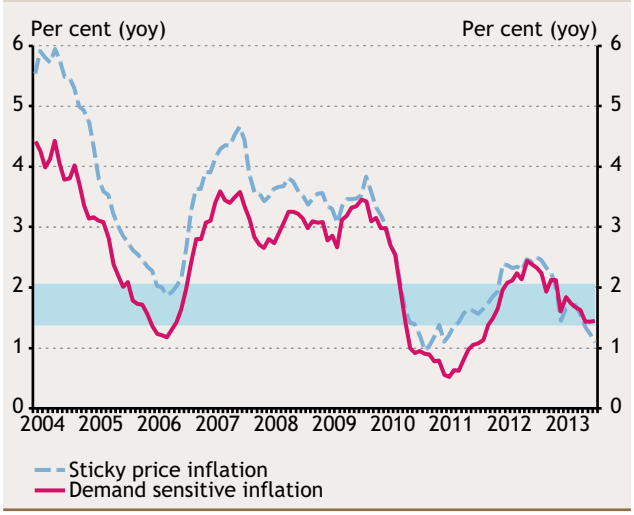
Note: Estimation is carried out using monthly data for the 2004 january to 2012 december period.
** Significant at the 10% level, ** Significant at the 5% level, *** Significant at the 1% level.*

[11] As long as the difference between the average values of the measures equals zero. In any other case, the difference between the measures readjusts to the average differential between the levels.

Table 6
Sensitivity test: mean deviations between the inflation of demand-sensitive products and HICP across EU member states
(percentage points)

	Full sample average	Regional average
2004–2013	1.0	1.5
2004–2009	1.3	1.8
2009–2013	0.7	1.1

Chart 4
Range of price changes for demand-sensitive products consistent with the 3 per cent inflation target
(January 2004–July 2013)



(R^2) of the right-hand side variables increases. Countries where the performance of underlying measures is relatively higher in terms of the average explanatory power for all time horizons, do in fact pay more attention to these measures.

Ranges consistent with the inflation target

In addition to the dynamics of the measures, another key question for monetary policy regarding the use of the underlying measure is the identification of the level consistent with the inflation target defined in terms of the consumer price index. Answering this question requires identification of the typical size of the gap between the consumer price index and the underlying measures. Correcting the CPI target for this gap yields a hypothetical target value, which helps to determine if the underlying measure of inflation is consistent with price stability.

This article has determined the typical gap level on the basis of international experience. The range displayed on Chart 4 shows the adjusted target value, calculated[12] as the average difference between the measures of HICP inflation and demand-sensitive inflation based on historical data of EU member states. The average rate of inflation of demand-sensitive items in the countries under review is typically lower that the rate of change of the HICP.

The range presented reflects a high degree of uncertainty concerning the corrected target measure. The difference varies both across countries and over time, and is usually lower in developed EU-countries and higher in Central and Eastern European countries (see Table 6). Based on the differentials calculated using the period following the economic crisis of 2008–2009, the hypothetical range would shift up (see Table 6). Given that the corrected target measure is strongly influenced by the time horizon used in the calculation, one should focus on the range constructed on the basis of the longer time horizon.

CONCLUSION

Central bank decision-making and communication is strongly facilitated by the availability of measures capturing underlying trends in inflation. First, the use of underlying measures is expedient, thanks to their ability to filter out from inflation the effects of temporary shocks and thereby convey a reliable picture of recent inflationary trends. Second, they are relatively good predictors of changes in inflation. In an ideal scenario, the average rate of the underlying measure equals that of headline inflation over the long term. This property facilitates the use of such measures for the purpose of public communications, as the difference between the underlying measure and headline inflation is a good proxy of current inflationary pressure.

With regard to the Hungarian indicators, the results can be summarised as follows. The measures developed and used by the MNB are in line with international best practice. The volatility of the Hungarian underlying measures of inflation is significantly lower than that of the consumer price index, and the measures possess substantial predictive power for

[12] Hypothetical target value = inflation target – average difference between HICP and demand sensitive inflation.

inflation over a 4–6-quarter horizon. No measure is capable of best performance with respect to all of the criteria. As a result, robust statements can only be made on the basis of assessing a combination of multiple measures.

At the same time, the largest hindrance to the domestic use of underlying inflation measures is the significant and long-term discrepancy between the average of the consumer price index and that of the underlying measures. This discrepancy hinders both the quantitative assessment of the measures and their application in public communications. This situation may prompt the central bank to publish a value different from the inflation target, a kind of reference value for the underlying measure, or else place the emphasis in its communication on the dynamics rather than the specific value of the measure. Given that the reference value, consistent with the target in the medium term, may change with the business cycle, and over time as the inflation environment changes, for the time being the MNB opts for the latter practice in its communication regime.

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APPENDIX

Table A1
Key measures derived by excluding product groups characterised by volatile price changes

Central Bank	Underlying measures
Magyar Nemzeti Bank	Demand sensitive inflation
	Sticky price inflation
	Core inflation excluding indirect taxes
Reserve Bank of Australia	CPI net of fruit, vegetables, and fuel prices
Bank of Canada	CPIX: net of 8 most volatile CPI components and changes in indirect taxes
	CPI-XFET: CPI excluding food, energy and the effect of indirect taxes
Česká národní banka	CPI adjusted for first-round effects of indirect taxes
	CPI net of administered prices and first round effects of indirect taxes
	CPI net of food prices, administered prices, indirect tax changes and fuels
European Central Bank	HICP excluding energy
	HICPex: HICP excluding unprocessed food and energy prices
	HICP excluding food and energy prices
Federal Reserve	PCE excluding food and energy
Narodowy Bank Polski	CPI net of administered prices
	CPI net of food and energy prices
Norges Bank	CPI-AT: CPI adjusted for tax changes
	CPI-AE: CPI adjusted for energy products
	CPIXE: adjusted for tax and temporary fluctuations in energy prices
	CPI-ATE: CPI adjusted for tax changes and excluding energy products
Sveriges Riksbank	CPIX: excluding mortgage interest expenditure and indirect tax effects
	CPIF: CPI with fixed mortgage rate

Table A2
Measures filtering or re-weighting products or narrowly defined product groups

Central Bank	Underlying measures
Reserve Bank of Australia	15% trimmed mean
	Weighted median
Bank of Canada	MeanSTD: Trimmed to exclude values further than 1.5 standard deviations from the average
	Weighted median
	CPIW: CPI weights adjusted for the components variability and excluding the effect of indirect taxes
Narodowy Bank Polski	15% trimmed mean
	CPI net of most volatile prices (standard deviation of previous year)
Norges Bank	CPI-FW: CPI adjusted for frequency of price changes
Sveriges Riksbank	UND24: Product groups are weighted using the variance in the difference in the rate of change between the respective component and the total CPI for the last 24 months.
	TRIM85: 7.5% trimmed mean
	Median