

Macro Models and Monetary Policy Analysis

Bundesbank – Federal Reserve Bank of Philadelphia Spring 2012 Research Conference

Eltville, Germany

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FEDERAL RESERVE BANK
OF PHILADELPHIA

The views expressed today are my own and not necessarily
those of the Federal Reserve System or the FOMC.

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Introduction

Good afternoon. It is indeed a pleasure to be with you today. I want to thank President Weidmann for his hospitality, and Dr. Heinz Herrmann and the staff of the Bundesbank for inviting the staff of the Federal Reserve Bank of Philadelphia to co-organize the Bundesbank's 2012 Spring Conference. The conference papers address a multitude of issues that confront the current state of macroeconomics, and the discussion over the past two days shows that researchers are making important strides in understanding the macroeconomy. After spending over 30 years in academia, I have served the last six years as a policymaker trying to apply what economics has taught me. Needless to say, I picked a challenging time to undertake such an endeavor. But I have learned that, despite the advances in our understanding of economics, a number of issues remain unresolved in the context of modern macro models and their use for policy analysis. In my remarks today, I will touch on some issues facing policymakers that I believe state-of-the-art macro models would do well to confront. Before continuing, I should note that I speak for myself and not the Federal Reserve System or my colleagues on the Federal Open Market Committee.

More than 40 years ago, the rational expectations revolution in macroeconomics helped to shape a consensus among economists that only unanticipated shifts in monetary policy can have real effects. According to this consensus, only monetary surprises affect the real economy in the short to medium run because consumers, workers, employers, and investors cannot respond quickly enough to offset the effect of these policy actions on consumption, the labor market, and investment.¹

¹ See Sargent (1996).

But over the years this consensus view on the transmission mechanism of monetary policy to the real economy has evolved. The current generation of macro models, referred to as New Keynesian DSGE models,² rely on real and nominal frictions to transmit not only unanticipated but also systematic changes in monetary policy to the economy. Unexpected monetary shocks drive movements in output, consumption, investment, hours worked, and employment in DSGE models. However, in contrast to the earlier literature, it is the relevance of systematic movements in monetary policy that makes these models of so much interest for policy analysis. Systematic policy changes are represented in these models by Taylor-type rules, in which the policy interest rate responds to changes in inflation and a measure of real activity, such as output growth. Armed with forecasts of inflation and output growth, a central bank can assess the impact that different policy rate paths may have on the economy. The ability to do this type of policy analysis helps explain the widespread use of New Keynesian DSGE models at central banks around the world.

These modern macro models stress the importance of credibility and systematic policy, as well as forward-looking rational agents, in the determination of economic outcomes. In doing so, they offer guidance to policymakers about how to structure policies that will improve the policy framework and, therefore, economic performance. Nonetheless, I think there is room for improving the models and the advice they deliver on policy options. Before discussing several of these improvements, it is important to appreciate the “rules of the game” of the New Keynesian DSGE framework.

The New Keynesian Framework

New Keynesian DSGE models are the latest update to real business cycle, or RBC, theory. Given my own research in this area, it probably does not surprise many of you that I find the RBC paradigm a useful and valuable platform on which to build our macroeconomic models.³ One goal of real business cycle theory is to study the predictions of dynamic general equilibrium models, in which optimizing and forward-looking consumers, workers, employers, and investors are endowed with rational expectations. A shortcoming many see in the simple real business cycle model is its difficulty in internally generating persistent changes in output and employment from a transitory or temporary external shock to, say, productivity.⁴ The recognition of this problem has

² DSGE stands for dynamic stochastic general equilibrium.

³ See Long and Plosser (1983) and King, Plosser, and Rebelo (1988a, b).

⁴ See King and Plosser (1994), Rotemberg and Woodford (1995), and Cogley and Nason (1993, 1995).

inspired variations on the simple model, of which the New Keynesian revival is an example.

