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Contents

1 Introduction 7

2 Methodology 9

3 The Small Model of Czech Monetary Transmission 11

4 Simulation Results: Where Are the Trade-offs? 17

5 Concluding Remarks 23

References 25

1 Introduction

For most of its recent history, the Czech Republic – similarly to other transitional countries – has been committed to reducing the rate of inflation in order to ensure convergence towards EU inflation within a reasonable period of time. In December 1997, the Czech Republic became the first transitional economy to adopt an inflation-targeting framework (ITF) for its monetary policy. This change in strategy created a situation in which the targeted disinflation rate was suddenly explicit, because the first two inflation targets were publicly announced as an integral part of the ITF.

Under this particular arrangement, one question logically followed: what is the appropriate rate of disinflation to be targeted? Deciding what rate of disinflation is least costly in terms of the volatility of important economic variables is not an easy task, since relative costs depend on monetary transmission in a given economy. In order to receive quantitative results, it is necessary to approximate monetary transmission with a model and reactions of policymakers with a policy rule. Two points are worth emphasising in this respect. First, we call a superior disinflation (targeted) rate "appropriate" in order to stress that it is least costly in a particular model framework, and hence, need not represent an absolute social optimum. Second, the targeted disinflation rate need not correspond to the observed rate due to shocks that hit the economy in real life as well as during simulations.

2 Methodology

We apply methodology that has been widely used in literature on policy rules in order to compare alternative monetary strategies. Our benchmark studies are Batini, Haldane (1999 a, b), which use the same methodology in order to find the optimum forecast horizon for the UK central bank. They calibrate and estimate a small forward-looking model of the monetary transmission mechanism. During simulations, the model is hit by shocks that correspond to shocks actually affecting the economy. The magnitude of shocks is derived from past data. The model is closed by alternative policy rules.

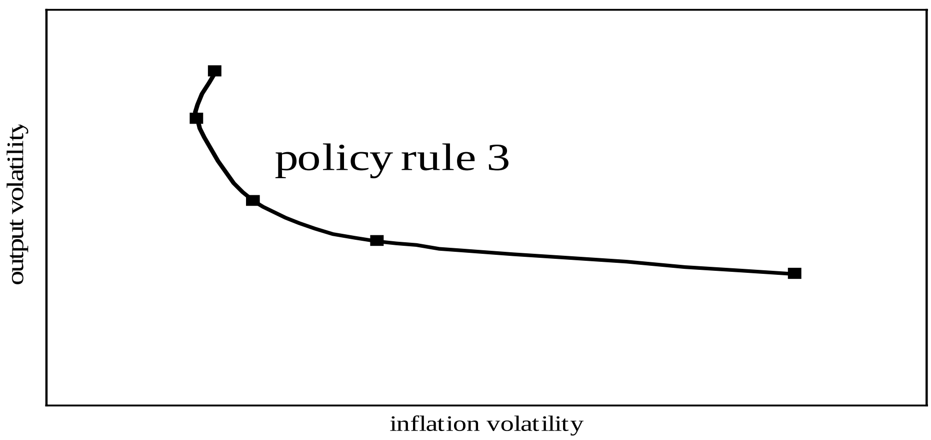
In this paper, we use the model of the Czech economy built in the same spirit and described in our previous work – Mahadeva, Šmídková (2000). Several empirical problems relate to the model-based analysis of the Czech economy. Few findings have been established from past research, and the short samples of available data are plagued by structural breaks. One particular example of a coefficient for which no consensus estimate exists is the effect of the output gap on inflation in the Phillips curve. In order to provide some guidance as to what the inherent uncertainty in Phillips curve estimates could mean for monetary policy, this paper examines the outcomes of simulations using alternative values for this important, yet, unknown coefficient.

It is worth noting that the ITF has been more often used as a stabilisation strategy rather than a disinflation strategy. Hence, the question of what is the appropriate rate of disinflation is quite new in empirical literature on policy rules. We need to specify policy rules in terms of declining inflation targets in order to approximate different disinflation strategies. Also, we need to consider nominal convergence when measuring the volatility of variables in order to distinguish the desired trend from costly volatility.

