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Cecília Hornok and Zoltán M. Jakab

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A CASE STUDY ON THE CZECH, HUNGARIAN, POLISH, SLOVAKIAN AND SLOVENIAN CENTRAL BANKS

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National Bank of Hungary
H-1850 Budapest
Szabadság tér 8-9.
http://www.mnb.hu

Abstract

The paper examines the inflation forecasting practice and the related institutional framework at the central banks of five Central European countries (the Czech Republic, Hungary, Poland, Slovakia and Slovenia). The first part of the paper presents the general aspects of the comparative analysis, which primarily follow the requirements of inflation targeting monetary regimes. The second part consists of individual country case studies, which give detailed description of the institutional framework and forecasting practice at the five central banks considered.

This report was initially prepared for the Basle meeting of the Governors of the Czech National Bank, National Bank of Hungary, National Bank of Poland, National Bank of Slovakia and Bank of Slovenia on 11th of March, 2002. The country studies were prepared by experts from the national central banks, and the editorial work was completed by the staff of the National Bank of Hungary. The task of the editors was twofold: creating a common framework and summarising the main findings of country-studies. However, the scope of the editors was to leave the content of country studies unchanged.

Authors:

Czech National Bank:

Jaromir Benes (Jaromir.Benes@cnb.cz)
David Vavra (David.Vavra@cnb.cz)

National Bank of Hungary:

Cecília Hornok (hornokc@mnb.hu)
Zoltán M. Jakab (jakabz@mnb.hu)

National Bank of Poland:

Bohdan Klos (Bohdan.Klos@nbp.x400.net.pl)
Tomasz Lyziak (Tomasz.Lyziak@nbp.x400.net.pl)

National Bank of Slovakia:

Miroslav Gavura (Miroslav_Gavura@nbs.sk)

Bank of Slovenia:

Matejka Kavcic (Matejka.Kavcic@bsi.si)

1. Summary

This report presents a general view on the current practice of inflation forecasting in five Central European countries (CEC5) and provides detailed case studies written by country experts of the different central banks. Prior to the comparative analysis of the forecasting regimes, however, it is worth noting that different monetary regimes place different emphasis on inflation forecasting. In particular, the regime of direct inflation targeting applied by the Czech Republic, Hungary and Poland has explicit requirements for the forecasting system, which were the basis of forming the six general aspects of the analysis presented below.[1] These are the degree of transparency, the forecast procedure, the output of the forecast, the forecast horizon and frequency, the type of the forecasting model and the conditional versus unconditional nature of the forecast. Table 1 shows the summary of our comparative analysis.

Table 1 Main features of inflation forecasting systems in CEC5 central banks

	Transparency	*Procedure*	*Output*	*Horizon, frequency*	*Models*	*Conditionality*
Czech	Quarterly publication of comprehensive forecasts	Discrete involvement of policy makers	Point estimate and range	6-8 quarters, quarterly	Structural models, partial equations, expert info	Both conditional and unconditional
Hungarian	Quarterly publication of comprehensive forecasts	Iterative, stepwise involvement of policy makers	Point estimate and fanchart	6-8 quarters, quarterly	Partial equations, expert info, simulation models	Conditional
Polish	Quarterly publication of backward looking analysis	No involvement of policy makers	Point estimate and scenarios	4-6 quarters, monthly	Structural model, partial equations, expert info	Both conditional and unconditional
Slovakian	Annual publication, monthly updates	Iterative, stepwise involvement of policy makers	Range	4 quarters, monthly	No models, mostly expert judgement	n/a
Slovenian	Semi-annual publication of comprehensive forecasts	No involvement of policy makers	Point estimate and range	8 quarters, at least twice a year	Structural model, expert judgement	Conditional

[1] Pagan and Robertson (1999) Forecasting for Policy, *mimeo*, provides a general description on forecasting for policy in developed economies. (http://econrsss.anu.edu.au/staff/adrian). See also Kohn (2000) "Report to the Non-Executive Directors of the Court of the Bank of England on Monetary Policy Processes and the Work of Monetary Analysis", and Svensson (2001) "Independent Review of the Operation of Monetary Policy in New Zealand: Report to the Minister of Finance", February 2001.

1.1 Degree of transparency

Besides other factors, a higher degree of transparency can be achieved through the regular publication of a central bank's inflation forecasts. In this respect, the Czech, Hungarian and Polish systems include the regular (quarterly) publication of reports on inflation, which present the banks' view on the future inflation development. The difference between the Czech/Hungarian and the Polish systems is that the Polish inflation report is more backward looking and does not include an explicit inflation forecast, but it only conveys a more general message on how the policy-makers see the future inflationary environment. In contrast, the National Bank of Slovakia (NBS) releases its economic forecasts in the form of an annual monetary programme, which might be subject of revision carried out regularly in the second quarter, while the analyses of current developments are published monthly. The Bank of Slovenia (BoS) publishes forecasts less frequently (at least twice a year) and it has no separate report for inflation. As a further contribution to transparency, the inflation reports of the Czech and Hungarian national banks (CNB, and NBH, respectively) analyse the future course of the factors influencing the inflation development and give forecasts for other major macroeconomic variables such as GDP and its components, current account or foreign demand. A comprehensive macroeconomic analysis and forecast thereby provides a transparent background for their view on the projected path of inflation.

