Discussion*

The paper by Kevin Moran typifies the recent approach of the Bank of Canada and other central banks; economists first develop macroeconomic models with rigorous microfoundations and estimate them with Bayesian methods to ensure their consistency with data before examining their policy implications.

Two sets of questions from Moran's paper frame my analysis. First, there are important questions of comparative statics: What are the welfare benefits of reducing the deterministic steady-state inflation rate from 2 per cent to zero? This question has broad relevance, since inflation has recently averaged about 2 per cent in many industrialized countries. Instead of examining the benefits of reducing inflation from 2 per cent to zero, one might determine the optimal value of the deterministic steady-state inflation rate. Micro-founded models naturally yield a rigorous answer to that question. One need only establish an objective function for the policy-maker; the solution to the first-order conditions determines the optimal rate of inflation. This approach has been pursued in several papers, for example, those by Khan, King, and Wolman (2003) and by Schmitt-Grohé and Uribe (2004a,b). It would be useful to conduct a similar exercise using Moran's model.

Several considerations are important in determining the optimal, deterministic steady-state inflation rate. One is the role of real money balances. Moran introduces money in two ways: for purchasing consumer goods and for purchasing capital goods. When firms need cash to invest, there are greater benefits to reducing inflation and nominal interest rates in the steady

---

state. Another important propagation mechanism related to the steady-state inflation rate is the credit channel. As stated in Christiano, Eichenbaum, and Evans (2005), firms borrow to finance their labour cost, and therefore the nominal interest rate enters the firm's cost function directly. For that reason, reducing nominal interest rates improves productive efficiency. Mechanisms to determine wages and prices are also important. But this is almost invisible in Moran's analysis. He follows Christiano, Eichenbaum, and Evans in assuming that both workers and firms index wages and prices completely to lagged inflation; the steady-state inflation rate does not affect wages and prices at all.

Other papers from this conference show that most prices do not change continuously; many prices are adjusted once every six months or year. The evidence from microdata suggests that price indexation is not a good description of reality. In addition, macro estimates of the backward-looking component of the hybrid Phillips curve are typically small. Wages are not typically indexed to inflation, either. Nominal wages are fixed for six months to a year. The absence of wage or price indexation implies that steady-state inflation rates create inefficient price and wage dispersion. Since such inefficiencies are highly relevant in the analysis of Rotemberg and Woodford (1999), it would be useful for Moran to explore this in further work. Another very important question is the extent to which the tax system is not completely indexed. Some work by Edge and Rudd (2002) has examined this issue. Non-indexation of taxation may also prove relevant in assessing the costs and benefits of different inflation rates.

Moran notes that the optimal, deterministic steady-state inflation rate is not the most relevant statistic in a stochastic economy. An inflation target is typically defined in reference to an average inflation rate that the central bank is trying to achieve over a period of time. Thus, the stochastic steady state or stochastic mean of inflation becomes more relevant. For computing optimality in this sense, the zero-lower-bound problem should be important.

Before proceeding to the second set of questions, it is worth noting that the choice of model to denote as benchmark is not an innocuous one. Of the two models Moran presents, his second model probably fits the data better, based on the results of Christiano, Eichenbaum, and Evans (2005) and those of Smets and Wouters (2003). The benefits of dropping inflation to zero are about twice as big as in the model Moran denoted as the benchmark. The model by Lopez-Salido and Levin (2004) includes the credit channel and wage indexation but not price indexation. In that model, optimal inflation is actually minus 1 per cent in our baseline case and as much as minus 2 per cent in a case with a more distorted economy. In that economy, the Friedman rule suggests an inflation rate of minus 4 per cent. Similar calculations could

be made in the context of Moran's model, but it would be more useful to address the issues of the stochastic steady state, considerations about the zero bound, and non-indexation of the tax structure before considering these calculations definitive.

A second set of important questions concerns transition dynamics. What are the first-order welfare costs associated with the transition from 2 to zero per cent? In a model where the capital stock plays an explicit role, it is important to examine conditional welfare, not unconditional welfare. In the paper by Ortega and Rebei, targeting the non-traded inflation rate improves welfare even though such targeting induces output volatility. Kollmann (2002) explains one reason for this paradox: If policy-makers care about unconditional welfare, when policy induces volatility, households increase their precautionary savings. Since people have a stronger incentive to save, the steady-state capital stock rises. But this analysis ignores the cost of increasing the capital stock. In essence, the distinction between conditional versus unconditional welfare maximization is analogous to golden-rule versus modified-golden-rule considerations.

Another dynamics question is: How much does communication matter? If a central bank reduced average inflation from 2 per cent to 1 or zero, how much does its communications strategy matter? In Moran's analysis, particularly in the model following Christiano, Eichenbaum, and Evans, communication issues are irrelevant. The difference between the complete-information case, which is 19 per cent of the steady state, and the learning case, which is 15 per cent, is minor. In effect, it does not matter whether the central bank starts the disinflation and households understand, or whether it takes them three or four years to notice. Wage and price indexation create intrinsic nominal persistence, implying that communication is unimportant.