With the model of the Czech economy, a stochastic simulation is first performed on using a policy rule that targets slow disinflation. The experiment is then repeated with alternative policy rules that target faster disinflation. After each experiment, we estimate the unconditional means and variances of output, inflation and other important variables. We use these outcomes to produce indicators of what alternative rates of disinflation imply for interest rates, output and the trade balance. Results can be interpreted to inform us about the consequences of targeting disinflation too rapidly or too slowly. For example, if several alternative policy rules produce the following combinations of output and inflation volatility (See Chart 1), then the third rule is closest to the origin. Hence, it is superior to other rules with respect to the constraint given by monetary transmission (under the assumption that the loss function of a policy maker has a reasonable form).

Chart 1

Constraint Given by Specific Monetary Transmission



Note: The third policy rule (policy rule 3) is closest to the origin and hence implies the lowest costs in terms of volatility of inflation and output.

3 The Small Model of Czech Monetary Transmission

Batini, Haldane (1999(a)) and Svensson (1999) contain references to the predecessors and theoretical foundations of the small, open economy monetary policy model that we use for our simulations. One reason why this class of models is suitable when working with Czech data is worth mentioning. It is important that the model is semi-structural, particularly in the sense that the transmission mechanism is written independently of the policy regime. Using a structural model guards to a certain extent against the Lucas critique.

A reduced-form model – unrestricted VARs for example – would be more open to the risk of reflecting the influence of previous Czech monetary policy regimes, which are however, not taken up in this study. Also, in the rapidly changing environment of the Czech economy in transition, untreated estimates on past data can be a poor guide to the present and future. A more structural approach allows prior assumptions about economic theory to be imposed on the calibrations to reflect transition. As a consequence, though, the paper's results are conditional on these assumptions.

The small model comprises the following equations and baseline parameter values:

$$y_t = \ln(\exp dd_t + \exp x_t - \exp m_t) \qquad (1)$$

where y is output (log), dd is demand (log), x is export (log) and m is import (log)

$$dd_t = dd_t^s + c_{10} + c_{11}(i_t - \exp\inf_t) + c_{12}(dd_{t-1} - dd_{t-1}^s) + \varepsilon_{1t} \tag{2}$$

where $dd - dd^s$ is the demand gap (log), i is the domestic interest rate (%), $\inf$ is the inflation rate (%)

with c_{10} =0.03, c_{11} =-0.37 and c_{12} =0.51

$$m_t = c_{20} + c_{21}dd_{t-1} + c_{22}(pf_{t-1} + e_{t-1} - p_{t-1}) + c_{23}\Delta dd_t + \varepsilon_{2t} \tag{3}$$

where pf is the foreign price level (log), e is the exchange rate (log), p is the domestic price level (log)

with c_{20} = 2.82, c_{21} =0.93, c_{22} =-0.82 and c_{23} = 0.51

$$x_t = c_{30} + c_{31}yf_t + c_{32}(pf_t + e_t - p_t) + c_{33}x_{t-1} + \varepsilon_{3t} \tag{4}$$

where yf is foreign output (log)

with c_{30} = -55.17, c_{31} =1.95, c_{32} =0.27 and c_{33} =0.60

$$\Delta e_t = c_{40}\left(E_{t-1}\Delta e_t^e - \frac{i_{t-1} - if_{t-1}}{4} + c_{41}\right) + \varepsilon_{4t} \tag{5}$$

where if is the foreign interest rate (%)

with c_{40} =-0.80 and c_{41} =-0.02

$$e_T = e_{T-1} \tag{6}$$

a terminal condition

$$\Delta_4 p_t = \exp\inf_t + c_{50}(\Delta_4 p_{t-1} - c_{51}(\Delta_4 pf_{t-1} + \Delta_4 e_{t-1})) + c_{52}(y_{t-1} - y_{t-1}^s) + \varepsilon_{5t} \tag{7}$$

where $y - y^s$ is the output gap (log)

with c_{50} = -0.47, c_{51} =0.3 and c_{52} =0.15 for baseline simulation (0.5 in the sensitivity test)

$$\Delta_4 p_T = c_{51}(\Delta_4 pf_T + \Delta_4 e_T) \tag{8}$$

a terminal condition

$$\exp\inf_t = c_{70}E_t\Delta_4 p_{t+1}^e + (1 - c_{70})\Delta_4 p_{t-1} \tag{9}$$

with c_{70} =0.2.

