

**Interest and Prices – Foundations of a Theory of Monetary Policy, A Review Essay**

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Running head: Interest and Prices: A Review Essay

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I have not provided an abstract since this is a book review.

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The evolution of research on monetary policy over the past two decades has been dramatic. The 1980s through the mid-1990s were dominated by work building on the insights of Kydland and Prescott, employing the notion of dynamic consistency to offer a theory of monetary policy, one in which discretionary policy by central banks led to socially costly inflation. Researchers studied the nature of the time inconsistency of monetary policy and developed solutions, ranging from appointing conservatives to developing incentive contracts, to imposing inflation targets. Whether central bankers learned, in the words of Ben McCallum to “just do it,” or the nature of the incentives they faced changed, inflation was reduced in the industrialized economies during the 1980s and early 1990s. In the low inflation environment since, central banks have, in the eyes of many monetary economists, changed from a source of (often) politically induced inflation to maximizers of social welfare.

This shift has opened up new and productive collaborations between academic economists and central bank economists interested in issues of monetary policy design. Much of this work builds on the basic foundations provided by the marriage of dynamic stochastic general equilibrium models, with their emphasis on optimizing behavior by economic agents and careful attention to budget constraints and equilibrium conditions, with simple models of price stickiness. Early contributors to these foundations include Yun (1996), Rotemberg and Woodford (1997), and Goodfriend and King (1997). The resulting framework for macroeconomic analysis, in its simplest form, boils down to an expectational IS curve, an inflation adjustment equation, and a specification of monetary policy in terms of either an objective function or a rule for setting the nominal rate of interest.

The research that has developed since these early papers has provided new insights into the transmission process of monetary policy, the objectives of stabilization policy, and the relationship between policy rules and the determinacy of equilibrium, to mention just a few of the topics that have been explored. Michael Woodford has been a major contributor in each of these areas, and in Interest and Prices: Foundations of a Theory of Monetary Policy (Princeton University Press, 2003, 785 pages) he provides what will be widely recognized as the definitive treatise on the new Keynesian approach to monetary policy. It is a measure of the recent progress in monetary analysis that many of Woodford's results are now well known, thanks to the working paper versions of the book's chapters, Woodford's other writings, and the research of many other academic and central bank economists. The importance of the Taylor Principle, for example, or the role of inertia in optimal policy when agents are forward-looking are just two examples. But the breadth of Woodford's contribution to recent developments in monetary economic is driven home by the publication of this work in a single volume.

Woodford makes contributions to the theory of price level determination under interest rate policies in cashless economies with flexible prices, to our understanding of the role of monetary policy in ensuring a determinate equilibrium, and to the design of optimal instrument rules. Every page is filled with nuanced discussions of special cases, exceptions, and extensions to the basic framework, and the approach to monetary economics and policy design is characterized by a consistency (down to the notation) that allows readers to sample easily from among the various chapters. The book will be an invaluable resource for academic and central bank researchers, as well as for graduate students in monetary economics.

In building a rigorous foundation for monetary policy analysis, Woodford rejects the traditional focus on the nominal quantity of money, desiring instead to provide “theoretical foundations for a rule-based approach to monetary policy (p. 2),” where these rules take the form of interest rate rules. This focus reflects the “new consensus in favor of a monetary policy that is disciplined by clear rules ... (p. 2).” These rules are “principles of systematic conduct for institutions that are aware of the consequences of their actions and take responsibility for them, choosing their policies with careful attention to what they accomplish (p. 2).” Part I (Chapters 2-5) outlines the theoretical framework Woodford uses to analyze interest rate rules, first in the case of a flexible price, cashless economy, then with the addition of monetary frictions, and then with the addition of nominal rigidities. The analysis blends theory and empirical evidence and explores numerous extensions that help bridge the gaps between the two. Part II (Chapters 6-8) focuses on optimal monetary policy, developing the model-consistent objectives for policy, the notion of optimal commitment, and the instrument rules that can implement optimal policy. What *Interest and Prices* succeeds in doing is to provide a systematic treatment of these topics, and many others, while also providing numerous extensions and refinements that illustrate the richness of the general approach to monetary analysis.

