

**IMF Working Paper**

Research Department

**Czech Magic: Implementing Inflation-Forecast Targeting at the CNB**

**Prepared by Kevin Clinton, Tibor Hlédik, Tomáš Holub,  
Douglas Laxton, and Hou Wang<sup>1</sup>**

Authorized for distribution by Douglas Laxton

January 2017

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**Abstract**

This paper describes the CNB's experience implementing an inflation-forecast targeting (IFT) regime, and the building of a system for providing the economic information that policymakers need to implement IFT. The CNB's experience has been very successful in establishing confidence in monetary policy in the Czech Republic and should provide useful guidance for other central banks that are considering adopting an IFT regime.

JEL Classification Numbers: E30, E31, E58

Keywords: Inflation Targeting, Monetary Policy, Optimal Control

Author's E-Mail Address: [KClinton@rogers.com](mailto:KClinton@rogers.com); [Tibor.Hledik@cnb.cz](mailto:Tibor.Hledik@cnb.cz);  
[Tomas.Holub@cnb.cz](mailto:Tomas.Holub@cnb.cz); [DLaxton@imf.org](mailto:DLaxton@imf.org); [HWang2@imf.org](mailto:HWang2@imf.org)

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<sup>1</sup> We thank Aleš Bulíř for his suggestions on the topics considered in the paper as well as Jan Syrovátka, Luboš Růžička, and Rita Choi for data inputs and excellent research assistance.

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## I. INTRODUCTION

### 1.1 Background

This paper describes the Czech National Bank (CNB)'s experience implementing an Inflation-Forecast Targeting (IFT) regime, and the building of a system for providing the economic information that policymakers need to implement IFT.<sup>2</sup> This experience has been very successful. Its main achievement has been to establish confidence in monetary policy in the face of the many disturbances that have hit the economy this century. The Czech experience should provide useful guidance for other countries that are considering monetary policy reforms of the same kind.

We start with an overview of the issues that led the CNB to adopt this regime.

During the 1990s, central bankers came to realize that the better their policies were understood, the more effective they were—a remarkable turnaround within one generation for a profession formerly reputed (not entirely fairly) for secrecy. With respect to numerical variables, the debate at inflation-targeting (IT) central banks has been about what to disclose above and beyond the target for the rate of inflation and the current setting of the policy interest rate instrument—in particular, about what elements of the quarterly macroeconomic forecast of the central bank should be released. Publishing the forecast for inflation and output has not been controversial, because policymakers had to show the public that they did have a plan for anchoring long-term inflation expectations, and that the plan recognized the potential short-run implications for output. Moreover, Svensson (1997) pointed out that the central bank's inflation forecast represents an ideal conditional intermediate target, since it takes into account all available information, including the preferences of the policymakers and their view of how the economy works. The flexible IT regime now in place at many central banks is operationally the same as IFT.

IT logically implies an endogenous interest rate. A model in which the interest rate is exogenous has no nominal anchor—the inflation rate drifts indeterminately following disturbances. Under IT, the nominal anchor for the economy is provided by the expectation that the rate of inflation will converge to the announced long-run objective. This implies an expectation that in response to any shock, monetary policy will react in such a way as to return inflation to the long-run target. For the policy to be coherent and logically consistent, the interest rate must adjust to the requirements of the target. Many central banks incorporate this principle into their forecasting models and thus produce an endogenous path for the interest rate. However, most of these institutions have, so far, decided not to publish the path,

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<sup>2</sup> For a discussion of the principles and applications of IFT, see Clinton and others (2015), Alichì and others (2015a, b), Arbatli and others (2016), and Obstfeld and others (2016).

their view being that the policy rate has to be free to respond at any decision meeting to all possible contingencies, and that they do not want to confuse the public by appearing to have a commitment of some kind towards the interest rate.<sup>3</sup>

A leading group of central banks, including the CNB, has gone to full disclosure. This may have been motivated by a desire to increase the transparency of monetary policy, which in itself is surely a good thing, but there have also been solid practical reasons for the move. Any policy interest rate decision by the central bank must involve more than a one-period setting. Changes in the very short-run interest rate controlled by the central bank confined to the short period between policy decision meetings would have negligible macroeconomic effects. Firms and households borrow and invest at much longer terms. To affect spending, monetary policy has to influence interest rates at these terms, and this requires an influence over market expectations for the future policy interest rate, not just its current level.<sup>4</sup> Consistent with this, at a given decision, the policymakers must have in mind some path for the future policy rate—albeit a tentative, conditional path, better described by a band than by a single line—when they set the rate for the short period until the next meeting.

In view of the lagged effects of monetary policy, a variety of such paths is possible; and the path chosen by policymakers would reflect their preferences regarding the short-run trade-off between inflation and output. For example, in general, a higher weight on output stability would imply smoother adjustments of the interest rate in response to shocks and a slower return to the long-run inflation target.

Full disclosure of the central bank forecast could reinforce the effectiveness of monetary policy in two ways. First, by showing a coherent view of the future, with inflation returning over the medium term to the desired long-run target rate, confidence in the goal, a reliable value of money, would be strengthened. Second, the published path for the short-term interest rate would help move the term structure of interest rates in a way that would assist the transmission mechanism. In terms of objectives, the payoff from this reinforcement of policy effectiveness would be a reduced cost of eliminating deviations of actual inflation from the long-run target rate, or equivalently, an improved short-run inflation-output trade-off.<sup>5</sup>

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<sup>3</sup> Freedman and Laxton (2009) discuss this issue in more depth.

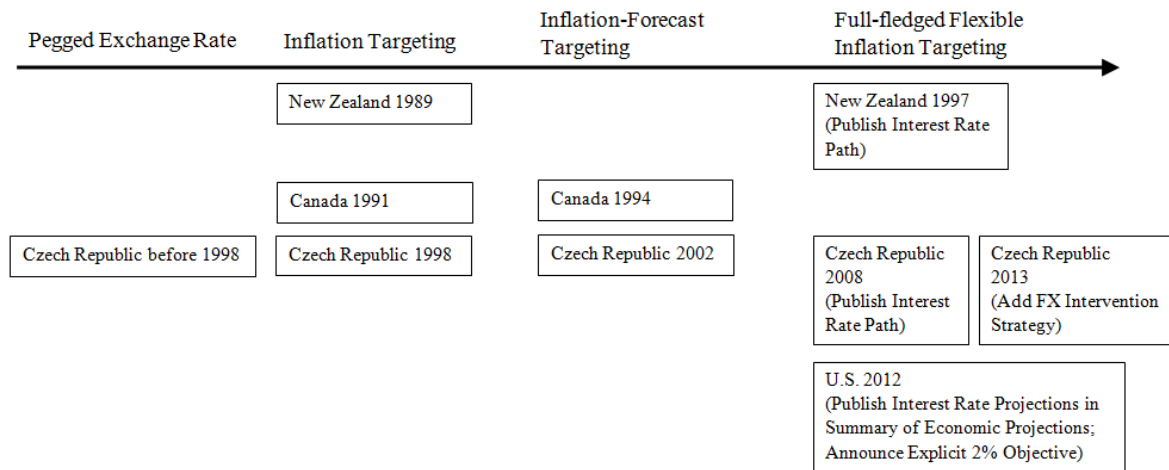
<sup>4</sup> Thus, Woodford (2005) highlights management of expectations as a key task in the practice of central banking, and Svensson (2007) argues for publishing the central bank's forecast interest rate path. See also Clinton and others (2015) for a discussion of the practical issues involved with developing analytical frameworks and monetary policy models to support IFT regimes.

<sup>5</sup> See Blanchard and Galí (2007) and Laxton and N'Diaye (2002).

The history of IT provides a line of openness, or accountability (Figure 1). Milestones along the continuum have been:

- announcement of targets with a multi-year horizon—clarity of target;
- precision on the policy interest rate setting—clarity of instrument;
- transparent communications on policy implementation;
- publication of inflation (and output) forecast—clarity of intermediate target—IFT;
- publication of a conditional forecast path and confidence bands for the short-term interest rate.

**Figure 1. The Transparency Continuum**



Source: Constructed by authors.

## 1.2 Inflation-forecast targeting

IFT is based on the principle that, given a long-term objective for the rate of inflation, the central bank's own forecast of inflation is an ideal intermediate target. The reason for this is that the forecast would embody all the relevant information available to the central bank, including knowledge of the policymakers' preferences with respect to the trade-off between deviations of inflation from target and output from potential, and the bank's view of the monetary policy transmission mechanism as summarized in its core macroeconomic forecasting model. A key aspect of IFT is that the policy interest rate is an endogenous variable: it responds to eliminate any deviations between actual inflation and its objective. In a monetary policy model, the interest rate responses are derived from a policy reaction function or from a loss-minimizing procedure.<sup>6</sup> Putting IFT into practice requires an explicit

<sup>6</sup> See Alichí and others (2015b) for a comparison of monetary policy reaction functions and the direct minimization of a loss function to more efficiently manage the short-run output-inflation trade-off.

model, because the calculation of even a single endogenous path for the interest rate is too complex a task for casual theorizing. An effective strategy requires the central bank to have a credible model-based framework. Indeed, credibility is at the center of the whole regime. In particular, the better the expectations of the public align with the objectives of monetary policy, the lower are the costs of achieving those objectives. This involves transparent communications.

For the purposes of this paper, then, IFT means that:

- monetary policy is based on a long-run low inflation target, and a medium-term forecast path to this target;
- the forecast path for the short-term interest rate—the policy instrument—is endogenous within the model, with the rate varying to achieve the long-run inflation target and to eliminate any output gap;
- the forecast is a key input into the MPC decision, but only an input—members of the MPC need not agree with the forecast, but use it as an important basis for explaining their own views.
- soon after the policy decision, the associated forecast path for key macroeconomic variables is disclosed, highlighting the path for the inflation rate;
- the rationale for policy actions is explained in greater depth at regular intervals (usually quarterly) in a Monetary Policy Report (MPR—sometimes, less aptly, called an Inflation Report);
- the MPR outlines the conditional forecast path for the short-term interest rate, either with a qualitative description, or with explicit numbers;
- the central bank emphasizes the risks to its assessments, verbally, and with confidence bands for those variables for which numerical forecasts are published.

Examples of IFT central banks that publish the endogenous interest rate forecast include the Reserve Bank of New Zealand, the Czech National Bank, the Bank of Israel, the Norges Bank, and the Sveriges Riksbank (see Box 1). Because of the increased opportunities to learn from others, it has become possible for newer entrants to leapfrog the pack, and in some respects jump straight to the frontiers, as the Bank of Israel and the Norges Bank have shown. The U.S. Federal Reserve is one of the best recent examples of an IFT central bank given the strong emphasis on its dual mandate (specifying full employment as well as low inflation) and the Fed's 2012 announcement of a 2 percent long-term inflation objective.

Under IFT, the central bank communicates to the public not just a possible path for the future policy rate (and for special measures where these are a factor), but also a sense of how this path might change in response to a variety of developments, and a rationale for policy actions. Thus, there is an aspect of improved accountability, as well as improved policy effectiveness, with an IFT strategy.



### Box 1. Some Leaders in Monetary Policy Transparency

*“Monetary policy works by affecting expectations about the future interest rate. It is the entire interest rate path that is important for future inflation and resource utilization, not merely the interest rate over the coming weeks. The Riksbank has therefore come to the conclusion that the only right thing is to explicitly discuss the interest rate path and to choose a particular path as the main forecast, as well as publishing the interest rate path and justifying its selection. This is in my opinion the most effective way of conducting monetary policy. Not to discuss and select a particular interest rate path as a main forecast would be an incomplete decision-making process. Not to publish the interest rate forecast would be to hide the most important information.”*

*-- Lars Svensson (2007)*

**New Zealand** in 1989 was the first country to adopt a simple version of IT. Today it has a full-fledged IFT regime. Monetary policy credibility has risen over time. As one of the early pioneers, the Reserve Bank of New Zealand (RBNZ) had to learn by doing. It subsequently also learned from others, in particular the Bank of Canada, on process, and from IMF advice. Inflation was quickly reduced, to less than 2 percent in 1992, but heavy reliance on the exchange rate channel led to excessive costs in keeping inflation close to the target. The RBNZ introduced the first fully structured framework for conducting policy under IFT, the so-called forecasting and policy analysis system or FPAS, in 1997, and jumped straight to IFT, with immediate full disclosure of the central bank forecast including the path of the policy interest rate. See Hunt, Rose and Scott (2000) for documentation of the core model of the RBNZ's FPAS. See also Archer (2005) for a discussion of their experiences publishing the path for the policy rate.

**The Czech Republic** adopted IT in 1998. The preceding year saw the collapse of a fixed exchange rate policy and widespread bank failures. Difficulties in the transition to the post-Communist market economy were still evident, with important prices yet to be liberalized. Inflation had been running at almost 10 percent since 1993, and was accelerating at the time IT was adopted. With assistance from Bank of Canada staff and the IMF, the Czech National Bank (CNB) was using an FPAS, with a model-based forecast, by 2002. The CNB began publishing its quarterly forecast in detail in 2002, but only used words to describe the assumptions about monetary policy at that time. Starting in the beginning of 2008, the CNB published the path of the policy rate in a fan chart. Surveys of inflation expectations for the past decade have shown strong public confidence in the 2 percent target. Internationally, Czech monetary policy is in the forefront of monetary policy transparency. See Coats, Laxton and Rose (2003) for the documentation of the CNB's initial FPAS, and Alichí and others (2015a) for a detailed discussion of the Czech experience.

**Sweden** switched to IT after a currency crisis and the collapse of its fixed exchange rate regime at the beginning of the 1990s. The Sveriges Riksbank announced in January 1993 an

### Box 1 Continued...

inflation target of 2 percent for the CPI, with a tolerance interval of  $\pm 1$  percent, to apply from 1995. Initially, the forecasts were made under the assumption that the policy rate would not change during the forecast period. Since October 2005, the Riksbank abandoned the constant interest rate assumption and moved forward to using an assumption that policy rate would develop in line with financial market expectations. To improve monetary policy transparency and openness, the Riksbank in 2007 started publishing its own endogenous forecast for the policy rate in the Monetary Policy Report.

**Israel** adopted IT in 1997. Up to the early 1990s the exchange rate had served as the nominal anchor of monetary policy. In the first half of the 1990s the weight of the exchange rate as an anchor of monetary policy declined, until mid-1997, when the exchange rate band was significantly widened and the exchange rate regime effectively became a floating rate one. Since 1997 Israel switched to an IT regime in a floating exchange rate environment, and the main policy instrument is the interest rate set by the Bank of Israel. However, Bank of Israel did not start publishing its endogenous interest rate forecast until 2007. See Argov and others (2007) for documentation of the Bank of Israel macroeconomic model.