The operator Δ_4 indicates the difference between the present value and the value four quarters earlier, and Δ indicates the difference in comparison to the previous quarter's value. The variable $E_t z^e_{t+s}$ refers to the rational expectation of variable z at time t+s, calculated at time t. The parameters were either calibrated or estimated using data from 1994:I–1997:IV. Results of the estimations, as well as reasons for choosing a specific value of the calibrated parameter, are described in our previous study, Mahadeva, Šmídková (2000).

Equation (1) is the familiar identity that links real private-sector GDP to the aggregate of real domestic demand, imports, and exports. For simplicity, we excluded government expenditure from demand and output variables. Equation (2) is the IS curve. Aggregate private-sector domestic demand depends on the cost of borrowing, which depends on a measure of the short-term *ex ante* real rate of interest and its lagged value. Domestic demand is affected relative to its steady-state level where that steady state is estimated by a simple time trend. The import and export equations, numbered (3) and (4), respectively, summarise how trade is linked to growth and inflation through income and price effects. The dynamic adjustment equation (5) is used to forecast the nominal exchange rate, and equation (6) defines the terminal condition.

All the price-setting influences are combined in a Phillips curve – equation (7). The functional form that seems to capture the lag structure best assumes that the difference between annual inflation and next-period expected inflation is a function of the lagged private-sector GDP gap and the last period's deviation of inflation from its long-run relationship with import price inflation. If private-sector domestic demand is in equilibrium, expectations are consistent with actual inflation, and annual inflation is constant, then the annual CPI inflation rate will be described by the long-run relationship with import price inflation. Due to the absence of adequate labour market data for the Czech economy, we chose not to incorporate wages and employment into the model explicitly. The inflation-expectation block reflects our attempt to model wage-setting behaviour implicitly.

A summary of the model would describe it as emphasising that there are three transmission channels of monetary policy: (i) the real interest rate, (ii) inflation expectations, and (iii) the exchange rate. As inflation is sticky and slow to adjust, inflation expectations are not likely to shift much in response to temporary monetary policy movements. It will be persistent, long-run monetary policy changes that can affect inflation through altering long-run expectations. The real-interest-rate channel describes how nominal interest changes affect the real *ex ante* interest rate, and subsequently consumption and investment. But the extent to which lower domestic demand affects GDP depends on offsetting trade imbalances. Whether lower GDP goes on to reduce inflation further depends then on the Phillips-curve link. The exchange rate affects the economy directly (via import prices) as well as indirectly (if the Phillips-curve relationship is significant).

The second stage in setting up our experiment is to develop a hypothetical policy rule for setting interest rates that can be incorporated into the model. This rule is a stylised description of our counterfactual Czech monetary policy that is described in Hrnčíř, Šmídková (1999). It is used as a yardstick – a comparison across different rules approximating the comparison across the monetary policies that they represent. Our rule can then be written as follows:

$$i_t = c_{80} i_{t-1} + (1 - c_{80})\left(\mathrm{target}_t + if_t - \Delta_4 pf_t + \gamma\left(\Delta_4 p_{t+j} - \mathrm{target}_{\mathrm{t+j}}\right)\right) \quad (10)$$

where *target* is the targeted inflation rate (%)

with baseline parameter values c_{80}=0.2 , j=4, and γ=3, and the target reflecting inflation falling from 9% in 1994 to 2% in 2008 at a desirable rate.