*Interest and Prices* is actually best viewed as a theory *for* monetary policy, rather than a theory *of* monetary policy. Woodford’s purpose is not, for example, to explain why there were (widely viewed) policy failures in the 1970s. Instead, the treatise provides a manual for the design of optimal interest rate rules. Viewed as a policy manual, one can ask whether *Interest and Prices* actually does offer useful advice to policy makers. In

many ways, it certainly does, most particularly in the approach it argues policy makers should use when thinking about policy design. But in other ways, as I will discuss, it is less clear how Woodford's approach can guide actual policy. To highlight these issues, I will focus on two aspects of Woodford's contribution—the general Wicksellian approach to the monetary transmission process that he adopts and his approach to a rule-based theory of monetary policy.

### *The Wicksellian approach*

In his 1898 treatise, Knut Wicksell outlined a theory of price level determination in which a key role was played by the relationship between the money rate of interest and the natural rate of interest.<sup>1</sup> In Woodford's approach, the natural real rate of interest is the rate associated with the absence of the nominal rigidities that account for short-run monetary non-neutralities, and the gap between the actual interest rate and the natural real rate represents the key channel through which central bank actions affect the economy.

Woodford correctly shows that there is no inconsistency in developing a theory of the general price level in which monetary policy is characterized by control of a nominal interest rate rather than control of the money supply. Beginning with a cashless endowment economy in which money serves only as a unit of account and prices are perfectly flexible, Woodford discusses how a central bank is able to determine the price level through its control over short-term nominal interest rates. Controlling the nominal rate does not require, as Woodford shows, that the central bank control a nominal aggregate whose demand is well-defined. The current operating procedures of the Reserve Bank of New Zealand provide a functioning example of a central bank

implementing monetary policy through interest rates while maintaining settlement balances constant. With flexible prices, the Fisher equation linking the nominal interest rate to expected inflation together with the central bank's policy rule determine the equilibrium behavior of the price level. When prices are sticky, as in most of Woodford's analysis, equilibrium also requires a specification of the factors that determine the real rate of interest outside the flexible-price equilibrium. In economies in which monetary frictions make money essential, there will be equilibrium paths for the money stock associated with interest rate policies, but Woodford argues that "...it does not seem at all natural or useful to try to *explain* the predicted paths of inflation and output as *consequences* of the implied path of the money supply." (p. 48).

What is critical, as Woodford emphasizes in virtually every chapter, is the form of the interest rate rule. Rules that specify the setting of the nominal interest rate as a function purely of predetermined and exogenous variables do not ensure a unique, determinate equilibrium, even though, in equilibrium, the nominal rate is a function of such predetermined and exogenous variables. That is, the equilibrium solution for the nominal rate under the optimal policy cannot be used as the central bank's reaction function to implement the optimal policy. Attempting to do so leads to multiple rational expectations equilibria. What is required is a rule that responds to endogenous variables (and in a manner that generally obeys the Taylor Principle) in a way that rules out all but the unique, optimal equilibrium.

While Woodford emphasizes the gap between the nominal rate (the policy instrument) and the natural real rate, a natural question arises. If the purpose is to provide a theory to guide monetary policy, is this interest rate gap a useful quantity for policy

makers? The answer depends, and for reasons Woodford himself clearly spells out. For example, in the simple versions of the basic model, the gap between the natural rate and the nominal interest rate is zero under an optimal monetary policy, but this does not mean that central banks should implement policy by moving the nominal rate to track movements in the natural rate. The natural rate of interest depends on all the various shocks that can affect the economy's flexible-price equilibrium level of output, and a policy that simply aims to keep the gap equal to zero leads to indeterminacy. Ensuring a unique, rational expectations equilibrium with zero inflation, for example, requires that the central bank move interest rates sufficiently if inflation should deviate from zero. But because, in equilibrium, inflation does not deviate from zero, the public's beliefs about policy actions that are off the equilibrium path become critical for supporting the unique equilibrium. So just instructing a central bank to keep the gap equal to zero is not a sufficient description of policy. Still, a historical series on the gap could provide a useful ex-post indicator for evaluating policy, limited however by the fact that the flexible-price equilibrium real rate of interest is unobservable.

