Summary of Papers Presented at the Conference "Models and Monetary Policy: Research in the Tradition of Dale Henderson, Richard Porter, and Peter Tinsley"

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On March 26 and 27, 2004, the Federal Reserve Board held a conference in Washington, D.C., on the application of economic models to the analysis of monetary policy issues. The papers presented at the conference addressed several topics that, because they are of interest to central bankers, have been a prominent feature of Federal Reserve research over the years. In particular, the papers represent research in the tradition of work carried out over the past thirty-five years at the Federal Reserve by three prominent staff economists—Dale W. Henderson, Richard D. Porter, and Peter A. Tinsley. Thus, the conference partly served as a celebration of the contributions made by these individuals to policy-related research since the late 1960s.

Among the specific topics addressed at the conference were the influence of uncertainty on policymaking; the design of formal rules to guide policy actions; the role of money in the transmission of monetary policy; the determination of asset prices; and econometric techniques for estimating dynamic models of the economy. This summary discusses the papers in the order presented at the conference.[1]

1. The conference sessions also included a panel consisting of Ben S. Bernanke, William Poole, and John B. Taylor, who discussed the current state of central bank research and likely directions for future work. A list of the conference papers appears at the end of this article along with an alphabetical list of authors and their affiliations at the time of the conference. For a limited period, the papers will be available at www.federalreserve.gov/events/conferences/mmp2004/program.htm. In early 2005, the Federal Reserve Board will publish a conference volume that will include a revised version of each conference paper, commentaries on each paper by the conference discussants, and an appreciation summarizing the careers of Henderson, Porter, and Tinsley.

Lars Peter Hansen and Thomas J. Sargent

One way that economists gain insights about how to make sound economic decisions in an uncertain world is to study simple problems in which the optimal way to behave can be unambiguously derived. In the 1950s, Herbert Simon and Henri Theil derived a simple principle that has been central to the study of economic decisionmaking under uncertainty.[2] Under their assumptions, they show that the optimal choice under uncertainty can be derived in two steps: First, form your best forecast of the relevant unknown variables, and second, act as you would if you were certain that your forecast would come true. This result has come to be known as the *certainty-equivalence* principle: Once one forms the best forecast of future conditions, the nature and the degree of uncertainty play no further role in decisionmaking. As might be expected, certainty equivalence applies only under very restrictive conditions, and economists have extensively studied cases in which the certainty-equivalence principle does not generate the best possible decisions. Nonetheless, certainty equivalence remains an important benchmark case to consider and has proven extremely useful both in understanding more-complicated theoretical cases and in thinking about real-world problems.

A critical assumption underlying the certainty-equivalence principle is that decisionmakers, be they households, firms, or policymakers, know the true model of the economy. No one knows, of course, the full, true nature of the economy. Thus, households, firms, and policymakers may find it appropriate to take this uncertainty into account in deciding how to act. In "'Certainty Equivalence' and 'Model Uncertainty'," Lars Peter Hansen and Thomas J. Sargent consider economic decisionmaking under model

2. Herbert Simon (1956), "Dynamic Programming under Uncertainty with a Quadratic Criterion Function," *Econometrica*, vol. 24, pp. 74–81; and Henri Theil (1957), "A Note on Certainty Equivalence in Dynamic Planning," *Econometrica*, vol. 25, pp. 346–49.

uncertainty. In their paper, the decisionmaker does not know the true model of the economy but knows only a set of models containing the true model. The authors' approach differs from Bayesian decision theory, in which the decisionmaker assigns to each model a probability that it is the true one and then chooses the decision that is the best response on average across all the competing models. Instead, Hansen and Sargent consider a form of ''robust decisionmaking'' in which the decisionmaker chooses the decision that maximizes his or her welfare in the worst-case scenario—that is, when the true model turns out to be the worst possible model from the standpoint of the agent. Robust decisionmaking is quite complicated, especially if what happens to be the worst-case model depends on which decision the agent chooses.

The paper shows that, even under this cautious approach to taking account of model uncertainty, a surprising and useful version of the certainty-equivalence principle prevails. Once again, the optimal decision under uncertainty can be seen as the solution of an equivalent problem under certainty. In this case, however, one does not take as certain the best objective forecast of the relevant variables; rather, the forecast is ''tilted'' or ''twisted'' in a particular way to reflect the agent's desire to minimize suffering if the worst-case model prevails. The results of the paper shed light on the nature of the cautious behavior induced by the desire for decisions that are robust in this way.