As a stylised representation of inflation targeting, our interest rate setting rule combines three elements. It depends on policymakers' expectations of the deviation of future inflation ($\Delta_4 p_{t+j}$) from the target rate ($\mathrm{target}_{\mathrm{t+j}}$), the choice of horizon (j) that is for our purpose fixed close to the optimum horizon according to our previous research, and the way falling target values are set. The last parameter is the subject matter of the research presented in this paper. The targeted rate of inflation is determined by a disinflation path that approximates various convergence strategies of a central bank. They differ in the speed of disinflation. Nevertheless, they produce the same inflation at the end of the convergence period, which is for our purposes 2008.

The final element in our experiments is the shocks that hit the economy. The mix should resemble the disturbances that the Czech economy could conceivably face in the future. Many sources of volatility are unique to transitional economies. For example, the economy could be shocked by repeated corrections in relative prices towards their free-market proportions[1]. The Czech economy also experiences shocks more typical of other economies: changes in world demand for Czech goods, falls in commodity and oil prices, and variations in the foreign exchange market's perception of the risk of holding koruna-denominated assets[2]. Table 1 shows our calibrations that correspond to the above-mentioned intuition.

Table 1

Scaling of the Shocks

Sources of uncertainty	**Standard errors**
Equation uncertainty	
Inflation	0.7
IS curve	3.8
Imports	5.2
Exports	8.2
Exchange rate	2.0
Exogenous variable uncertainty	
Foreign price of imports	6.0

Note: Exogenous variable uncertainty refers to external shock. Equation uncertainty refers to imperfect information about the economic relationship. Standard errors are in percentage points.

[1]The transitional shocks and their consequences are described in several studies (for example, Hájek, 1997).

[2] An assessment of the importance of external shocks is reviewed in inflation reports (for example, the Czech National Bank's Inflation Reports from July 1998 and October 1998).

4 Simulation Results: Where Are the Trade-offs?

We use our small model to run a series of simulations that differ in the rate of disinflation targeted by a policy rule. We specify a range of seven alternative rates of disinflation including a very slow rate, a linear rate and a fast rate. For example, under the slow rule, inflation is allowed to increase from 9 % to 13 % in the first three years. Under the linear rule, the targeted rate of inflation falls after the first three years from 9 % to 8.3 %. Under the fast rule, inflation is targeted to drop to 5.2 %. This implies that 42 % of inflation would be eliminated in the first three years of the fourteen-year period. In order to measure the relative costs of alternative policy rules, we calculate the indicators of volatility in inflation, output, the trade balance and interest rates from our simulation results. We calculate values of these indicators for the first three years of the disinflation period, since we want to keep our calculations inside our estimation sample. According to our intuition, this approach imposes a certain bias on potential policy conclusions. We comment on this problem in the concluding remarks.

Table 2 shows the outcome of baseline simulations in which the impact of the output gap on inflation in the Phillips curve is standard[3]. The variability of inflation is

[3] Under the baseline scenario, parameter c52 equals 0.15. This value is close to the average

highest for the two extreme cases, and lowest for rules that target a linear rate of disinflation. A similar outcome is obtained for nominal interest rates. The slower the rate of disinflation, the higher the average output gap is. This feature corresponds to the Czech data from our sample period during which excess demand was associated with higher inflation. The average trade balance deficit is higher for faster disinflation rates.

Table 2

Outcome of the Baseline Simulations

Targeted disinflation	Variability of inflation (%)	Average output gap (% of GDP)	Variability of interest rates (%)	Average trade deficit (% of GDP)
Fast	1.42	1.17	2.12	6.35
	1.37	1.79	1.94	6.32
	1.35	2.14	1.87	6.31
Linear	1.34	2.53	1.84	6.29
	1.34	2.95	1.86	6.27
	1.36	3.40	1.96	6.24
Slow	1.42	4.44	2.46	6.19

Note: Output files with simulated values of endogenous variables can be obtained from the authors. This table summarises the results in the form of indicators for the period of 1994–1996.

We plot our indicators against each other to see where the trade-offs are. Charts 2–4 show whether lower variability in inflation along inflation targets is costly in terms of a higher average output gap, higher variability of nominal interest rates and a higher average trade deficit. Chart 5 gives an example of a sensitivity test. This test compares the trade-off between the volatility of inflation and output under the baseline scenario with the trade-off obtained under an alternative assumption that the output gap's impact on inflation is higher.

