WICKSELL AFTER WOODFORD

BY

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I. INTRODUCTION

The New Neoclassical Synthesis that Michael Woodford puts forward in his *Interest and Prices* (2003) is primarily a synthesis of New Classical and New Keynesian ideas. Yet Woodford presents it as an encompassing approach that goes much further back in time to integrate the *pre*-Keynesian macroeconomics of Knut Wicksell and his followers. Starting with the title, the book contains many references to *Geldzins und Güterpreise* (1898), Wicksell's landmark contribution to monetary theory which was translated as *Interest and Prices* in 1936. Woodford relates his concept of a "monetary policy without money" to Wicksell's concept of the pure credit system and to Wicksell's proposal to eliminate inflation by adjusting nominal interest rates to changes in the price level—an idea that has much in common with modern policy rules *à la* Taylor. He presents the core model of the new synthesis (in shorthand: IS + AS + Taylor rule) as a "neo-Wicksellian framework" that serves to analyze the dynamics of interest-rate gaps and output gaps (2003, chapter 4).[1] Referring to the Wicksellians of the 1920s and 1930s (primarily Erik Lindahl, Gunnar Myrdal, and Friedrich A. Hayek), Woodford grounds his advocacy of rules to fight inflation on the potential non-neutrality of monetary policy: "[I]t is because instability of the general level of prices causes substantial real distortions—leading to inefficient variation both in aggregate employment and output and in the sectoral composition of economic activity—that price stability is important" (2003, p. 5). He thus sees his analysis of interest-rate and output gaps as "an attempt to resurrect a view" that the old Wicksellians had developed in their analyses of cumulative processes.

However, Woodford doubts that the original "Wicksellian theory can provide a basis for the kind of quantitative analysis in which a modern central bank must engage" (2003, p. 5–6). Bridging the gap between the old-style approach and modern econometrics may have its problems, but Woodford brings in intertemporal general-equilibrium theory as the main prerequisite for a proper theory of monetary policy. He argues that old-style Wicksellian theory does not conform to "modern

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[1] Unless stated otherwise, citations of (2003, pp. xx) refer to Woodford's *Interest and Prices.*

standards of conceptual rigor," because it lacks explicit microfoundations. So he has the work cut out for himself.

In the following we discuss whether Woodford succeeds in fully integrating the central concepts of Wicksellian theory into the new synthesis. The relevant concepts are: the pure credit economy, the natural rate of interest, the cumulative process, the (non-)neutrality of money, in the short and the long run, and rules for monetary policy.[2]

To keep the paper short, we concede without further discussion that Woodford's comparison of Wicksellian interest-rate rules to the Taylor rule and other designs of monetary policy is a success. It gives both precision to the original ideas and perspective to present debates. With respect to the other four concepts, however, we argue that Woodford has failed (so far) to integrate them into the framework of the new neoclassical synthesis. We show that their treatment either lacks conceptual rigour, as in the case of the pure credit economy, or remains substantially different from the original theories, as in the cases of the natural rate, the cumulative process and the (non-)neutrality of money. In section II we compare the paleo- and neo-Wicksellian versions of the pure credit economy. In sections III and IV we contrast Woodford's treatment of real effects of monetary policy (mostly) with Lindahl's writings on the matter, since Lindahl's work is in this respect more comparable to the neo-Wicksellian framework than that of Wicksell or other Wicksellians. Section V concludes.

II. THE PURE CREDIT ECONOMY

The Original Concept(s)

Wicksell presented his *Interest and Prices* (1898) as "a study of the causes regulating the value of money." His core idea was to reformulate the quantity theory of money in terms of an interest-rate mechanism that explains changes in the price level as effects of changes in investors' demand for loans. This mechanism would yield a more general explanation of secular inflation and deflation, as it would work even in a "pure credit system"—a world without any given supply of base money.

Wicksell (1898 [1936, pp. 70–76]) described the "pure credit system" as an economy in which all payments are made by transfers between bank accounts, and in which all deposits earn interest. Loans make deposits whose volume is not limited by any cash constraint. Whatever the banks lend will be spent in purchases of goods and services and returned to the system through the sellers' accounts. If banks expand their business lending at a similar pace (as is to be expected in a competitive setting), they will not face adverse balances in the interbank clearing or any other reserve drains. The supply of (deposit) money in the banking *system* is completely endogenous "No matter what amount of money may be demanded from the banks, that is the amount which they are in a position to lend ... The 'supply of money' is thus furnished by the demand itself" (Wicksell 1898 [1936, pp. 110–11]).

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[2]These concepts are not, of course, exclusively Wicksellian; but all of them had (at least some of) their origins in the works of Wicksell and his early followers.