The paper also provides important insights into the way to analyze this sort of decisionmaking. The solution is cast as the result of an imaginary two-player game in which a fictional opposing player maliciously chooses the worst possible model for the agent. Further, the paper shows that the robust decisionmaking can be interpreted as a form of Bayesian decisionmaking in which, once again, the probabilities of outcomes are twisted in a particular way to reflect the desire for robustness.

JOHN C. WILLIAMS

The pervasive nature of structural change in the economy presents a great challenge for macroeconomic modeling and policy analysis, in no small part because it significantly complicates the estimation of the data-generating processes of key unobserved variables, such as the natural rates of interest and unemployment. Traditionally, evaluating macroeconomic policy using econometrics has involved two steps. The first step tackles the estimation of a model of the economy, including the unobserved natural rates of interest and unemployment. In the second step, the best policy is selected by employing the estimated model and natural rate variables as if they were free of estimation error. This two-step approach has proven attractive because separating model estimation from policy selection simplifies analysis. Under certain strong assumptions, the certainty-equivalence principle suggests that one can find the best policy by first modeling key variables and then choosing the policy as if the model's forecasts were certain to come true.[3]

Because the certainty-equivalence principle assumes knowledge of the true model of the economy, it implies precise knowledge of the equations determining unobserved variables such as the natural rates of interest and unemployment, a requirement that is surely not satisfied in the case of monetary policymaking. The uncertainty regarding modeling these natural rates has many sources, but one of the most important seems to be the presence of structural change in the macroeconomy.

In ''Robust Estimation and Monetary Policy with Unobserved Structural Change,'' John C. Williams examines, through an estimated model of the U.S. economy, the quantitative significance of structural change for the implementation of monetary policy. Williams first documents the considerable uncertainty associated with modeling the natural rates of interest and unemployment. The data are insufficiently informative to allow a clear choice among alternative estimated models for either natural rate. Importantly, as Williams shows, the policy suggested by applying the certainty-equivalence principle to one of these models often will lead to very poor policy outcomes if one of the other models happens to be true. The problem seems to arise mainly from the differences in the natural rate models. The costs of improperly ignoring uncertainty about the natural rates are especially pronounced in terms of the variability of inflation. The certainty-equivalent policies suggest that policymakers have considerable ability to limit fluctuations in both output and inflation, but this result seems to rest heavily on the model in question being exactly correct. When applied in other models that fit the data about as well, the suggested policies are often far from optimal.

In light of his finding, Williams investigates alternative solutions to the joint problem of estimation and policy feedback in the presence of uncertainty about how to model the natural rates of interest

3. As discussed earlier, the first step involves forming a ''best forecast'' of key variables. Under standard assumptions, that forecast will come from estimating the correct econometric model.

and unemployment. He identifies strategies that are robust in the sense of providing very good policy outcomes no matter which model is correct. He finds that estimating these natural rates using simple estimators such as weighted averages of sample means performs well for the purpose of formulating robust policy. He also finds that, with these estimators, the optimal policy under uncertainty incorporates a significant degree of policy inertia—that is, a dependence of the current interest rate setting on its value in the previous period—and responds less aggressively to perceived unemployment gaps than certainty equivalence would suggest. Finally, he shows that adopting this joint estimation and control procedure proves highly effective at mitigating the effects of misspecification and mismeasurement of the natural rates of interest and unemployment.

Jeffrey C. Fuhrer and Giovanni P. Olivei

Understanding why important economic indicators such as unemployment, output, and inflation gradually rise and fall over the business cycle is of central importance to many macroeconomic issues, including the optimal conduct of monetary policy. At least since the work of John Maynard Keynes, macroeconomists have debated the business-cycle role of ''sticky'' prices and wages—prices and wages that respond only sluggishly to new conditions. Sticky prices have the potential to give a special role to expectations of future economic conditions. If, say, a manufacturer is going to post and maintain a price for an extended period, he or she needs to take account of not only current conditions but also the conditions expected to prevail over the extended period. The nature and the degree of such forward-looking price-setting behavior have important consequences for an understanding of the optimal response of monetary policy to the business cycle; hence, building an empirical model that provides a realistic account of the way expectations feed into prices and wages is a critical—and hotly debated—area of research.