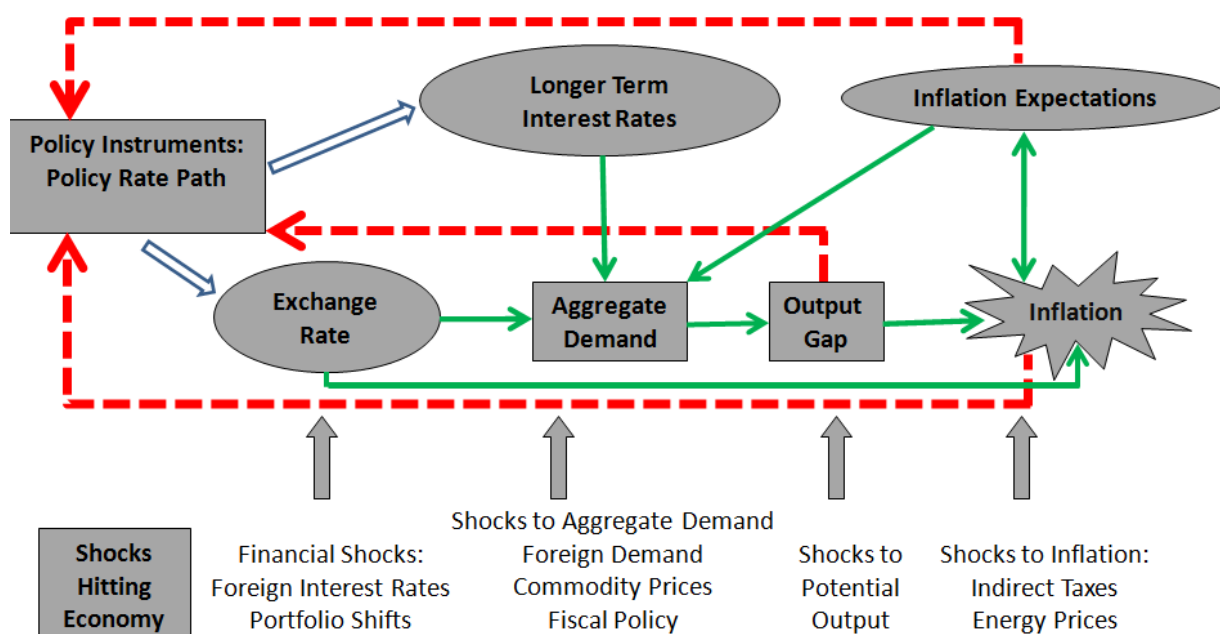
**Norway** adopted an inflation target of 2.5 percent for monetary policy in March 2001, ending its long history of exchange rate targeting (beginning with fixed peg and later moved to a managed-float system) dating back to the silver standard in the mid-1800s. Officially, Norges Bank started to publish its own policy rate forecast in November 2005, after New Zealand and followed by Sweden and the Czech Republic. Prior to full disclosure of its interest rate forecast, the Bank had established and published criteria for an appropriate interest rate path, which served as useful communication tool to explain to the public the objectives and instruments of the central bank and the output-inflation trade-off. See Qvigstad (2005) for details.

**The United States** Federal Reserve announced an inflation target in 2012, with a long-run goal of 2 percent PCE inflation. The Fed has long had a sophisticated FPAS in place. A debate on transparency is currently taking place within the FOMC. For example, Plosser (2014) urges the Fed to consider publishing a focused monetary policy report. Mester (2015) argues for releasing each FOMC participant's economic projections (without attribution), with paths for the policy instruments (including forward guidance and quantitative easing). A difficulty here is that all FOMC members have their own forecast. A simpler way of going forward might be to present the Federal Reserve Board staff forecast as the baseline for discussions of policy, as is done in the CNB, which treats the staff forecast as one important, but not the only, piece of information used by policymakers. In September 2015, the Fed introduced a modest enhancement to the Summary of Economic Projections by publishing the median projections across FOMC participants. See Alichu and others (2015b) for recommendations to the Fed on further improving its monetary policy making.

### 1.3 The nominal anchor

The credibility of the long-run inflation target underpins IFT. Everything pivots around the anchor provided by the firm expectation of the public that monetary policy will in the long run keep inflation stable and near the target rate. This, in turn requires that policy responds systematically to the requirements of this objective. A model of the process is depicted in Figure 2.

**Figure 2. Monetary Policy Model: IFT Feedback Response and Transmission**



Source: Clinton and others (2015).

With a forward-looking policy, the future expected path of the policy interest rate is adjusted when unanticipated disturbances hit the economy, in order to bring inflation back to the target gradually over a period of time that limits the disruptions to output. This policy feedback, via an endogenous short-term interest rate, represented by the red dashed arrows in the flowchart, ensures that the nominal anchor holds.

### 1.4 The transmission mechanism

Macroeconomic models traditionally emphasize two main channels for the influence of monetary policy on the economy: the domestic channel, via the short-term market interest rate, which is controlled quite closely by the central bank; and the external channel, via the exchange rate.

The difference between IFT with an endogenous, forward-looking policy reaction function, and some other approaches to IT, for example use of an exogenous forecast interest rate path (including a path derived from market forward rates), or use of a simple Taylor rule, is that the latter do not have explicit feedback from the expected future inflation rate to the policy instrument.<sup>7</sup> If the figure were modified to represent an exogenous interest rate path, the red dashed feedback arrows would be erased.

Modern monetary policy models emphasize the role of expectations in the transmission mechanism. Policy affects what interest rates businesses and households face through the impact of the policy rates expected in the future—i.e., the level of the yield curve—rather than the current policy rate in itself. This is reflected in the rectangle for the “Policy Rate Path”—the whole *path* expected for the medium term, not just the current setting, is what counts. Likewise, the size of the impact on the change of a given policy action is also a function of the expected duration of the action.

Recognition of the crucial role of expectations has been reflected in the increased attention that central banks have given to transparent communications about monetary policy. When monetary policy is constrained by the effective lower bound (ELB), the ability of a credible central bank to affect expectations in a helpful direction provides a means for an effective anti-deflation policy (Box 2—see also Svensson, 2003).

## 1.5 Forecasting and Policy Analysis System

Policy interest rate decisions are made on a regular, pre-announced schedule.<sup>8</sup> The FPAS is the organized set-up providing the regular flow of macroeconomic information to policymakers for their decisions on the policy interest rate. Main elements of the FPAS are:

- a monetary policy model containing a loss function or policy reaction function under which the short-term interest rate responds endogenously to return inflation to the long-run target;
- a system of communication between policymakers and model builders, to ensure that the model structure broadly captures the key features of the transmission mechanism as viewed by the policymakers;
- a system of communication between policymakers and the forecasters before and during forecast production, to develop a consensus set of assumptions for a baseline, and for alternative scenarios.

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<sup>7</sup> See Clinton and others (2015) and references therein for a discussion of inflation-forecast-based (IFB) reaction functions and their use in monetary policy models developed in IFT central banks.

<sup>8</sup> The frequency of policy meetings varies across central banks, for example: 6 per year at the Norges Bank and Swedish Riksbank; 8 at the Bank of Canada, the Czech National Bank, the Reserve Bank of New Zealand, the Bank of England, the European Central Bank, and the U.S. Federal Reserve; 12 at the Central Bank of Chile.

### **Box 2. Medium-term Inflation Expectations as Shock Absorbers or Amplifiers**

In normal times, following a contractionary shock, policy would react with a rate cut which has its effects on inflation and output via the usual transmission mechanism. At the effective lower bound (ELB), the story is more complicated as the nominal interest rate cannot decline, but a somewhat weakened version of the mechanism could still apply, through real interest rates and the real exchange rate. That is, expected inflation provides a channel via which forward guidance can stimulate the economy. If monetary policy is active, and credible, it could persuade the public that it will eventually get inflation back up to the long-run target. With the promise of a sufficiently vigorous policy, which commits to holding the interest rate near the ELB for an extended future period, the public would expect increased inflation in the future. This would reduce longer-term real rates of interest even though the nominal rate is at the ELB. These movements serve as a buffer to the shock. Under such circumstances, the central bank might show a forecast in which, over the medium term, inflation overshoots before returning to the long-run target (see Alichí and others, 2015a, b).

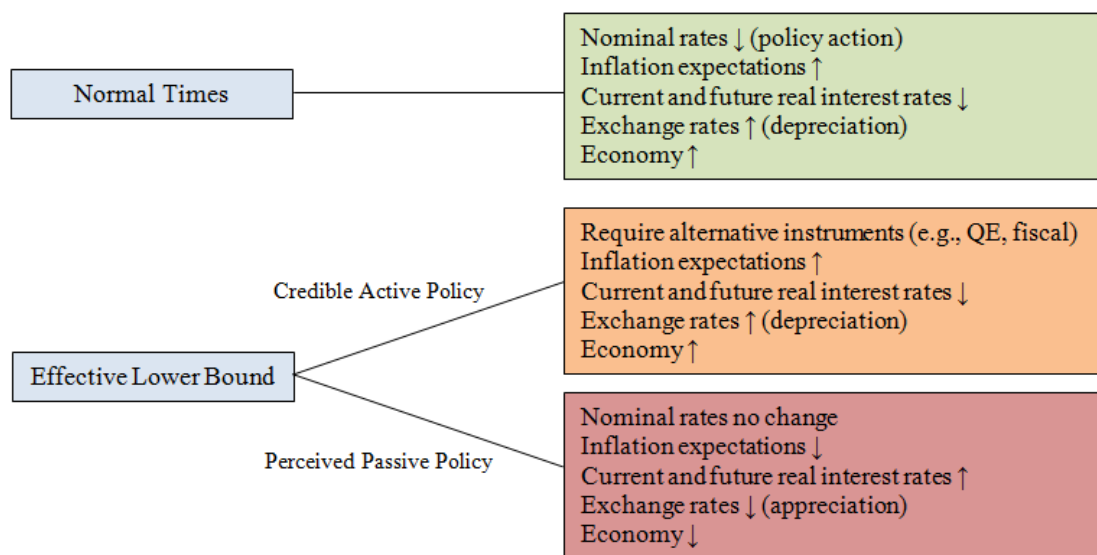
Moreover, in this case, the real exchange rate would depreciate, and asset prices would rise (see Clinton and others, 2015). That is, the real price of foreign exchange also responds in an equilibrating way, a normal aspect of the transmission mechanism. Thus, the real interest rate channel would be amplified in the open-economy case by the real exchange rate channel. A very similar argument to that for the real exchange rate applies to asset prices. An increase in the expected medium-term rate of inflation that reduces real interest rates would boost asset prices through the lower real discount rate, and through the positive impact of exchange rate depreciation on profits. Increased asset prices would stimulate spending.

To achieve this result, the central bank has to persuade people: that the nominal interest rate will remain at the floor for an extended period; and that the rate of inflation will rise over the medium term, perhaps above the long-run target; but that the rate of inflation will eventually return to target. Is this a realistic prospect? The exchange rate policy used by the Czech National Bank since 2013, which has relied heavily on influencing expectations, suggests that, under a transparent IFT framework, it can be.

If, however, monetary policy were passive, and not credible, the real exchange rate and asset prices would amplify a contractionary shock, because the expected rate of inflation would fall (equivalently, the expected rate of deflation would rise). At the ELB, real interest rates would rise, the real exchange would appreciate, and asset prices would fall. This is the classic deflation trap. The flowchart illustrates the difference between the 2 policy regimes.

## Box 2 Continued...

**Box Figure 2.1. Expectations as Absorbers or Amplifiers Following a Contractionary Shock**



Source: Adapted from Clinton and others (2015).

The forecast necessarily includes an endogenous short-term interest rate, under the control of the central bank (not necessarily direct), that responds to any development that affects the rate of inflation in such a way as to return it, over a medium-term horizon, to the long-run target.<sup>9</sup>

The system provides these key inputs for decision making:

- baseline forecasts—including an endogenous forecast path for the short-term interest rate;
- risk assessments surrounding the baseline;
- alternative scenarios to the baseline—each with an endogenous interest rate path.

<sup>9</sup> The short-term rate in the model need not be the actual rate announced by the central bank. The former should apply to a wide range of borrowing costs in the financial market (e.g., a 3-month rate), whereas the latter is usually a very short-term rate (e.g., an overnight repo rate) on central bank facilities. In practice, the announced policy rate has a heavy influence on all short-term market rates.

Each FPAS forecast—baseline and alternative scenarios—contains: (a) an inflation rate projection that shows a return to the long-run target (in the event of a deviation) within a medium-term horizon; and (b) an endogenous path for the policy interest rate.<sup>10</sup> Under IFT, as discussed in more detail later, the relevant medium-term horizon for getting inflation back on target is not fixed. It depends on the source and size of the shocks that create deviations: in many cases the gaps might be substantially eliminated within 4-6 quarters, but more obdurate shocks may take more time.

The FPAS forecast provides a frame of reference for policy discussions. Individual policymakers may use it to highlight what they regard as the decisive issues at a policy meeting—either by agreeing broadly with the FPAS baseline forecast, or by pointing out their differences with it.

Every central bank embarking on IT has started with policy information systems not specifically designed for the job.<sup>11</sup> They had to scramble to adapt existing procedures, which meant ad hoc adjustments, and inefficient use of resources. Within a few years, inflation targeters have usually installed an adequate FPAS. In each case, the system has been modified and extended over time, to become well-oiled machines at the most advanced IFT central banks. The lesson would be that the absence of a suitable FPAS is not a good argument for delaying the adoption of IT, but for investing in such a system immediately after the regime is adopted. By learning from the accumulation of relevant experience at other institutions, FPAS development since the mid-1990s has proceeded more rapidly than was the case for the early adopters. Modifications that better serve the needs of a given central bank can be introduced over time—an FPAS never stands still.

### **1.6 To publish or not to publish the forecast policy rate**

All IFT central banks publish the forecast for the major macroeconomic variables that goes with their inflation forecast. This is an integral part of the policy transparency that comes with the approach. However, there are differences on disclosure of the endogenous path for the projected interest rate. Table 1 identifies 13 IFT central banks, of which 6 publish an explicit numerical policy rate path and alternative scenarios.

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<sup>10</sup> The focus here is on the interest rate, but of course the model also produces a consistent forecast for the whole range of relevant endogenous macroeconomic variables.

<sup>11</sup> See Clinton and others (2015), Argov and others (2007), Coats, Laxton and Rose (2003), and Hunt, Rose and Scott (2008) for a discussion of these issues.

**Table 1. Policy Communications of IFT Central Banks**

Country	Publish the Policy Rate Path and in Some Cases Confidence Bands (if yes, year when started)
New Zealand	Yes (1997)
Norway	Yes (2005)
Sweden	Yes (2007)
Israel	Yes (2007)
Czech Republic	Yes (2008)
United States	Yes (2012)
Canada	No
Chile	No
Colombia	No
Hungary	No
South Korea	No
Peru	No
Turkey	No

Source: Various central bank reports.

The principal worry about publishing the explicit path for projected interest rates has been that people might misinterpret it as a commitment, regardless of changing developments, or underestimate the central bank's perception of the uncertainties that lie ahead.<sup>12</sup> This concern, however, has been dealt with, first, by publishing confidence bands around the endogenous interest rate path, and second, and more important, by emphasizing the conditional nature of the projection. Indeed, one of the most important messages that an IFT central bank has to communicate to the public—whether it publishes an explicit rate path or not—is that the forecast is conditional upon information available at the time of writing and will almost certainly change as new information (and new interpretations) become available. Again, a quote from the CNB illustrates the point:<sup>13</sup>

“It is vital, however, that all users of the central bank's forecasts are aware that the published forecast-consistent interest rate path should in no way be interpreted as a commitment of the central bank to set interest rates in line with the forecast... the forecast represents the most

<sup>12</sup> See, for example, Poloz (2014). In the past the Bank of Canada did not publish the path of the policy rate path, but used words to describe the policy assumptions in their output and inflation forecasts. For example, in the MPR from April 2013 they described the policy assumptions as “... This projection includes a gradual reduction in monetary stimulus over the projection horizon, consistent with achieving the inflation target.”

<sup>13</sup> Czech National Bank, Inflation Report I/2008.



probable future path of interest rates under given initial assumptions and information. New information on the domestic and global economy that comes in after the forecast is drawn up can change the interest rate outlook.”

Central banks have generally been quite cautious in moving to a published rate forecast. In most cases the practice followed many years after the adoption of IT—the shortest gap was 4 years at the Norges Bank. To reach the point where publishing an endogenous interest rate path became a feasible option, the central banks first had to build models with endogenous policy rates, and then use them as the basic forecasting tool. Policymakers then had to become confident in the process and output of their FPAS before they were ready to publish the explicit path and confidence bands for the interest rate forecast.