In some passages, Wicksell referred to the multi-bank *Giro* systems of his time. However, "for the sake of simplicity" he reduced his systematic analysis of pure credit systems to the description of a single institution, the Ideal Bank (1898 [1936, pp. 71–76]). The concept of the pure credit was thus used in at least two different versions. In one version, it was a part of pattern predictions about the evolution of finance. Refining their techniques of risk consolidation and economizing on cash, the banks would acquire the potential to expand and contract nominal aggregate demand without limits (Wicksell 1898 [1936, pp. 62–69], 1915 [1935, pp. 79–87]). In the other version, the fictitious centralization of credit helped to simplify the analysis of monetary policy and cumulative price changes. Wicksell (1898) originally presented his pure credit economy as formed by a system of profit maximizing banks (or a single profit maximizer "Ideal Bank" with several branches) where gold is no longer used as means of payment but remains the standard of value of the economy. The long-run value of money is, therefore, determined by the demand for gold as a commodity and its marginal cost of production. The replacement of gold as standard of value involved, as suggested by Wicksell, a monetary reform that makes the unit employed in the accounts of banks both the medium of exchange and the measure of value. The central bank would be the only bank that remunerates its deposits at the same rate that it charges for its loans, as suggested by Wicksell (1919) in his plan to reform the Swedish credit system after the abolition of the gold standard. Under the assumption that there is no demand for central bank notes, the only way the central bank can make its discount rate "effective" in the credit market is by setting the interest rate paid on its deposits. As private financial intermediaries lend money to sectors of the economy where risk evaluation by the central bank is difficult, they would still be able to charge a rate of interest higher than the central bank's. Furthermore, Wicksell (1898 [1936, pp. 74–75]) pointed out that some savers may "risk a portion of their property" and deal directly with "risky and protracted enterprises" through shares, debentures etc. Such nominal assets are, therefore, not perfect substitutes for central bank deposits. The presence of private banks and of other financial assets does not change the essential features of Wicksell's pure credit, where the central bank's deposit rate becomes the basic rate of the system (see Boianovsky 1998, section IV).

Wicksell's followers made use of both the centralized and the decentralized version.[3] Hayek (1929 [1933, pp. 144–76]) described modern banking as a system that is extremely "elastic in the credit supply" even though each bank may be acting strictly in accordance with the principles of "sound banking." As the result of a coordination failure that is typical for monetary economies, the banking system can generate credit expansions that affect prices and production so as to bring about cyclical fluctuations of output and employment. Lindahl (1930 [1939, part II]), on the other hand, based his re-examination of Wicksell (1898) on the "simplifying assumption" of a completely centralized banking system. The "Bank"—interpreted by Lindahl as a public central bank — manages the supply of loans simply by varying its loan rate of interest, "with a perfectly free hand to carry out its credit policy" (Lindahl 1930 [1939, pp. 139]). The supply of money (deposits) is endogenous

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[3]For further discussion of different concepts of the pure credit economy see Hicks (1989, chapter 12), Trautwein (1997), Boianovsky (1998), and Boianovsky and Erreygers (2005).

just as in Wicksell's original case. Lindahl, who rejected the simple causality theorem of the quantity theory of money, used this framework mainly to show that price expectations play a key role in the determination of *both* the price level *and* the supply of money (see Boianovsky and Trautwein 2006).

Woodford's Purely Cashless Economy

Woodford's neo-Wicksellian theory of monetary policy is based on the assumption that central banks can control short-term market rates of interest and, hence, affect inflation without taking any recourse to monetary aggregates. In order to show this, Woodford (2003, pp. 64–74) presents a model of a "purely cashless economy." In that model, "markets are perfectly competitive, prices adjust continuously to clear markets, and there exist markets in which state-contingent securities of any kind may be traded" (2003, p. 62). As is well known, no one would have to hold money in this world of complete financial markets, as all payments could be effected by transfers of other assets (see Arrow and Hahn 1971, pp. 337–39, and Hahn 1988). Woodford assumes nevertheless that there is a "distinguished financial asset" that forms "the monetary base" insofar as it defines the unit of account. The base money is a liability of the central bank that represents nothing but a claim to payment in terms of itself. There is no cash in the economy, since all base money is held in and transferred between bank accounts.

