



# Editor's Introduction

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**R**ecent advances in monetary policy research involve general equilibrium modeling. There is often a long lag between the time new ideas gain acceptance in academic circles and the time when they are integrated into the policymaking process. One purpose of our annual conferences is to shorten that lag by supporting research aimed directly at issues policymakers care about. For instance, in this conference we look at practical implications of recent research in general equilibrium modeling. Three of the six papers focus on the long-term bond market. Bond markets often play the role of “canary in the mine-shaft,” providing early warning about shifts in expectations of monetary policy. The longer-term interest rates are also seen as more important for aggregate demand, especially for investment. Because the Fed operates with a target for the interest rate on overnight lending in the market for federal funds, it is natural for us to want to know more about how monetary policy affects the term structure of interest rates and how expectations about monetary policy are revealed in market pricing.

The Thirty-First Annual Policy Conference of the Federal Reserve Bank of St. Louis brought together economists working at the frontier in monetary policy research, bringing new ideas that have come from research in general equilibrium modeling. Participants at the conference highlighted both the promise and the limitations of recent advances.

## A POLICY MODEL FOR THE U.K. ECONOMY

In the first paper presented at the conference, Riccardo DiCecio and Edward Nelson presented a monetary policy model estimated to fit U.K. data. The model is a dynamic stochastic general equilibrium (DSGE) model based on the popular work of Christiano, Eichenbaum, and Evans (2005; CEE). This version of the DSGE model is characterized by a number of economic frictions arising from wage and price contracts, wage and price indexation to the previous period's inflation rate, habit formation in consumption, investment adjustment costs, variable capital utilization, and an assumption that firms must pay their wage bill with funds borrowed in the previous period. This is a New Keynesian (NK) version of the DSGE model, named for the exogenous price and/or wages frictions that are imposed.

The identification of macroeconomic models has always been a problem because of the large number of parameters relative to the short spans of time over which we can credibly assume that economic structure has been stationary. Of course, having a new policy model for the United Kingdom is important in its own right, but it is also important to investigate the mapping of models into reality using all the data available.

The U.K. data offer an interesting challenge to the authors. The advantage of the U.K. experience is that they have had many policy changes—changes that induce a reaction that help the

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Federal Reserve Bank of St. Louis *Review*, July/August 2007, 89(4), pp. 209-13.

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econometrician identity the effects of policy. On the other hand, the numerous changes in monetary and fiscal policies make it difficult to model a general policy rule that spans the available history. Indeed, the authors find that they cannot estimate a stable policy function if they include the full data set from 1962 through 2005. Instead, they present several sets of results based on different observation periods.

In general, the authors report preference and production parameter estimates for the United Kingdom that are consistent with those estimated by CEE for the United States; however, there is less evidence for the United Kingdom that variable capacity utilization matters. The most important finding for the United Kingdom that differs sharply from CEE's finding for the United States is that it is price stickiness and not wage stickiness that is the most important in the monetary transmission mechanism.

In their comments on the paper, Martin Fukač and Adrian Pagan discussed important issues involving the econometric methods used by the authors (and CEE) and made specific recommendations for future research. DiCecio and Nelson began by estimating a monetary policy shock in a structural vector autoregression (VAR) model. The estimation procedure is optimal conditional on the assumption that the monetary policy shock is identified correctly. The parameters of the model were chosen to minimize a measure of the distance between the model's impulse responses to a monetary policy shock and those estimated in the VAR. Fukač and Pagan outline specific steps for extending this research using a larger number of identified shocks (and their related impulse responses). They also recommend and outline a method that involves fitting the Euler equations directly, rather than matching impulse response functions.

## HOW SHOULD POLICYMAKERS REACT TO CHANGING TERM PREMIUMS?

Glenn Rudebusch, Brain Sack, and Eric Swanson investigate the relationship between

components of the term structure of interest rates and monetary policy. They ask whether it is changes in expected future short rates or changes in term (risk) premiums that are important for aggregate demand. Their work is motivated by the unusual (lack of) response of long-term bond yields throughout the most recent period of substantial monetary policy tightening.

They begin by quoting Fed officials who suggest that the recent decline in term premiums will be expansionary and, therefore, should be countered with a relatively higher path for the federal funds rate. They show that it is expected future rates (and not term premiums) that determine aggregate demand in the linearized NK model that is routinely used to analyze policy issues.

