The scientific illusion of New Keynesian monetary theory

Abstract

It is shown that New Keynesian monetary theory is a scientific illusion because it rests on moneyless Walrasian general equilibrium micro-foundations. Walrasian general equilibrium models require a Walrasian or Arrow-Debreu auction but this auction is a substitute for money and empties the model of all the issues of interest to regulators and central bankers. The New Keynesian model perpetuates Patinkin's 'invalid classical dichotomy' and is incapable of providing any guidance on the analysis of interest rate rules or inflation targeting. In its cashless limit, liquidity, inflation and nominal interest rate rules cannot be defined in the New Keynesian model.

Key words; Walrasian-Arrow-Debreu auction; consensus model, Walrasian general equilibrium microfoundations, cashless limit.

JEL categories: E12, B22, B40, E50

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Introduction

Until very recently many monetary theorists endorsed the 'scientific' approach to monetary policy based on microeconomic foundations pioneered by Clarida, Galí and Gertler (1999) and this approach was extended by Woodford (2003) and reasserted by Galí and Gertler (2007) and Galí (2008). Furthermore, Goodfriend (2007) outlined how the 'consensus' model of monetary policy based on this scientific approach had received global acceptance.

Despite this consensus, the global financial crisis has focussed attention on the state of contemporary monetary theory by raising questions about the theory that justified current policies. Buiter (2008) and Goodhart (2008) are examples of economists who make some telling criticisms. Buiter (2008, p. 31, fn 9) notes that macroeconomists went into the current crisis singularly unprepared as their models could not ask questions about liquidity let alone answer them while Goodhart (2008, p. 14, fn 11) wonders how central bankers got suckered into believing in the 'consensus model' of monetary policy.[1] These criticisms are in stark contrast to the earlier glowing endorsement of the scientific foundations underpinning 'consensus' model of monetary policy.

In this paper I argue that the New Keynesian version of the 'consensus' model is indeed a scientific illusion based on flawed microeconomic foundations and perpetuates a fatal flaw in the approach to monetary theory that has dogged the profession for the last 70 years, if not longer. Furthermore, the arguments apply, *mutatis mudandis*, to all applications of quantitative stochastic general equilibrium models based on Walrasian general equilibrium micro-foundations.[2]

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[1] An earlier critique of the 'consensus model' by Arestis and Sawyer (2004) is also revealing.

[2] See Rogers (2006, 2007a, b) for a critique of frictionless models of money. The conceptual confusion is not confined to the New Keynesians as MCandless (2008, Chapter 8 p. 184 chapter 9 p. 236 emphasis added) accounts for the mistreatment of money in RBC models along the following lines:

"The requirement that money be used to purchase goods, or at least some goods, is simply imposed. *Nothing in the model explains why money is used or what particular benefit comes from using money*. However, for most practical purposes,

The embrace of micro-foundations by contemporary monetary theorists amounts to the *de facto* embrace of Walrasian or Fisherian general equilibrium theory as 'the' method of economic theory to the exclusion of other approaches. Interestingly, Solow (1986) warned about confusing the need for micro-foundations with the adoption of Walrasian general equilibrium micro-foundations. What happened to the Marshallian micro-foundations employed by Keynes? In any event, the embrace of Walrasian general equilibrium micro-foundations has had devastating consequences for monetary theory. The reason for this lies with an often tacit and un-stated assumption that is required to employ the Walrasian general equilibrium model. This assumption is the Walrasian, Arrow-Debreu or time-0 auction that underpins all forms of Walrasian general equilibrium theory.[3]

The consequences of this auction were recognised immediately by Frank Hahn (1953, 1965) who repeatedly reinforced the message in Hahn (1973a, b and 1982) as did Arrow in Arrow and Hahn (1971). Essentially, models based on the

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the same can be said about how most of us use money day to day. There is nothing in daily life that much explains why we use money except that it is what our employer gives us for the lobor we provide and what the grocer accepts in exchange for the food we want to consume. This is usually a good enough reason for using money day to day and the reason we use it in this chapter [on the CIA model]….
Adding money to the model creates an additional complication in solving the model. *The presence of money puts a friction into the economy* so that equilibrium will not necessarily be that of a frictionless competitive equilibrium".
In chapter 9, dealing with money in the utility function he goes on to observe:
"*Putting money into general equilibrium microfoundations model is not easy*. In the cash-in-advance model, it was simply assumed that money had to be used to make certain types of purchases, in our case, consumption goods. There was no real theoretical rationale for that assumption other than the empirical observation that we seem to find money being used on one side of most transactions. *If one takes this empirical observation as a given, then the cash-in-advance models are fine*."