The approach taken in these models is to incorporate a structure of real and nominal frictions into the real business cycle framework. These frictions are placed in DSGE models, in part, to make real economic activity respond to anticipated and unanticipated changes in monetary policy, at least, in the short to medium run. The real frictions that drive internal propagation of monetary policy often include habit formation in consumption, that is, how past consumption influences current consumption; the costs of capital used in production; and the resources expended by adding new investment to the existing stock of capital. New Keynesian DSGE models also include the costs faced by monopolistic firms and households when setting their prices and nominal wages. A nominal friction often assumed in Keynesian DSGE models is that firms and households have to wait a fixed interval of time before they can reset their prices and wages in a forward-looking, optimal manner. A rule of the game in these models is that the interactions of these nominal frictions with real frictions give rise to persistent monetary nonneutralities over the business cycle.⁵ It is this monetary transmission mechanism that makes the New Keynesian DSGE models attractive to central banks.

An assumption of these models is that the structure of these real and nominal frictions, which transmit changes in monetary policy to the real economy, well-approximate the true underlying rigidities of the actual economy and are not affected by changes in monetary policy. This assumption implies that the frictions faced by consumers, workers, employers, and investors cannot be eliminated at any price they might be willing to pay. Although the actors in actual economies probably recognize the incentives they have to innovate — think of the strategy to use continuous pricing on line for many goods and services — or to seek insurance to minimize the costs of the frictions, these actions and markets are ruled out by the “rules of the game” of New Keynesian DSGE modeling.

Another important rule of the game prescribes that monetary policy is represented by an interest rate or Taylor-type reaction function that policymakers are committed to follow and that everyone believes will, in fact, be followed. This ingredient of New Keynesian DSGE models most often commits a central bank to increase its policy rate when inflation or output rises above the target set by the central bank. And this

⁵ See Christiano, Eichenbaum, and Evans (2005) and Smets and Wouters (2007).

commitment is assumed to be fully credible according to the rules of the game of New Keynesian DSGE models. Policy changes are then evaluated as deviations from the invariant policy rule to which policymakers are credibly committed.

The Lucas Critique Revisited with Respect to New Keynesian DSGE Models

In my view, the current rules of the game of New Keynesian DSGE models run afoul of the Lucas critique – a seminal work for my generation of macroeconomists and for each generation since.⁶ The Lucas critique teaches us that to do policy analysis correctly, we must understand the relationship between economic outcomes and the beliefs of economic agents about the policy regime. Equally important is the Lucas critique’s warning against using models whose structure changes with the alternative government policies under consideration.⁷ Policy changes are almost never once and for all. So, many economists would argue that an economic model that maps states of the world to outcomes but that does not model how policy shifts across alternative regimes would fail the Lucas critique because it would not be policy invariant.⁸ Instead, economists could better judge the effects of competing policy options by building models that account for the way in which policymakers switch between alternative policy regimes as economic circumstances change.⁹

For example, I have always been uncomfortable with the New Keynesian model’s assumption that wage and price setters have market power but, at the same time, are unable or unwilling to change prices in response to anticipated and systematic shifts in monetary policy. This suggests that the deep structure of nominal frictions in New Keynesian DSGE models should do more than measure the length of time that firms and households wait for a chance to reset their prices and wages.¹⁰ Moreover, it raises

⁶ See Lucas (1976).

⁷ The Lucas critique does not apply to the forecasting problem. An aim of forecasters is to develop models immune from systematic forecast errors instead of models whose structure is immutable in the face of shifting policy regimes.

⁸ See Cooley, LeRoy, and Raymon (1984), Sargent (1984), Sims (1982, 1987), and Leeper and Zha (2003).

⁹ See Leeper and Zha (2003), Cogley and Sargent (2005), Sims and Zha (2006), and Leeper and Davig (2006).

¹⁰ Economic history is replete with examples of systematic monetary policy interventions creating incentives for consumers, workers, employers, and investors to alter their decision rules and actions, including the German hyperinflation of the early 1920s, the Great Inflation of the 1970s, and the Volcker disinflation; see Sargent (1983, 1999).

questions about the mechanism by which monetary policy shocks are transmitted to the real economy in these models.

I might also note here that the evidence from micro data on price behavior is not particularly consistent with the implications of the usual staggered price-setting assumptions in these models.¹¹ When the real and nominal frictions of New Keynesian models do not reflect the incentives faced by economic actors in actual economies, these models violate the Lucas critique's policy invariance dictum, and thus, the policy advice these models offer must be interpreted with caution.