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estimate according to a study on a sample of European countries. See Britton, Whitley (1997). For an alternative scenario, we use a significantly higher value (0.5).

Chart 2

Trade-off between inflation and output variability

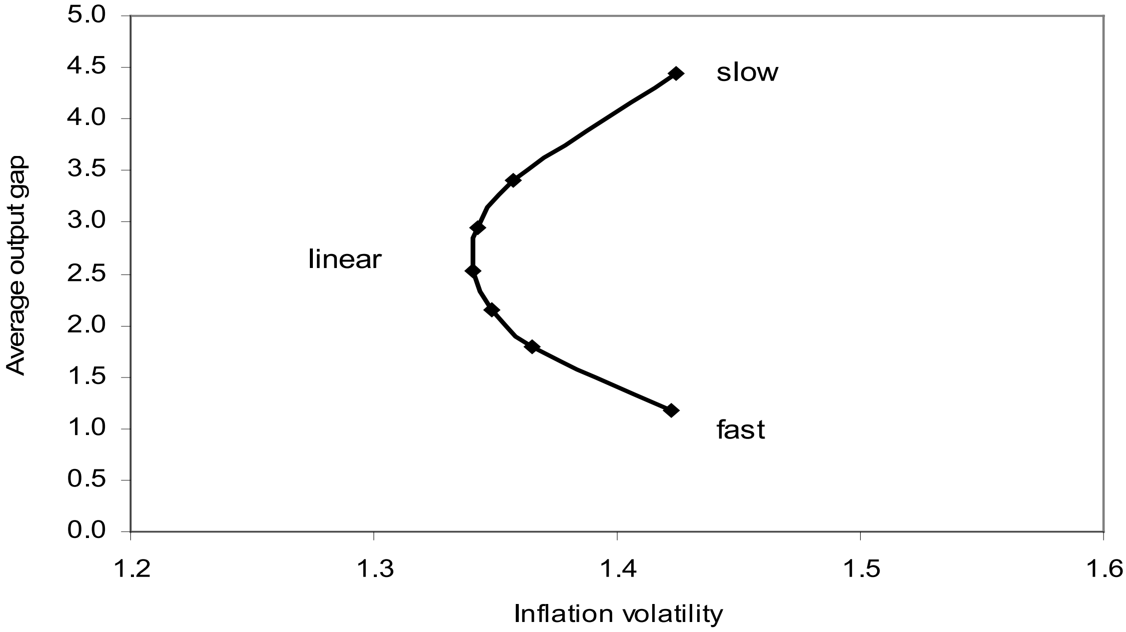

Chart 3

Trade-off between inflation and interest rate variability

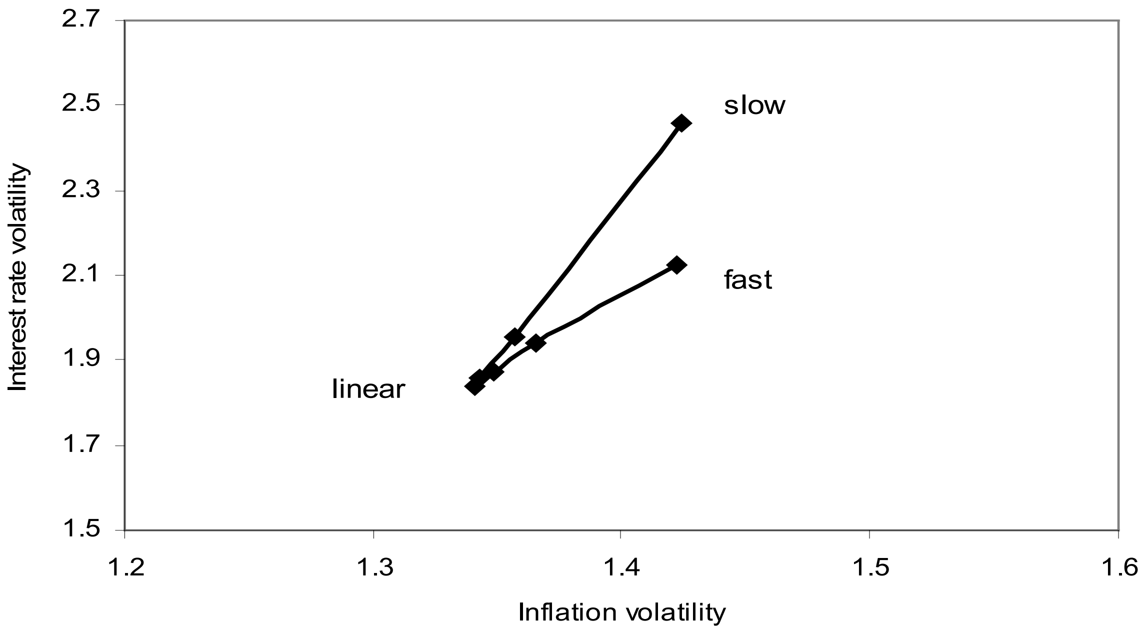

Chart 4

Trade-off between inflation variability and the trade balance

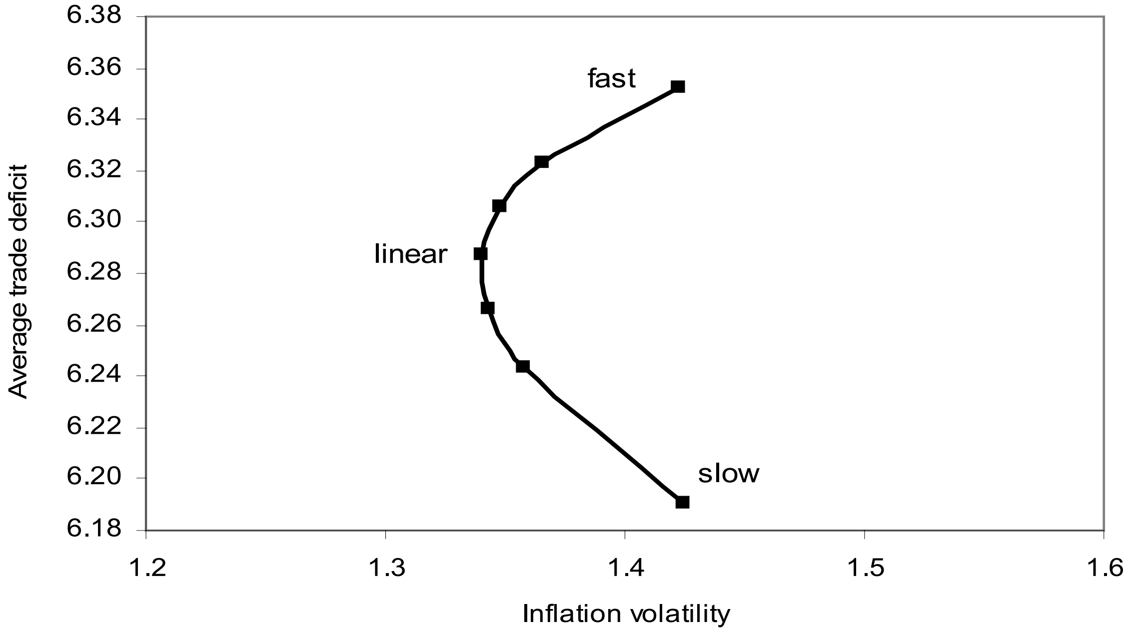

Chart 5

Sensitivity analysis: stronger impact of the output gap

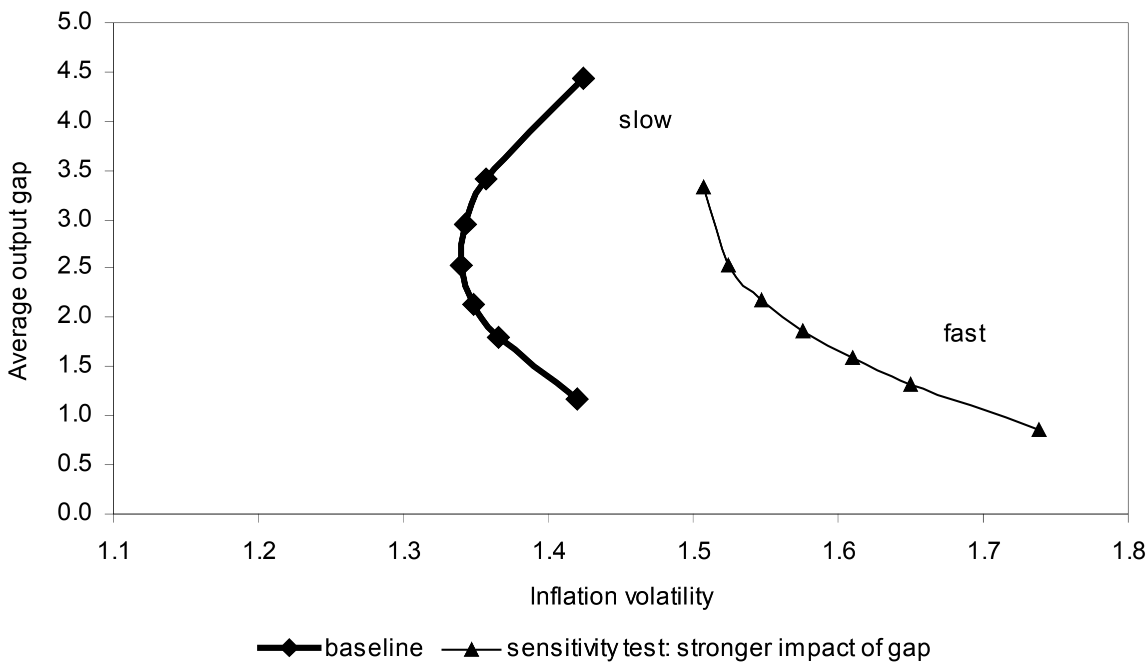

Chart 2 illustrates that near-linear rules are better at limiting the volatility of inflation around targeted rates. Quicker disinflation is associated with more stable output, since the output gap is closer to zero. Hence, with the baseline Phillips curve, faster disinflation rates (i.e. faster than linear) are preferable. According to