Markets on the other hand have adapted surprisingly quickly. As for the perceived communications risks, the experience in New Zealand since June 1997, Norway since November 2005, Sweden since February 2007, Israel since July 2007 and the Czech Republic since February 2008 suggests that concerns have been overblown. In particular, the financial market participants did not find it difficult to accept the idea of the conditionality of a projected interest rate path. For example, in the case of Sweden, whereas Riksbank officials stated at the outset that they expected that it would take some time for people to learn and accept the system, in practice this adjustment seems to have been fairly quick.<sup>14</sup>

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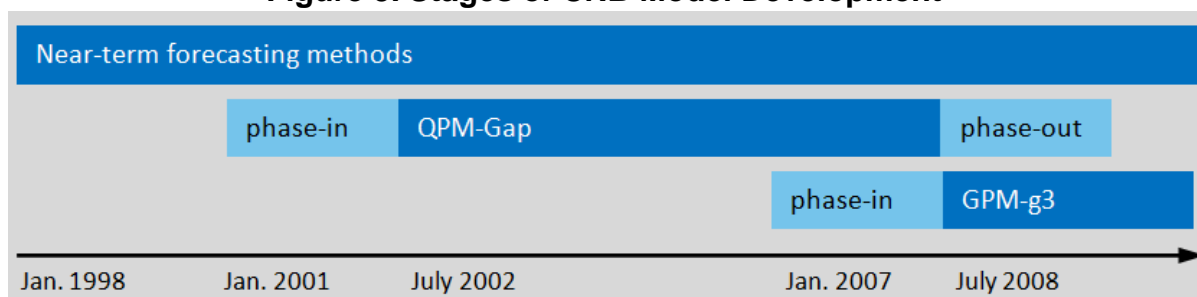
<sup>14</sup> For example, see the statement by the Governor of the Riksbank, Ingves (2007). The absence of any particular problem for these central banks suggests that they are very effective communicators, or that the fear of a perceived commitment to an interest rate forecast was overblown.

## II. DEVELOPMENT OF THE CZECH NATIONAL BANK FPAS

### 2.1 Initial years—near-term forecast methods

Model development for inflation targeting at the CNB can be split into three distinct stages (Figure 3). The first, 1998 until mid-2002, relied on data-driven, near-term forecasting (NTF) models. The second, 2002-2008, used a small scale core model (QPM-Gap) for forecasting and related analysis. The third stage started in mid-2008, when QPM-Gap was replaced with a DSGE model, labelled QPM-g3 in our paper.

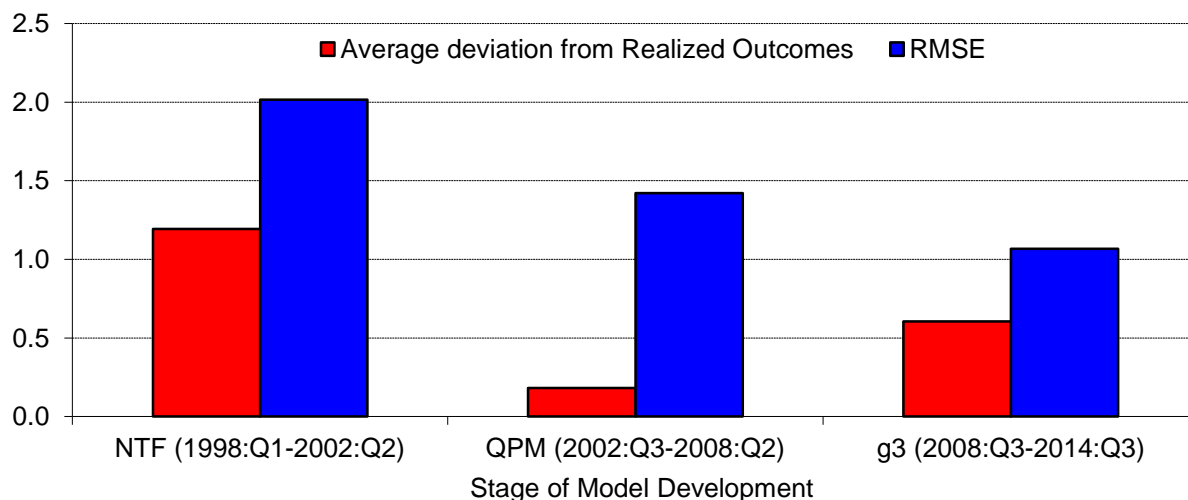
**Figure 3. Stages of CNB Model Development**



Source: CNB.

Progress has been rewarded with increased accuracy for 4-quarter-ahead inflation forecasts (see Figure 4). Moreover, the decline in forecasting errors under QPM-g3 was achieved during the economic turbulence following the global financial and economic crisis, and despite the ELB on interest rates. Nevertheless, unexpected external anti-inflationary shocks led to over-predictions of inflation, which were amplified by the ELB constraint that was not fully offset by the use of unconventional monetary policy.

**Figure 4. Accuracy of CNB's 4Q-Ahead Inflation Forecasts**



Source: CNB, own calculations.

The pre-1998 monetary policy framework was based on a combination of a pegged exchange rate regime with money targeting. Analysis focused on the balance of payments and monetary aggregates. There was no perceived urgency to develop a modern monetary policy model to forecast economic developments and control the inflation process. After the May 1997 currency crisis knocked away the exchange rate anchor peg, the central bank was forced to look for a new anchor for monetary stability, and by the end of the year it chose inflation targeting.<sup>15</sup> The preparatory period was thus extremely short. In 1998, the CNB embarked on inflation targeting without an appropriate infrastructure or forecasting methods (see Coats, Laxton and Rose, 2003). It had to rely on the data-driven near-term forecasting methods, and expert judgment.<sup>16</sup>

Inadequate forecasting methods, together with the volatile macroeconomic environment and unstable inflation expectations, contributed to very large forecast errors in the initial years of inflation targeting (Holub and Hurník, 2008; Šmídková, ed., 2008). An important part of the sudden and unpredicted disinflation in 1998-1999 could be attributed to a sudden fall in global and food prices in that period, i.e. to exogenous shocks. However, it can also be argued that the NTF methods underestimated the disinflationary impacts of the economic recession, and of a sharp rebound of the exchange rate. The main cause of the recession was a domestic banking crisis, and credit squeeze. Inflation fell very quickly almost to zero, i.e. well below the target and forecast. Monetary policy, not unfairly, came under criticism for being overly tight, and for making the recession unnecessarily deep.

NTF methods do have a comparative advantage for the short end of inflation forecasting horizon. This is true especially for quantifying the near-term (i.e., this quarter and the next) impact of cost-push shocks, such as changes in indirect taxes, price deregulation, and global commodity price fluctuations. However, even for these factors, for horizons beyond a couple of quarters it is important to take account of the monetary policy environment. In general, following a shock, a credible monetary policy will re-establish the targeted inflation rate over the medium term, with the time profile of adjustment depending on the nature, size, and duration of the source of the shock. Depending on the preferences of policymakers with respect to the short-run output-inflation trade-off, inflation may be brought back to target more or less quickly. A proper forecasting framework takes all such variables into account, and incorporates a well-specified monetary policy transmission mechanism. The 1998-vintage NTF analytical tools, however, embodied the then widely-held beliefs that interest rates played very limited role in affecting aggregate demand, and that inflation was mainly

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<sup>15</sup> The decision to start inflation targeting was actually taken by the Board in December 1997, effective from January 1998.

<sup>16</sup> See Isard and Laxton (2000) and Laxton and Scott (2000) for an initial discussion of the role of models to support IFT, as well as Laxton, Rose and Scott (2009) for an update.

determined by cost-push shocks. Thus, in addition to being wrong about the disinflation process, they did not provide a useful guide to the appropriate degree of monetary policy easing once it became clear that inflation was dropping at a faster than desired pace. As a result of these forecast errors, and an awareness within the CNB of practices and models in use at central banks that were at a more advanced stage of inflation targeting, the incentives were established to create a new forecasting and policy analysis system (FPAS), with a medium-term focus, and an active role for monetary policy (see Coats, Laxton and Rose, 2003).

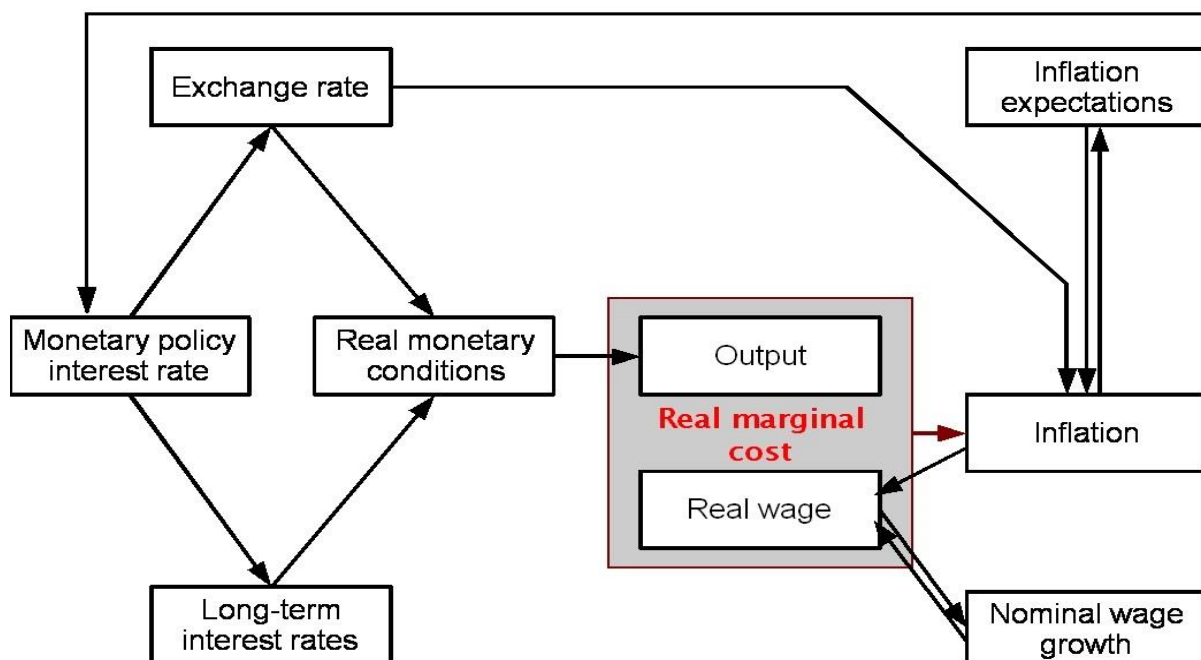
## **2.2 Medium-term focus—QPM-Gap**

QPM-Gap, a small-scale calibrated monetary policy model for the Czech Republic, was developed over several years, with technical assistance from the IMF (see Coats, Laxton and Rose, 2003). The model's introduction into the CNB's policy decision making involved several steps. First, the central bank had to commit the necessary staff resources: the model development and forecasting team; the team head; the model operators; and the relevant sectoral specialists. Second, model development proceeded step-by-step, from a pilot version of QPM-Gap, focusing on the key channels of the policy transmission mechanism. Third, the model's calibration was improved over time by bringing the model closer to data. This time-consuming task (it took about 18 months) involved testing the model's dynamic properties, evaluating the model-consistent estimates of unobserved variables, and identifying the key demand- and supply-side shocks. The staff tested the model's forecasting properties through in-sample simulations and shadow forecasts (Figure 3). Sectoral specialists were consulted on the plausibility of the latter, and the magnitudes and timing of model responses to shocks. Finally, policymakers and staff agreed upon a set of operational rules, specifying the timeframe of the forecast, personal responsibilities and clear deadlines for each stage of the process.

The switch to QPM-Gap in July 2002 can be regarded as the start of IFT in the Czech Republic: QPM-Gap had the appropriate medium-term focus; it included forward-looking channels; the monetary policy transmission mechanism had an internal channel (through a forward-looking interest rate term structure), and an external channel (through the exchange rate); and last, but not least it had the all-important endogenous, policy-determined, short-term interest rate.

Figure 5 outlines the structure. The model disaggregated inflation, with separate Phillips curves for core, food and fuel inflation, with administered prices being exogenous. The latter aspect smoothed the transition from the previous NTF inflation forecasting method. The real side of the economy in QPM-Gap was represented by a single aggregate output gap. The NTF team developed tools to decompose the aggregate GDP forecast from QPM-Gap into expenditure components, as policymakers wanted to see forecasts for household consumption, government consumption, investment, exports and imports.

**Figure 5. CNB's QPM-Gap Model – Extended Version from January 2007**



Source: CNB, Inflation Report, I/2007.

QPM-Gap style models are a good starting point for countries planning to adopt, or in the early years of, inflation targeting. They provide the necessary features to facilitate forward-looking monetary policy discussion. At the same time they are adaptable to different—and evolving—country circumstances, and are not too demanding on human and other resources. In the Czech case, there were three material modifications to QPM-Gap during its 6 years as the core forecasting model.

First, staff recalibrated the assumptions about long-term equilibrium paths, with an increase in the rate of appreciation of the equilibrium real exchange rate, and a reduction in the domestic real equilibrium interest rate. These changes were motivated by forecast errors, in particular by an observed strong uptrend in the real exchange rate that was not having a visible negative effect on the real economy. A second modification explicitly recognized the impact of domestic wage developments as a factor in CPI inflation. The real wage gap was added to the output gap as a component of the real marginal cost gap (as in Figure 5). This extension of QPM-Gap drew on experience with the new GPM-g3 model, which was already being phased in. Third, staff reduced the second-round effects of administrative measures and other short-term cost-push shocks in the Phillips curve. This was in line with the observed weakening of pass-through effects. It also recognized the lower inflation persistence emerging in work on the new GPM-g3 model.

These model changes contributed to the improved forecasting performance described above, illustrating that model development based on assessments of the sources of past forecast errors is a valuable part of the FPAS (see Filáček, 2007; Brázdík, Humplová, and Kopřiva, 2014).

### 2.3 DSGE model—QPM-g3

In 2008, the CNB switched to a DSGE model, QPM-g3, as its core quarterly projection model.<sup>17</sup> As with the initial QPM-Gap, the switch was preceded by intensive debate, testing and shadow forecasting, including an alternative forecast scenario published in the Inflation Report II/2008. Table 2 provides a comparison between QPM-Gap and QPM-g3 (details for QPM-g3 are in Andrle and others, 2009). The QPM-g3 model is derived from behavioral principles. It works with time series in levels to preserve stock-flow consistency, whereas QPM-Gap used cyclical gaps from pre-filtered trends. Since GDP is disaggregated on national accounts lines, QPM-g3 does not need to use NTF disaggregation tools for the major components of spending.<sup>18</sup> However, since QPM-g3 does not itself have components of inflation, the modeling and projections team developed satellite models using Kalman-filter based methods to provide such detail.<sup>19</sup>

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<sup>17</sup> The CNB was introduced to DSGE models by IMF technical assistance (TA) and, in fact, the model used on the TA mission was one of the first DSGE models ever developed in a policymaking institution (for a description of the calibration to the Czech Republic see Laxton and Pesenti, 2003). However, it is important to emphasize that the GPM-g3 model was developed from scratch by modelers at the CNB and was the first DSGE model to be used as a core quarterly projection model in an IFT central bank. The developers of the Czech models have provided extensive technical assistance to other central banks working on developing IFT frameworks.

<sup>18</sup> See [http://www.cnb.cz/en/monetary\\_policy/inflation\\_reports/2008/2008\\_III/boxes\\_annexes/ir\\_2008\\_III\\_box\\_1.html](http://www.cnb.cz/en/monetary_policy/inflation_reports/2008/2008_III/boxes_annexes/ir_2008_III_box_1.html) for the sectoral and production structure of the GPM-g3 model.

<sup>19</sup> The members of the modeling and projection team generate baseline scenarios using the QPM-g3 and are also responsible, on a rotating basis, for model development. The CNB's forecasting team is a considerably larger group of staff—the modeling and projection team is a subset of it. The forecasting team includes management of the Monetary Department and all the technically-oriented staff responsible for the analysis and forecasts of particular sectors (external and domestic economy, financial sector issues, fiscal policy, etc.). This also includes staff responsible for the CNB's communications of the forecast and monetary policy.

**Table 2. Comparison of QPM-g3 and QPM-Gap**

QPM-g3	QPM-Gap
explicit derivation using “behavioural principles”	reduced form
model-consistent expectations	model-consistent expectations
stock-flow consistency	flows only
basic national accounts disaggregation	no GDP structure
works with level variables	works with “gaps”
balanced-growth path with technology trends	equilibrium trends
simple fiscal block	implicit treatment
inflation-forecast-based interest rate reaction function	inflation-forecast-based interest rate reaction function
carefully chosen “structural shocks”	residuals for each equation

Source: CNB, Andrlé and others (2009).