1.2 Forecast procedure

The main objective of the inflation forecast is to serve as a policy tool for the monetary policy decision-making body. The forecasting system therefore is likely to follow a certain procedure, which determines how the forecast is made and presented to the policy-makers as well as the ex post evaluation of the forecast in light of new information on the state of the economy. One of the most important features of this procedure is the degree of the policy-makers' involvement in the preparation of the forecast. At one end, at the CNB, the NBH and the NBS the policy-makers are explicitly involved in the forecasting process and the relationship between the policy-makers and the staff is characterised by close co-operation. The rationale behind this practice is that credibility requires the decisions of the monetary policy decision-making body to be in line with the implications of the inflation forecast. In the above systems policy-makers can generally propose modifications of assumptions on the exogenous variables before the forecast is made and they give the risk assessment to capture the uncertainty after the baseline forecast is prepared. [2] Nevertheless, there is a slight difference between these regimes: while the Czech Board enters the forecasting process in a discrete way, the Hungarian as well as Slovak systems are iterative processes involving several rounds of discussion, which help separate the role of the staff and that of the policy-makers. In contrast with the above practices, the forecasting regimes of the NBP and the BoS do not rely on any involvement of the

[2] In the Hungarian case, the rules of forming assumptions on the exogenous factors are explicitly laid down (e.g. the future path of the exchange rate is assumed to be constant at its last observed average monthly level) and the Monetary Council can modify these rules only by asking it officially. The changes are then published in the Quarterly Report on Inflation.

policy-makers, but the final analysis and forecast prepared by the staff is only presented to and discussed by the decision-making body.[3]

Other important procedural issues include the determination of publication dates and the ex post evaluation of forecast results. In some cases the publication dates are fixed and published in advance (e.g. the NBH fixes and publishes the publication dates half-year in advance, while its Czech counterpart fixes the dates but does not publish them), while other central banks do not apply such rules. Central banks also differ in how they perform the ex post evaluation of earlier forecasts. Some systems explicitly involve the follow-up of earlier forecast results in light of the information arrived in between two forecast intervals. As three examples of this practice, the CNB, NBH and NBS carries out monthly evaluations of their published forecasts, which serve the basis for possible future improvements in the forecasting work and supports monetary decision-making in the interim period.

1.3 Output of the forecast

The output of the inflation forecast can also differ in at least two important respects, namely, what measure of inflation is forecasted and how uncertainty around the central projection is presented. The measure of inflation generally used for presenting the central projections by the CEC5 central banks is the annual rate of headline CPI inflation.[4] In addition, however, most central banks treat some measure of core inflation as well in order to separate the more volatile components of the consumer basket. On the other hand, there are large differences in the ways of presenting the uncertainties surrounding the central forecast. The CNB determines lower and upper bounds around its forecast, the NBS provides range forecasts, while the BoS publishes a central point forecasts with a range. The NBP captures uncertainty by preparing internal forecasts for different scenarios together with the central forecast and the NBH publishes a fan chart representing the probability distribution around the point estimate.[5] In most of the cases, forecasts of other macroeconomic variables are also prepared, which, together with the presentation and interpretation of the economic forces behind the inflation development, may support the credibility of the inflation forecast.

1.4 Forecast horizon and frequency

The choice of the forecast *horizon* may depend on two things. First, it is to cover a time period long enough for the monetary policy to have its effect on the real economy, and second, it is to be short enough to facilitate reliable forecasting. The usual choice of forecast horizon in the CEC5 countries is around six quarters. The CNB and the NBH set the horizon at six to eight quarters, while the NBP is more flexible by providing its main forecast for four to six quarters. A shorter (four quarters) horizon is chosen by NBS and a longer one (eight quarters) is applied at BoS. In addition to the main forecast, which serve as the most important policy tool,

[3] In the Polish system, any involvement of the policy-maker is complicated by the fact that the forecast is to be presented to two different bodies: first to the NBP Board (consisting of insider members) and then to the Monetary Policy Council (where 9 out of 10 members are outsiders).

[4] Until December 2001, the CNB has been the only exception by targeting and forecasting net inflation (i.e. CPI minus administered prices).

[5] The fan chart is created in accordance with the risk assessment of the policy-makers and is published together with an official statement of the Monetary Council.

longer-term, macroeconometric model-based forecasts are also available at the CNB and the NBP for three and three/four years of forecast horizon, respectively.

The choice of the forecast *frequency*, i.e. how often a forecast is prepared, is constrained by institutional features such as how often policy-makers have meetings, and the frequency of publication of national statistics. In this respect, the CNB and the NBH produce forecasts quarterly, while the NBP and the NBS prepare forecasts more frequently, on a monthly basis.[6] In contrast, forecasts are prepared less frequently at the Slovenian central bank, where new forecasts are prepared only (at least) twice a year. Nevertheless, it should be noted that neither the NBS nor the BoS follow a direct inflation-targeting monetary regime.

1.5 Type of the forecasting model

As Pagan and Robertson (1999) argues for developed economies, forecasting for policy should be based on a pluralistic approach, where several different methods - ranging from expert judgement to sophisticated structural model forecasting – are used. All CEC5 central banks use a pluralistic approach in the sense that even in those countries which have macroeconometric models (Czech Republic, Poland, Slovenia), results from sectoral and specialists' information are also highly taken into account when forecasting inflation.

The main difference between methods is to what extent they build on formal econometric models and in the relative importance of non-model vs. model-based methods. At one end, the BoS relies on one structural model and the results are modified using expert information. At the other end, the NBS does not use econometric models, but its projections are mostly based on expert information and judgement. As an interim case, at the NBH, the central inflation forecast lies on both partial and aggregate econometric equations and expert judgement (non-model approaches). The NBH possesses only one empirical general-equilibrium model (NIGEM)[7], which is mostly used for special issues and policy simulations. The CNB uses several models (e.g. core QPM, NIGEM, HERMIN) for medium term forecasts and for policy simulations. At the same time, however, short-term forecasts are prepared using expert judgement and partial econometric models. Near term forecasts in the NBP are also based on partial equations and expert judgement. Consistency is achieved through an analytical scheme. At the same time, there is a quarterly structural econometric model (MSMI) of inflation to prepare short- and medium-term forecast and risk-scenarios, as well. (In addition a small structural model (MSMTM) is also established to analyse monetary transmission mechanism.)

1.6 Conditional versus unconditional forecast

As opposed to other forecasts central bank forecasts are special in the sense that the most important variable in inflation – monetary policy – can not be treated as either an endogenous or simply an exogenous variable. Therefore it might be problematic in communication that the published forecast may not be the expected inflation, because monetary policy may change throughout the forecast horizon. However, unconditional forecasts (when monetary policy responds via a reaction function) are also not optimal

[6] The NBS prepares forecasts monthly but publishes them only twice a year.