When the output gap relevant for welfare analysis (and so an objective of monetary policy) is also the sole driving force for inflation, the interest rate gap provides a sufficient statistic for the impact of monetary policy. The standard new Keynesian model satisfies this requirement: inflation is a function of expected future inflation and real marginal cost, real marginal cost is proportional to the gap between output and the flexible-price equilibrium output, and this output gap is also the correct measure that appears in the second-order approximation to the welfare of the representative agent. But this is a special case. It fails to hold when the flexible-price equilibrium output is not the

welfare optimal output level, although this case may be less relevant if central bankers view the output dimension of their task, as many actual central banks do, as one of stabilizing output around potential rather than around an optimal level that adjusts for the microeconomic distortions in the economy. More importantly, however, it fails to hold when Woodford adds a cost shock to the inflation equation or when wages (as well as prices) are sticky, cases of considerable relevance for policy design. In these more general cases, there is no presumption that optimal policy would result in a zero interest rate gap. Thus, the focus on the Wicksellian interest rate gap seems somewhat overdone.

### *The nature of optimal rules*

Woodford argues consistently for rule-based monetary policy, but rules of a specific sort. As is well known, in forward-looking models the standard solution to optimal policy under commitment, when the policy decision is taken at an initial time  $t_0$ , sets the Lagrangian multipliers associated with past commitments to zero while simultaneously committing never to do so again. That is, there is an inherent time inconsistency in the initial period of the optimal commitment policy. This problem is common; in models of optimal seigniorage, it is efficient to engage in rapid inflation in the first period to tax existing holdings of money, while promising not to do so again.

Woodford argues instead for policy that is optimal from a “timeless perspective,” a perspective that does not privilege period  $t_0$  in any way. Under the timeless perspective, the Lagrangian multipliers associated with earlier commitments must be the same (time invariant) function of the predetermined and exogenous variables as the current and future multipliers are in the optimal commitment equilibrium. Heuristically, this requires

that at time  $t_0$  the central bank implement the policy that it would have found optimal to commit to if it had solved the optimal commitment policy at some earlier date. In doing so “the central bank is choosing to conform to a rule to which it should have wished to be *expected* to conform had the question been considered earlier without any restriction of this kind upon conduct at date  $t_0$ .” (p. 539)

As McCallum and Nelson (2004) stress, economists have, since Lucas (1976), focused on the behavior of economies under alternative policy regimes. That is, the assumption lying behind the standard rational expectations solution is that all agents have been behaving in systematic ways that allow rational expectations to be well defined and a stationary stochastic equilibrium to be obtained. Thus, the notion that the policy maker has been behaving in a manner that remains constant (not that the actions taken each period are the same but rather the decision rules are) is the most natural way to think of a commitment policy.

Less clear is the extent to which Woodford’s policy recommendations can provide actual guidance to central banks that find themselves, for one reason or another, in a situation of high inflation and low credibility. There is little analysis of how such a central bank can best move from its current policy to an optimal commitment policy. Policy evaluations are conducted assuming the private sector knows the central bank will honor its future commitments without fully discussing how this comes about. Ultimately, Woodford requires that central banks “just do it.”

The advantage of commitment in forward-looking models comes from the ability of the central bank to affect the public’s expectations of future interest rates. But the difficulty of doing so is illustrated by the Federal Reserve’s recent attempts to signal its

future intentions. By inserting the language “considerable period” into FOMC press releases during 2003, the Fed was attempting to let private agents know that interest rates would remain low for some time. However, as the Fed attempted in 2004 to modify its language about the future path of interest rates, it discovered that “fine-tuning” expectations is difficult. The central bank in Woodford’s model is never faced with such problems. While he does examine the learnability of the rational expectations equilibrium, there is less discussion of the potential short-run costs of adopting the optimal commitment policy. In a sense, the focus is on situations in which a central bank has already achieved low and stable inflation and now is concerned with fine-tuning its optimal rule.