Given that Woodford's base model excludes monetary frictions, there is no specific demand for base money. Other riskless nominal assets are perfect substitutes for those liabilities of the central bank (2003, p. 63). Therefore Woodford explores the conditions under which "the private sector" would be willing to hold money in a model of asset pricing under rational expectations. In this model, the infinitely lived representative household maximizes intertemporal utility from the consumption of the economy's single good. Making the standard assumptions for this class of intertemporal general-equilibrium models and postulating that the money supply is always positive (a prerequisite for monetary policy), Woodford shows that household optimization requires that the money rate of interest, i_t^m, equals the rate of return on other assets, i_t (2003, p. 69).

The asset-pricing model is thus held to provide the base for demonstrating that a Wicksellian interest-rate rule (a positive feedback to deviations of the price level from the target path) can yield determinate rational-expectations equilibrium paths of the prices and interest rates (2003, pp. 74–82, 635–37). Woodford carries this result over to the discussion of monetary policy in the neo-Wicksellian framework. In all the rest of his book the arbitrage relation of the basic model, $i_t = i_t^m$, is used to justify the simplifying assumption "that the central bank can directly control the short-term market rate i_t" (2003, p. 239, n. 4).

Comparison

It is obvious that Woodford's approach to modeling the cashless economy differs in many important aspects from the Wicksellian concepts of a pure credit system. Woodford's version has a complete set of financial markets, which makes the

existence of intermediaries such as banks non-essential (see also Goodhart 2004, pp. 198–99). The original versions set the focus on one single financial market, in which banks play the key role as suppliers of loans and money (deposits) that can create both in excess of previously deposited savings. In the versions that stress the systemic capacity of commercial banks to generate monetary expansion and contraction (e.g. Wicksell 1898, chapter 6 and Hayek 1929, chapter IV), the transmission of monetary policy may be significantly modified by the intermediaries and their attempts to economize on the use of "base money." Woodford (2003, pp. 31, 35, 63 n.1) occasionally touches upon these issues, but he seems to be convinced that the present channel systems of implementing interest-rate policy work well enough to provide a sufficiently general theory of policy transmission (2003, pp. 24–37). In the rest of his foundations of a theory of monetary policy, (private) banks and other intermediaries play no role at all; they are not, at any rate, integrated in the analysis. Woodford's approach fails to make clear how the anecdotal stories about interest-rate channels in the banking system could be related to the analytical "complete market"-story; and it ignores all banking-specific "frictions" in monetary policy transmission that have been the stuff of much New Keynesian theorizing and empirical research.[4]

Woodford's model of the cashless economy might be seen as a relative of Wicksell's and Lindahl's thought experiments, but the differences are more significant than the parallels. In old-style Wicksellian theory, the demand for money (=deposits) is determined by the firms' demand for loans (=deposits) to finance investment. Speaking in Robertsonian terms, it is demand for "money to spend." Woodford, on the other hand, analyzes the cashless economy in terms of household demand for "money to hold." His neo-Wicksellian theory is about utility-maximization by way of holding stocks of assets, whereas paleo-Wicksellian theory is about profit-maximization by way of generating flows of credit. Does Woodford's asset-pricing model convincingly show that the central bank can take control of interest rates and determine the development of prices in a cashless economy? We doubt this for the reason that, in a setting of perfect competition and complete financial markets, other riskless nominal assets are perfect substitutes for money, so the law of one price rules. The central bank is then a price-taker, not a price-setter.

Woodford (2003, pp. 35–36) thinks otherwise, as he argues that "the special situation of the central bank, as issuer of liabilities that promise to pay only additional units of its own liabilities, allows the central bank to fix both the nominal interest yield on its liabilities and the quantity of them in existence" (2003, p. 63). However, in Woodford's frictionless setting, the liabilities of the central bank play only the role of a unit of account, not the role of a means of payment. *If* other riskless nominal assets are perfect substitutes for money, the central bank cannot fix nominal interest rates independent of the market rates for those substitutes, because the latter can by assumption be used to settle any debts. So Woodford must assume (implicitly) that there is some friction that makes all other assets *im*perfect substitutes of the "base money" and, hence, gives the central bank the power to vary its "price" and quantity at

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[4]In this respect, Woodford's approach differs strongly from the literature on the recent "Credit View" in which Ben Bernanke, Marc Gertler, and others have stressed the modifying influences of the bank-lending and balance-sheet channels on monetary policy transmission. For a comparison of this Credit View with the Wicksellian view see Trautwein (2000).

will; but then the model is not what it purports to be: free of monetary frictions. If, on the other hand, Woodford does not make that assumption, the model does not show what it claims to show: the power of the central bank to control interest rates.