[7] A calibrated model is also used for policy analysis and simulation, see Benczúr-Simon-Várpalotai (2002), Disinflation Simulations with a Small Model of an Open Economy. (www.mnb.hu)

in communication, because market may read the forecast as a policy statement: the Central Bank *plans* to behave as it was projected. Some central banks – following the practice of e.g. the Bank of England – has opted for publishing conditional forecasts: what would happen if monetary conditions were unaltered. In this sense the five countries form two distinct groups: the CNB, the NBH and the BoS publish conditional forecasts for the short term (not longer than two years)[8]. At the same time, the NBP prepares both conditional (assuming unchanged interest rates) and unconditional forecasts, while the Slovenian forecasts are unconditional. In the medium term, however, Czech forecasts are also unconditional, and the sole model at the NBH – NIGEM – may also treat monetary policy endogenously.

[8] The difference between the Czech and the Hungarian case is that CNB treats both the interest and exchange rate, while NBH handles only the nominal exchange rate exogenously.

2. Country Case Studies

2. 1 The Czech National Bank[9]

2.1.1 General features of the inflation forecast of the CNB

The Czech National Bank has committed to an explicit inflation target since the end of 1997; the forecast of inflation and real economic activity is therefore the main information basis for the Czech National Bank Board's (*BB* henceforth) decision-making. As such, the forecast is the most important part of what we call Forecasting and Policy Analysis System (*FPAS*) and what we may think of as a kit of tools designed to support the policy making process. The system has, however, an important procedural content as well, for it is also the sequence of procedural steps in the proper forecast process. As any other system, nor *FPAS* will ever be complete, so many of its features referred to below are constantly evolving over time, as the knowledge about the economic mechanisms improves and requirements of the policy maker change.

Traditionally, different requirements have been put by the *BB* on the long and short end of the forecast. As a result, two kinds of forecast are produced by the Monetary Department each quarter, differing both by the horizon and methods used:

- **Conditional near-term forecast,** where the intimate expert knowledge is the dominating building block. Paths of market policy interest rates and nominal exchange rates are kept exogenous (see below), based on the information available at the moment of the forecast production. The near term forecast is therefore meant to be conditional upon the information set at that moment. The forecast horizon is six quarters.
- **Unconditional medium-term integrated forecast** centers around the core Quarterly Projection Model (*QPM*) and operates on the monetary policy transmission horizon. Market interest rates and nominal exchange rate are determined by the model mechanisms (i.e. monetary policy reaction function and exchange rate equation, respectively); both are assumed to be responsive to changing monetary conditions. The forecast horizon is 3 years. On the short end, the forecast's integral component are the outcomes of the near-term forecast, because detailed expert knowledge is assumed to be superior in describing idiosyncratic shocks driving the economy in the short run. Behavioural Model mechanisms take over later in the horizon, where variables are freer to move in response to changing monetary conditions. The exact extent of this weighting is a subject of an intense debate within the department and is evolving over time.

The outcomes of the two forecasts are summarised in the primary internal document – Report on Current State of the Economy (*RCSE*) – and submitted to *BB* each quarter[10]. After the document has been approved on the *BB* meeting, the bank releases the primary public document – Inflation Report (*IR*), which also contains the Czech National Bank's official inflation forecast. Today, the officially published forecast is

[9] Written by Jaromir Benes and David Vavra from the Czech National Bank.
[10] In between quarters, monthly (smaller-size) *RCSEs* are also produced. Their purpose is to monitor the situation, consider changes in the assumptions underlying the quarterly forecast and reflect those in minor forecast revisions.

the near-term (6-quarter ahead) conditional forecast (year-on-year headline inflation[11] with lower and upper bounds).

2.1.2 The forecasting process at the CNB

The proper forecast work proceeds in several stages and takes approximately one month of each quarter. This is the typical structure of items that appear in each forecast timetable:

1. **Issue Meetings**. These are starting points to each forecast and serve a) to identify current key issues, i.e. events and developments which mostly contribute to the inflation and real activity prospect, which give informal picture of the initial state of the economy and likely forecast outcomes, b) to present baseline paths for exogenous variables[12].
2. Meetings to achieve consensus on a) **initial position of the economy in the cycle** and b) formulation of long-run trends and **alternative scenarios**. Ad a) Most of real variables (real output, real interest and exchange rates, etc.) appear decomposed into their fundamental trends and business-cyclical part (gaps) in the model used for medium-term forecast. Ad b) Proposals for alternative (risk) scenarios come mostly from the step-1 assessment of the key issues.
3. **Near-term** forecast.
4. **First round** of model based medium-term conditional forecast.
5. **Second** and other **rounds** integrate near-term expert and medium-term model based forecasts. Both baseline and alternative scenarios are simulated.
6. **Post Mortem** meeting is to give a highly informal feedback of weak points of the process and relevant suggestions for further development of *FPAS*.

Although the forecast is viewed as staff-driven in principle, *BB* as the exclusive end-user naturally enters the forecast process in a discrete way, mainly in steps 2, when it can provide its estimates of the initial conditions and future trends, and step 5, when it should be responsible for formulating alternative scenarios which would asses the uncertainties they are mostly concerned with.

2.1.3 Forecasting methodology

Although the wheel-horse of the whole *FPAS* is the core *QPM*, many other tools and methods are extensively employed during the forecast process. We may structure them into the following classes ordered descendingly in the degree of applied formal apparatus:

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[11] CNB used to target *net* inflation (i.e. CPI net of administered prices) till Dec 2001. Since Jan 2001 onwards it has reformulated its policy in terms of *headline* (i.e. full CPI) inflation conditional upon the pre-announced fiscal development. (Both net and headline targets overlapped in 2001). Style of public inflation forecast has followed this changeover, of course.

[12] Exogenous variables forecast rules:

- Foreign (German) GDP, PPI, CPI, interest rates and oil price: Consensus Forecasts, simple linear extrapolation where necessary.
- Domestic policy interest rate and nominal exchange rates for near-term conditional forecast: based on market expectations (forward rates); for medium-term unconditional forecast: endogenous variables.
- Fiscal accounts: baseline produced in co-operation with Treasury.