Although using DSGE models for forecasting has been questioned (e.g., Fukač and Pagan, 2006), the experience of the CNB has been positive. As already noted, the forecasting performance for inflation on the monetary policy horizon has improved, at least since the early stages of the Great Recession, during which the large forecast errors can be attributed to wrong assumptions rather than to a wrong model.

The disaggregated nature, and the structural form, of QPM-g3 have provided degrees of freedom for incorporating judgment in a consistent way (see Brůha and others, 2013). At the same time, the forecasting team has been able to develop procedures for using the QPM-g3 model to address ELB issues (see Franta and others, 2014).

In the QPM-Gap model, the output gap was the main domestic driving force of underlying inflation (at least until the real wage gap was added in January 2007). In QPM-g3, underlying inflation is driven by real marginal costs and mark-ups. There is no aggregate output gap as such, although there is a high correlation between mark-ups in QPM-g3’s domestic intermediate sector and standard output gap estimates. Since policymakers still want to see output gap estimates, these are provided via estimates of potential output from a suite of non-core models, e.g., a univariate HP filter, a multi-equation Kalman filter inherited from the

QPM-Gap period, and a production function (Hájková and Hurník, 2007).<sup>20</sup> These output gap estimates have helped distinguish demand-driven from supply-driven deflation risks during the period when the ELB has been binding (Franta and others, 2014).

## **2.4 Organizational changes to better integrate views of near-term forecasters and macro modelers**

While a monetary policy model such as QPM is an essential organizing tool, an effective FPAS consists of much more than just a model. The forecasting process, for example, should allow efficient use of expert judgment and NTF input in the baseline forecasts produced with the core model. The core model is necessarily simplified, as an effort to incorporate many features of reality would make it too complex and difficult to maintain and operate. In particular, a model focused on medium-term macro dynamics is unlikely to capture short-term idiosyncratic factors that are routinely watched by experts. Therefore, during a given forecasting exercise, model users input expert judgment on relevant factors that are absent from the model itself. Brůha and others (2013) provide several real-life case studies from the CNB's experience, showing how incorporating expert information into a structural framework may be useful during turbulent times. Policymaking benefits from forecasts and analyses that credibly incorporate the key features of actual economic circumstances.

A key managerial issue here is to make sure that the modelling team and sectoral experts cooperate effectively. There is a risk in any bureaucracy that individuals will instead seek to maximize their own influence, and thus their perceived importance for the institution. The original forecast organization at the CNB in 2002-2003 was unfortunately not immune from this risk. Historically, the NTF experts and the modeling and projections team had been split into two divisions with two heads ("Real Economy Division" and "Economic Modeling Division"; Figure 6). This created tensions. These became apparent during the process of integrating the near-term and medium-term forecasts. For example, there could be forecast revisions unrelated to new pieces of information, but rather to changes in the "bargaining power" of the two groups. In 2003 members of the Board expressed dissatisfaction with the forecasting process.<sup>21</sup>

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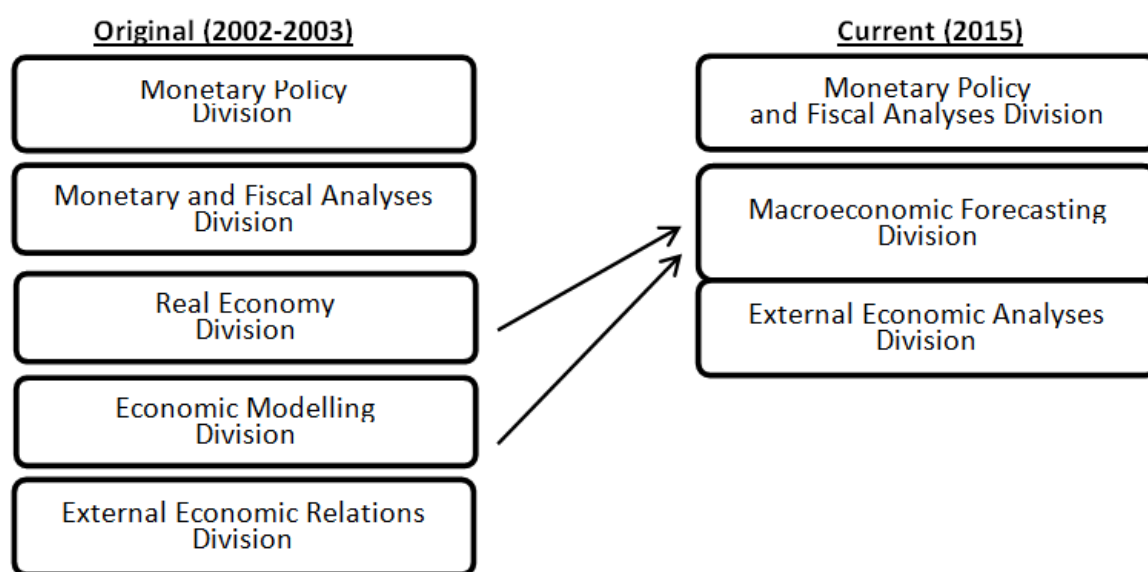
<sup>20</sup> See CNB's Inflation Report I/2010 Box 2 for a description of the various methods used by the bank and the uncertainties surrounding the calculation of potential output.

<sup>21</sup> For example, very critical remarks can be found in the transcript for the 30 October 2003 Board meeting (available in Czech language only): [http://www.cnb.cz/miranda2/export/sites/www.cnb.cz/cs/menova\\_politika/br\\_zapisy\\_z\\_jednani/2003/2003\\_10\\_30/pt\\_10\\_SZ\\_30\\_10\\_03.pdf](http://www.cnb.cz/miranda2/export/sites/www.cnb.cz/cs/menova_politika/br_zapisy_z_jednani/2003/2003_10_30/pt_10_SZ_30_10_03.pdf).



A restructuring in 2004 merged the two teams into a single Macroeconomic Forecasting Division (Figure 6). A division director is now responsible for managing the whole forecast process, and for making sure that both groups make co-operative input into the final forecast. A department-wide forecasting team, of about 10 people, ensures that the other divisions of the department are actively involved in the forecasting process. The team head is chosen from the core model operators, with the job rotating, usually after 2-4 forecast exercises. All divisions send experts to the team, which reports to the management of the department, and presents its work at several departmental meetings during each forecasting round. The head of the forecasting team gives the forecast presentations at meetings with the CNB Board.

**Figure 6. Evolution of the Organizational Structure at CNB**



Source: CNB.

The forecasting process lasts about seven weeks and follows a detailed timetable, an outline of which is summarized in Table 3. The actual timetable specifies precise deadlines for all major steps in the forecasting process and individual responsibilities of the staff members. It is a key managerial tool in the whole forecasting process.

**Table 3. Timetable of the Forecasting Process**

Meeting	Week
Issues meeting	1
Meeting on forecasting techniques and past forecast evaluation	2
NTF presentation to the department	3
Meeting on initial conditions and forecast assumptions	3
Meeting with the Board on initial conditions	4
First version of the forecast	4
Meeting with the Board on alternative scenarios	5
Approval of the forecast	5
Drafting of the Situation Report / Inflation Report	6
Meeting on the monetary policy recommendation	7
CNB Board's monetary policy meeting	7
Post mortem meeting	7/8

Source: CNB.

The original practice was to take 3-4-quarter-ahead NTF forecasts as given (i.e. overriding the model-based predictions). This quickly generated problems. The procedure resulted from a compromise—i.e. an attempt to ease the transition from a purely NTF-based forecast to model-based forecast. Given the degree of persistence in the QPM-Gap, which matched the business-cycle data, the forecasts for the most relevant policy time horizon were dominated by the NTF input. They therefore suffered from many of the same problems as the forecasts in the NTF period. The Board underestimated the legacy impact, and assumed that the new core model was to blame.

In 2004 the practice was changed. Since then, CNB forecasts of the key macroeconomic variables use NTF estimates only for the most recent quarter (nowcasts), and/or for one-quarter-ahead forecasts. The NTF team also prepares forecasts for regulated prices, indirect tax changes and government consumption, which are exogenous inputs into the model over the whole forecast horizon. Similar treatment applies to the foreign economic outlook (from the External Economic Analyses Division, Figure 6), and to fiscal impulse estimates (from the Monetary Policy and Fiscal Analyses Division). Expert judgments influence the forecasts when NTF experts make a convincing argument. The general-equilibrium core model framework assures that these judgments are implemented in a consistent way, such that their impact on the forecast can be quantified and transparently communicated to policymakers as well as to the public (Brůha and others, 2013).

The transition to this new system was not smooth. At the first application, the Board felt discomfort about a sudden change from the preceding forecast.<sup>22</sup> And the forecast turned out to be quite inaccurate.<sup>23</sup> Nevertheless, over time the new system proved worthwhile, with a reduction in forecasting errors.

These experiences stress the importance of:

- clear communications between staff and policymakers from the outset of a quarterly projection round, so that modifications to models or assumptions do not take policymakers by surprise, and so that forecasters confront the main concerns of policymakers about the economic conjuncture;
- open communication and close cooperation across divisions, so that by the end of the process all members are working from an agreed set of assumptions.

Appropriate modalities for good communication and cooperation can be honed over time. In the Czech case, the occasional hiccup revealed a weakness in the system that led to an improvement.

## 2.5 The human resource input

An effective FPAS team does not have to be large, but it does need a balance of complementary skills. CNB experience suggests that the process can be started with a relatively small team, and strengthened over time. Specialized modeling skills are not acquired quickly, either through training of existing staff, or through recruitment. In both cases, it is more important to have a good match between job requirements and individual skills, than to fill an open position without delay. This said, narrow specialization is unhelpful, either from the cooperative viewpoint of team output, or from the individual viewpoint of the careers of team members. Diversification of skill profiles can be achieved through encouraging staff to take an interest in the broader aspects of the work of the team, and through timely job rotation—policies that are at the same time likely to improve the work environment and the quality of output.

The setup in 1998 at the CNB was not well suited to IT. Most economists at the Monetary Department (MD) were employed as sectoral specialists focusing on analyses of the real

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<sup>22</sup> See the transcript of the 29 April 2004 meeting, which is unfortunately also available in the Czech only: [http://www.cnb.cz/miranda2/export/sites/www.cnb.cz/cs/menova\\_politika/br\\_zapisy\\_z\\_jednani/2004/2004\\_04\\_29/pt\\_04\\_SZ\\_29\\_04\\_04.pdf](http://www.cnb.cz/miranda2/export/sites/www.cnb.cz/cs/menova_politika/br_zapisy_z_jednani/2004/2004_04_29/pt_04_SZ_29_04_04.pdf). Already its first sentence by one of the Vice-Governors is revealing in this regard: “Abrupt swings in the opinion on the economy are inappropriate.”

<sup>23</sup> Antoničová and others (2008) claim that: “In terms of the size of the integrated forecast error, the April 2004 and October 2005 forecasts can be regarded as the least successful.”

economy, monetary developments, and the balance of payments. They were applying NTF methods. Until 1997, this was not much of a drawback for practical purposes, as the CNB had very limited monetary policy autonomy under the pegged exchange rate regime—the central bank fixed the value of the Czech koruna to a 2-currency basket (weighted 65 percent German mark, and 35 percent U.S. dollar). Forecasting was based on expert judgment and simple NTF methods. There was a widespread belief among the CNB staff at the time, reflected in the models in use, that the level of the short-term interest rate had a negligible effect on aggregate demand.

Monetary policy modeling involved few economists. This unfavorable resource ratio—very common in many central banks prior to IT—was also a legacy of the previous regime. More fundamentally, the lack of know-how in structural modeling and modern macroeconomics meant that economists at the CNB had an opportunity to acquire first-hand knowledge about the functioning of a market-based economy. Economics departments of Czech universities modernized courses only gradually after 1990, so that the supply of well-qualified graduates with some knowledge of modern macroeconomics was very limited. These constraints largely explain why, even in the late 1990s, the monetary department’s output was still largely characterized by descriptive and heavily statistically-oriented material.

However, the Czech education system did provide the population with high-quality education in particular areas, especially in mathematics and other technical subjects. The few economists at the CNB that were focusing on modern macroeconomic analysis produced work of high technical quality. Moreover, by the turn of the century, graduates well-schooled in modern macroeconomics were emerging from the universities, and the CNB became a very successful recruiter of talent from these universities.

Of course, it is important to have the relevant technical skills.<sup>24</sup> Purely technical knowledge, however, is not sufficient—all members of the forecasting team should have at least some acquaintance with modern, open-economy, macroeconomic theory, and some should be experts in the field. Very useful assets are strong economic intuition, and a close understanding of the data. Economists with a talent for synthesizing various strands of thought, and with drafting skills, can shape the central bank’s economic story of a forecast into an intelligible narrative, without losing the technical insights. (The right amount of technical detail depends on the audience—for example policymakers or academics would demand more than journalists or the general public.)

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<sup>24</sup> Useful software today includes MATLAB, IRIS, DYNARE, SIRIUS, and PYTHON. Model-related technical knowledge covers univariate and multivariate filtering (HP, bandpass, and Kalman) as well as solution methods for solving linear and nonlinear dynamic stochastic general equilibrium models. For useful examples of programs using these software see [www.douglaslaxton.org](http://www.douglaslaxton.org).

Senior management put a high priority on the development of the FPAS. By 2001 the development of the FPAS was well underway, with 3-4 economists in the modeling and projections team, and 6-8 sectoral specialists. In-house training, supported by IMF technical assistance, gradually created a critical mass of knowledge and staff. The IMF technical assistance involved state-of-the-art modeling, but was not merely technical in nature. It also provided a focus on FPAS *modus operandi*: roles for individual teams; timing of stages within a forecast exercise; incorporating off-model information into the forecasts, etc.<sup>25</sup> Such a system is perhaps the main difference between academic, one-off, analyses, and the ongoing flow of forecasts and related analyses in a policymaking institution.

Senior management has continued to support the FPAS. By acknowledging that the input of the FPAS made a difference to their decisions, policymakers boosted morale, and created a strong incentive for staff to remain with the team and perform well. Moreover, the opportunity to acquire valuable know-how, and to add to individual human capital—evidenced at the CNB by the fact that economists who assisted the launch of the FPAS, became leading experts in modeling and forecasting on the international level—is also a motivating factor.

These incentives are all the more important in view of the need to keep staff turnover at manageable levels.<sup>26</sup> Forecasting rounds involve a schedule of daily meetings and rigid deadlines. Solutions have to be found for unexpected economic or technical problems. Compromises have to be struck between differing staff views on various issues. Presentations for policymakers have to be prepared with tight deadlines. And after the exercise is over, once a quarter, forecast error evaluations have to be made.<sup>27</sup> The nature of the work puts enormous pressure on the forecasting team and can result in significant stress given the tight deadlines.<sup>28</sup> However, over time, an experienced forecast team will start to solve problems in a more routine manner, especially if they have a basic analytical framework and set of

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<sup>25</sup> See Coats, Laxton and Rose (2003) for documentation of the initial FPAS developed at the CNB.

<sup>26</sup> The time pressure on staff can be reduced by automating regular processes, including data management, production of charts, tables and presentations, etc. This requires a significant investment of time by technically-skilled staff initially, but pays off in the longer run in terms of avoiding laborious activities and reducing the risk of human error.

<sup>27</sup> Each quarter CNB staff does a forecast evaluation, based on a detailed model-consistent analysis of the factors contributing to forecast errors. The results of these evaluations are presented to the policymakers. They help identify priority areas for model improvement.

<sup>28</sup> The modeling and projections team have grown over time to six economists. The enlargement of the team made it possible to create a rotational system composed of two 3-member teams, which rotate on an annual basis between forecasting and model development. During each calendar year one of the 3-member teams is responsible for the forecast and the other team does model development and economic research to support the FPAS.

modeling tools that have been designed specifically to support an IFT monetary policy framework.