From a policy perspective, the assumption that a central bank can always and everywhere credibly commit to its policy rule is, I believe, also questionable. While it is desirable for policymakers to do so — and in practice, I seek ways to make policy more systematic and more credible — commitment is a luxury few central bankers ever actually have, and fewer still faithfully follow.

During the 1980s and 1990s, it was quite common to hear in workshops and seminars the criticism that a model didn't satisfy the Lucas critique. I thought this was often a cheap shot because almost no model satisfactorily dealt with the issue. And during a period when the policy regime was apparently fairly stable — which many argued it mostly was during those years — the failure to satisfy the Lucas critique seemed somewhat less troublesome. However, in my view, throughout the crisis of the last few years and its aftermath, the Lucas critique has become decidedly more relevant. Policy actions have become increasingly discretionary. Moreover, the financial crisis and associated policy responses have left many central banks operating with their policy rate near the zero lower bound; this means that they are no longer following a systematic rule, if they ever were. Given that central bankers are, in fact, acting in a discretionary manner, whether it is because they are at the zero bound or because they cannot or will not commit, how are we to interpret policy advice coming from models that assume full commitment to a systematic rule? I think this point is driven home by noting that a number of central banks have been openly discussing different regimes, from price-level targeting to nominal GDP targeting. In such an environment where policymakers actively debate alternative regimes, how confident can we be about the policy advice that follows from models in which that is never contemplated?

¹¹ See Maćkowiak and Smets (2009) and Alvarez and Burriel (2010).

Some Directions for Furthering the Research Agenda

While I have been pointing out some limitations of DSGE models, I would like to end my remarks with six suggestions I believe would be fruitful for the research agenda.

First, I believe we should work to give the real and nominal frictions that underpin the monetary propagation mechanism of New Keynesian DSGE models deeper and more empirically supported structural foundations. There is already much work being done on this in the areas of search models applied to labor markets and studies of the behavior of prices at the firm level. Many of you at this conference have made significant contributions to this literature.

Second, on the policy dimension, the impact of the zero lower bound on central bank policy rates remains, as a central banker once said, a conundrum. The zero lower bound introduces nonlinearity into the analysis of monetary policy that macroeconomists and policymakers still do not fully understand. New Keynesian models have made some progress in solving this problem,¹² but a complete understanding of the zero bound conundrum involves recasting a New Keynesian DSGE model to show how it can provide an economically meaningful story of the set of shocks, financial markets, and frictions that explain the financial crisis, the resulting recession, and the weak recovery that has followed. This might be asking a lot, but a good challenge usually produces extraordinary research.

Third, we must make progress in our analysis of credibility and commitment. The New Keynesian framework mostly assumes that policymakers are fully credible in their commitment to a specified policy rule. If that is not the case in practice, how do policymakers assess the policy advice these models deliver? Policy at the zero lower bound is a leading example of this issue. According to the New Keynesian model, zero lower bound policies rely on policymakers guiding the public's expectations of when an initial interest rate increase will occur in the future. If the credibility of this forward guidance is questioned, evaluation of the zero lower bound policy has to account for the public's beliefs that commitment to this policy is incomplete. I have found that policymakers like to presume that their policy actions are completely credible and then engage in decisions accordingly. Yet if that presumption is wrong, those policies will not

¹²See Braun, Körber, and Waki (2012), Carlstrom, Fuerst, and Paustian (2012), and Fernández-Villaverde, Gordon, Guerrón-Quintana, and Rubio-Ramírez (2012).

have the desired or predicted outcomes. Is there a way to design and estimate policy responses in such a world? Can reputational models be adapted for this purpose?

Fourth, and related, macroeconomists need to consider how to integrate the institutional design of central banks into our macroeconomic models. Different designs permit different degrees of discretion for a central bank. For example, responsibility for setting monetary policy is often delegated by an elected legislature to an independent central bank. However, the mandates given to central banks differ across countries. The Fed is often said to have a dual mandate; some banks have a hierarchal mandate; and others have a single mandate. Yet economists endow their New Keynesian DSGE models with strikingly uniform Taylor-type rules, always assuming complete credibility. Policy analysis might be improved by considering the institutional design of central banks and how it relates to the ability to commit and the specification of the Taylor-type rules that go into New Keynesian models. Central banks with different levels of discretion will respond differently to the same set of shocks.