Let us relate the problem more explicitly to old-style Wicksellian theory: In Woodford's model, the household's portfolio is described as a mix of money holdings and the holding of a portfolio of *other* financial assets. This portfolio is at first assumed to be an unspecified mix of privately issued liabilities or claims on the government, since "any pattern of future state-contingent payoffs that a household may desire can be arranged (for the appropriate price)" (2003, p. 65). A few pages farther down the portfolio is confined to riskless government bonds (2003, p. 71). As described before, there are two interest rates in the system: the "money rate", i_t^m, and the rate of return on other assets (now the "bond rate"), i_t. In equilibrium all arbitrage opportunities must be exhausted, so the money rate of interest must equal the bond rate, if the money supply is to be positive (2003, p. 69).

Does the central bank have the power to generate or prevent inflation in a Wicksellian fashion? If, as in Wicksellian theory, the bank would lower i_t^m (or not react to a rise in i_t), an arbitrage opportunity would arise and base money would no longer be held in equilibrium.[5] However, this case is simply excluded by Woodford's assumption that the supply of base money is positive at all dates (2003, p. 71). One might object that a model "without monetary frictions" can hardly be said to have proper microfoundations, if the holding of money-balances is simply forced upon the representative household by assumption.

This sort of criticism is perhaps oversimplifying, as rational expectations should be taken into account. In the asset-pricing model of Woodford's chapter 2, the equilibrium real rate of return is given by the intertemporal marginal rate of substitution (the rate of time preference) of the representative household. It is connected to the nominal rate of return, i_t, through the Fisher effect, i.e., by taking account of expected inflation (2003, p. 71).[6] This means "that a central bank can have no effect on nominal interest rates except insofar as it can shift inflation expectations" (2003, p. 139). How can it generate expectations of a rise in the price level? Under rational expectations it can do that only by *raising* the money rate, i_t^m —quite contrary to the original Wicksellian story (not to speak of reality).[7] Due to the arbitrage condition, the nominal rate of return on other assets would have to follow. In this sense the central bank might be said to be able to affect nominal interest rates.

Yet it remains doubtful whether this result alone can justify the assumption "that the central bank can directly control the short-term market rate i_t" (2003, p. 239, n. 4), which is of key importance for the rest of the book. Based on the afore-described model we could just as well claim that the government, as the issuer of bonds, controls

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[5]The only exception would be a corresponding change in the preference for money. Other assets would no longer be perfect substitutes and the model would have "monetary frictions." Woodford (2000, p. 68) implicitly introduces a liquidity premium on money by way of the condition that $i_t \geq i_t^m$. This serves to define the intertemporal budget constraint for the household by excluding the finance of unlimited consumption. The cashless economy represents thus the limiting case $i_t = i_t^m$, because the other assets are perfect substitutes for money.

[6]Simplified in log-linear terms, the equilibrium real rate of interest is equal to the equilibrium nominal rate of interest minus expected inflation.

[7]A similar argument has been made by McCallum (1986), but was criticized by Howitt (1992) for failing to take account of the learning processes required for convergence on rational expectations.

the market rate. Or, what if we assume, for the moment, that commercial banks issue assets that are perfect substitutes for base money? How could the central bank stop inflation, if the other banks start raising i_t? What would then justify Woodford's assumption of a "Wicksellian policy regime ... under which the interest paid on base money is equal at all times to the central bank's current interest-rate target" (2003, pp. 74–75)—without making the central bank go out of business or tolerate the inflation generated by the commercial banks? To answer these questions by asserting that the representative household would rationally expect the price level to fall, whenever the central bank lowers the money rate of interest, would be dodging the issue. We conclude that Woodford's discussion of interest-rate rules does not seem to have a rigorous base in his model of the cashless economy.

III. THE CUMULATIVE PROCESS AND THE NATURAL RATE OF INTEREST

Wicksell's and Lindahl's Views

The hallmark of old-style Wicksellian theory is the idea that discrepancies between the "market rate of interest" (i.e., the loan rate as shorthand for general credit conditions) and the "capital rate" (i.e., the expected rate of return to real investment) cause cumulative changes in the rate of inflation which, under certain conditions, affect the levels and structures of production. The pace of the change in the price level depends on both the extent of that discrepancy and on the expectation formation assumption. However, the older Wicksellians were divided over the question whether the capital rate is a "natural rate of interest" that is not affected by changes in the market rate of interest. Consequently, they differed a lot with respect to the degree of attention that they paid to real effects of cumulative price changes and monetary policy. In this paper, it is neither possible nor desirable to discuss all those differences (see, for instance, Trautwein 2000, 2004). We will rather set the focus on Lindahl's monetary theory, since that approach seems to be most suitable for a direct comparison with Woodford's approach (see Boianovsky and Trautwein 2006).