It is important then, that after a certain period of time forecast team members have the opportunity to work on other projects with less stressful deadlines and longer planning horizons (e.g., model development, NTF work, training, or even secondment to some other central bank or research institution). At the CNB economists from the FT regularly switch between forecasting and research. That is, for a one-year period three members of the modeling and projections team help produce forecasts, while the remaining members do model development and research. Ideally, the selected research projects focus on some aspect of model development, e.g., extensions with new blocks.<sup>29</sup> Experience of the CNB (but also from other central banks) suggests that research by FT members is more fruitful than external research for core model improvements—in part because the costs of knowledge transfer are so much less. On the other hand, research projects should not be vetted narrowly. A researcher pursuing an idea of their own occasionally comes up with a mind-changer—we never know where the next good idea is going to come from.

Even an appreciative working environment, and a system of job rotation that allows staff time to pursue—and publish—other research interests, cannot ensure retention of crucial staff. There will always be departures. This means that at least 2 individuals should be capable of performing in each position—another argument for job rotation. In principle the economics staff should be sufficiently flexible that, between forecasts, the entire FPAS team could be switched for another—the outgoing members taking over the functions of the incoming. The idea is not that such a switch would ever be a good idea in practice, but that the system has adequate backup. This also applies to models and data sets—all of which should be fully documented and stored, such that they are accessible to the whole team, and not just to particular individuals.

### III. POLICY PERFORMANCE

The Czech Republic has earned a reputation of a successful IFT country in spite of the fact that actual inflation has often deviated significantly from announced targets, and the output gap has often been far from zero. The data show a bias to the downside, with inflation being more often below the target than above it (Šmídková, ed., 2008). According to the loss function, until 2006 the inflation targeting error was the more costly facet (Figure 7).<sup>30</sup> Since

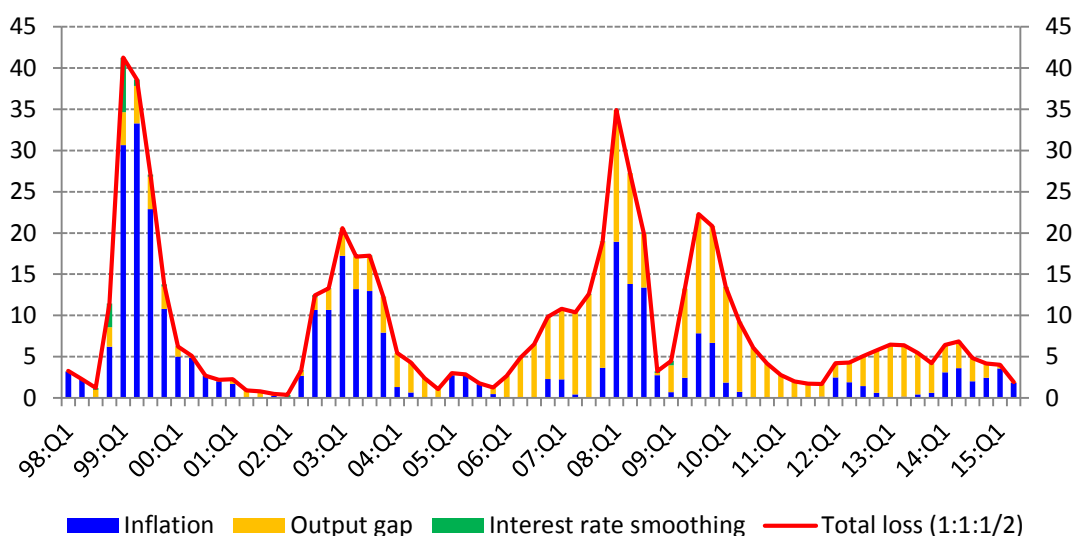
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<sup>29</sup> During the initial period of the Great Recession the policymakers were concerned with the role of financial frictions in the transmission mechanism. In order to test the forecasting model for the presence (and magnitude) of shocks originated from the financial sector, the model was extended to include a financial block. This work was carried out by those members of the FT who were not responsible for forecasting at the time.

<sup>30</sup> The loss function assigns a weight of 1, 1, and 0.5 on the squared deviation of inflation from its target, output gap, and change in the policy rate, respectively.

then, for prolonged periods—e.g., 2006-08, and 2009-14—output gaps have been more dominant (interest rate variability has been a negligible factor throughout). During the years of the Global Financial Crisis, both inflation and output gaps made a large contribution to the loss.

**Figure 7. Loss-Function Values for the Czech IT/IFT Period**



Source: CNB, own calculations.

The undershooting of the inflation target in the early years, however, probably did little harm to the CNB's long-term reputation (despite strong criticism in real time), as it helped dispel memories of double-digit inflation before 1998. From the viewpoint of an endogenous credibility model, the surprisingly low rate of inflation at the turn of the century helped convince people that monetary policy had indeed reformed from the previous high-inflation regime to a new low-inflation regime.<sup>31</sup> Several other elements contributed to anchored inflation expectations (Holub and Hurník, 2008). First, the CNB has been able to execute a consistent, forward-looking, approach to monetary policy. Under the flexible IFT framework, strong exogenous macroeconomic shocks did lead to significant deviations of inflation from the target, and of economic activity from potential. But monetary policy instruments were systematically adjusted to bring inflation back to target over time (Franta and others, 2014; Alichí and others, 2015b). Moreover, the CNB was able to demonstrate that its actions were indeed in line with its objectives, through transparent communications, and the use of

<sup>31</sup> Alichí and others (2009) present a model in which people are initially undecided as to whether monetary policy will adhere to a new announced low-inflation target, or revert to a previous policy of high inflation. In their expectations of future inflation, some weight attaches both to the new target and the old high rate. Over time, the central bank builds credibility by keeping inflation low: the weight on the announced target goes to one, while that on the old high rate goes to zero.

defendable, up-to-date analytical tools. Because of the lagged effect of changes in monetary policy instruments, the behavior of the central bank cannot be monitored in real time simply on the basis of policy outcomes. Instead, people would be looking at recent policy actions, and forming views on whether they are likely to be in line with achieving the objectives. The ability to provide a coherent narrative of how interest rates, and the economy in general, might behave over the medium term, as inflation was brought back to the announced target, was crucial for building the credibility of the Czech IFT regime.

## **IV. EXPERIENCE WITH FULL TRANSPARENCY**

### **4.1 Background**

At the outset of IT, when the CNB relied on the NTF methods, interest rates (as well as the exchange rate) were assumed to be constant over the forecast horizon. There was no need to think about publication of the interest rate path. But such a forecast was burdened with obvious disadvantages (Skořepa and Kotlán, 2006). It ignored the nominal anchor responsibility of monetary policy, and was thus not internally consistent. It was not easily comparable to forecasts of financial market analysts and other institutions, which incorporated their best guess about future monetary policy. The forecast did not provide quantified guidance on the direction and speed of actions required to achieve policy objectives. And when the policy rate was changed, in a direction consistent with the inflation pressures in the most recent forecast, the CNB faced questions on whether the forecast was still valid, and if not, what an updated forecast would look like. This question was hard to answer given the lack of well-defined forward-looking monetary policy transmission in the existing CNB forecasting tools.

Following the introduction of the initial QPM-Gap model in 2002, the forecast did produce an endogenous interest rate path (for the 3-month PRIBOR). This path was described qualitatively at press conferences and in Inflation Reports, with limited information on its slope. At the time, this was considered to be an appealing option, as full transparency was considered fairly controversial in some circles. For example, Mishkin (2004) stated: “Although economists understand that any policy path projected by the central bank is inherently conditional because changes in the state of the economy will require a change in the policy path, the public is far less likely to understand this. When new information comes in and the central bank changes the policy rate from its projected path, the public may see this as a renegeing on its announced policy or an indication that the central bank’s previous policy settings were a mistake.” Mishkin’s risk-of-confusion argument is now much less convincing given the combined experiences of IFT central banks and their capacity to produce confidence bands.

The CNB, however, was moving towards full disclosure. It began to provide verbal descriptions of the shape of its endogenous interest rate path, and its slope in comparison with the market yield curve. It published the coefficients of its interest rate reaction function

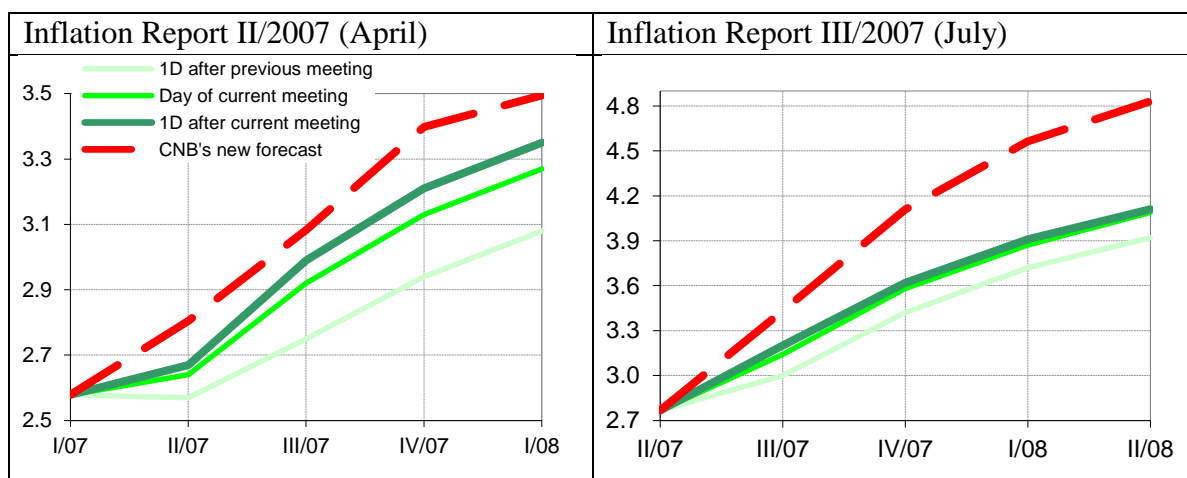


(Coats, Laxton and Rose, 2003). This allowed analysts and market participants to understand reasonably well the systematic behavior of monetary policy. And the central bank's statements about future interest rates got more nuanced and precise as time passed. In the end, the central bank forecasts may have been affecting the market interest rate outlook in pretty much the same way as if the numerical focus path were disclosed, but without the risk of creating falsely perceived commitment.<sup>32</sup>

Consider the forecast for the monetary policy meeting of April 2007.<sup>33</sup> The left-hand panel of Figure 8 compares the interest rate path in the forecast with the market outlook implied by forward rate agreements (FRA) in three different moments of time:

- one day after the preceding March monetary policy meeting;
- the day of the April meeting;
- the day after the meeting.<sup>34</sup>

**Figure 8. CNB's Interest Rate Path and FRA Outlook – Verbal Communication Period**



Source: CNB, own calculation.

<sup>32</sup> Filáček and Saxa (2010) found strong effects of CNB forecasts on forecasts for interest rates and inflation of financial market analysts. Interestingly, they found that the start of publication of the CNB's interest rate path strengthened the central bank's coordination role for the inflation and exchange rate forecasts, but not for the interest rate outlook itself.

<sup>33</sup> Until the end of 2007, the CNB's Bank Board met to discuss monetary issues once a month. Since the beginning of 2008 there are only eight such meetings a year.

<sup>34</sup> We are grateful to Jan Syrovátka from the CNB's Monetary Department for having shared with us his archive of these figures and the corresponding data.

The shift between the first pair of dates would reflect the information from the previous meeting and any other new information between the previous and respective policy meeting. If the market understands the monetary policy framework, the path would have shifted towards the April endogenous interest rate path. This was indeed the case. The shift between the second pair of dates captures the immediate market response to the announced policy decision. There was a further shift towards the as yet unpublished numerical forecast path. This suggests that the forecast was credible, and effective in shaping market expectations. The day-after shift also indicates that the information provided in the central bank announcement and the press conference, in and of itself contained new information that was not priced-in by the market before, because the actual policy rate was held constant (albeit with two members voting for an increase).<sup>35</sup> It is nevertheless interesting that the market path still remained somewhat below the CNB forecast path: this suggests an element of backward-looking expectations, or a differing analysis of the economy; in either case, there is the possibility that explicit publication would bring the market view even closer to the CNB forecast path.

Moreover, there were instances when the verbal description did not bring full convergence of the market outlook to the forecast path. This is illustrated in the right-hand panel of Figure 8, which relates to the CNB forecast for July 2007. During the interval between meetings there had been a modest increase of the market interest rate outlook. The July decision raised the actual policy rate by 25 basis points (with one Board member voting for 50 basis points<sup>36</sup>), and press release said that “Consistent with the macroeconomic forecast and its assumptions is growth in nominal interest rates.” Yet after the meeting the market rate outlook did not change at all, and stayed well below the new unpublished interest rate path—whereas the bank was forecasting an increase of more than 200 basis points over a 1-year horizon, the market was anticipating little more than 100 basis points. This example highlights the potential for a material strengthening of the monetary policy transmission, through a fully transparent publication of the interest rate path.

Starting in early 2008, the CNB decided to also publish the path for the 3-month PRIBOR, in a fan chart with confidence bands based on past forecast errors.<sup>37</sup> This step was taken to

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<sup>35</sup> The press conference release stated: “Consistent with the macroeconomic forecast and its assumptions is a gradual rise in nominal interest rates over the entire forecast horizon.” In the Inflation Report, published later, it was made public that “The interest rate path consistent with the aforementioned CNB forecast was slightly above the expectations of financial market analysts in the near future. At the longer horizon, it was higher.”

<sup>36</sup> The voting ratios for the July 2007 meeting were presented on a press conference on 26th July 2007. The presentation for the press conference can be found here: [https://www.cnb.cz/miranda2/export/sites/www.cnb.cz/en/monetary\\_policy/bank\\_board\\_minutes/2007/download/TK\\_07SZ2007\\_AJ.pdf](https://www.cnb.cz/miranda2/export/sites/www.cnb.cz/en/monetary_policy/bank_board_minutes/2007/download/TK_07SZ2007_AJ.pdf)

<sup>37</sup> This decision was announced on 8 March 2007.

enhance the transparency of the CNB forecast and the associated monetary-policy decisions, and to increase the effectiveness of monetary policy transmission. At the same time, the relatively wide confidence bands illustrated the degree of uncertainty and the conditional nature of the published path.

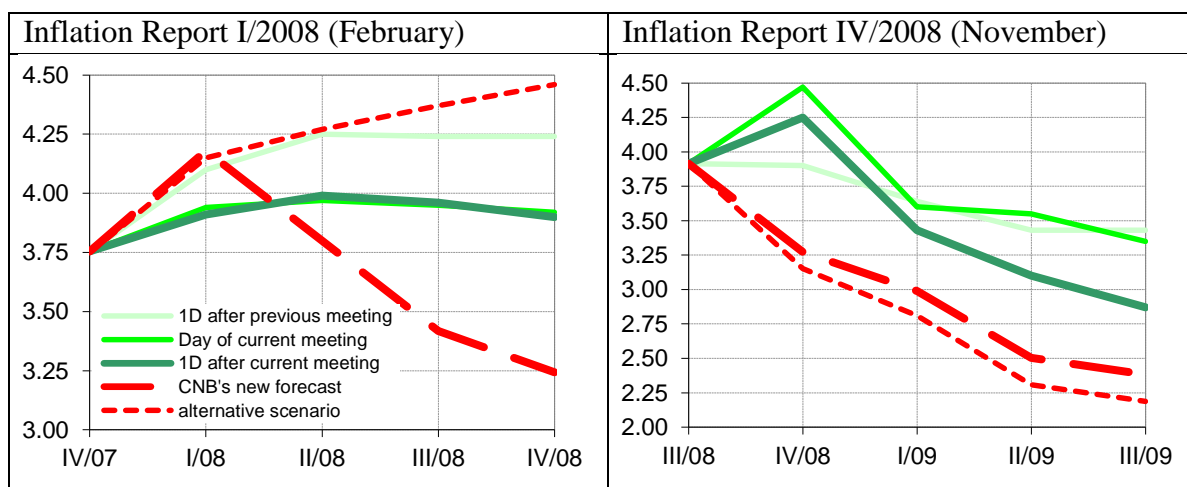
## 4.2 Some interesting episodes for interest-rate-forecast publication

### 4.2.1 February 2008

The forecast suggested that, after a final step in the up-cycle in early-2008, rate-cutting would start later during the year. This was hard to believe for most observers at that time due to the high inflation rate (it approached 8 percent) and robust economic growth. However, the story in the forecast was such that much of the increase in inflation was temporary, as a result of an increased food and administered prices and indirect tax changes, and that any second-round effects would be muted, given the softening in the forecast for output.<sup>38</sup>

Pre-policy meeting, the market had priced in a flatter interest rate outlook, but had no immediate reaction at all to the published forecast, which showed a drop in the interest rate of 100 basis points by the end of 2008 (Figure 9, left-hand panel).