1. **System of formal models** to facilitate medium-term forecast

- Core *QPM,* which is a sort of small-scale dynamic quasi-general equilibrium model with well-defined long-run fundamental trends and monetary business cycle part with nominal (price and wage) stickiness.
- Dynamic large-scale stock-flow models to check consistency and to prepare risk scenarios, especially those related to foreign development (Hermin Czech Republic, NIGEM)
- Satellite models, e.g. unobserved components models (advanced filtration methods) – decomposition of real output, real interest rates and real exchange rates into long-run fundamental trends and cyclical fluctuations at a business cycle frequency (gaps).
- Time series models, which help to calibrate model parameters, check model properties, capture structural changes in parameters, assess importance of events, which lie out of the model scope, etc.

2. **Near-term forecast tools**

- Combine intimate sectoral expert knowledge with simple regression models to recognise the influence of idiosyncratic events that are believed to outweigh behavioural effects in the short run.

3. **Expert judgement**

- Identification of key topical issues, which are driven by forces and mechanisms not covered explicitly in the (QPM) model mechanisms.
- Evaluation of their qualitative and quantitative effect (including evaluation of channels through which they might enter model mechanisms).
- Inclusion of such effects into the model-based forecast rounds (step 5 above) if agreed.

2.2 National Bank of Hungary[13]

Under the new inflation-targeting regime starting in mid-2001, we had only four complete forecasting rounds so far, so our process of preparing inflation forecasts is still under review. Though nothing is 'carved into stone', there are some general principles that we expect to be unaltered even if their application may change over time.

2.2.1 General features of the inflation forecast of the NBH

As a monetary policy tool the inflation forecast replaces the role of the exchange rate when we moved from the narrow band crawling peg to a wide band inflation-targeting regime. It can only fulfil its new role if it is communicated clearly to the public and if its place in monetary policy making is unambiguous. This is why we publish the inflation forecast regularly in a transparent way in our Quarterly Report on Inflation, which also contains the evaluation of the previous forecast in light of the latest inflation developments. Besides, the publication of the new NBH Background Studies series also serves the purpose of a clear and transparent communication.

To start the discussion of general features of the inflation forecast with its *time horizon*, the chosen six to eight quarters ahead forecast is a compromise between the requirements of monetary policy making (long enough horizon to allow for the lags of real economy reacting to nominal measures) and practical considerations (our limited ability to forecast). In addition, however, there is a special emphasis on end-of-year forecasts as inflation targets are formulated in terms of December CPI figures.

Next, the internal function of the inflation forecast is to provide support to policy makers when deciding on interest rates or exchange rate policy. So our inflation forecast is a *conditional* one in terms of monetary policy assumptions. As currently we only take into account the direct exchange rate channel of monetary policy (see more on this later) this translates to the assumption of a constant HUF/EUR exchange rate (initially at its last monthly value) for the whole forecasting period. This does not necessarily imply a constant policy interest rate though as the policy may react to changes in risk premium, etc. However, as interest rates are not modelled explicitly neither in the real economy nor the inflation forecast systems, this so far has not led to inconsistency.

We also fix the values of some *exogenous variables* initially at their last observed value (oil prices, EUR/USD exchange rate, etc.) but the reasoning behind is different. In case of variables difficult to predict we think it is more transparent that we do not attempt to describe their future path. Also, this way the policy maker is assured that he is given an unbiased staff projection which he can then modify to reflect his own 'subjective' view of future developments.

That *policymakers* are explicitly involved in preparing the inflation forecast is its next special feature owing to, again, the policy tool nature of the inflation projection (we describe the iteration process that brings this about below).

Finally, by 'inflation forecast' we usually refer to not only the central point estimation but also the shape of *uncertainty* around it. The inflation fanchart is drawn to convey

[13] Written by Cecília Hornok and Zoltán M. Jakab from the National Bank of Hungary.

both type of information. However, we do realise the difficulty of shifting public discussion from the points estimates implying an unwarranted feel of precision to uncertainty distributions.

2.2.2 The forecasting process at the NBH

As we said, the policymakers are explicitly involved in preparing the inflation forecast. This is important, as it is *them* not the staff who have to make decisions so the final forecast must reflect their views as much as possible. Their engagement is 'explicit' in a sense that first they are given an unbiased 'objective' set of staff projections and shock simulations which then they are asked to comment and, if they like, modify. The transparency of this is ensured through an iterative process involving multiple meetings between the Economics Department (henceforth Staff) and the Council.

We have published the steps of this process in our November 2001 Report on inflation (pp. 41-43) so we only summarise it here. The process involves three meetings between the staff and the Council. Its timing is determined by the publication dates of the main macro statistics. The end of the process is the electronic publication of the Report on the NBH homepage of which dates are fixed and published half year in advance.

The *first meeting* takes place about 7 weeks before the publication of the Report. At the "Issues meeting" the Council is given a list of factors that might influence the inflation projection over the current forecasting horizon. They discuss *verbally* the set of assumptions on which the central projection would be based and of the potential deviations, which would then shape the uncertainty distribution. No actual forecasts are presented at this stage.

After all necessary macro data has arrived the Staff prepares *the first version* of the inflation forecast using the above finalised set of assumptions and shocks. These are 'staff projections' in that they are based on the 'objective' assessment of the staff on both the central case scenario and the potential deviations. It is this point when using the simple rules described before for some assumptions (oil price, USD exchange rate, etc.) ensures that the staff has not taken into account the presumed views of the policymakers on such fine details. At this meeting the Council discusses the 'staff projections'. Their involvement is formalised by a *questionnaire* in which, for each assumption, they are asked whether they agree with the assessment of the staff regarding separately the central path and the possible deviations (their direction and extent). Their answers in principle reflect their collective (consensus) judgement not an arithmetic mean of the different views of the Council members.

The Staff prepares the *final forecast* based on the requested changes to a Council meeting around one week before the publication of the Report. Thus, the final fanchart reflects the forecast of the Council as described above. All new pieces of information, which becomes available since the first version of the forecast, are also incorporated. At this meeting the Council considers whether, in the light of the inflation outlook, monetary conditions are appropriate. They issue a Statement, which includes *their* summary of the inflation outlook and also the final fanchart. If they decide on a change in the policy interest rate – or, implicitly, in the desired exchange rate path –, it is then incorporated into a preliminary (not numbered) chapter of the Report (their Statement) but does not alter the inflation forecast. At this meeting the Council decides what should constitute the public version of the Report on inflation.