Let me offer a slightly different take on this issue. Policymakers are not Ramsey social planners. They are individuals who respond to incentives like every other actor in the economy. Those incentives are often shaped by the nature of the institutions in which they operate. Yet the models we use often ignore both the institutional environment and the rational behavior of policymakers. The models often ask policymakers to undertake actions that run counter to the incentives they face. How should economists then think about the policy advice their models offer and the outcomes they should expect? How should we think about the design of our institutions? This is not an unexplored arena, but if we are to take the policy guidance from our models seriously, we must think harder about such issues in the context of our models.

This leads to my fifth suggestion. Monetary theory has given a great deal of thought to rules and credibility in the design of monetary policy, but the recent crisis suggests that we need to think more about the design of lender-of-last-resort policy and the institutional mechanism for its execution. Whether to act as the lender of last resort is discretionary, but does it have to be so? Are there ways to make it more systematic ex ante? If so, how?

My sixth and final thought concerns moral hazard, which is addressed in only a handful of models. Moral hazard looms large when one thinks about lender-of-last-resort activities. But it is also a factor when monetary policy uses discretion to deviate from its policy rule. If the central bank has credibility that it will return to the rule once it has

deviated, this may not be much of a problem. On the other hand, a central bank with less credibility, or no credibility, may run the risk of inducing excessive risk-taking. An example of this might be the so-called “Greenspan put,” in which the markets perceived that when asset prices fell, the Fed would respond by reducing interest rates. Do monetary policy actions that appear to react to the stock market induce moral hazard and excessive risk-taking? Does having lender-of-last-resort powers influence the central bank’s monetary policy decisions, especially at moments when it is not clear whether the economy is in the midst of a financial crisis? Does the combination of lender-of-last-resort responsibilities with discretionary monetary policy create moral hazard perils for a central bank, encouraging it to take riskier actions? I do not know the answer to these questions, but addressing them and the other challenges I have mentioned with New Keynesian DSGE models should prove useful for evaluating the merits of different institutional designs for central banks.

Conclusion

The financial crisis and recession have raised new challenges for policymakers and researchers. The degree to which policy actions, for better or worse, have become increasingly discretionary should give us pause as we try to evaluate policy choices in the context of the workhorse New Keynesian framework, especially given its assumption of credibly committed policymakers. Indeed, the Lucas critique would seem to take on new relevance in this post-crisis world. Central banks need to ask if discretionary policies can create incentives that fundamentally change the actions and expectations of consumers, workers, firms, and investors. Characterizing policy in this way also raises issues of whether the institutional design of central banks matters for evaluating monetary policy. I hope my comments today encourage you, as well as the wider community of macroeconomists, to pursue these research questions that are relevant to our efforts to improve our policy choices.

References

An, Sungbae, and Frank Schorfheide. "Bayesian Analysis of DSGE Models," *Econometric Reviews*, 26 (2007), pp. 113-172.

Alvarez, Luis J., and Pablo Burriel. "Is a Calvo Price Setting Model Consistent with Individual Price Data?" *B.E. Journal of Macroeconomics*, 10:1, 13 (2010).

Braun, R. Anton, Lena M. Körber, and Yuichiro Waki. "Some Unpleasant Properties of Log-linearized Solutions When the Nominal Rate Is Zero," Federal Reserve Bank of Atlanta Working Paper 12-5 (2012).

Carlstrom, Charles T., Timothy S. Fuerst, and Matthias Paustian. "How Inflationary Is an Extended Period of Low Interest Rates?," Federal Reserve Bank of Cleveland Working Paper 12-2 (2012).

Christiano, Lawrence J., Martin Eichenbaum, and Charles I. Evans. "Nominal Rigidities and the Dynamic Effects of a Shock to Monetary Policy," *Journal of Political Economy*, 113(February 2005), pp. 1-45.

Cogley, Timothy, and James M. Nason. "Impulse Dynamics and Propagation Mechanisms in a Real Business Cycle Model," *Economics Letters*, 43(December 1993), pp. 77-81.

Cogley, Timothy, and James M. Nason. "Output Dynamics in Real-Business-Cycle Models," *American Economic Review*, 85(June 1995), pp. 492-511.

Cogley, Timothy, and Thomas J. Sargent. "Drifts and Volatilities: Monetary Policies and Outcomes in the Post-WWII US," *Review of Economic Dynamics*, 8(2005), pp. 262-302.