They go on to model term premiums in the NK framework and use the model to show that the relationship between term premiums and output depends on the source of the shock. For monetary policy and technology shocks, the relationship is negative. They show that, in the case of government spending shocks, the relationship is positive, but in all cases the effect on the term premium is small. They conclude that the sources of the shocks are important and that the current state of the art in DSGE modeling is inherently biased against finding any effect of term premiums. When time-varying term premiums are explicitly modeled, as in this paper, the effects are necessarily third-order (and therefore small).

The last part of this study is a survey and sample of recent research that uses a reduced-form approach to investigate the ability of term premiums to predict future output growth. Introducing a difference specification, they report new results showing that changes in term premiums are negatively related to future output growth.

In commenting on this paper, John Cochrane reviews the facts from several points of view. He concludes that term premiums are driven by business cycle risk, but cannot offer (and does not see on the horizon) a theory that will explain the facts or predict movements in interest rates.

## MODELING LONG-RUN RISKS IN FINANCIAL MARKETS

The standard neoclassical growth model, which forms the basis of almost all the DSGE models used in policy analysis, cannot account for important features in financial markets. For example, such models cannot explain the large premium that investors require to invest in risky assets and they cannot explain the high volatility of returns on long-term assets. Over the past few years, Ravi Bansal and several coauthors have attacked this problem by adapting the Epstein and Zin (1989) model of preferences to a world with long-run consumption risk. In this conference paper, Bansal summarizes much of that research and, in the process of summarizing it, describes the modifications to the neoclassical growth model that help to explain the stochastic properties of asset prices.

The key mechanism is to add long-run risks to an Epstein-Zin model of preferences and calibrate it to match important features of asset returns. The intuition is that short-run shocks to consumption contain a small bit of information about the future long-run consumption path. The Epstein-Zin framework separates the parameter governing relative risk aversion from the intertemporal elasticity of substitution (IES). This is important for explaining the asset pricing puzzles without assuming unrealistically high risk aversion. Within this framework, Bansal demonstrates that choosing a value greater than 1 for the IES is necessary for matching the observed positive price of volatility risk. He argues that previous estimates of the IES were biased downward because they ignored the effect of time-varying consumption volatility.

Bansal also surveys a large literature that has adopted this long-run risk model to study a variety of puzzles in the asset pricing literature, including the equity premium puzzle, the excessive volatility puzzles, and the predictability of returns across assets sorted by size, momentum, and book-to-market values. This framework has also been adapted to foreign exchange market anomalies and, as we see in the next paper, the unexplained high volatility of the term structure of interest rates.

In his comments, Thomas Sargent explains why this paper is important for macroeconomists: Solving the puzzles surrounding the empirical fit of the consumption Euler equation is essential for New Keynesian economists who want to use the investment-saving (IS) relation to model the monetary transmission mechanism. He also provides a provocative interpretation of the parameters of the Epstein-Zin utility function when there is uncertainty about the driving process for consumption. This interpretation allows very reasonable assumptions about the IES and the coefficient of relative risk aversion while still matching important empirical asset pricing regularities.

## DOES MONETARY POLICY MATTER FOR THE TERM STRUCTURE OF VOLATILITY?

In the next paper, Michael Gallmeyer, Burton Hollifield, Francisco Palomino, and Stanley Zin extend the two-factor affine model of the term structure by adding a third factor, the monetary policy shock. Their goal is to understand better how the monetary policy rule can affect the stochastic properties of the term structure of interest rates. They start with an equilibrium model with interesting features that have been found useful in accounting for the behavior of asset prices. The model has Epstein-Zin preferences, which allow separation between the coefficient of relative risk aversion and the intertemporal rate of substitution in consumption. The consumption process includes a small, highly persistent component as recommended by Bansal and Yaron (2004), and it adopts a Taylor rule for monetary policy.

The key insight from general equilibrium theory is that when the Fed implements monetary policy using a short-term interest rate target, inflation rates must adjust to clear the bond market. The result is that the factors that drive inflation will be the same factors that drive risk premiums over the term structure. This paper uses the framework of the affine term-structure model with market clearing prices to show how the parameters in the monetary policy rule affect the stochastic

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volatility of term premiums in both the real and nominal term structures.

The authors show that they can replicate many features of the bond market. With a positive intertemporal elasticity of substitution they can match the upward slope in the average term structure (and very closely if this parameter is set equal to unity). The model helps explain the term structure of volatility, but only with policy shocks that result in too much inflation volatility relative to the data. This model of monetary policy implies too much volatility in maturities of less than a year and not enough at the longer maturities.