One of the things that Lindahl and Woodford have in common is that both emphasize the role of "central banking as management of expectations" (Woodford 2003, p. 15). For Lindahl, the formation of expectations in the cumulative process played a crucial role for the determination of the speed and extent of inflation (and deflation). In that respect, Wicksell's influence should not be underrated. Wicksell (1898 [1936, p. 96]) suggested that:

> [t]he upward movement will in some measure 'create its own draught'" because, "once the entrepreneurs begin to rely upon [inflation] continuing—as soon, that is to say, as they start reckoning on a future rise in prices—, the actual rise will become more and more rapid. In the extreme case in which the expected rise in prices is each time fully discounted, the annual rise in prices will be indefinitely great (1898 [1936, p. 148]).

In his last comment on the cumulative process, Wicksell (1922, p. xii n.1) argued that inflation might accelerate even if people only adapt their expectations to *past* changes

in the price level: "As long as the change in prices . . . is believed to be temporary, it will in fact remain permanent; as soon as it is considered to be permanent, it will become progressive, and when it is eventually seen as progressive, it will turn into an avalanche."[8]

Lindahl (1930) extended Wicksell's discussion to the question of how far interest-rate gaps and inflation can cause changes in the capital stock and real output. He rejected Wicksell's conjecture that the expected rate of return to real investment could be interpreted as a "natural rate" that serves both as equilibrium benchmark and attractor for the market rate of interest. He argued that the natural-rate concept makes sense only under the assumption of complete homogeneity of inputs and outputs (Lindahl 1930 [1939, pp. 247–48]). In a monetary economy, the rate of return to investment *ex ante* is determined by expectations about money prices and the relative price of loans. Hence, it is not independent and cannot be considered as an attractor for the market rate of interest.

Lindahl defined the equilibrium rate of interest as the rate that matches planned saving with investment and thus makes profit expectations consistent with intertemporal consumer preferences. It implies "such a development of prices as is in accordance with the expectations of the public, so far as this is possible" (Lindahl 1930 [1939, p. 252]). Exploring the scope for monetary policy, Lindahl compared the effects of a lowering of the loan rate on prices, investment and income under different assumptions about initial capacity utilization, the flexibility of investment and wages, and the degree to which expectations are adapted to inflation (Lindahl 1930 [1939, pp. 161–83]). If capacities are fully utilized and all prices are fully flexible, the price level would instantly "soar upwards to an indefinite extent." Under the "more realistic assumption" of an *upward* "stickiness of wages," however, consumer prices rise more gradually. Consumption falls below planned levels, whereas the loan-financed expansion of investment leads to windfall profits from inflation that the firms will tend to reinvest. The cumulative process has thus the potential to increase output and bring inflation to a halt again. The redistribution of real income through inflation thus makes saving adjust to investment, rather than *vice versa* (as in the classical view of intertemporal allocation).

Wicksell on a Negative Natural Rate of Interest

Wicksell (1911 [1958, p. 181]) discussed the possibility of a negative natural rate of interest when agents expect a lower real income in the future. This possibility would be incompatible with Böhm-Bawerk's famous first reason for the existence of a positive rate of interest (1889 [1890, pp. 250–51]). Böhm-Bawerk had argued that those who expect a less abundant satisfaction of their needs in the future can always hoard present goods, especially if durable objects such as gold are accepted as means of exchange. Wicksell argued that this can only establish a floor to the rate of interest, but not in itself lead to a positive agio for present goods. "It can only ensure that

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[8]With regard to this passage, Woodford's claim that "Wicksell does not discuss endogenous inflation expectations" (2003, p. 46 n. 40) does not appear to be quite correct. For a more detailed discussion of Wicksell's views on the role of expectations see Boianovsky and Trautwein (2001).

the difference of value in the *negative* direction does not fall below the costs or risks of storing those objects." This argument came back under another guise in Wicksell's interpretation of the depression phase of the business cycle when, due to the interest inelasticity of the demand for fixed capital goods caused by a temporary saturation of investment opportunities, no positive market rate of interest may equilibrate saving and investment at full employment (see Wicksell 1907 [1953]; Boianovsky 1995, section 4). Under those circumstances, the lower limit to the natural rate of interest is given, according to Wicksell, by the rate of return to inventory holding, as influenced by the expectation that prices of raw materials and durable consumption goods will eventually return to their "normal" levels. Hence, although monetary policy cannot prevent a deflation at the bottom of the cyclical depression, a reduction of the market rate of interest to its lowest positive level should encourage production for stock holding, thereby reducing the rate of deflation that equilibrates the goods market.