**Figure 9. CNB's Interest Rate Path and FRA Outlook – Two 2008 Case Studies**



Source: CNB, own calculations.

<sup>38</sup> Ex post, this can be regarded as an illustration of how IFT can outperform a backward-looking approach to inflation targeting. Of course, the actual depth of the Global Financial Crisis was unforeseen at that time, and eventually the rate cuts were much deeper than the February forecast had suggested.

The lack of reaction can be attributed to excessive discounting of the published rate projection, which may have been encouraged by overly qualified communications on the part of the central bank:<sup>39</sup>

- the prior effort to explain conditionality may have been overdone—it gave a reason to ignore the published rate projection;
- the Board emphasized uncertainties—“larger than usual” with “risks on both sides”;
- the CNB published an alternative scenario, using the previous version of QPM-Gap, which had much stronger inflation pass-through effects, which showed an endogenous interest rate path (Figure 9) above the market outlook.

In view of these cautious and mixed communications, it is not surprising that the market outlook came out between the baseline forecast and the alternative.

#### **4.2.2 November 2008**

The short end of the market outlook had diverged from the forecast interest rate path before the meeting, due to a sharp rise in money market risk premiums, post-Lehman collapse (Figure 9, right-hand panel). After the policy meeting, the longer end of the market outlook converged reasonably close to the new published forecast.

Indeed, the numerical publication of the interest rate path does tend to affect the market expectations in practice, but not one-to-one, and not mechanically. The market understands that in normal times, the path is not a CNB’s commitment regarding the future evolution of rates, but is conditional on current and future macroeconomic developments. It was communicated from the very beginning, or actually even before the publication started, that “owing to the arrival of new information after the preparation of the forecast, and to board members’ different views of economic developments than as outlined in the Monetary and Statistics Department’s forecast, the actual interest rate path can deviate from the forecasted path.” On the positive side, the absence of a mechanical market reaction means that the risk of falsely perceived commitment has not been encountered in practice by the CNB, and also that no confusion arises if the Board is able to explain why it chose to deviate from the forecast. Ultimately, market expectations about future monetary policy are affected by the whole “package” of central bank communication, which includes not only the forecast and its interest rate path, but also alternative scenarios, communication of the Board regarding their assessment of risks, voting ratio of the CNB Board members, Minutes of the Board meeting (published with a lag of eight days), etc.

#### **4.2.3 May 2009 and November 2012—positive experiences**

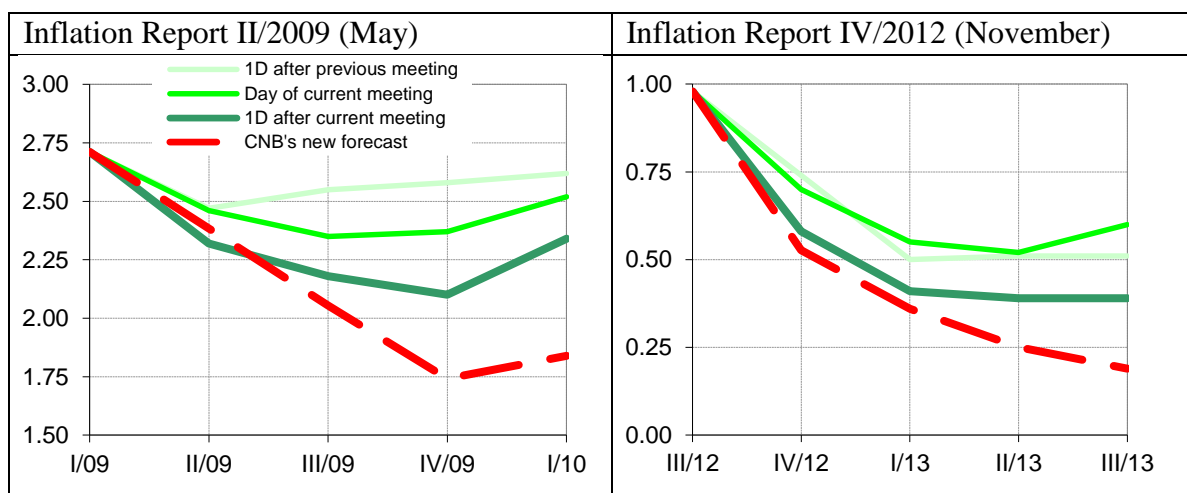
Other cases when market forecasts immediately moved closer to the published interest rate path can be seen in Figure 10.<sup>40</sup> With the post-crisis economic weakness and disinflation, the

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<sup>39</sup> Some Board members later expressed reservations about this forecast.

market outlook had been pricing in further rate cuts before the meeting, and the publication of even lower rates in the CNB forecast pushed down the market curve. The right panel, for the November 2012 meeting, shows a forecast path that goes to close to zero. Moreover, the Board issued a strengthened forward guidance statement: “... rates will remain at this level over a *longer horizon* until inflation pressures increase *significantly*.” The market outlook moved down immediately to a level consistent with the forecast, almost zero, policy rate (given the market risk premium) and with the associated forward guidance.

**Figure 10. CNB’s Interest Rate Path and FRA Outlook – Two Further Positive Cases**



Source: CNB, own calculations.

#### 4.2.4. November 2009 and February 2011—awkward experiences

Episodes when market forward rates moved away from the published interest rate path have been rarer. Two are illustrated in Figure 11. In November 2009, the forecast showed a need for a further rate cut, but the Board disagreed (the vote was 4:3 for unchanged rates). The market interest rate outlook moved up, farther from the published interest rate path.

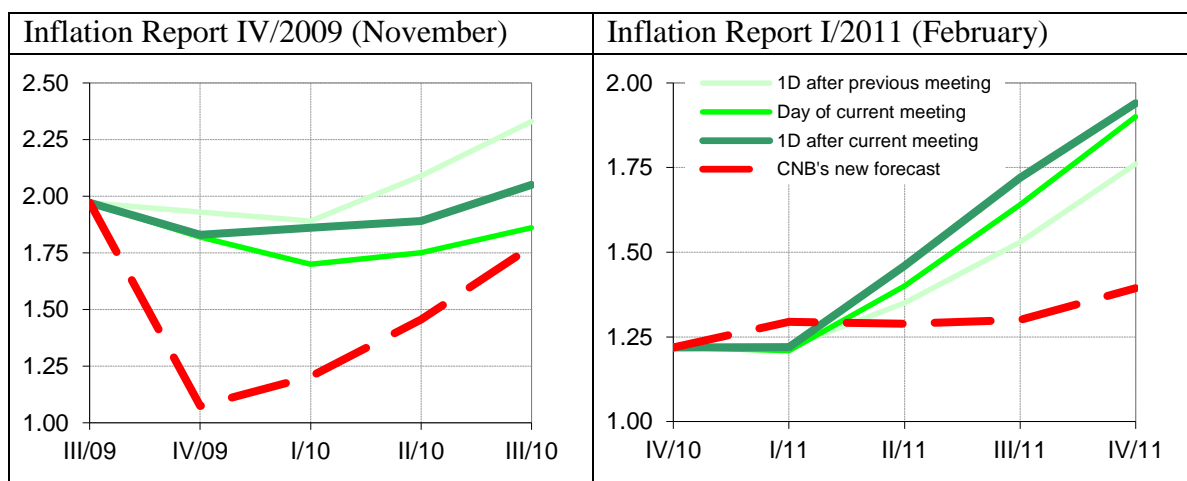
Confusion about the future policy path was partly resolved by the rate cut of 25 basis points at the next meeting.

The second episode of divergence in Figure 11 concerns the February 2011 Board meeting. A rise in current inflation, which mainly reflected increases in energy prices and indirect tax rates, and an ongoing swift recovery from the post-Lehman recession, led to a hawkish

<sup>40</sup> There are numerous other positive examples, e.g., Inflation Reports I/2009 (February meeting), III/2009 (August meeting), II/2010 (May meeting), IV/2010 (November meeting), II/2011 (May meeting), and to a lesser extent also II/2012 (May meeting) and III/2012 (August meeting).

market outlook.<sup>41</sup> The CNB's baseline interest rate path was almost flat for the one-year-ahead horizon, reflecting "the effects of fiscal consolidation ... and still low level of foreign interest rates in the short run" (Inflation Report, I/2011). The Board had asked the staff to prepare three alternatives, out of which only one implied rate increases. Three out of 7 Board members nevertheless voted for a 25 basis point increase at the meeting. The market reaction immediately moved its interest rate outlook farther above the published CNB forecast. The market thus put more weight on Board voting and communications than on the forecast. In retrospect, however, the staff forecast gave a better guide.

**Figure 11. CNB's Interest Rate Path and FRA Outlook – Two Negative Examples**



Source: CNB, own calculations.

#### 4.2.5 The ELB period

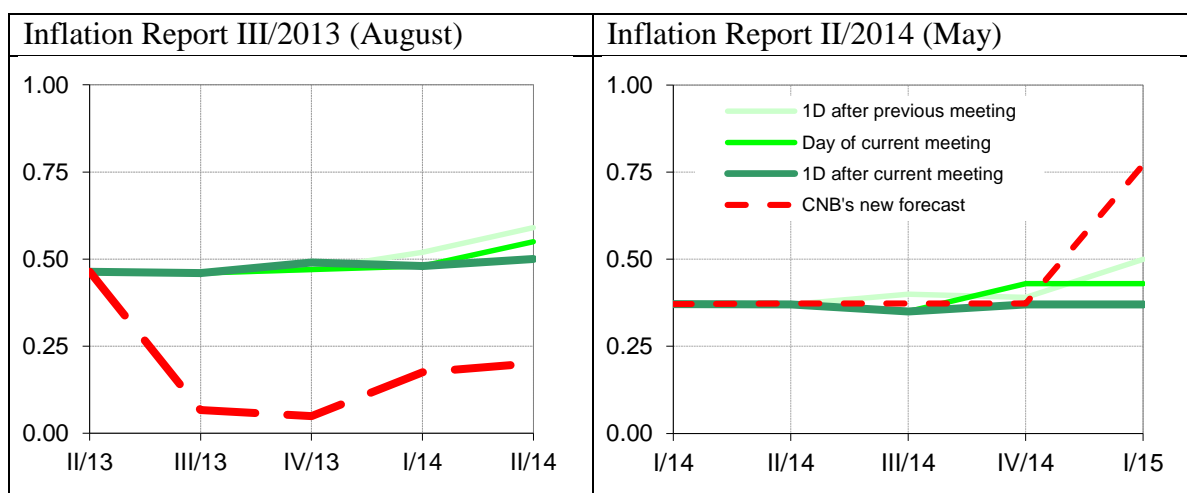
The ELB period since 2013 has highlighted the distinction between the CNB interest rate forecast, and the CNB policy commitment to inflation control. The left-hand panel of Figure 12 presents the interest rate path from the forecast published in Inflation Report III/2013 (August meeting). Given the money market premium, this path for 3-month PRIBOR would imply hypothetically negative policy rates. In effect, the forecast did not obey the ELB constraint, even though the Board had been communicating since September 2012 that it was not considering cutting rates below zero, and that it would instead rely on exchange rate depreciation if further monetary policy easing became needed (Franta and others, 2014). The market, rationally, ignored the published interest rate path and its 3-month PRIBOR outlook stayed at 50 basis points, consistent with a binding ELB.

<sup>41</sup> In addition, the ECB was moving toward an interest rate increase (premature, as it turned out).

The right-hand panel of Figure 12 relates to Inflation Report II/2014 (May meeting). At that time, the CNB was already using the exchange rate as a policy instrument, communicating at the same time that no interest rate increase would take place before the exit from this unconventional policy. Uncovered interest parity suggests that this indirectly implied strong and credible forward guidance on interest rates. In line with this, the market interest rate outlook over a one-year horizon has been consistently flat. The forecast in Inflation Report II/2014 (May meeting) assumed a renormalization of policy, and rising interest rates, in the first quarter of 2015, but disinflationary pressures were still mounting. The Board meeting in

May assessed the balance of risks as “being slightly anti-inflationary,” stating that “the probability of a later exit from the exchange rate commitment was increasing”. The market reacted in line with this, slightly decreasing its interest rate outlook. Subsequent CNB forecasts have further postponed the assumed timing of the exit, and the market outlook has remained extremely close to the CNB forecast paths.

**Figure 12. CNB’s Interest Rate Path and FRA Outlook – Two ELB Examples**



Source: CNB, own calculations.

#### 4.2.6 A summing up

Czech experience shows that the published interest rate path has the potential to affect the market outlook in support of the transmission of monetary policy. But this is only likely to happen if the other elements of communication do not confuse the picture. For example, if the Board’s assessment of risks, or an alternative central bank scenario, points strongly in another direction, the market is likely to ignore the central bank baseline forecast. In such circumstances, the market outlook may even move away from the published path in the baseline forecast. The perceived commitment problem has not in fact materialized: if anything, the market has tended to unduly downplay the central bank baseline forecast. Moreover, the high weight that the market continues to put on the communications of the Board indicates that people well understand that policymakers make the decisions, for which

the staff forecast is just an input. Market confusion is typically avoided as long as the Board is able to explain its actions in a way that is perceived by the market and analysts as consistent with the IFT logic. In the Czech case, November 2009 seems to be the only clear example of some confusion—and this event was a useful disciplining lesson for future communications.

### 4.3 Other aspects of transparency

Dincer and Eichengreen (2014) calculate an index of central bank transparency based on 5 broad criteria (political, economic, procedural, policy, and operational), each of which has 3 sub-categories. Their CNB index from an updated version of the database<sup>42</sup> is presented in Figure 13. It places the CNB as the second most transparent central banks in the sample of more than 100 central banks, with a score of 14.5 in 2014 (maximum 15).<sup>43</sup> The only ½ point missing to reach the maximum score of 15 relates to the explanation of policy decisions, which is actually questionable given that the CNB publishes not only minutes of the Board meetings, but since 2014 also written Statements of the Bank Board after each monetary policy meetings (see below). In any case, the estimated level of CNB transparency is high.<sup>44</sup>

Over time the CNB has broadened, deepened and speeded up its communications on policy actions. The Board issues a press release immediately after the decision is taken, and the Governor gives press conference the same afternoon. The monetary policy decision is explained either in the context of a new macroeconomic forecast (four times a year), or, for inter-forecast policy meetings, of a risk assessment to the previous quarterly forecast (also four times a year since 2008).<sup>45</sup> The presentations give the votes cast by the Board members on interest rate decisions. Since 2014, the Governor has provided a written explanation of the decision, followed by a Q&A session. Eight days after the policy meeting, the CNB

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<sup>42</sup> The Dincer and Eichengreen transparency database is at [http://eml.berkeley.edu/~eichengr/Dincer-Eichengreen\\_figures&tables\\_2014\\_9-4-15.pdf](http://eml.berkeley.edu/~eichengr/Dincer-Eichengreen_figures&tables_2014_9-4-15.pdf).

<sup>43</sup> This is a reassessment compared to Dincer and Eichengreen (2014), which gave the CNB a score of 12 for the 2008-2010 period, compared to 14.5 in the updated time series. In the earlier assessment, Dincer and Eichengreen did not award full transparency score to the CNB for data publication and forward-looking explanation of policy decisions, and regarded it as non-transparent in terms of publicly evaluating achievement of its operating targets, in contradiction to the actual practice.