After this almost two months long process the Report is published on the NBH website. Same day the Staff invites the media and the macro analysts to discuss the Report in the form of a lock-up open session. The questions taken are restricted to technical issues of the Report (there is no policymaker present) and the meeting is designed to facilitate a more sophisticated discussion of economic policy with the public.

Between two forecast sessions, every new data may be examined in the follow-up meetings, especially new inflation data are compared to forecast and evaluated at the weekly Operational Monetary Committee meetings[14].

2.2.3 Forecasting methodology

The Inflation Report contains projections for both the real economy and inflation. Although the final "product" is the inflation projection, Staff first begins with a central case for the real economy and then deals with inflation. The major exogenous variables in the real economy and the inflation forecasts are the oil price, the forint/euro and the euro/US dollar exchange rates, external demand, fiscal policy, business and consumer confidence, as well as agricultural producer prices.

The real economy central case-scenario is based on partial econometric equations and sectoral information as well[15]. However, as additional tools, the Economics Department also makes use of other methods for analysing special questions. Currently, the Hungarian block of NIGEM is the sole full empirical model at the NBH[16], which helps in policy simulations: e.g. macroeconomic effects of changes in external variables, the exchange rate regime, fiscal policy, determining the real costs of different inflation targets, etc[17].

NBH inflation projections are created using a combination of methods, which are compared to produce the central projection. In terms of methodology, the approach is pluralistic, relying equally on specialist information, inferences derived from econometric models and statistical forecasting techniques. Some of the methods start from the very bottom, using disaggregated – company, sectoral, product level, etc. – information, while others seek to capture the behaviour of larger aggregates by utilising econometric methods. For additional information we also take into account the results of time-series analysis (ARIMA forecasts) and other "nowcasting" or short-term forecasting methods. The final central case-scenario is then calculated, by creating the so-called "consensus forecast", which is a mixture of results of different methods.

A simplified analytical scheme of our inflation forecasting "model" is presented on Graph 1 below. The scheme shows only the major variables and their relations relevant for forecasting inflation. Real economy is therefore represented only *via* its direct effect on inflation.

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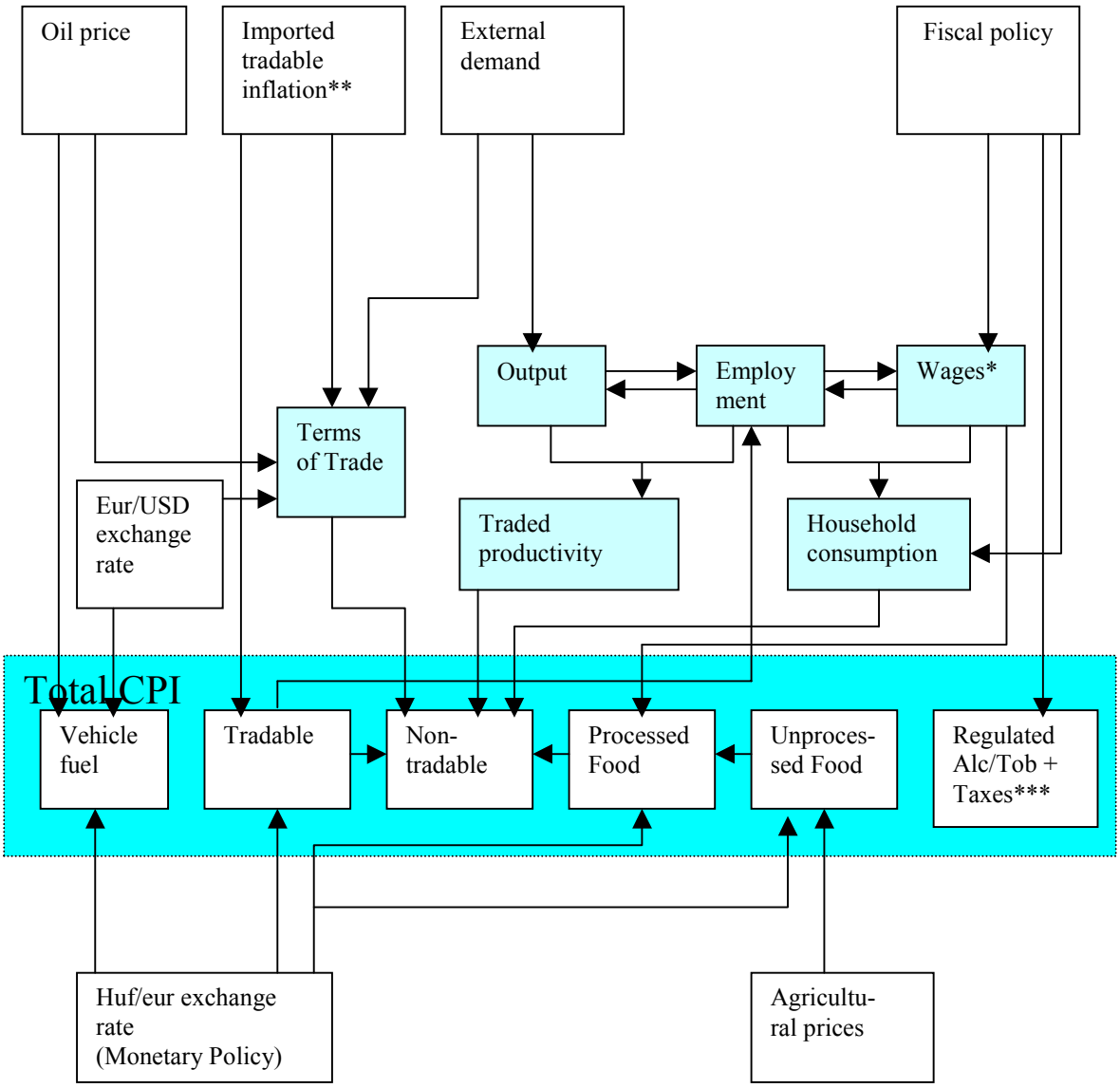
[14] The Operational Monetary Committee meetings, usually scheduled on Mondays, deal with short-term issues.

[15] See e.g. Jakab-Kovács-Lőrincz: Forecasting Hungarian Export Volume, NBH Working Paper, 2000/4 and Jakab-Vadas: Forecasting Hungarian household consumption with econometric methods, NBH Background Studies, 2001/1.