Chart 5, this trade-off becomes less obvious when the Phillips-curve relationship is stronger. When there is a strong Phillips-curve relationship, there is not really any ground for discriminating against a disinflation path, with the exception of the two extremes, at least in terms of inflation and output volatility.

Although the trade-off between the volatility of inflation and output is the most important outcome, our simulations also provide some measure of whether a trade-balance crisis could jeopardise the process of disinflation or whether interest rate volatility implied by a certain strategy would be too high for the banking sector to cope with. Chart 3 illustrates that the linear disinflation in our model is the least harmful for the banking sector. Chart 4 demonstrates that the second and third slowest rules in reducing inflation are superior in terms of the external balance.

5 Concluding Remarks

Firstly, our conclusions are based on estimated outcomes during the early years of disinflation. In this stage of disinflation, policy rules that aim at linear or slightly faster disinflation rates are superior to those aiming at slower disinflation and to those aiming at a very fast disinflation rate. If simulations were produced for a longer period, these superior rates would guarantee CPI inflation between 4.9% and 5.8% for the year 2000. As was already mentioned, a certain bias might be imposed by producing simulations within the sample period only. Specifically, with faster disinflation, costs can be expected to concentrate in the early stage of convergence, while with slower disinflation, they are probably postponed until later. Thus, when comparing the costs for the overall disinflation period, faster disinflation is likely to be favoured. For example, we expect that a longer simulation horizon will reduce the volatility of the trade balance since the real exchange rate will be more stable at the end of disinflation than at its initial stage.