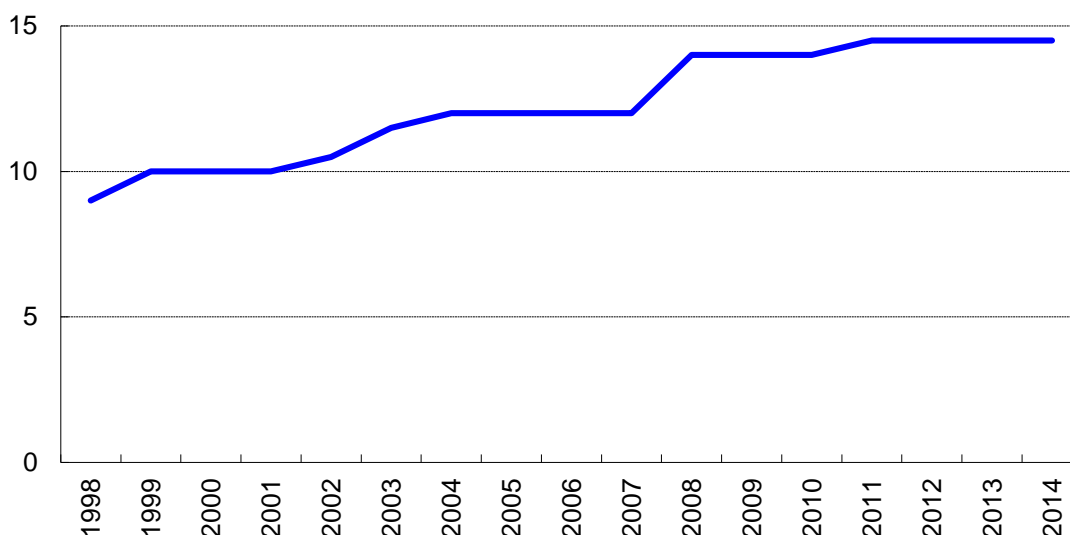
<sup>44</sup> Supporting evidence is that the CNB won the Central Banking Transparency Award 2015 from Central Banking Publications for openness and use of new communication tools. According to Central Banking Publications: “The CNB has long been considered among the top tier of central banks when it comes to openness... In the period under review, the CNB pushed the envelope even further—becoming the first central bank to publish blog posts from its senior officials.”

<sup>45</sup> Between 2009 and mid-2013 the CNB published a fan-chart for endogenous CZK/EUR exchange rate at the press conference—a practice that has been suspended since November 2013 when the CNB announced an exchange rate floor as an unconventional monetary policy instrument.



publishes the Minutes (with the individual votes since 2008), and the Inflation Report, which has full detail of the forecast. Over time, the structure of the Inflation Report has evolved to put more emphasis on the forward-looking content, and to deliver a more concise message.

**Figure 13. Dincer-Eichengreen Transparency Index for the CNB**



Source: Dincer and Eichengreen (2014) database, updated in 2015.

Another regular means of communication is a schedule of quarterly meetings with financial market analysts (both local and foreign), at which senior staff presents the new macroeconomic forecast, followed by a discussion with one or two Board members. These meetings now take place one day after the policy decision announcement, along with the release of the Executive Summary of the Inflation Report, which includes a detailed forecast table.<sup>46</sup>

Increased transparency has not caused huge awkwardness, or to our knowledge adversely affecting the quality of policy debates at the Board. Former Governor Tüma (2010), however, after his departure from the CNB, expressed doubts about the net benefits of publishing Board votes by name: “on the margin, publishing of individual votes goes too far and may actually be detrimental to good policy,” as “the greater transparency may lead to a more opportunistic behavior of the chairman and less frequent swing votes by the Board members.”<sup>47</sup> On the other hand, it is also true that in 2013 some Board members felt

<sup>46</sup> The Board publishes a full transcript of policy meetings with a delay of six years. The six-year lag was chosen to match the term in office of individual Board members, to avoid inhibiting frank and open debate. This publication has yet to attract much attention from academics or journalists.

<sup>47</sup> Tüma elaborated as follows: “I believe that the publishing of individual votes is increasingly pushing the Chairman to behave opportunistically (in the sense that he or she always joins the majority). And I can confirm  
(continued...) ”

discomfort when the Board decided not to publish the individual votes and to restrict communication of individual opinions on the exchange rate. This was a measure intended to avoid any confusion among the public that differing individual voices within the Board might create in extraordinary circumstances of relying on the exchange rate as monetary policy instrument (see Franta and others, 2014). In any case, publishing individual votes on monetary policy decision is not a must for an IFT central bank.

#### 4.4 Ownership of the forecast

“Ownership” of the forecast—who decides the guiding assumptions and judgments—reflects the management structure of the central bank, the nature of its monetary policy decision-making process, the extent to which policymakers shape the assumptions, and requirements for accountability. Since these differ in important ways across countries, one cannot speak about a universal best practice. The main forecast considered for policy decisions can be labeled interchangeably as a Board/MPC forecast, a staff forecast, or a central bank forecast.<sup>48</sup> There is no hard and fast line between these labels. They are all central bank forecasts, in that the institution is ultimately responsible for their production—it provides the resources, it publishes results, and it acknowledges their influence on policy decisions. Under any arrangement, one assumes that the central bank would always in the event of criticism defend the integrity of the forecasting process, and the quality of the underlying research. At the same time, nobody would expect it to defend any particular aspect of any given projection.

CNB Inflation Reports present forecast ownership in the following way: “The Inflation Report contains a description of the Czech National Bank’s new quarterly macroeconomic forecast... The forecast for the Czech economy is drawn up by the CNB’s Monetary Department. ... The forecast is the key, but not the only, input to the Bank Board’s decision-making. At its meetings during the quarter, the Bank Board discusses the current forecast and the balance of risks and uncertainties surrounding it. The Bank Board’s final decision may not correspond to the message of the forecast due to the arrival of new information since the forecast was drawn up and to the possibility of asymmetric assessment of the risks of the forecast and divergent views of some board members on the development of the external environment or the linkages between the various indicators within the Czech economy.” In operational terms one may say that the CNB forecast is a *staff* forecast, and not the *official* forecast of the central bank.

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that I felt the pressure intensely in the autumn of 2009 when I was outvoted a few times in key policy decisions. At that time, I seriously considered to resign. I also believe that the voting pattern of the Board members becomes less flexible—it is difficult to reverse your decision without appearing as admitting a mistake in the public’s eyes.”

<sup>48</sup> Policymakers may also have forecasts of their own. For example, the Federal Open Market Committee of the Federal Reserve publishes summaries of the economic projections of members.

The substantive difference between a staff and an official forecast lies in the degree to which the forecast is the basis for actual policy. To the extent that the forecast does by design reflect the view of policymakers, the key aspects are theirs to defend. Operationally, an official forecast would apply when Board/MPC members, or the Governor, are heavily involved in the forecasting process (e.g., the RBNZ). Given their involvement, policymakers have little room to deviate from the official forecast: they are accountable for it.

Board responsibility for the shape of a forecast would not be feasible at the CNB. The Board is not just a monetary policy decision-making body. It also oversees the management the central bank as an institution, a function that involves a wide range of highly technical, sensitive, and time-consuming responsibilities, including the supervision of the whole Czech financial system. This limits the time that individual Board members are able to devote to monetary policy. Time tracking software used by one Vice-Governor estimated that he devoted only 10 percent of his time to monetary policy, even though he oversaw the Monetary Department (Hampl, 2014). There are only two meetings of the staff with the Board during each forecasting exercise—one focused on assumptions and initial conditions, and the other on the alternative and sensitivity scenarios. In effect, the decision-making process, and the communication strategy of Board members, may be quite individualistic, as frequently surfaces in split votes.<sup>49</sup> On occasion, the Board as a whole may differ from the staff forecast (instances are noted in Section 4.2).

The question of ownership is related to the issues of communications and transparency. Where monetary policy decisions are made by votes in a committee—as opposed to consensus, or the Governor—each member may be basing their vote on an independent, more or less informal, forecast. The staff forecast, however, is likely to be the only fully coherent macroeconomic projection. It is also likely to be the point of departure for the various member outlooks, and the basis of reference for policy discussions. So it has an intrinsic interest from the viewpoint of public accountability, even if it is not necessarily the overriding factor in a committee vote.

The fact that Board members may express reservations may have eased the decision of the CNB to go for full disclosure. The central banks of Israel, Norway, Sweden, and the United States, which also maintain highly transparent communications, likewise make decisions by committee vote. This has not, however, been an overriding factor: in New Zealand, where the Governor alone is accountable for policy actions, and is engaged in the forecast process, the RBNZ has full disclosure.

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<sup>49</sup> See [http://www.cnb.cz/en/monetary\\_policy/bank\\_board\\_minutes/voting\\_of\\_the\\_bank\\_board.xlsx](http://www.cnb.cz/en/monetary_policy/bank_board_minutes/voting_of_the_bank_board.xlsx) for voting of the CNB Bank Board.

A staff forecast applies when the Board/MPC has got other management responsibilities and only limited involvement in the technical aspects of the forecast preparation, wants to retain discretion to deviate from the forecast, and is able to publicly distance itself from the staff's analyses. The record suggests that these conditions apply at the CNB.

#### **4.5 Communications—internal and external**

From the outset in 2002, CNB policymakers have provided steadfast support to the IFT FPAS, with its model-based forecasts. This has survived complete turnover of members of the Board level. Not that support came equally from all Board members, nor that the Board was happy with the forecasting system all the time: it relied on continuing hard work by the staff.<sup>50</sup> In this regard the Czech experience has several lessons:

- forecasts should be communicated to policymakers in digestible economic language that is not overwhelmed by technicalities;
- staff must incorporate judgment and relevant actual events into model-based forecasts;
- policymakers should be able to see the value added of model-based forecasts for making decisions under uncertainty (e.g., through alternative scenarios; alternative policy options; sensitivity analyses, etc.);
- the models need to be adaptable to changes in the economic environment (e.g., the ELB, and unconventional policy instruments);
- improved forecasting accuracy builds confidence in the FPAS.

The following subsections elaborate on these lessons.

##### **4.5.1 Clear language and explanation**

Modelers do not necessarily write well for a non-technical audience. At the CNB the managers of the Monetary Department, who typically are economists with good communications skills, play an important role in editing the final versions of the reports, using their experience with communications to the Board to strike the right balance between technical rigor and digestibility.

Model changes in particular require careful explanation. When the QPM-Gap model was replaced with the GPM-g3 model in mid-2008, some concepts familiar to the Board members disappeared, to be replaced with new ones. In QPM-Gap the inflation forecast was a function

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<sup>50</sup> Governor Tůma (2010): “Developing such a (forecasting) system and making it an acceptable methodology for decision makers was one of the major transformations taking place in the Bank in the last decade. This is because the decision making under IT is torn between two fundamental opposites. At one hand, all forecasts and decisions are wrong ex post, no matter how good forecasting system and models you have. Essentially, some of your assumptions always turn out incorrect. Yet, on the other hand, you need to feel comfortable to make a good decision ex ante—i.e. today.”

of the output gap, import prices and cost-push shocks. The QPM-g3 model replaced the output gap with endogenous real marginal costs of producing consumer goods and with firms' mark-ups. The change was difficult for the Board members to digest.<sup>51</sup> Several rounds of non-technical presentations of the new model to the Board members were needed to facilitate the transition. Presentations are now routinely given to new Board members to facilitate their understanding of the forecast process and materials.

#### **4.5.2 Judgment input**

Brůha and others (2013) note that it is crucial to supplement the model structure with judgements that often affect the optimal future course of monetary policy. Interestingly, they also point out that sometimes it avoids confusion to apply even such adjustments that have no material effect on the policy outlook, if they take explicit account of real world events that are likely to capture the attention of an informed audience. For example, after the Global Financial Crisis, the “cash-for-clunkers” subsidies introduced in Western Europe to boost slumping demand for new autos made headlines. They did moderate the decline in Czech exports, but at the same time this reduced selling pressure on the koruna. The forecast assessment of the overall impact on the Czech inflation and interest rate was neutral. It was nevertheless important to incorporate the subsidies explicitly into the forecast, because otherwise the Board and other readers would have thought that the forecast story had forgotten something obvious.

#### **4.5.3 Reckoning for uncertainty**

Decision-making is trickiest under situations of high uncertainty—e.g., the early stages of the Global Financial Crisis, the start of the European sovereign debt crisis, and the first contact with the ELB. In such situations, the Board often commissions alternative scenarios and sensitivity analyses that help them see how the monetary policy outlook would change with different assumptions. A model-based forecasting system greatly facilitates such derivations. In contrast, to produce even one such scenario under an NTF-based system would require time-consuming iterations among sectoral specialists. Policymakers have found reassuring the capacity for systematic examination of alternative feasible outcomes (Tůma, 2010).<sup>52</sup> Forecasting tools that help policymakers promptly, at the very time they are weighing risks of alternative actions, and giving thought to the communications aspects, have special value (Hampl, 2014).

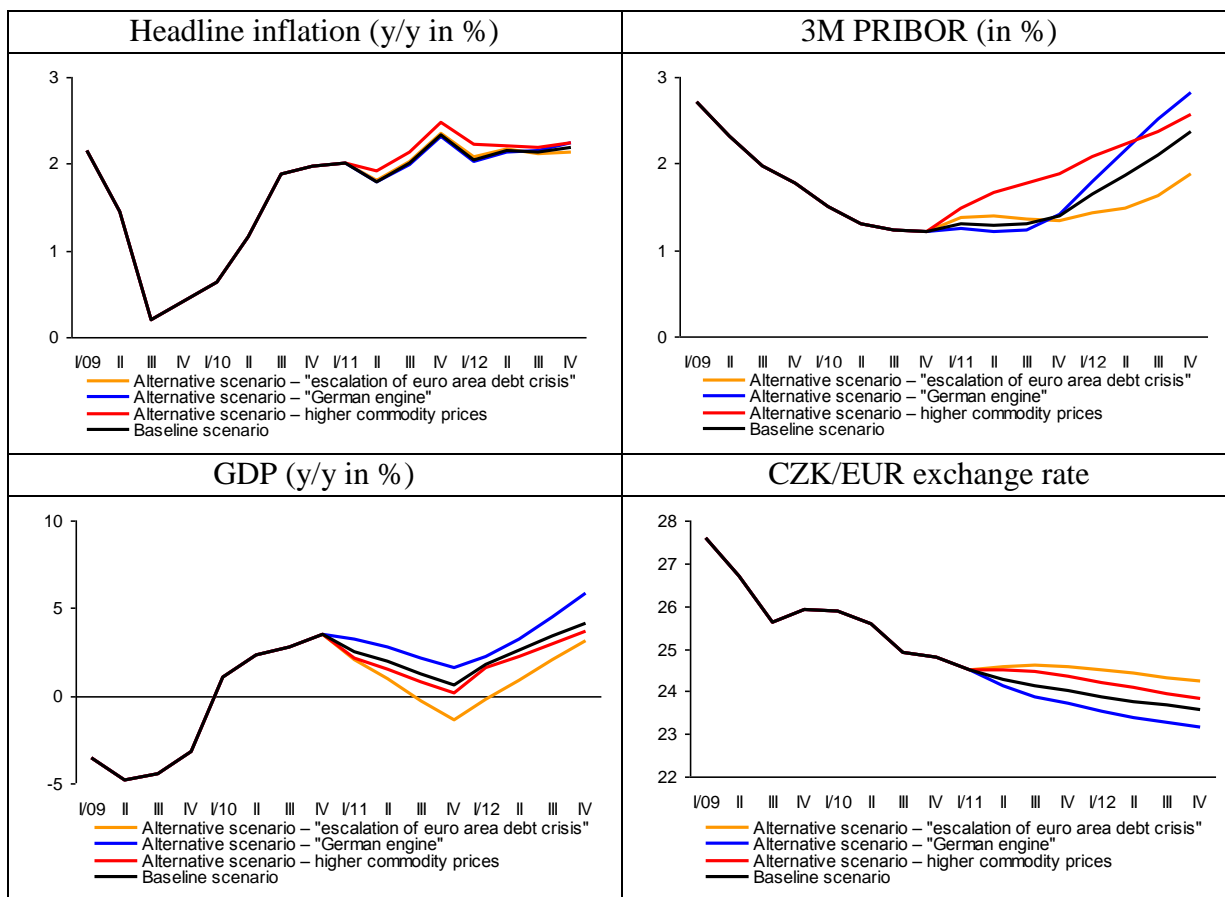
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<sup>51</sup> See Hampl (2014), slide 23.