Woodford's Approach in Comparison

Woodford bases his theory on forward-looking behavior of the private sector, all throughout the book. For him, like for Lindahl, nominal rigidities are the key to the explanation of real effects of monetary policy—and the effects on real output are shown to be substantial and persistent (2003, pp. 188–200). He uses a Calvo-style model of staggered price-setting to derive a new Keynesian Phillips Curve, i.e., an AS relation between inflation dynamics and deviations of actual real output from the "natural rate" (the output level that would prevail if prices were flexible). Calvo pricing is a rather mechanical framework, in which the timing of price changes is independent of inflation. Woodford (2003, pp. 141–42) defends the method as analytically convenient and empirically relevant, but he also admits freely that this procedure has its drawbacks. In the context of this paper it should be noted that the assumed price-setting behavior is plausible only (if at all) in an environment of low inflation. It should not be applied to the analysis of accelerating or persistently high inflation that was at the core of old-style Wicksellian theory. In a framework that is based on forward-looking behavior it is even less acceptable than in Lindahl's framework where expectations are mostly adaptive.

Moreover, we find Woodford's analytical treatment of nominal rigidities somewhat confusing insofar as the rigidities are presented as being both optimal *and* suboptimal. This point is related to Woodford's concepts of natural rates. Woodford (2003, pp. 151–52, 247–52) defines the natural rates of output and interest as the equilibrium real output and the equilibrium real rate of return in the case of *perfectly flexible* prices.[9] In Woodford's framework they serve as purely hypothetical benchmarks for the definition of interest-rate gaps and output gaps and, hence, for the assessment of the real effects of monetary policy. The rates are given by consumers' preferences and producers' technologies. In accordance with the standards of RBC theory, to

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[9]It is not clear why Woodford includes "equilibrium" in the definitions. Unlike Wicksell and the older Wicksellians, he does not present his examination of changes in inflation and output in terms of disequilibrium analysis. He also seems to avoid the use of the notion of multiple equilibria.

which Woodford refers in various places, his concepts of natural rates should thus represent optimal and efficient dynamic paths of real output and interest. But can it be inferred that they are optimal and efficient, when the nominal rigidities, i.e., the "delays involved before the next time that prices are reconsidered . . . are taken here to be an institutional fact, just like the available production technology" (2003, p. 7)? Shouldn't the rigidities then be part of the natural rate definitions? Moreover, Woodford suggests that the rigidities can be considered efficient in the sense that the benefits from the reduction in the menu cost of price adjustments are expected to be greater than the costs of abstaining from continuous price adjustments (2003, p. 142). This would imply that price flexibility is not optimal *per se*, and that Woodford's concepts of natural rates of output and inflation do not represent optima.[10]

A similar problem of separation between "optimal" and "suboptimal" rigidities arises with respect to Woodford's definition of the natural rate in an extension of the basic neo-Wicksellian model that allows for endogenous variation in the capital stock (2003, pp. 372–78). In this case, the equilibrium real rate of return under flexible prices depends upon the capital stock which is now "a function of past monetary policy, among other things, when prices are sticky" (2003, p. 372). It no longer refers to an exogenous process. A consequent solution would therefore be to define the natural rate as referring to the capital stock that *would* exist *if* prices had always been flexible in the past. Yet Woodford (2003, p. 372) finds it "odd to define the economy's 'natural' level of activity, and correspondingly the associated 'natural' level of interest rates, in a way that makes the capital stock that actually exists and the effects of this upon the economy's productive capacity irrelevant." He therefore defines a "constant-capital natural rate of output" that is based on the given capital stock at date *t* and indicates what real output and interest "*would* be, given current and expected future real disturbances, if prices were flexible *and* the capital stock did not vary from its steady-state level" (2003, p. 373).

One is tempted here to employ the old Wicksellian distinction between *ex ante* and *ex post*, since Woodford's definition of the constant-capital natural rate of output resembles Lindahl's treatment of a change in the capital stock by way of forced saving. As an effect of expansionary monetary policy, such a change is not optimal *ex ante*, but insofar as it helps to enlarge the output of consumption goods, it may be considered optimal *ex post*. Furthermore, and regardless of the differences in the underlying definitions of the benchmark equilibrium rate and the policy instrument, Woodford seems to share Lindahl's view that the "natural rate" is not an attractor for the "market rate" of interest.

Woodford's (2003, pp. 50–51) account of the determination of the equilibrium path of the price level under the assumption of flexible prices is based on the Fisher equation linking the nominal interest rate to expected price changes together with the central bank's interest rate rule. As pointed out by Woodford, this is quite different from the Wicksellian cumulative process, since there is no distinction between the actual and the natural rates of interest. Woodford's account is reminiscent of

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[10]Woodford (2003, pp. 411–16) discusses the case of a "mildly inefficient natural rate of output," but relates the inefficiencies only to monopolistic market power and distorting taxation. Moreover, as pointed out by Walsh (2005), in the more general case when a cost shock is added the inflation equation, the zero interest rate gap may not be the optimal policy.