[16] For more details see Jakab-Kovács (2002), Hungary in the NIGEM model, NBH Working Paper, 2002/3. In addition to the NIGEM model, a calibrated model is also used for policy analysis and simulation, see Benczúr-Simon-Várpalotai (2002), Disinflation Simulations with a Small Model of an Open Economy, NBH Working Paper, 2002/4.

[17] See e.g. Chapter V-1 in the November 2001 Quarterly Report on Inflation.

Graph 1 Simplified analytical scheme – Hungary



* In the specialist system, wage earnings also influence tradable prices. "Wages" is the NBH's own wage inflation measure.
***German tradable prices from Eurostat New Cronos statistics, code: IGOODSXE*
**** Taxes on vehicle fuel is also incorporated.*

Forecasts are prepared and published for several macroeconomic variables at different levels of aggregation. Real economy forecasts are published for GDP and some of its main components, industrial production, the current account, and saving/investment in a sectoral decomposition. The CPI is also forecasted at a disaggregated level with the following components: tradables, market services, processed and nonprocessed food inflation, market-priced energy, vehicle fuel and regulated prices as well as prices of alcoholic drinks and tobacco.[18]

[18] The NBH has produced its own CPI classification, different from that of the Central Statistical Office and similar to that of the European Central Bank. The detailed NBH CPI figures are also published on the NBH website.

As noted earlier, the NBH's inflation forecast is not simply a point estimate, but a probability distribution, the fanchart. The fanchart is created through several steps. As a starting point, past forecast errors of the NBH are calculated. Although prior to the inflation targeting regime NBH forecasts were not made public, more than 6 years of monthly observations on the track record is accessible. As a second step, the Council assesses the key risk factors surrounding the central case-scenario, where each shock's weight equals to the product of its standard deviation and its effect on inflation (the multiplier[19]).[20]

[19] The multipliers show the inflationary effects of one unit change in the shock-variable. Multipliers were published in the November 2001 Inflation Report, see Table IV-3.

[20] The band widths of our fanchart are not significantly different from those of the fancharts published by the Swedish and the Brazilian central banks, while the band widths of the Bank of England fanchart are found narrower in almost every forecast horizon.

2.3 National Bank of Poland[21]

2.3.1 General features of the inflation forecast of the NBP

According to well know forecasting principles a single prediction methodology (usually based on a limited set of information and data processed in a specific – but strict – way) is not able to take into account all pieces of information available, so it is not able to produce sufficiently precise forecasts. Better predictions (in terms of *ex post* measures of forecast accuracy) may be obtained using several specific approaches and several sets of information. This approach is also followed in the internal forecasting process of the NBP: there is no single preferred technique to analyse and forecast Polish inflation.

The forecasts of inflation and other macroeconomic variables are based on an analytical scheme, supplemented by autoregressive and expert forecasts, as well as the structural model, and the results are presented to the NBP Board and Monetary Policy Council every month. The Monetary Policy Council does not publish quantified inflation forecasts, but the MPC's point of view on the inflation prospects in Poland is published in the *Report of Inflation* every quarter.

2.3.2 The forecasting process and methodology at the NBP

NBP experts monitor the performance of financial markets, the real sphere of the economy, the economies of the main trading partners, the current standing of the state and local budgets, the money as well as the labour market, foreign trade and the household sector, the activity and financial standing of enterprises and so on. Food prices, for example, constitute an important component of the Polish CPI basket and tend to be volatile, therefore a small group of analysts monitors the agricultural developments and evaluate the influence of food prices on the current and future inflation. In addition, a single equation (reduced form) model is estimated to quantify the impact. The evaluation of economic situation in these areas is prepared each month for the meetings of the NBP's Board and the Monetary Policy Council. The analysis and forecast of the potential impact of an issue under consideration on the inflation process is provided.

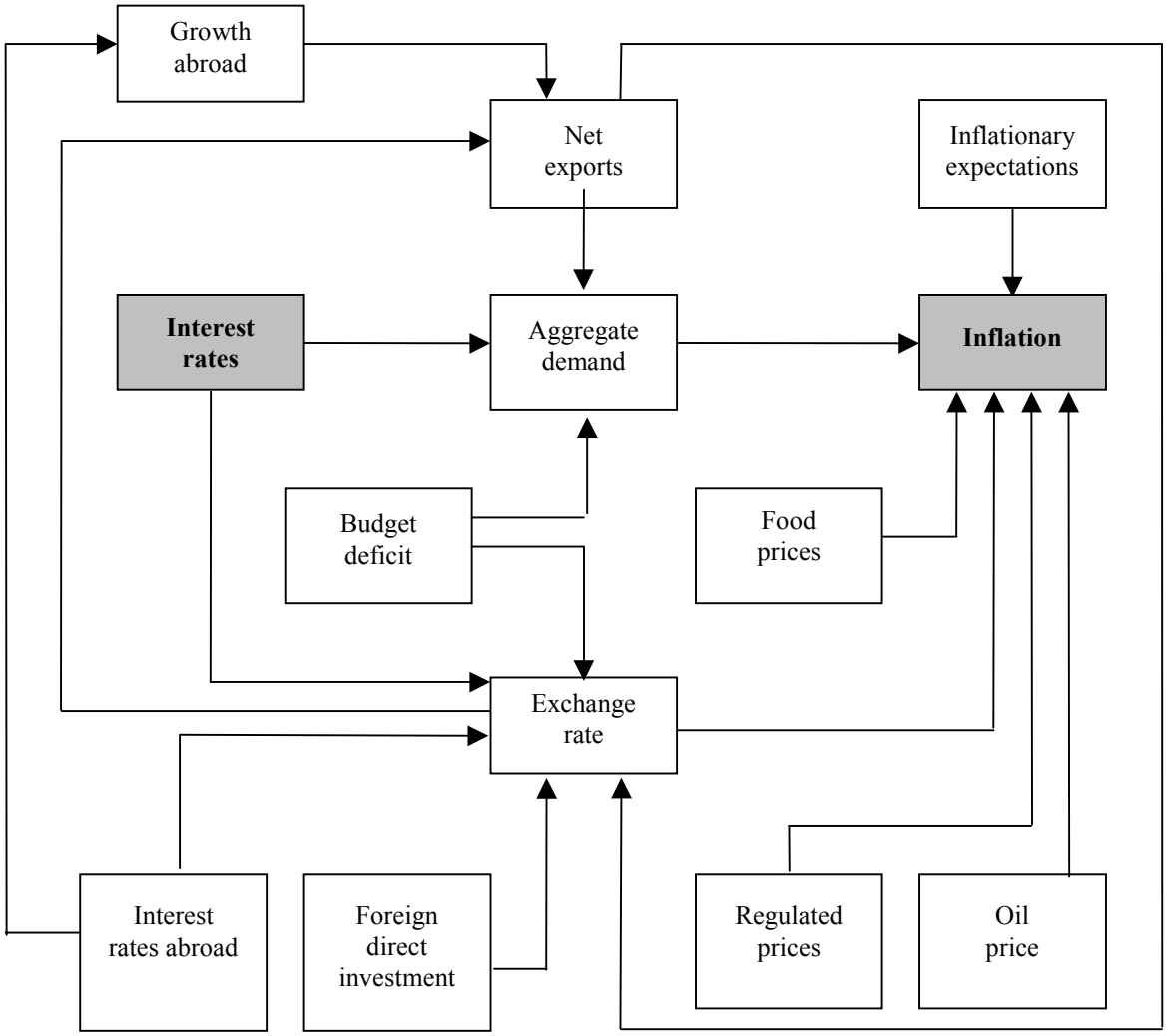
Despite the methods and techniques experts use to make their forecasts, the final version of these partial analyses express to a large extent experts' personal point of view. Experts are not constrained by any formal procedure of prediction, although some of them may use formal (partial) models. The result of the experts' work is a set of partial opinions, analyses, and forecasts. In general, it does not describe the economy consistently. Therefore an analytical scheme has been worked out. The scheme is used to prepare consistent forecasts and scenarios for the whole economy. It integrates different opinions, different analytical methodologies as well as different schools of economic thought into one picture of the economy.