Pamela Labadie commented on an early version of this paper that was presented at the conference. She commended the authors for the interesting mapping of the Epstein-Zin preferences with stochastic volatility into the Duffie-Kan affine term-structure framework. She also made suggestions for sensitivity testing and extensions, many of which are reflected in the final version printed in this volume.

## MONETARY POLICY AND ECONOMIC EQUILIBRIUM

A key insight from general equilibrium analysis is that the nature of the economic equilibrium is highly dependent on the form of the policy function. The rational expectations revolution of the 1970s taught us that people take account of expected policy when they make decisions and that it matters for how effective a policy might be. In their paper, “Monetary Policy as Equilibrium Selection,” Gaetano Antinolfi, Costas Azariadis, and Jim Bullard show another way that the form of policy can affect the nature of the equilibrium in the real economy. They develop a model to show why active policy feedback rules such as those proposed by Taylor (1993) may be needed to help credit markets function smoothly and to concentrate expectations on desirable outcomes.

They model an exchange economy where households have variable income levels and borrow in credit markets to smooth consumption. Optimal allocation of consumption across time

and individuals cannot be achieved when there is imperfect enforcement of loan contracts. Lenders may respond to the limited enforcement by limiting the amount of debt to a low-income household. The authors discuss monetary and fiscal policies that might be used to achieve the optimal allocation of consumption in the presence of such credit-market frictions.

They argue that the fiscal policies that would solve the consumer’s problem are dependent on the policymaker having detailed knowledge about the distribution of individual incomes and argue that a policy involving monetary transfers may offer a feasible alternative. They show that passive policies such as constant monetary growth will not solve the problem, but policies that respond to information about the state of the economy may. The model presented in this paper is highly stylized. In the conclusion, the authors suggest how it might be made more realistic and speculate that the results will hold in a more general class of models.

In his comments on the paper, Peter Ireland notes that this paper is the first to use active versus passive policy rules to investigate optimal policy in a model where the role for money is explicitly modeled with agents who differ in a fundamental way (here the difference is in the income stream). He goes on to list questions raised, but not answered, by this paper—questions about the need for a policy solution, credibility, time consistency, and the robustness of the policy recommendation in more general models.

## WHY DOES BETTER FIT NOT ALWAYS MAKE A BETTER MODEL?

In the final paper, Narayana Kocherlakota addresses the issue of using statistical fit to select parameters in a DSGE model that will be used to give policy advice. He begins with an example in which the model with the poorer fit gives the better policy advice. At one level, this might seem to be a trivial exercise. The model with perfect fit is estimated with Bayesian methods starting with an incorrect prior. The problem is that, even with infinite time series, an incorrect prior will

not be changed if the model is not identified. But the point of the paper is not to show that such an outcome is possible, but to argue that it is likely given current practice in this literature and to suggest procedures for avoiding the mistake.

The general intuition is that econometric estimation of complicated macroeconomic models is quite difficult because we do not have enough secure prior information to guarantee correct identification of parameters. Kocherlakota argues that to get full identification in DSGE models, the researcher typically makes untestable assumptions about the distribution of the shock processes. The larger the model, the more shocks are needed to get identification. As we add more and more shocks, we are including shocks about which we know less and less. Any quantitative answers given by the model will be conditioned on the appropriateness of untestable assumptions about the shocks.

In the particular example involving tax policy, getting the correct answer involves making correct assumptions about the statistical properties of the labor supply shock. The example illustrates the importance of understanding which elements of the model are essential for getting good policy advice.

Kocherlakota goes on to describe a general procedure for avoiding the use of untestable assumptions about the shock processes. This procedure is based on the belief that we have better prior information about the parameters of the preference and production functions than we do about the shock processes. It recommends using partially identified models as a way of avoiding “incredible” identification assumptions.

In his comment, Lee Ohanian argues that solving the identification problem raised by Kocherlakota may be more difficult than is

suggested in this paper. The reason is that Kocherlakota’s example required getting only one parameter correctly identified, yet resulted in a wide range of uncertainty about the effects of policy. In general, policy choices will depend on more than one critical parameter, making identification more difficult and the estimates of policy effects more uncertain. He notes that Kocherlakota’s critique of econometric practice has been around a long time, even if often ignored for the sake of expediency. He argues that the canonical central bank model of inflation based on the Phillips curve suffers from this critique: that is, it is identified and the fit is maximized by a proliferation of shocks and associated untestable assumptions.

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