Hicks's (1946, pp. 251–54) interpretation of Wicksell's process as an equilibrium phenomenon, with no actual discrepancies between the money and the natural rates. However, in contrast with Hicks, Woodford does not conclude from that that Wicksell's theory is of little use as guide to banking policy. Moreover, the distinction between those two rates of interest, together with Wicksell's notion that changes in the natural rate are important sources of price-level variation, can only be accommodated by a model with sticky prices and output gaps (Woodford 2003, pp. 276–78). The problems posed by a negative natural rate of interest are also mentioned by Woodford (2003, pp. 134–35, 251–52), who suggests that a sharp deflation can be avoided by a regime that creates expectations of subsequent inflation. This is not inconsistent with Wicksell's approach, although Wicksell's distinction between long (or "fixed") and short (or "liquid") investment is not part of Woodford's framework. It is, on the other hand, only implicit in Wicksell that monetary policy should not aim at stabilizing prices at depression level, while Woodford makes clear that the central bank should in that context replace its zero inflation target by a policy commitment able to generate expectations of a higher future price level (see also Eggertsson and Woodford 2003).

IV. REAL EFFECTS OF MONETARY POLICY

Lindahl's View

Lindahl did not believe that the central bank could consistently exploit the redistributive income-mechanism, as described in section 3.1, to generate output growth. Price expectations would soon be adapted to inflation and accelerate the pace of inflation. The conflicts arising from "the redistribution of incomes in favour of entrepreneurs and to the disadvantage of fixed income receivers and workers" could make it "necessary to arrest the movement before the amount of capital appropriate to the lower rate of interest has been accumulated" (Lindahl 1930 [1939, pp. 183, 182]). In order to avoid such disorder, Lindahl pleaded for the setting of rules for monetary policy. He actually dedicated a whole book (Lindahl 1929) to the discussion of alternative concepts of rules, based on two principles for "rational monetary policy" (1929, pp. 4–8). First, the authorities should set, publicize and follow a clear norm for monetary policy, so as to inspire trust in the rule of law and in economic relations. Second, the norm should be chosen so as to minimize the deviations between intended and actual outcomes of all transactions in terms of money. The two norms that, according to Lindahl, come closest to these principles are (a) the rule of price level stability, and (b) the rule that the price level should move in inverse proportion to general productivity. Lindahl (1929, chapter IV) expressed a preference for (b), which had originally been formulated by David Davidson in critique of Wicksell. He argued that it would lead to efficient risk-sharing between entrepreneurs and creditors. In the case of negative (positive) productivity shocks, rising (falling) prices would stabilize the economy by balancing the negative (positive) output effects on profits. The same argument would apply to wages, given Lindahl's observation (1929, pp. 62–65) that wages tend to be sticky in both directions and that the supply of labour is rather inelastic. The Davidson rule would deal with both rigidities, "so that, if productivity is rising,

workers get higher real wages through the lowering of the price level, even though money wages remain unchanged, and *vice versa* if productivity is falling" (1929, p. 63). As a long-term advisor to the Swedish central bank, Lindahl later advocated price-level stabilization, without giving up his preference for the Davidson rule. He insisted that the main task of monetary policy is to help the public to form consistent expectations.

In Lindahl's view, price (and wage) flexibility is not optimal *per se*, but an effect *and* reinforcing cause of accelerating and high inflation, which starts as a disequilibrium process and may end as an inefficient equilibrium (see Boianovsky and Trautwein 2006). In the absence of unemployed resources, the real effects of expansionary monetary policy are generated by a redistribution of incomes. Whether they amount to a non-neutrality of money in the short run only, or even the *long* run, depends both on the endogenous formation of inflation expectations and on the distributional conflicts that may truncate the traverse to a new structure of production. Hence, a policy that targets a stable price level, or even its reverse relation to productivity changes, is optimal because it coordinates expectations so as to match the plans for production and consumption.

Woodford's Approach in Comparison

Woodford also emphasizes the coordinating function of monetary policy and shows how an interest-rate rule that follows the Taylor principle (of over-proportional interest-rate responses to deviations of actual inflation from target inflation) can generate the learning dynamics for convergence on a determinate rational-expectations equilibrium (2003, pp. 261–76). But the income redistribution and the problems of maladjustment of investment and saving that are central to the explanation of real effects in old-style Wicksellian models can hardly be accommodated in Woodford's framework for three reasons.