The central issue in this research concerns the degree to which price setters look to the future. Are they *inertial*, that is, focused on current or past conditions? Or are they mainly *forward looking*, that is, focused on projected conditions in the period over which the price will hold? The difficulty in this literature is that, in either case, current prices could explain future prices. In the inertial explanation, current prices are a fairly direct determinant of future prices. Under the forward-looking explanation, last month's prices explain next month's because past prices are a good predictor of future prices. If pricing behavior is somewhat inertial, both these explanations are likely to be correct, and sorting out their relative importance raises subtle econometric issues. Clearly, if one can find economic variables that behave very differently depending on which case is correct, these variables can be used to help settle the issue. Econometricians call such variables *instruments.*[4]

In ''Estimating Forward-Looking Euler Equations with GMM Estimators: An Optimal Instruments Approach,'' Jeffrey C. Fuhrer and Giovanni P. Olivei compare different methods for choosing instrumental variables in the estimation of forward-looking output and inflation equations.[5] They follow earlier work in showing that the instrumental variables used in conventional estimation of such equations are weak—the behavior of the instruments in the forward-looking case do not differ much from that in the inertial case. To mitigate this problem, the authors propose an estimation procedure based on instrumental variables that exploits more completely the differential predictions of the two theories.[6] They call this procedure an ''optimal instruments'' approach and show that it has some desirable statistical properties (for example, it shares some of the properties of maximum-likelihood estimation). The authors use computer simulations to show that the new approach substantially resolves the weak-instruments problem and that, in contrast with the conventional method, the estimates of key parameters obtained using the new method tend to be about right on average. Further, the optimal-instruments method provides a more stringent test of the hypothesis of forward-looking behavior because the method more completely assesses the predictions of the model.

The authors show, through simulations, that the estimates made with the optimal-instruments approach should be more reliable than those made with conventional techniques; then they apply the method to equations for output and for inflation using U.S. data. For both relations, the estimates using the new method indicate a much larger inertial component, and hence a smaller role for forward-

4. To clearly resolve which theory is correct, econometricians need variables that meet certain conditions for valid instruments. In the current case, the goal is to estimate the role of expected future conditions—as opposed to recent past conditions—in setting prices. Because price expectations are not directly observed in the economy, a useful instrumental variable would, say, rise when price expectations rise for reasons other than a rise in current prices.

5. GMM is the abbreviation for general method of moments.

6. More formally, the instruments are based on imposing the restrictions of the forward-looking model regarding how current variables should affect expectations of the future.

looking behavior, than is suggested by conventional estimation.

Pierpaolo Benigno and Michael Woodford

In ''Optimal Stabilization Policy when Wages and Prices Are Sticky: The Case of a Distorted Steady State,'' Pierpaolo Benigno and Michael Woodford consider the optimal design of monetary policy when both prices and wages display considerable inertia. The authors are especially interested in whether the recent findings of Christopher J. Erceg, Dale W. Henderson, and Andrew T. Levin hold in the context of a more general model of the economy.[7] In their model, Erceg, Henderson, and Levin assumed the existence of output and employment subsidies that eliminate any distortions arising from the market power of monopolistically competitive firms. As a result, a monetary policy that stabilizes prices yields a steady-state level of output that is efficient. Benigno and Woodford point out, however, that the property of efficiency does not hold in the absence of such subsidies. Under more-realistic assumptions about subsidies and taxes, stabilization policy will influence not only the steady-state variability of wages, prices, and output but also the average equilibrium levels of these factors. Thus, optimal monetary policy under these more-general conditions involves a more complicated set of tradeoffs and may imply central bank behavior that differs significantly from that derived from a simpler model.

To investigate this possibility, Benigno and Woodford extend the analysis of Erceg, Henderson, and Levin by using a model in which the steady-state level of output under a zero-inflation policy is suboptimal because of tax distortions and market power. Like the previous researchers, Benigno and Woodford find that the expected utility of the representative household can be approximated by a quadratic loss function with no linear terms, a result implying that the welfare associated with a given policy rule can still be readily evaluated (to second-order accuracy) using a first-order-accurate solution of the model. Also, they continue to find that the welfare-theoretic loss function has three terms capturing the distortions arising from nonzero levels of wage inflation, price inflation, and an appropriately defined measure of the output gap.

