The CNB Forecasting and Policy Analysis System in a historical perspective

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<table>
<thead>
<tr>
<th></th>
<th>Table of Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>IT regime and implications for design of Forecasting and Policy Analysis System (FPAS)</td>
</tr>
<tr>
<td>2</td>
<td>Forecasting and Policy Analysis System</td>
</tr>
<tr>
<td>3</td>
<td>Models</td>
</tr>
</tbody>
</table>
Design of MP regime under IT Regime

• IT regime:
  • Has a key role for macroeconomic forecast and its communication
    • Time lag in transmission of MP
    • Horizon of the most efficient transmission (up to 6 quarters)
    • Forward-looking approach and impact of inflation expectations
  • Answer question what is need to fulfil inflation target
Czech Republic forced out of a soft-peg exchange rate regime (combined with money targeting) in May 1997

A jump in actual and expected inflation after the currency turmoil

IT used as a disinflationary strategy in a destabilised economy in a period of strong exogenous shocks (Asian and Russian crises, volatile oil and food prices; price deregulations in 1998, etc.)

The first transition country to adopt IT (8th in the World, 1st New Zealand 1990)

Small open economy (SOE)

Volatile capital flows

Large share of volatile items in CPI basket at this moment (food, fuel)
• Challenges of long-run convergence (real appreciation)
• Experience challenging in the first years, inflation targeting system evolving over time
• Targets originally set for net inflation, since 2002 for headline inflation
• Explicit application of escape clauses since 1999 (currently less explicit again)
• Forecasting technique changed from conditional to unconditional, integrated one in 2002
• Communication strategy, increasing of transparency graded CNB as one of the most transparent CB in the world
FPAS key features

- Monetary department
  - Main concern is to produce inflation forecast
  - Necessary to be able to produce the forecast - development of models
  - FPAS = processes + techniques
- FPAS as the support for conducting MP within IT regime
- FPAS core is regular quarterly macroeconomic projection exercise
Role of the forecast:

- Where the economy is and what are the current trends
- What are their likely evolution into the future
- What are the implicit risks
- What are the underlying pressures in terms of MP
FPAS is a system

- FPAS was progressively developed as a system
- Important also externally: encourage forward looking agents to form their expectations according to systematic reactions of CEB
- Careful planning and documentation
- Seamless technical background
FPAS tools

- Core model
- Near term forecasting (NTF) techniques:
  - Econometric models
  - Analysis of detailed/individual data
  - Expert views
  - Data support/adjustment/collection
  - Satellite models
- Fiscal policy estimates
- Exchange rate and external development models/analysis
Models versus experts view?

- Experts views superior in the near term
- Models tools provide consistency checks and ensure interpretability
- Final outcome based on judgments (staff + bank board)
- Its staff projection, not a model forecast!
Forecasting Process and Its Organisation

- Forecasting process takes five weeks
- Three stage structure of meeting (prediction team meetings, meetings with section and with bank board)
- Interaction with Department
  - Department Director and Division Directors
  - 6 meeting approx.
- Interaction with Bank Board
  - Two meetings before the bank board MP decision meeting
    - Alternative scenarios
    - Sensitivity scenarios
  - Post-mortem meeting (after bank board MP decision and press conference)
  - Publishing in the Inflation Report, Inflation Report is now 95 % of internal MP report on situation
- Its staff projection and recommendation, not a model forecast!
- But the decision is made by policymakers - bank board MP decision may be different from the baseline scenario and staff MP recommendation.
Until the first half of 2002, the CNB forecast was performed by econometric models = today near-term forecasting methods (NTF)

- Exchange rate (ER) and interest rates (IR) were fully exogenous, implicitly was assumed their stability
- CNB forecast was fully conditional
- Not a core model, but set of econometric models

Model QPM has become a major prediction mechanism from the second half of 2002

Since July 2008 we moved to G3 (DSGE) as the core prediction model

Within predictions provided by G3 (formerly QPM) is NTF used for:

- Data collection and data preprocessing
- Prediction of exogenous variables for the G3 (QPM)
- Analysis of actual economic development and initial conditions
- Comparative benchmark up to 8 quarters
- Prediction of variables which are not included in the core model
Integration process
Set of the issues:

- Relatively short time series
- A lot of changes in statistical methodology:
  - Expected future EU harmonization
  - Leaving statistics relevant for planned economy
  - Absence of broad data automation and internet utilization
  - Absence of (modern) set of coincidence indicators
- Intensive structural changes (privatization, inflow of FDI)
- Price Deregulation (high share of administered prices in the CPI)
- Significant changes in the orientation of foreign trade
Fully conditional forecast up to 2002 (ii)

- No core model but set of the econometric model, mostly OLS
  - CPI, other price indices
  - Labour market
  - Economic activity (SNA, indicators)
- Consistency though:
  - Iteration between models (slow), building relationship between blocks
  - Multi-equation econometric model (also for sensitivity scenarios)
- Conditional forecast = no endogenous domestic monetary policy
- Limited influence of foreign monetary policy (foreign IR)
Advantages:
- Fast and simple redesign in terms of changing the data
- Relatively accurate predictions in the short term
- Broadly based expert knowledge and expert assumptions