First, while investment demand is central to old-style Wicksellian models, it is introduced only as an extension to the core of the neo-Wicksellian model (2003, pp. 352–78). The discussion of vertically differentiated structures (intermediate goods and final goods) is minimal and restrictive.[11] The goods structure is horizontally differentiated. There exists a variety of consumption goods to facilitate the introduction of price setting (through monopolistic competition)—and this allows Woodford to discuss some structural issues, such as sectoral asymmetries or relative-price distortions (2003, pp. 200–204, 396–405). But these have little to do with the structural issues discussed by Lindahl (or Hayek and Myrdal).

Second, firm-ownership is not specified. In a model with identical households, the representative household must hold a representative portfolio of assets. What the household loses in inflation due to wage and price stickiness, it wins by gains on other assets. The "social injustice" and the distributional conflicts that motivated

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[11]The simplifying assumption that "while all sectors purchase investment goods from the same suppliers (i.e., that the investment goods used by the different sectors are perfect substitutes for their producers), these goods cease to be substitutable once they have been purchased" (2003, p. 354) may create an irreversibility of investment, but cannot capture the mismatch problems between capital goods and consumption goods industries discussed by Hayek (1929) and Lindahl (1930).

old-style Wicksellians to advocate price-level stabilization are not easily captured in this framework.

Finally, the time horizon of the real effects of monetary policy is not quite clear in Woodford's analysis. Is money non-neutral only in the short run? This is the impression one gets from most of the impulse-response diagrams and the surrounding discussions in chapters 3–5. Or is money non-neutral even in the long run? That might be concluded from various remarks in the introductory chapter and from the discussion of investment in the neo-Wicksellian model (2003, pp. 361–72). In the latter case, Woodford would certainly go beyond the consensus view in the New Neoclassical Synthesis, which has it that money is non-neutral in the short run, but neutral in the long. However, throughout the book, Woodford has carefully avoided to mention the n-word. We don't find "neutrality" or "non-neutrality" of money, or monetary policy, in the index,[12] and the word is sparsely used, let alone discussed, in the text. The non-neutrality at the base of Woodford's analysis is defined as the discrepancy between the flexible-price benchmark of a natural rate of output and actual output under nominal rigidities. The discrepancy is endogenous to inflation, whereas the price-setting behavior is not. The analytical rigidity of the nominal rigidities in the model is perhaps a price to pay for the use of the hypothesis of forward-looking behavior. It makes it difficult to assess the precise meaning of "non-neutrality" in the neo-Wicksellian model.

V. CONCLUSION

In the preceding sections, we have emphasized the differences between Woodford's neo-Wicksellianism and old-style Wicksellian theory, as is perhaps natural when one wishes to give Wicksell and (some of) his early followers a new lease of life. Yet there is no doubt that Woodford's book has helped to make progress in the analysis of many Wicksellian issues. He has, for example, greatly advanced our understanding of the connections between Wicksell's proposal of a simple interest-rate rule and modern Taylor-type rules. He has contributed in many facets to a rigorous discussion of monetary policy as "management of expectations," which was of central importance to Lindahl. Moreover, Woodford has put the concept of the pure credit economy in the center of monetary economics, together with the notion that interest rate rules can render the price level determinate.

In other aspects, we have found Woodford's approach either lacking or very different from earlier Wicksellian approaches. Some of the shortcomings and differences may turn out to be semantic issues, but most of them are due to differences in the modeling strategies. Woodford interprets his book as an attempt to translate Wicksellian ideas to modern standards of conceptual rigor. Those standards demand that the holding of base money, the formation of expectations and the existence of nominal rigidities be explained as outcomes of utility-maximizing rational behavior. Despite the formidable comprehensiveness of modeling techniques discussed in Woodford's

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[12]The index has one entry for "neutral rate of interest" which refers to discussions in the U.S. Monetary Policy Committee.

Interest and Prices, his neo-Wicksellian model seems, in some crucial aspects, to be wide off the mark than the approaches of the old Wicksellians. Even though Woodford's model is supposed to be based on a model of "monetary policy without monetary frictions," it takes implicit recourse to frictions. Furthermore, Woodford simply assumes forward-looking behavior and Calvo pricing, whereas Lindahl, for example, made expectations and nominal rigidities (or, rather, their elimination) endogenous to the cumulative process. This raises the question whether central issues in Wicksellian theories, such as "monetary control in the cashless economy" or "long-run non-neutralities of monetary policy," can be tackled by way of intertemporal general-equilibrium modelling along the lines followed in the most recent *Interest and Prices*.

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