What more can be said about this form of crooked thinking?
[3] The simple Walrasian auction is based on recontracting to establish equilibrium exchange ratios while the Arrow-Debreu model is based on a time-0 auction. For a description of the time-0 auction in the Arrow-Debreu model see Ljungqvist and Sargent (2004, p. 217)

Walrasian or Arrow-Debreu auction have no role for money, credit, liquidity, banks or a central bank. Money or credit has no role because the Walrasian auction reduces the model to perfect barter and the Arrow-Debreu extension to a world of complete markets with Arrow securities eliminates uncertainty. Under a Walrasian auction all commodities are equally liquid and the concept of liquidity as the conversion of an asset into money without loss is not defined – see Lucas (1984) and Buiter (2008, pp. 25-33). Consequently, and this is often overlooked, Walrasian general equilibrium models have nothing to say about theories of the price level or inflation let alone provide the foundations for a theory of monetary policy. Yet this is precisely what we are expected to believe by New Keynesian monetary theorists and some exponents of the Walrasian general equilibrium analysis of financial crises.[4]

To elaborate on what Goodhart (2008) has described as the continuing muddle in monetary theory this paper examines the New Keynesian Framework for the analysis of monetary policy presented by Jordi Galí (2008). It is shown that the New Keynesian framework is a recasting of the old classical dichotomy in new clothes and perpetuates all the logical and conceptual muddles associated with attempts to integrate money and Walrasian general equilibrium theory – an impossible task. Although general equilibrium theory based on Walrasian microeconomic foundations is perceived by many to be 'the' method of contemporary monetary theory because it provides rigorous scientific foundations for numerical stochastic general equilibrium models, these models are empty of anything of interest to monetary theorists, bankers, regulators and central bankers.

The remainder of the paper proceeds as follows. Section 2 briefly outlines the history of the logical and conceptual muddles thrown up by attempts to enforce a role for money in models where no money is required. Section 3 outlines the New Keynesian approach to monetary theory. Section 4 exposes the scientific illusion of New Keynesian monetary theory and policy by revealing its logical

[4] See for example Allen and Gale's (2007, chapter 2) analysis of the efficient allocation of risk on Euclidean space or the definition of 'liquidity' as the conversion of a unit of jam today into a unit of jam tomorrow.

and conceptual flaws exposed by earlier attempts to enforce a role for money where it is not required. Section 5 briefly reviews the 'approximation theorem' defence of moneyless models as a foundation for a theory of monetary policy. Section 6 concludes.

2 Money and Walrasian general equilibrium theory

The fundamental incompatibility between monetary and Walrasian general equilibrium theory was well stated by Hahn (1982, p.1), and Arrow and Hahn (1971, pp. 356-7) stress the importance of money contracts for the foundations of monetary theory. Essentially what Hahn and Arrow and Hahn were telling us is that under a Walrasian or Arrow-Debreu auction there is no role for any of the functions of money. The auction effectively replaces all the functions of money, credit and banks in a world of *perfect barter*. The usual real world frictions that accompany barter, such as the double-coincidence of wants, or asymmetries of information or externalities and bankruptcies that are of interest to regulators and central bankers in monetary economies cannot arise under a Walrasian or Arrow Debreu auction. As Laidler (1990) explained, money and the Walrasian or Arrow-Debreu auctions are substitutes not complements!

Instead, under such auctions, not only can anything in a consumption bundle be traded directly today, but consumption goods (if there is more than one) can be traded for consumption goods in the future. Such trades obviously cannot be executed in reality but are permitted in the model under the Walrasian or Arrow-Debreu auctions which are isomorphic with the Fisherian perfect market for commodity loans, i.e. how much jam can be given up today in exchange for a unit of jam at a future date – see Samuelson (1967). There is no role for money, credit or banks in dynamic stochastic general equilibrium models built on Walrasian microfoundations and failure to recognise this simple fact accounts for almost all the confusion that has characterised attempts to introduce money into Walrasian general equilibrium models at least since Patinkin (1965), and probably earlier.

The most famous attempt to square this circle was indeed Patinkin's introduction of money into the utility function as a means of integrating

monetary and value theory (for value theory read Walrasian general equilibrium theory). Although many contemporary monetary theorists still follow Patinkin's lead it is now generally understood that, under a Walrasian auction, it is not possible to give money utility that is distinguishable from the utility of consumption. But in reality money has utility because it gives access to trades, production and security that would not be available without it. By contrast, under a Walrasian or Arrow-Debreu auction, money-in-the-utility-function cannot be justified unless money can be consumed. But that rather defeats the purpose of monetary theory.