Disadvantages:
- No endogenous monetary policy:
  - Difficult formulation of MP recommendations conditional forecast
  - Conditional forecast (no change) vs. active monetary policy in the future
  - Limited role of inflation expectations in the IT regime
- Slow forecasting process, difficult to create quickly consistent alternative or sensitivity scenarios

Solution:
- In the short term discuss and evaluate existing methods
- Built-up the new core model with endogenous monetary policy - OPM
The Quarterly Projection Model (QPM)

- QPM:
  - Small open-economy gap model
  - Reflects inflation targeting regime
  - Linked to quarterly data

- Two separate blocks:
  - Long run equilibrium trends
  - Cyclical Fluctuations - gaps
Long Run Trends (QPM)

- Trend series
  - History is estimated by a simple statistical model (Kalman filter) and expert judgement
  - Forecast: exogenous (expert judgement), respecting steady state properties of QPM
- Important equilibrium real values:
  - Economic output
  - Wages
  - Exchange rate
  - Interest rate
- Monetary decision has marginal impact on long term real trends
Cyclical Part (QPM)

- Description of the position of the Czech economy
- Monetary policy characteristics:
  - Inflation targeting regime
  - Forward looking policy
  - Focus on deviations from the target reaction to expected inflation a year ahead
  - Floating exchange rate - endogenous
- Description of behavior economic agents includes forward looking components
- Price frictions:
  - Wage stickiness
  - Final price stickiness
  - Expectation stickiness
Structure of the QPM (QPM)

- Deviation from target
- Long interest rate
- Inflation expectations
- 3 Month interest rate
- RMCI
- Output gap
- Inflation
- Exchange rate
- Policy neutral interest rate level
- Trend real interest rate
- Risk premium
- Trend of real exchange appreciation
Transmission mechanism (QPM)

- **3 Month interest rate**
- **Exchange rate**
- **RMCI**
- **Output gap**
- **Foreign gap**
- **Inflation expectations**
- **Inflation**

**Shocks hitting the economy**
- Financial shocks:
  - Foreign interest rates
  - Portfolio changes
- Demand shocks:
  - Foreign demand
  - Fiscal policy
- Inflation shocks:
  - Indirect taxes
  - Energy prices
Transmission mechanism (QPM)

- Real Economy:
  - Real Marginal Costs Gap
  - Output Gap
  - Real Wage Gap
- Phillips Curves: Price and Wage inflation
- Expectations: Price and Wage Inflation Expectations
- Uncovered Interest Rate Parity (UIP)
- Reaction Function
Experience with the QPM (i)

Benefits:
- Consistent relationship between ER, IR and CPI in the future
- Full implementation of foreign variables and policy
- Easy to formulate MP recommendation
- Easy to switch from baseline to alternative scenario
- Possibility to create and discuss many different version of forecast

Cons:
- No structure of GDP in the model (satellite NTF model)
- In 2006-2008 (more than 6% GDP growth) was hard to identify the potential of Czech economy
- Problem of identification of cyclical position of your main trading partners (EU gap, we are expert for the Czech economy primarily)
- No structure of expenditure side of GDP (complicated satellite decomposition)
Other notes:

- Output gap in the QPM is not a observable variable - communication problem with:
  - Rest of the bank (bank board, other colleagues)
  - Other analyst
  - Journalists, the public (the CNB is independent, but the public institution...)

- Description of the gap model must be written/spoken in the human speech! Gap is a simplification of the reality, not a real story.

- Misinterpretation: output gap in the QPM is a measure of inflation pressures, not ”classical” (Cobb-Douglas) production function approach!

- The importance of cooperation between OPM creators/operators and the rest members of forecasting team (NTF, fiscal experts,...)

- Versions of gap (QPM) model are widely used and still implemented in many developing countries
The Structural Model G3

- Motivation to build (2005-8) and implement (2008) the new model
  - More detailed structure desired to describe households consumption, investment, trade balance etc
  - Necessity to cover areas which aren't endogenously contained in the existing framework
  - Richer model structure and structural consistency enables better analyse of particular issues
  - How to set-up trends is the core forecasting issue - G3 ensures internal consistency of trends
G3 versus QPM

**QPM:**
- reduced form
- only flow variables
- no expenditure or income structure of GDP
- gap structure
- equilibrium trends
- fiscal implemented through residual term
- enormous amount of forecasting knowledge

**G3:**
- consistent behavioral assumptions
- consistent stocks and flows
- consistent national accounting
- levels of variables
- productivities
- structured fiscal block
The new g3 model has replaced QPM in July 2008