To what extent does Moran's model match the salient features of historical disinflationary episodes? The paper needs to address that question before proceeding to policy analysis. Otherwise, readers do not know whether to interpret the policy recommendations as quantitative or suggestive. There are two historical episodes that the model should be able to replicate. Both Canada and the United States experienced major disinflation in the early 1980s, as inflation dropped from 10 per cent around 1980 to around 4 per cent by 1984. Both countries had similar output gaps that reached troughs of 6 to 8 per cent below potential in the first two years of the disinflation, followed by recoveries a year or two later. In Moran's model, the output-gap response to the disinflation is disproportionately small, and the recovery to potential lasts only three quarters. Moran thus underestimates the cost of a non-credible disinflation.

In theory, a credible disinflation should be virtually costless. Italy achieved disinflation over four years, 1994 to 1998, without any substantial sacrifice in economic growth. The key to this disinflation was that the government communicated its commitment to meeting the Maastricht criteria, and the central bank communicated its desire to make meeting those criteria possible. Long-run expectations fell; short-run inflation fell as well. Models of disinflation should also be able to match this episode.

In Erceg and Levin (2003), some effort is expended to fit historical episodes, such as the protracted recession in the United States and Canada. That model used four-quarter, Taylor (1980) wage and price contracts. Both Moran and Christiano, Eichenbaum, and Evans (2005) use Calvo (1983) wage and price contracts. In Erceg and Levin, contracts are not indexed to inflation, so prices cannot change until they are reoptimized. This choice reflects the view that intrinsic persistence comes from the learning process and not from an indexation scheme. People who believe that the model of Erceg and Levin fits disinflations better than that of Christiano, Eichenbaum, and Evans have a different perspective on the importance of communication. An analysis in the context of Erceg and Levin shows that the recession associated with a disinflationary episode becomes deeper as the disinflation becomes less credible.

The paper by Moran uses a model in the spirit of Christiano, Eichenbaum, and Evans. That model is popular, but some caution is needed. Using six to eight aggregate series and 40 years of post-war data, many models have observationally equivalent representations. The investment-cost specification in Christiano, Eichenbaum, and Evans, which produces a hump-shape response to a transitory policy shock, yields too muted a response to a permanent shock. During the Volcker disinflation, there was a pronounced drop in auto sales and housing construction. Auto workers mailed car keys to Volcker, saying that they represent cars not being sold. Construction workers sent wooden boards to Volcker, saying that they represent unbuilt houses. In a model with durable goods, it would be possible to represent these features.

References

Calvo, G.A. 1983. "Staggered Prices in a Utility-Maximizing Framework." *Journal of Monetary Economics* 12 (3): 383–98.

Christiano, L.J., M. Eichenbaum, and C.L. Evans. 2005. "Nominal Rigidities and the Dynamic Effects of a Shock to Monetary Policy." *Journal of Political Economy* 113 (1): 1–45.

Edge, R.M. and J.B. Rudd. 2002. "Taxation and the Taylor Principle." Board of Governors of the Federal Reserve System. Finance and Economics Discussion Series No. 2002–51.

Erceg, C.J. and A.T. Levin. 2003. "Imperfect Credibility and Inflation Persistence." *Journal of Monetary Economics* 50 (4): 915–44.

Khan, A., R.G. King, and A.L. Wolman. 2003. "Optimal Monetary Policy." *Review of Economic Studies* 70 (4): 825–60.

Kollmann, R. 2002. "Monetary Policy Rules in the Open Economy: Effects on Welfare and Business Cycles." *Journal of Monetary Economics* 49 (5): 989–1015.

Lopez-Salido, D. and A.T. Levin. 2004. "Optimal Monetary Policy with Endogenous Capital Accumulation." Society for Economic Dynamics Meeting Paper No. 826.

Rotemberg, J.J. and M. Woodford. 1999. "The Cyclical Behaviour of Prices and Costs." In *Handbook of Macroeconomics*, Volume 1B, edited by J.B. Taylor and M. Woodford, chapter 16. Amsterdam: Elsevier Press.

Schmitt-Grohé, S. and M. Uribe. 2004a. "Solving Dynamic General Equilibrium Models Using a Second-Order Approximation to the Policy Function." *Journal of Economic Dynamics and Control* 28 (4): 755–75.

———. 2004b. "Optimal Operational Monetary Policy in the Christiano-Eichenbaum-Evans Model of the U.S. Business Cycle." National Bureau of Economic Research Working Paper No. 10724.

Smets, F. and R. Wouters. 2003. "An Estimated Dynamic Stochastic General Equilibrium Model of the Euro Area." *Journal of the European Economic Association* 1 (5): 1123–175.

Taylor, J.B. 1980. "Aggregate Dynamics and Staggered Contracts." *Journal of Political Economy* 88 (1): 1–23.