Cooley, Thomas F., Stephen F. LeRoy, and Neil Raymon. "Econometric Policy Evaluation: Note," *American Economic Review*, 74 (June 1984), pp. 467-70.

Fernández-Villaverde, Jesus, Pablo A. Guerrón-Quintana, and Juan F. Rubio-Ramírez. "The New Macroeconometrics: A Bayesian Approach," in A. O'Hagan and A.M. West eds., *The Oxford Handbook of Applied Bayesian Analysis*. Oxford: Oxford University Press, 2011.

Fernández-Villaverde, Jesus, Grey Gordon, Pablo A. Guerrón-Quintana, and Juan F. Rubio-Ramírez. "Non-linear Adventures at the Zero Lower Bound," Federal Reserve Bank of Philadelphia Working Paper 12-10 (2012)..

King, Robert G., and Charles I. Plosser. "Real Business Cycles and the Test of the Adelmans," *Journal of Monetary Economics*, 33(April 1994), pp. 405-38.

- King, Robert G., Charles I. Plosser, and Sergio T. Rebelo. "Production, Growth, and Business Cycles: I. The Basic Neoclassical Model," *Journal of Monetary Economics*, 33(May 1988a), pp. 195-232.
- King, Robert G., Charles I. Plosser, and Sergio T. Rebelo. "Production, Growth, and Business Cycles: II. The Basic Neoclassical Model," *Journal of Monetary Economics*, 33 (May 1988b), pp. 309-42.
- Leeper, Eric M., and Troy Davig. "Generalizing the Taylor Principle," *American Economic Review*, 97(June 2006), pp. 607-35.
- Leeper, Eric M., and Tao Zha. "Modest Policy Interventions," *Journal of Monetary Economics*, 50 (2003), pp. 1673-1700.
- Long, John B., and Charles I. Plosser. "Real Business Cycles," *Journal of Political Economy*, 91(February 1983), pp. 39-69.
- Lucas, Robert E., Jr. "Econometric Policy Evaluation: A Critique," in K. Brunner and A. Meltzer, eds. *Carnegie-Rochester Conference Series on Public Policy* 1, 1976, pp. 19-46.
- Maćkowiak, Bartosz, and Frank Smets. "Implications of Microeconomic Price Data for Macroeconomic Models," in J. Fuhrer, Y. Kodrzycki, J. Little, and G. Olivei, eds., *Understanding Inflation and the Implications for Monetary Policy: A Phillips Curve Perspective*. Boston: MIT Press, October 2009, pp. 291-333.
- Rotemberg, Julio, J., and Michael Woodford. "Real-Business-Cycle Models and Forecastable Movements in Output, Hours, and Consumption," *American Economic Review*, 86 (June 1995), pp. 71-89.
- Sargent, Thomas J. "The Ends of Four Big Inflations," in Hall, R.E., ed., *Inflation: Causes and Effects*. Chicago: University of Chicago Press, 1983.
- Sargent, Thomas J. "Vector Autoregressions, Expectations, and Advice," *American Economic Review*, 74 (May 1984), pp. 408-15.
- Sargent, Thomas J. "Expectations and the Non-neutrality of Lucas," *Journal of Monetary Economics*, 37 (1996), pp. 535-48.
- Sargent, Thomas J. *The Conquest of American Inflation*. Princeton, NJ: Princeton University Press, 1999.
- Sims, Christopher A. "Policy Analysis with Econometric Models," *Brookings Papers on Economic Activity*, 1 (1982), pp. 107-52.

Sims, Christopher A. "A Rational Expectations Framework for Short Run Policy Analysis," in W.A. Barnett and K.J. Singleton, eds., *New Approaches to Monetary Economics: Proceedings of the Second International Symposium in Economic Theory and Econometrics*, Cambridge: Cambridge University Press, 1987.

Sims, Christopher A., and Tao Zha. "Were There Regime Switches in U.S. Monetary Policy?," *American Economic Review*, 96 (2006), pp. 54-81.

Smets, Frank, and Rafael Wouters. "Shocks and Frictions in US Business Cycles: A Bayesian DSGE Approach," *American Economic Review*, 97 (June 2007), pp. 586-606.