<sup>52</sup> Tůma (2010): “The forecasting system must give the policymakers the comfort in making these ex ante decisions under uncertainty. This implies that forecasting accuracy is not as important as the ability to consistently differentiate between various alternative future developments. Our forecasting system has developed over the years to a truly disciplining tool for the policy debates and a platform for analyzing risks and their policy implications. These properties made it an acceptable tool for the policymakers.”

An example relates to February 2011.<sup>53</sup> High uncertainties led the Board to request 3 alternative scenarios to the baseline. The economy was rebounding from the Great Recession, supported by the impressive performance of the German economy, the main trading partner of the Czech Republic. Even so, the outlook of foreign demand was not particularly encouraging, and domestic fiscal policy was quite restrictive. Thus the baseline forecast showed a slowdown (Figure 14).

**Figure 14. Baseline and Alternative Scenarios from Inflation Report I/2011**



Source: CNB, own calculations.

Some Board members requested the staff to prepare an alternative scenario with an ongoing “German engine.”<sup>54</sup> Unsurprisingly, this scenario led to a more optimistic GDP forecast. At

<sup>53</sup> Other cases are in Brůha and others (2013).

<sup>54</sup> For all the three scenarios, an alternative outlook for foreign variables was first simulated using the global NiGEM model. In the second step, it was used in the GPM-g3 model to produce alternative forecasts for the Czech economy.

the same time, though, it suggested that faster growth driven by foreign demand would be associated with a more pronounced exchange rate appreciation, and hence little change in the inflation or interest rate outlook. A second risk seen by some Board members was a possibility of higher global commodity prices—i.e. an adverse supply shock. This would imply a currency depreciation relative to baseline, immediate interest rate increases, higher inflation for a while, and somewhat weaker economic growth. The third perceived risk was a much weaker euro area associated in view of the sovereign debt problems in the periphery. This would imply a renewed downturn, and depreciation in the exchange rate relative to baseline—which together implied an offsetting impact on inflation, and hence no need soon to change interest rates. In the end, the different risk perceptions led to a split vote at the February 2011 Board meeting, with the majority deciding to keep the rates unchanged, and a minority voting for a 25 basis point increase. But all Board members appreciated the quantitative insights from the model-based alternative scenarios.

#### **4.5.4 ELB—systematic forward guidance under IFT<sup>55</sup>**

By 2010, the Czech economy seemed to be recovering from the Global Financial Crisis and Great Recession. It then experienced another slowdown starting in late 2011, the result of a marked slowdown in demand from the euro zone and continuing domestic fiscal consolidation. In autumn 2012 observed inflation was below the CNB's 2% target, the economy was operating below its potential, and the CNB's inflation forecast signaled undershooting of the target. As a result of the CNB's effort to curb the cumulating disinflationary pressures, short-term policy rates reached the ELB in November 2012. Since conventional monetary policy had run out of space, the central bank needed a new policy instrument to continue with its IFT strategy. Results of in-house analyses and series of discussions led to the conclusion that weakening the nominal exchange rate would be an effective monetary policy tool, capable of supporting the inflation target as a credible nominal anchor to the Czech economy.<sup>56</sup> This new monetary policy instrument at the ELB environment was necessary to ensure the continuity of the IFT regime, focusing on stabilizing inflation expectations around the CNB's target.

Starting in September 2012, the Board signaled that it was considering the use of the exchange rate as an additional tool of monetary policy. In subsequent meetings, the CNB provided projections that suggested that a further easing in monetary conditions was necessary. It then reinforced this message through verbal interventions. The bank stressed, that it was prepared to weaken the nominal exchange rate should inflation forecast

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<sup>55</sup> For more on CNB's experience of adding the exchange rate as a complementary monetary policy tool to stimulate the economy when the policy rate is at the effective lower bound, see Alichí and others (2015a), Clinton and others (2015) and Franta and others (2014).

<sup>56</sup> For more arguments explaining why the exchange rate was judged to be the most efficient policy tool in the Czech circumstances see Franta and others (2014).

undershoot the target at the monetary policy horizon. This strategy was successful until autumn 2013. It prevented the nominal exchange rate to appreciate, but the effectiveness of these verbal interventions was gradually diminishing. Forward guidance on the policy rate, introduced in November 2012, was also used to further ease monetary conditions.<sup>57</sup>

During the mid-2012 to beginning-of-2013 period the modeling and projections team of the CNB made strenuous efforts to adjust the GPM-g3 model to be able to provide the policymakers with model-consistent scenarios in the ELB environment, using the nominal exchange rate as an additional instrument.<sup>58</sup> By the beginning of 2013, the forecasting team was ready to operate the GPM-g3 model using the exchange rate as instrument instead of the short-term nominal policy rate (Franta and others, 2014). The desired future path of the new policy instrument (the nominal exchange rate in this case), consistent with keeping inflation close to the target, was simulated through deriving fully-anticipated shocks to the exchange rate equation (a hybrid version of the uncovered interest rate parity). Technically this was accomplished through a constrained optimization routine that derived anticipated exchange rate shocks to construct a smooth future path of the nominal exchange rate consistent with keeping short-term interest rates close to the ELB and expected future inflation as near to the inflation target as possible. The algorithm for deriving the desired exchange rate path, consistent with the IFT regime, was developed iteratively to yield results that were considered by the forecasting team sufficiently plausible to enter into the policy debate.

The behavior of public expectations is critical to the effectiveness of monetary policy in the ELB environment. Its impact on the real economy derives from a drop in the real interest rate. The model simulations<sup>59</sup> in Figure 15 show the effects of a fully-anticipated 5% weakening of the exchange rate for various lengths of stay of the policy rate at the ELB. The longer the ELB binding, the higher is the effect of a depreciation of the exchange rate on inflation and the more positive the impact on the real economy.<sup>60</sup> It's worth noting, that the simultaneous effect of the weak exchange rate and zero interest rate (resulting in a negative real interest rate) is the main factor behind the growing real consumption. At the same time,

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<sup>57</sup> Governor Singer stressed on the press conference, taking place on November 1, that “*Interest rates will remain at this level (i.e. technical zero) over a longer horizon until inflation pressures increase significantly*”. The presentation from the November 1 press conference can be found here: [http://www.cnb.cz/miranda2/export/sites/www.cnb.cz/en/monetary\\_policy/bank\\_board\\_minutes/2012/download/tk\\_07sz2012\\_aj.pdf](http://www.cnb.cz/miranda2/export/sites/www.cnb.cz/en/monetary_policy/bank_board_minutes/2012/download/tk_07sz2012_aj.pdf)

<sup>58</sup> The version of the GPM-g3 model at that moment was linear and without the ELB constraint, and thus had no role for unconventional monetary policy.

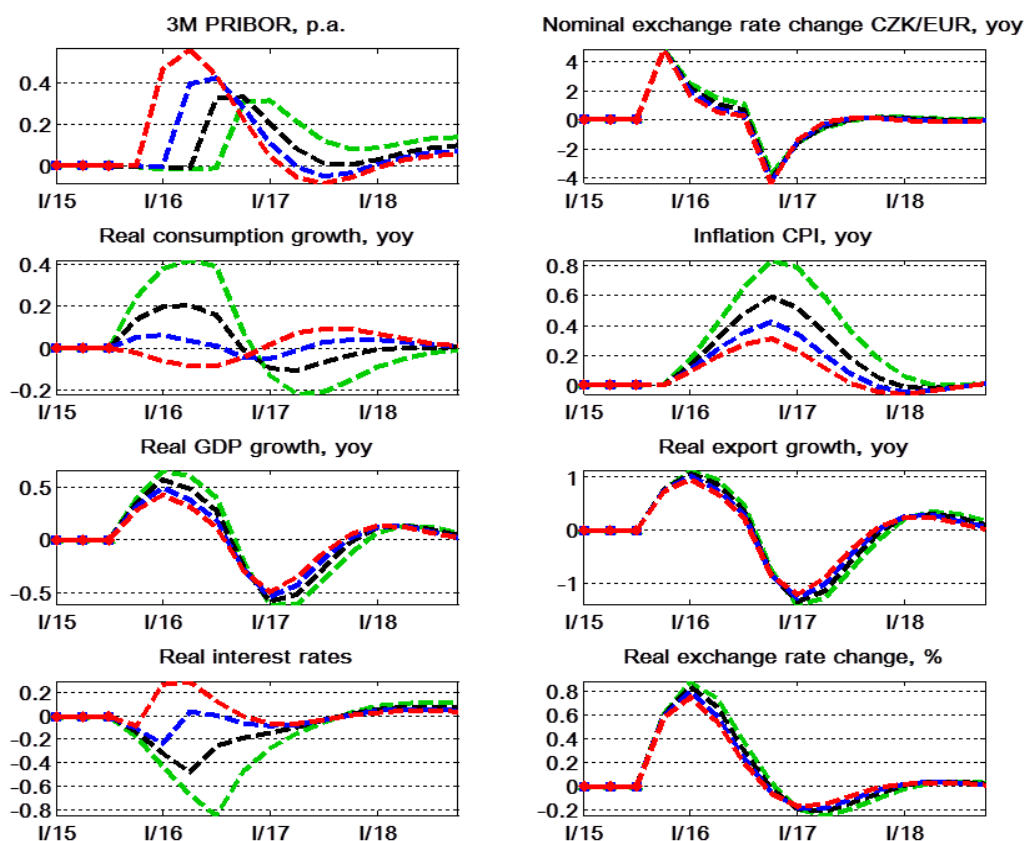
<sup>59</sup> The “real-time versions” of these simulations were produced in 2013 by František Brázdk, Tibor Hlédik, Zuzana Humplová and František Kopřiva. Figure 15 presents an improved version prepared by Jaromír Tonner.

<sup>60</sup> This also shows the importance of the expectations channel, through which the central bank can influence the pass-through of changes in the exchange rate to prices using forward guidance (Franta and others, 2014).



the depreciation of the real exchange rate supports real exports. The combined effect of the real exchange rate and interest rate channels produces a significant positive effect on real GDP growth. The main implication of these results for monetary policy, however, is that the weakening of the exchange rate, combined with forward guidance should produce pronounced positive effects on inflation; especially when monetary policy is credibly committed to such policy.

**Figure 15. GPM-g3 Model Impulse Responses to a Fully Anticipated 5-percent Weakening of the Exchange Rate for Different Lengths of Stay at the ELB**



Source: CNB, own calculation.

The modified forecasting framework allowed the staff to assess the implications of the ELB for the baseline forecast, and, in an alternative scenario, to explore the possible effects of an unconventional policy of exchange rate depreciation. Subsequently, the Board requested model-based ex post assessments of the impact of the exchange rate instrument.

#### 4.5.5 A summing up

It was not easy to establish good two-way communication between staff and the Board on the setting-up of the model-based FPAS, and there was some awkwardness when the staff moved

to a new model. But in the end the effort was worthwhile, and the process has worked reasonably smoothly. Open, two-way, dialogue has helped staff provide information that policymakers have found to be useful, and this in turn has increased the confidence of the Board in the model-based FPAS. Without such mutual support, it will be difficult to implement IFT successfully.

## V. CONCLUSIONS

This paper describes various facets of the development and practice of flexible inflation targeting—or, equivalently in practice, IFT—in the Czech Republic since the turn of the century. A remarkable feature of this history is that over the course of less than a decade, Czech monetary policy went from a fairly primitive condition, in a country with very limited experience with the functioning of a modern market economy, to the frontier of the state of the art. The transformation included an ongoing investment in human capital; the development of up-to-date models for forecasting and policy analysis; institutional reorganizations to allow efficient provision of relevant economic intelligence to inform policy decisions; improvements in the dialogue between economists and policymakers to ensure that they were working from mutually comprehensible assumptions; and a bold opening up of external communications, with complete disclosure of the central bank's economic forecast.

Moreover, policymakers did not impose their views on staff in such a way that the CNB forecast was a mere reflection of the views of senior management. Instead, economists were allowed a degree of freedom, which allowed productive internal discussions. In turn, the central bank made clear to the public that the forecast was a very important input into interest rate decisions, but not the only input. Indeed, on several occasions members of the Board have expressed substantive differences with the baseline forecast. On the other hand, the paper describes various episodes in which the staff outlook, and associated risk analyses, turned out to have material value-added in terms of decisions made by the Board. In all, the model-based forecasts gave policymakers several useful things: a starting point, at least, for their deliberations; confidence that their actions reflected a thorough consideration of the issues; and a means to explain their actions with a coherent economic narrative.

The core model in an FPAS for IFT has to have an endogenous short-term interest rate, determined by monetary policy, and an important role for forward-looking expectations on the part of the central bank as well as the public. Experience at the CNB underlines, however, that the core model has to be adapted over time, and that no one model provides all the answers. For example, QPM-Gap did not incorporate the effect on inflation from marginal costs and labor market rigidities that a macroeconomic theory may suggest relevant. These were added to a later version of QPM-Gap. Eventually, the CNB has moved to a new DSGE model (QPM-g3) as its core forecasting model. While it is important to recognize that a gap model or DSGE model contain some key macroeconomic principles (endogenous interest

rate forecast) that have to be factored into any policy-consistent forecast, it does not explicitly account for a multitude of factors that may at times exert a non-negligible influence on the economy.

In a central bank, where model-based forecasts and analyses affect policy decisions, it is important that sectoral experts, model users, and policymakers, always keep in mind the insights of general macroeconomic theory, and the knowledge gleaned from experience. They need to think in terms of how agents and markets behave, under constraints that include real-world frictions such as wage stickiness, and backward-looking expectations. DSGE models attempt to do this within an explicit optimizing structure, but even they rely on simplifications and are inevitably incomplete as descriptions of the real world. More generally, no tractable model incorporates all variables that will affect a forecast, or perfectly captures the main causal mechanisms. It follows that good forecasts do not emerge mechanically from a single model, but are always shaped by insights from complementary models, and from the judgments of forecasters. This will be as true for the current generation of DSGE models, represented by QPM-g3, as it was for the previous generation, represented by QPM-Gap.

An optimistic conclusion from all this, given experience in the Czech Republic and elsewhere, is that a newcomer to IFT can make a useful start with a simple gap model, as long as appropriate adjustments are made in the production of forecasts and related analyses. In the meantime, research can go ahead on the more advanced DSGE models that will eventually replace them. The functioning of the FPAS usually does not undergo a radical change when such a transfer takes place.

The crucial role of informed judgment is most clear for near-term forecasts, since it is a well-established fact that the combined knowledge of a group of sectoral experts will outperform a model for forecasting accuracy for horizons of up to 2 quarters. The comparative advantage of a model is that it captures the feedback of policy, which has a pervasive, and eventually determining, effect on the rate of inflation as the medium term evolves. A good FPAS therefore involves a systematic merging of the near-term forecast, which has heavy sector-expert input, with the medium-term forecast, which allows the model freer rein. This is more easily achieved when a single manager oversees the entire forecast horizon, as well as the development of relevant models. Clear delineation of responsibilities in this regard at the CNB has streamlined the production process, and improved the quality, of the forecast.

One gauge of the success of CNB monetary policy is its impact on the wider world. Thus, within the Czech Republic, there is much more awareness today than at the start of the decade about the relevant issues. Better informed media coverage over time has been an important outcome. More important, for the long run, has been the growth of interest in monetary policy at the universities and graduate schools, and the emergence of a generation of highly qualified, policy-oriented, monetary theorists and model builders. This has given

the central bank itself a deeper pool for recruitment. The ability to recruit and maintain in-house human capital, of sufficient size and flexibility to cope with turnover, is crucial for the sustainability of an effective FPAS. Outside the Czech Republic, the CNB has become a recognized leader for the formulation and conduct of monetary policy. Despite the relatively small size of the institution, the CNB has become an important contributor of technical assistance to numerous central banks in the world.

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