The existence of a distorted steady state in the more-general model, however, does influence the weight placed on each of the three objectives. In addition, tax distortions and market power alter the definition of target output used to compute the output gap, thereby causing the target rate of output to diverge from the equilibrium output level that would obtain under fully flexible wages and prices. As a result, the simple policy rules of the sort that Erceg, Henderson, and Levin considered—that is, rules that stabilize a weighted average of wage and price inflation with no reference to the output gap, or rules that stabilize a weighted average of price inflation and the output gap with no reference to wages—appear to be poorer in their approximation of the fully optimal strategy.

Nonetheless, Benigno and Woodford find that the main conclusion of the earlier work remains valid: If wages are sticky, then variations in wages give rise to distortions similar to those caused by variations in sticky prices, and monetary policy should act to mitigate welfare losses associated with both factors. Under such circumstances, targeting price inflation alone will be suboptimal, and appreciable welfare gains will ensue from targeting prices, wages, and the output gap.

Matthew B. Canzoneri, Robert E. Cumby, and Behzad T. Diba

Since the early 1990s, many central banks have adopted price inflation targeting as a framework for implementing monetary policy. Although central banks have chosen this strategy for various reasons, the literature on monetary policy design suggests one motivation: avoiding persistent movements in the price level, which give rise to economic distortions that reduce the welfare of households. This reduction in welfare arises in the context of a class of models that economists often use to characterize the workings of the economy—the so-called New Neoclassical Synthesis (NNS). If prices exhibit significant inertia, policymakers avoid the loss of household welfare in an optimal way if they fix the aggregate price level. However, the recent work of Erceg, Henderson, and Levin has called this conclusion into question.[8] In particular, their findings suggest that if the NNS model is generalized to allow for inertia in nominal wages, then, by targeting prices alone, the central bank no longer maximizes consumer welfare. To do so, it must instead respond to movements in both

7. Christopher J. Erceg, Dale W. Henderson, and Andrew T. Levin (2000), ''Optimal Monetary Policy with Staggered Wage and Price Contracts,'' *Journal of Monetary Economics*, vol. 46 (October), pp. 281–313.

8. Erceg, Henderson, and Levin, ''Optimal Monetary Policy.''

prices and nominal wages or to movements in prices and one of the main determinants of wages, the output gap.

In ''Price and Wage Inflation Targeting: Variations on a Theme by Erceg, Henderson, and Levin,'' Matthew B. Canzoneri, Robert E. Cumby, and Behzad T. Diba expand upon this recent work by investigating the potential benefits of targeting both prices and nominal wages. They use the standard NNS model to see how social welfare is influenced by the adoption of different monetary policy rules for responding to macroeconomic disturbances. They use variations of the NSS model to determine which aspects of the economy have an important bearing on the relative merits of price and wage targeting. Among the variations are specifications with and without distortions arising from monopolistic competition; specifications with different treatments of capital and its role in the production process; and specifications that allow for random disturbances to consumer spending and for productivity shocks.

Canzoneri, Cumby, and Diba derive three main conclusions from their analysis. First, they find that incorporating capital into the model has a significant quantitative effect on their results. The way in which capital enters the model appears to be less important, however; in particular, making the sale of existing capital uneconomic, a move implying that existing capital is firm-specific, does not have large normative implications. Second, under a policy that adjusts interest rates to inflation prospects alone, a level of price fluctuation exists below which rate tightening does not pay. In contrast, under a policy that targets only wages, the tighter the targeting rule, the better. Third, and perhaps most surprising, a policy of aggressively targeting nominal wages leads to better outcomes than a policy of targeting only price inflation. For example, for a particular specification of the economic model, targeting price inflation imposes welfare costs that are greater than those imposed by a wage-targeting strategy designed to yield the same volatility of price inflation. Finally, Canzoneri, Cumby, and Diba find that hybrid rules—those in which interest rates respond to movements in both prices and wages—do not lead to much better policy outcomes than does a policy of aggressively targeting nominal wages, a finding that contrasts with previous findings in this field.

Bennett T. McCallum and Edward Nelson

In their paper ''Targeting vs. Instrument Rules for Monetary Policy,'' Bennett T. McCallum and Edward Nelson compare alternative ways to characterize rule-based monetary policy. Traditionally, the term *monetary policy rule* has been used in the sense of ''instrument rules''—specific formulas for setting the federal funds rate, money growth, or some other controllable instrument in response to current economic conditions, as measured by recent data or forecasts. However, in the ongoing debate regarding the best way to characterize rule-based monetary policy, so-called targeting rules have been proposed as an alternative. Unlike instrument rules, targeting rules do not describe explicitly how the policy instrument must be set. Rather, they convey the implicit prescription that policy must attain the policymaker's objective.