The analytical scheme is used in order to prepare scenario projections of the key macroeconomic variables (with the focus on inflation), which are presented regularly to the Governing Board of the National Bank of Poland and to the Monetary Policy Council. Within the analytical scheme both quantitative tools and expert judgements are used. This kind of eclectic approach, treated not as alternative but complementary

[21] Written by Bohdan Klos and Tomasz Lyziak from the National Bank of Poland.

to econometric models, aims at making the best use of all sources of information available, which – due to different types of data problems – cannot be included in one consistent model. The scheme is grounded on three fundamental relationships suggested by economic theory: the aggregate demand curve, the uncovered interest rate parity (with risk premium components) and the Phillips curve. Expert judgements refer – among others – to predictions of the performance of food prices, regulated prices, oil prices in international markets and the economic growth abroad. The uncertainties concerning the inflation prospects, particularly vast in transition economies, are reflected in different scenarios analysed, within which different assumptions on the explanatory variables are applied. If necessary, there is more than one iteration within the analytical scheme. Inflation forecasts are presented and discussed with experts responsible for selected assumptions. If they find preliminary assumptions not in line with the final results, those assumptions are adjusted and the forecasting procedure pictured above starts again.

Graph 2 Analytical scheme - Poland



Though the above mentioned scheme may be regarded a "macroeconomic model", first of all, it harmonises and makes consistent forecasting activity of experts (regardless of their methods and way of thinking).

Understanding the need to make the forecasting process more transparent and robust to subjective mistakes, in particular to separate experts' judgements from more objective (estimated) relationships, the NBP staff develops and uses more regular macroeconomic models. The largest one developed in NBP is a quarterly structural model of inflation (so-called MSMI). The model focuses on inflation and includes some inflation generation mechanisms (monetary long-run roots of inflation, wage-price spiral, output gap, inflation expectations, and the role of endogenous exchange rate[22]), but MSMI is – in fact – an econometric New-Keynesian (supply-demand) macro model of the Polish economy. The model has been used to prepare short- and medium-term (up to four years ahead) scenarios. Since it is (more or less) a standard macro model, it may be used to solve typical exercises. For example, the main scenario is – usually – supplemented by:[23]

- evaluation of sensitivity of the scenario (endogenous variables) to particular assumptions (based on deterministic multiplier analyses);
- evaluation of uncertainty (risk) of the scenario and forecasts (based on stochastic simulations);

Another macroeconomic model developed in NBP – the small structural model of monetary transmission in Poland (MSMTM) – was created with the aim to provide a stylised representation of the monetary transmission channels in Poland, consistent with the theory of economics and capturing specific features of the economy. The model was designed to emphasise two specific issues connected with monetary transmission in Poland, namely, the operation of the bank lending channel and the character of individuals' inflationary expectations. Core equations of MSMTM are: the aggregate demand curve, the monetary base curve, price-wage system[24], uncovered interest rate parity (UIP) and the monetary policy rule. Although the structure of MSMTM – similar to those of Svensson (1998), McCallum and Nelson (1999), Batini and Haldane (1999) models – is rather simple and does not provide the users with as complex description of the economy as MSMI, MSMTM has been found useful in:

- simulating the pass-through of NBP monetary policy decisions (multiplier analyses), inclusive of separating the effects of different transmission channels;
- preparing medium-term forecasts.

To avoid repeated, systematic errors experts evaluate forecast accuracy, analyse and decompose forecast errors. Knowing the source of errors, they can improve the forecasting methodology and/or the analytical tools. The evaluation of forecasts is not a formalised process in NBP, however the sources of forecast errors are subject of analysis in each new material presented to the MPC.

[22] There are 12 stochastic equations and (ca.) 30 identities. The structural parameters of dynamic equations are estimated econometrically; some long-run relations are imposed.
[23] It is certainly possible to solve other typical problems (deterministic or stochastic optimum control exercise, or evaluate policy proposals).
[24] Alternatively, in the reduced form, the Phillips curve exclusively.