CNB was one of the first central banks to use a DSGE model as a core policy tool

Testing the new model

- Real-time forecasting exercises since 01/2007
- Shadow forecasts with the g3 model to make the switch as smooth as possible
- Testing the model properties, historical recursive filtering and forecasting
Dynamic stochastic general equilibrium models:

- GE theory: describes the behavior of the whole economy (interaction of many markets)
- Stochastic: the model economy is hit by various shocks
- Dynamic: the model shows the interactions among markets and variables over time

DSGE models are widely used today:

- Macro research
- Tools for policymakers to conduct their policies = core models of central banks
G3 Features (i)

- SOE model, tailor-made for the Czech economy to fit the stylized facts
- Based on behavioral principles and production structure of the economy
- Set of real rigidities and frictions
- Cascade of nominal rigidities, imperfect exchange rate pass-through
- Emphasis on foreign trade issues (import intensity of export, openness of Czech economy)
• Rich structure to cope with Czech data

• 11 sectors:
  • Households
  • 2 intermediate goods production sectors (domestic and import)
  • 4 final goods production sectors: consumption, investment, export, government
  • Monetary and fiscal policy authorities
  • Forex dealers
  • Rest of the world
G3 structure

Flow of goods & services

Rest of the World

GDP value

Imports → Investment

Consumption → Intermediate

Government

Exports

Capital

Labor
G3: Households, Government, Firms

- **Households**
  - Consume final consumption goods, rent capital to intermediate-goods firms, trade nominal government bonds and monopolistically supply differentiated labour
  - Wage-setting follows Calvo-Yun contracts
  - Households own all domestic firms and receive their profits

- **Government**
  - Collects tax revenues, consume goods, issues nominal bonds
  - Ricardian setting

- **Firms**
  - Multiple monopolistically competitive goods producing sectors
    - Each with possibly different degree of price stickiness
    - Calvo-Yun pricing
  - This cascading creates desirable interactions among real activity in various sectors and delivers (most importantly) multiple stages of exchange rate pass-through
• Forward-looking central bank implements inflation targeting regime using interest rate policy
• Monetary policy is credible
• Targets the deviation of y/y (MP-relevant) CPI inflation four periods ahead
  • MP inflation is the headline CPI inflation (incl. regulated prices) less immediate influence of changes in indirect taxation
G3: Headline CPI Components

Consumption prices – cost structure

Headline CPI

- Regulated Prices
  - Domestic Prices
    - Wages
    - Rental Rate
  - „Net Inflation“
    - Import Prices
      - Exchange Rate
      - Foreign Prices
For SOE models we need to close the model

Forex dealers
  - To trade international bonds
  - The setting implies a version of the UIP

A debt-elastic premium
  - Domestic agents face the interest rate that is increasing in the country's net foreign assets

The rest of the world sector is represented by the EU and is modelled exogenously
The model has balanced growth path (BGP)

We need a proper treatment of long-run behavior, not business cycle measures only

BGP determines a steady-state growth of the economy

Long-run solution of the model where all variables are either constant or grow at unique constant pace

No use of ad-hoc detrending and/or pre-filtering:
  - Trends and cycles are not separable
  - An ad-hoc filtering may destroy important trend-cycle interactions in the data because permanent shocks spillover to business cycle frequencies

After shock each variable gradually goes back to BGP

BGP is understand as *transitional path* to developed countries rather than long run or ultimate stage
• BGP Trends:
  • Trends in Relative Prices (consumption vs. investment)
  • Trade Openness (Increase in trade openness in the Czech economy)
    • the nominal shares framework allows for excess real growth of exports than GDP in the long-run, offset by opposite evolution of relative prices of exports to GDP deflator
    • openness technology accounts for the trend in the nominal share of trade on output and excess growth of trade over GDP
  • Increasing Goods Quality: changes in a composition of the foreign demand due to preference shifts, we define a quality technology process
  • Regulated Prices: Given an exogenous path of regulated prices, the CB can exercise its influence via (market) net inflation only (Rise in regulated prices leads to downward pressures for net inflation)
  • There is not a single-good counterpart of the GDP in the model.
  • Capital goods are produced using imported goods only (investment sector is very import intensive)
• Substantially richer structure of the economy (SNA, government sector)
• No detailed structure of inflation - a satellite model for net inflation decomposition (Kalman filter)
• Level variables for satellite computation (fiscal), without extra estimates out of the model
• G3 Version for Zero Lower Bound regime (inability to go with rates into negative territory, although basic versions of the model this allows)
• Avoiding the concept of output gap after the start of the economic crisis (large uncertainties in estimates of the gap in the years 2008-2010)
Be beware of interpreting the forecast:

- What is the prognosis? (similar ”OPM” questions, not gaps, but productivity)
- CNB began to publish even a trajectory of exchange rate (interpretation)

Potential for (further) development:

- Extended version on crude oil price (2nd half of 2014)
- More elaborated foreign block
- Extended fiscal block
- Endenization of regulated prices
- Continuous changes in the settings of long-term assumptions
Thank you for your attention
Contact

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