Two variants of these implicit rules have been suggested. A *general targeting rule* describes the specification of a central bank's objective function, whereas a *specific targeting rule* is a description of optimal policy behavior derived from both the central bank's objective function and a model of the economy.[9] With regard to the general targeting rule, McCallum and Nelson argue that referring to the specification of the policymaker's objective as a rule seems inappropriate. Instead, they think that clearly distinguishing between the terms *objectives* and *rules* is useful in policy analysis.

McCallum and Nelson examine in detail the specific targeting rules approach and compare it with the instrument-rules approach. Because specific targeting rules are, by definition, optimality conditions, their implicit policy prescriptions might seem better suited for describing optimal policy, such as the optimal-control approach to monetary policy design. As McCallum and Nelson point out, however, conditions that imply optimality in one model may be highly inappropriate in other specifications, as is the case with any optimal-control exercise. The optimality of the suggested solution is conditioned on accepting the assumed model structure as true beyond any doubt, a stance that is untenable in light of the ongoing dispute among economists concerning the proper specification of a model for the macroeconomy. Thus, McCallum and Nelson argue in favor of the traditional policy rules analysis, which attempts to identify simple rules that are robust to alternative model specifications.

The authors examine some possible limitations of simple rules that have sometimes been cited as arguments in favor of specific targeting rules: (1) Simple rules may omit from consideration important factors not included in the rule, (2) they may require judg-

9. The description of the optimal behavior generally comes in the form of a first-order condition for optimal policy.

mental adjustments, (3) they cannot be seen as once-and-for-all commitments because they must allow for modifications reflecting improvements to our knowledge, and (4) they may not accurately reflect the current practice of central banks. After examining these limitations in detail, McCallum and Nelson conclude that they do not present any compelling argument for preferring the specific targeting rules approach over the traditional policy rules analysis. In addition, McCallum and Nelson conduct several analytical exercises to examine whether implementation of targeting rules might result in lower interest rate variability relative to that associated with simple instrument rules. They show that, in their framework, once the relevant policy implementation errors for the two alternative approaches are properly accounted for, targeting rules generally result in greater interest rate variability.

David L. Kelly and Stephen F. LeRoy

The concept of liquidity plays a central role in the understanding of asset markets. One commonly thinks of money as the most liquid asset and of physical assets such as factories and houses as very illiquid. However, formal modeling of the features that make some assets more liquid than others has proven very difficult. Although everyone may agree that an asset is illiquid if it is difficult, costly, or time consuming to sell at a price close to its fair market value, the precise meanings of ''difficult'' and ''fair'' are not obvious in this context. Economists often use the term *frictions* to describe the collection of factors that make some assets less liquid than others. In part because modeling these frictions has proven so difficult, an important branch of research in macroeconomics omits them or treats them in an elementary manner. Under standard simplifications, for example, monetary policy makers can ignore the fact that factories are less liquid than Treasury bills.

In ''Liquidity and Fire Sales,'' David L. Kelly and Stephen F. LeRoy study one familiar aspect of liquidity—the fact that, for certain illiquid assets, the price they could fetch if the seller had to sell immediately might be considerably below what the assets could fetch if the seller waited for ''the right'' buyer. In this sense, houses are illiquid assets, whereas certain financial assets, such as Treasury bills, are quite liquid. Of course, sellers of houses generally attempt to be patient so that they can obtain something close to the best possible price, but occasionally one finds houses ''priced to sell'' by someone who has reason to be less patient. The latter case is a ''fire sale''—the sale of an asset at a price lower than the price that potential buyers, if they could be identified, would willingly pay.

Kelly and LeRoy formally study the notions of liquidity and fire sales as manifested in the market for the assets of a firm. The broadest features of the issue that the authors identify are relatively straightforward to understand. If the current owners are profitably operating the firm, they may be willing to sell it at an attractive price, but they will be in no hurry to do so. They certainly will not sell the firm at a fire-sale price. If the owners are currently operating at a loss, however, they may be able to find buyers who could operate the firm more profitably. The question for the current owners then becomes how aggressively to price the firm's assets. If the possible buyers have a wide range of valuations for the assets, then pricing becomes difficult. If the owner sets a fire-sale price, he or she may quickly find a willing buyer and limit the losses. Setting a higher price means waiting longer to find a buyer who values the assets most highly. This tactic is sensible if the higher price more than covers the extra losses incurred by waiting. The reasoning is sound, but it does not answer the question of exactly how various factors affect the price.