Secondly, our results are sensitive to some of the calibrations, and this can be studied in more detail by the repeating simulations for different values of these parameters. Our exercise comparing the results for two alternative values for the parameter defining the output gap's impact on inflation should show the reader what methodology can be used to broaden the set of outcomes. In order to calibrate the link between the output gap and the inflation coefficient model, we used the value derived from estimates for other countries. Alternatively, it is possible to try to derive the value of the parameter by another method. Specifically, a study of various types of nominal rigidities in the context of the Czech economy might shed more light on which theoretical background to use for reducing the form of the Phillips curve and give some hints for modifying the values of the parameters.

Thirdly, the process of nominal convergence cannot be separated from the process of real convergence. Certain modifications of the model reflect the problem of convergence. Our policy rules target the decelerating rate of inflation that converges to the EU's inflation in 2008. Real exchange rate appreciation is allowed by the model during the simulation period. However, more extensions to this framework can be considered. Since real convergence is linked with the productivity differential, it may imply that, during our simulation period, a better approximation of the real equilibrium interest rate can be found than the real rate abroad. If this parameter in a policy rule is modified, then it is worth considering linking it to a risk premium in the exchange rate equation that is now defined as a constant.

We trust that the results presented in this paper at least prove that it is possible to discover some features of the transmission mechanism of a transitional economy like the Czech Republic and, thus, provide some basis for discussion about Czech monetary policy. It would be interesting to see the results of similar simulations with a different model or with the same model re-estimated for more recent data. Above, we have identified three main areas in which the current work can be continued, because we think that this topic should be explored in further detail.

References

1. Batini N., Haldane, A. G. (1999), “Forward-looking Rules for Monetary Policy”. Bank of England Working Paper, No. 91, January (a).
2. Batini, N., Haldane, A. G. (1999), “Monetary Policy Rules” in Taylor, J., ed, NBER Conference Volume. University of Chicago Press, pp. 157–203 (b).
3. Britton, E., Whitley, J. (1997), “Comparing the Monetary Transmission Mechanism in France, Germany and the United Kingdom: Some Issues and Results”, Bank of England Quarterly Bulletin, 22, May, pp. 39–56.
4. CNB (1998), Czech National Bank: Inflation Report. Prague, Czech National Bank, April, July, October.
5. Di Nardo, J., Moore, M. P. (1999), “The Phillips Curve is Back? Using Panel Data to Analyse the Relationship between Unemployment and Inflation in an Open Economy”, NBER Working Paper, No 7328.
6. European Central Bank: *Convergence Report (2000),* European Central Bank.
7. Erceg, C. J., Henderson, D. W., Levin, A. T. (1999), “Tradeoffs between Inflation and Output-gap Variances in an Optimizing-agent Model”. Institute for International Economics, Stockholm University (Seminar Paper, No 650).
8. Hájek, M. et al (1997), “Macroeconomic Analysis of the Czech Economy”,

Prague, Institute of Economics of the Czech National Bank, Working Paper No. 82.

9. Hrnčíř, M., Šmídková, K. (1999), “Czech Approach to Inflation Targeting” Workshop on Inflation Targeting. Prague, Czech National Bank.
10. Haldane, A. G., Salmon, C. K. (1995), “Three Issues in Inflation Targets”, in Haldane A. G., ed, Targeting Inflation. London, Bank of England.
11. Mahadeva L., Šmídková K. (2000) Modelling a transmission mechanism of monetary policy in the Czech Republic, in Mahadeva, Sterne (ed.) *Monetary policy framework in a global context*, Routledge, London.
12. OECD (1998), OECD Surveys: The Czech Republic. Paris, Organization for Economic Cooperation and Development.
13. Sargent, T. J. (1982), “The Ends of Four Big Inflations in Inflations: Causes and Effects”, in by Hall, R. E., ed, Inflation Causes and Effects. Chicago: University of Chicago Press, pp. 41–97.
14. Svensson, L. E. O. (1998), “Open Economy Inflation Targeting (manuscript). IIES, Stockholm University.
15. Svensson, L. E. O. (1999), “Inflation Targeting as a Monetary Policy Rule”. Journal of Monetary Economics, 43, pp. 607–654.