2.4 National Bank of Slovakia[25]

2.4.1. General features of the inflation forecast of the NBS

The NBS's projections of inflation are based on an estimation of effects of both external and domestic factors affecting the price development in the Slovak Republic. The most important external factors include world economy developments, especially economic growth of our main trading partner countries, foreign price developments and especially the development of energy commodity prices on the world market, mainly oil prices that were characterised by high volatility during the last two years. Explicit values for these (exogenous) variables are set mostly from OECD projections.

A typical character of transition countries is that there is still a certain share of administered prices whose gradual liberalisation is a key factor in the development of consumer prices. Contribution of regulated prices to total inflation in the Slovak Republic represented more than 50 percent during the last three years. The steep adjustments and uncertainty of the schedule have tended to complicate the inflation story and led the NBS to develop a measure of underlying inflation, which is more stable and predictable. For monetary policy purposes the NBS started to monitor a so-called core inflation measure (excluding regulated prices and the effect of change in indirect taxes and subsidies).

As it was mentioned above, NBS's estimation of inflation is based on the schedule of adjustments to administrated prices. Knowledge in that is important on the one hand for the purposes of estimating the direct impact on headline inflation and on the other hand for forecasting secondary effects on the core inflation, which rebound in price development of other consumer prices, mainly market services. Because inflationary factors passes through into the individual price groups with varying intensity (which is clear from the different price growth between tradable and non-tradable sectors), the NBS tries to estimate price development separately in both sectors.

2.4.2 The forecasting process at the NBS

The inflation forecast is produced in several steps to support the decision-making process. The first scenario is prepared by the Monetary Policy Department of NBS. In this scenario, assumptions of exogenous variables and expected relations between monetary policy variables, real economy variables and the public sector are taken into account. Then follows the discussion meeting with members of the Banking Board and the Research Department. Judgements from this meeting are incorporated into the simulation process, and new predictions are created. The final version is submitted to the Banking Board meeting and then it is published. Inflation forecasts are published in the form of a range for the end of the coming year for both headline and core inflation.

The main publication through which the NBS communicates its monetary policy to the public is the Annual Monetary Program (which is published in almost full version). It contains an assessment of past and future developments in the real, fiscal, monetary and external sectors (which creates conditions and environment for inflation development) and presents the NBS's forecast of inflation for the coming year. Beside

[25] Written by Miroslav Gavura from the National Bank of Slovakia.

the estimations of the main monetary policy variables, there are also assumptions and judgements about expected development of individual factors affecting price development. The main risk assessment of the inflation projections is also presented.

Within a year, the actual development of inflation is extrapolated and compared with the estimated, projected range for the year-end. The predictions are updated every month according to the previous developments of consumer prices and other factors affecting inflation. Such short-term predictions of inflation on a monthly basis are prepared for operating purposes and decisions of the Banking Board to set up monetary policy instruments. These predictions are not published.

The monetary programme of the NBS is subject to regular actualisation (usually in May), when the latest knowledge and information about the developments of economic variables, plans of the government and up-to-date reactions of the economy are taken into account. According to this, some values (including inflation) might be changed, revised.

2.4.3 Forecasting methodology

Estimation methods used in inflation forecasting are not based on the use of econometric models, but rather on empirical evidence and projections. It is very difficult to measure strong direct impact from monetary policy onto inflation in transition countries as most of the transmission channels are deformed. Similar to other transition countries, there is a very strong impact of the exchange rate on prices, but "virtually no effect" from the interest rate. Reasons for the unsatisfactory results in modelling the transmission mechanism are the abundance of structural changes, the short time series and an insufficiently developed financial system. These problems do not allow the use of more advanced econometric methods in order to get more robust results. The statistical power of the inflation forecasting models in Slovakia still appears to be modest, especially when the forecast horizon extends for periods of one year or longer.

2.5 Bank of Slovenia[26]

2.5.1. General features of the inflation forecast of the BoS

Inflation forecasting in Slovenia is a part of extensive »forecasting« exercise done by the Analysis and Research Department of the Bank of Slovenia, at least twice a year. Forecasts are made using a structural model developed in the Analysis and Research Department of the Bank of Slovenia. This model also includes a block called prices and costs, where inflation forecasts are derived.

2.5.2 The forecasting process at the BoS

The Governing Board of the Bank of Slovenia discusses forecasts, but on the other hand does not take part in their preparation. We strictly distinguish between forecasts and the longer-term targets of the Bank of Slovenia. The horizon of the inflation forecast is two years.

When we prepare our forecast we do use explicit assumptions on the future course of some monetary policy variables (such as monetary aggregates, interest rates, exchange rates). So monetary variables are determined exogenously and our forecast is a conditional forecast. We announced our publication dates for the first time this year. These dates are the end of May and the end of November. We take into account the uncertainty surrounding our forecast. Therefore our forecast is a range with a central point. We do not perform ex post evaluation of our forecast, yet.

We try to describe obtained results to the public, rather than present a large amount of data. We try to focus the public attention on estimated GDP and inflation. We also stress what kind of behavior we can expect from individual economic factors in the future. In spite of all above we include some indices in tabulated form in our publication. Public forecast includes annual forecasts for consumer prices, administered prices and free prices. It also reports real GDP, GDP per capita, employment, real net wages, productivity, components of domestic demand, exports and imports of goods and services, current account, terms of trade, net financial inflows, foreign-exchange reserves, external debt, monetary aggregates, and domestic credits.

2.5.3 Forecasting methodology

We would like to have our forecasts as accurate as possible. Therefore, when we make a forecast, we check particular segments of the model with small ad-hoc analyses and small atheoretical models. The purpose of this exercise is to get deeper confidence in obtained results.

Wishing to get as realistic forecasts as possible, we try to get projections and other relevant information from other economic policies. An interesting example is a policy of the administered prices in competence of the Ministry of Economic Affairs. In the case that we do not get above projections we assume the growth of the administered prices by ourselves.

[26] Written by Matejka Kavcic, Ph.D., advisor at the Analysis and Research Department of the Bank of Slovenia.

We get values for main indicators of the international environment (i.e., exogenous variables) from forecasts of foreign institutions. We are trying to combine forecasts of different institutions. In that sense forecasts from Consensus Forecast, JP Morgan, World Economic Outlook (IMF), Main Economic Indicators, The Economist, and OPEC Bulletin are used.