Economists have derived useful formulas describing the pricing of liquid assets, such as the Black–Scholes option pricing formula, but they have found that deriving expressions for the pricing of illiquid assets is more difficult. This paper, which extends some earlier work by the authors and others aimed at deriving concrete implications of illiquidity, is composed mainly of an extended example. The example illustrates why fire-sale discounts occur in illiquid markets; it also shows that, in such markets, the fire-sale discounts may be sizable, whereas in liquid markets, a small discount is sufficient to ensure a quick sale.

Marvin Goodfriend

Monetary policy analysis is commonly examined in the context of models with a greatly simplified mechanism of monetary transmission. Such models ignore the central bank's control of the money supply and focus exclusively on the short-run nominal interest rate for monetary policy. Invariably, such models also fail to draw a distinction between narrow money (bank reserves) and broad money (bank deposits) and rule out, by assumption, financial frictions that may be important for understanding the role of financial intermediation in the economy.

In his paper ''Narrow Money, Broad Money, and the Transmission of Monetary Policy,'' Marvin Goodfriend develops a framework that integrates broad money demand with loan production, asset pricing, and arbitrage between banking and asset markets in order to explore the supply of and demand for broad money and the potential role of broad money in monetary transmission. The demand for broad money arises from at least two problems: First, not all markets that agents might want to use exist; second, agents are subject to uninsurable, idiosyncratic shocks.[10] Banks hold household demand deposits and use funds to make loans, subject to the collateral available in the economy and the effort needed to monitor loan performance. Goodfriend shows that the resulting macroeconomic equilibrium is considerably more complex than that obtained in traditional, greatly simplified monetary models. For instance, among the standard factors determining the observed net real returns on capital and bonds is the time preference of agents—the rate at which agents trade consumption today for consumption tomorrow. But the return on capital and bonds also depends on the broad liquidity services they may provide as collateral for loans.

Goodfriend uses the model to explore the links between the broad liquidity services that bank deposits provide and the scope for monetary policy makers to use the instruments of narrow money and the nominal interest rate to manage, react to, and take account of broad liquidity. Among other things, Goodfriend shows how the neutral level of an interbank interest rate policy instrument depends on factors affecting the provision of broad liquidity. He demonstrates that, although interest rate policy automatically insulates the economy against shocks to narrow liquidity, such policy must be modified to offset the effect on the economy of shocks to broad liquidity. In general, broad-liquidity conditions need to be taken into account in the pursuit of interest rate policy because (1) they influence the link between the interbank rate and market interest rates through their effect on the premium firms must pay to raise funds to finance illiquid investments and (2) they affect the behavior of market interest rates that the central bank must target in order to maintain overall macroeconomic stability with stable prices.

10. For example, when setting out on a sunny day, one must consider that trading one's bottle of sunscreen for an umbrella may be difficult should the weather change. One could hope to find a market in which to complete this trade or to buy insurance against this outcome, but carrying money with which to buy an umbrella should the need arise may be simpler.

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Conference Papers

Benigno, Pierpaolo, and Michael Woodford. "Optimal Stabilization Policy when Wages and Prices Are Sticky: The Case of a Distorted Steady State."

Canzoneri, Matthew B., Robert E. Cumby, and Behzad T. Diba. "Price and Wage Inflation Targeting: Variations on a Theme by Erceg, Henderson, and Levin."

Fuhrer, Jeffrey C., and Giovanni P. Olivei. "Estimating Forward-Looking Euler Equations with GMM Estimators: An Optimal Instruments Approach."

Goodfriend, Marvin. "Narrow Money, Broad Money, and the Transmission of Monetary Policy."

Hansen, Lars Peter, and Thomas J. Sargent. " 'Certainty Equivalence' and 'Model Uncertainty'."

Kelly, David L., and Stephen F. LeRoy. "Liquidity and Fire Sales."

McCallum, Bennett T., and Edward Nelson. "Targeting vs. Instrument Rules for Monetary Policy."

Williams, John C. "Robust Estimation and Monetary Policy with Unobserved Structural Change."

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