Woodford’s analysis deals with situations in which the principle of certainty equivalence applies. Policy rules that are robust to misspecification of the exogenous error processes are considered, but more fundamental and important sources of uncertainty are not dealt with. As Levin and Williams (2003) demonstrate, the optimal policy rules Woodford proposes may produce very bad outcomes if the model on which they are based turns out to be wrong or if the central bank employs parameter estimates that are incorrect. This argues for viewing the approach to policy that Woodford develops as an important starting point for further research that will investigate the manner in which these rules must be modified to address the uncertainty about the economy’s structure that policy makers confront in practice.

### *Integrating theory and policy*

Perhaps the most important contribution of Woodford’s work is his successful integration of monetary policy analysis with welfare economics. While this has been done previously

(e.g., Friedman 1969), the earlier literature focused on inflation as a tax, integrating it into the more general Ramsey approach to optimal taxation. While important, this work appeared to have little to say about the types of macroeconomic stabilization issues that occupy the attention of most central bankers and many monetary economists.

What Woodford has shown is that maximizing the welfare of the representative agent can also provide a framework for evaluating and designing stabilization policies. And, as he emphasizes, his approach provides strong support for price stability as an outcome of optimal policy. Whether the distortions that are central to this approach (i.e., relative price dispersion generated by nominal rigidities) will ultimately turn out to be those most relevant for the design of stabilization policies remains an open question. Woodford closes his treatise by saying “It is hoped that the present study will help to stimulate further work in this sphere and, in so doing, reveal as a practical possibility the sort of rational management of national standards of value that could only be dreamed of by the monetary reforms of a century ago.” (p. 623). His work has already stimulated a great deal of interesting research; whether it will live up to the promise contained in the final sentence remains to be seen. What is already clear, though, is that *Interest and Prices* is a major contribution to monetary economics.

Endnotes:

1. Wicksell’s treatise was also called *Interest and Prices*, but the subtitle, *A Study of the Causes Regulating the Value of Money*, clearly indicated his focus of interest. Many have noted the contrast between the title of Patinkin’s treatise, *Money, Interest, and Prices*, and Woodford’s *Interest and Prices* as making very clear the diminished role of the quantity of money in modern monetary theory.

## References

Friedman, M. (1969) The Optimum Quantity of Money. In *The Optimum Quantity of Money and Other Essays*. Pp. 1-50. Chicago: Aldine Publishing Co.

Goodfriend, Marvin and Robert G. King (1997) The New Neoclassical Synthesis and the Role of Monetary Policy. In B.S. Bernanke and J.J. Rotemberg (eds.), *NBER Macroeconomics Annual*, pp. 1-63. Cambridge, MA: MIT Press.

Levin, Andrew T. and John C. Williams (2003) Robust Monetary Policy with Competing Reference Models. *Journal of Monetary Economics* 50, 945-975.

Lucas, Robert E., Jr. (1976) Econometric Policy Evaluation: A Critique. Carnegie-Rochester Conference Series on Public Policy 1, 19-46.

McCallum, Bennett T. and Edward Nelson (2004) Timeless Perspective vs. Discretionary Monetary Policy in Forward-Looking Models. Federal Reserve Bank of St. Louis *Review* 86, 43-56.

Patinkin, Don (1965) *Money, Interest, and Prices: An Integration of Monetary and Value Theory*, 2<sup>nd</sup> ed., New York: Harper & Row.

Rotemberg, Julio J. and Michael Woodford (1997) An Optimizing-Based Econometric Model for the Evaluation of Monetary Policy. In B.S. Bernanke and J.J. Rotemberg (eds.), *NBER Macroeconomics Annual*, pp. 297-346. Cambridge, MA: MIT Press.

Sargent, Thomas. J. and Neil Wallace (1975) 'Rational' Expectations, the Optimal Monetary Instrument, and the Optimal Money Supply Rule. *Journal of Political Economy* 83, 241-254.

Wicksell, Knut (1936) *Interest and Prices: A Study of the Causes Regulating the Value of Money* English translation by R.F. Kahn, London: Macmillan, for the Royal Economic Society. Reprinted, New York: Augustus M. Kelly.

Woodford, Michael (2003) *Interest and Prices: Foundations of a Theory of Monetary Policy*. Princeton: Princeton University Press.

Yun, Tack (1996) Nominal Price Rigidity, Money Supply Endogeneity, and Business Cycles. *Journal of Monetary Economics* 37, 345-370.