Clower (1967) recognised some aspects of this shortcoming to Patinkin's analysis of money-in-the-utility-function and proposed his famous aphorism that: "money buys goods and goods buy money but goods do not buy goods". This is obviously true in the real world but now equally obviously not true under a Walrasian auction that produces a world of perfect barter. Consequently, Clower's proposal – to impose a cash-in-advance (CIA) constraint - merely compounded the confusion by converting money into a friction in Walrasian general equilibrium models. Imposing a CIA constraint on a model with a Walrasian or Arrow-Debreu auction imposes an additional constraint on agents that is not required under those auctions and so converts money into a welfare reducing friction. But as everyone knows, money is an invention that overcomes frictions. As Clower (1984, p. 275) later realised, imposing a CIA constraint was *contra* common sense and two hundred years of conventional wisdom. Unfortunately, by then the horse had bolted and the idea of a CIA had been blessed by Lucas (1984) and adopted by the profession.

With hindsight this was obviously the fundamental mistake that explains much of the muddle that describes contemporary monetary theory. Macroeconomics as a discipline based on Walrasian general equilibrium theory in its dynamic stochastic general equilibrium reincarnation has largely retreated to the logically secure cacoon offered by real business cycle theory – a moneyless model. In addition, by embracing Walrasian general equilibrium foundations, macroeconomics and monetary theory has abandoned its *raison d'être* – recognition that aggregate behaviour cannot be predicted or understood solely

by the study of microeconomic behaviour. Kirman (1989) explained how aggregate Walrasian analysis raised questions about the uniqueness of equilibrium and later, Kirman (1992), noted that, although the representative agent approach circumvents these questions, it is unable to deal with issues of aggregation that are central to macroeconomics. The representative agent analysis based on Walrasian general equilibrium foundations is incapable of dealing with asymmetries in information, externalities, or any of the paradoxes thrown up by aggregate behaviour – such as the paradox of liquidity. The consequence is that monetary and financial economics has become trapped in a 'looking glass' world where the English language is tortured until everyday words mean what the theorist wants them to mean. [5] The net result is a bad dose of cognitive dissonance where concepts and definitions that economists thought they understood take on new meanings.

A couple of prominent examples will illustrate the point. It has been long known that Walrasian general equilibrium theory has no use for the price level; it deals only in commodity relative rates of exchange.[6] The price level is of interest only to agents who use money and are concerned about the stability of its purchasing power. Under a Walrasian or Arrow Debreu auction since agents have no use for money they have no use for the concept of a price level. Despite this there have been many attempts to debate theories of the price level in the context of Walrasian general equilibrium models. The most notorious was the recent fiscal theory of the price level.[7] The lesson that should have been learnt from this debate was that Walrasian general equilibrium theory is incapable of generating

[5] Brain Loasby (1976, p. 27) noted that to be a good economist at that time (is it any different today?) one had to aspire to the White Queen's standard in *Alice Through the Looking Glass* and be capable of believing six impossible things before breakfast.

[6] Even the term 'prices' is misleading here as the relative 'prices' determined by the model are actually commodity rates of exchange, how much jam must be given up today for an apple or a unit of jam tomorrow. Furthermore there is no need for a *numeraire* under a Walrasian auction although one is often introduced. See Rogers (2008d)

[7] See the critique by Buiter (1999, 2002) and Rogers (2007a) critique of Cochrane's (2005) defence of the FTPL in a 'well-specified Walrasian general equilibrium model'.

any theory of the price level let alone adjudicating between a quantity theory and a fiscal theory.

Another example causing some degree of puzzlement is the practice of using so-called 'frictionless' models as a basis for the analysis of monetary policy and the reference to 'monetary frictions' in such models.[8] The wild duck has really taken a turn for the worse here! On inspection a frictionless model turns out to be nothing more than a 'well-specified Walrasian general equilibrium model'. But as we now know a well-specified Walrasian general equilibrium model has no use for money and the price level and following the widely held practice of adding a CIA constraint converts money into a friction.

Finally, and what is more perplexing, we are asked to believe that moneyless models can provide a sound theoretical foundation for a theory of monetary policy or can approximate such a theory in the guise of a calibrated (empirical ?) stochastic general equilibrium model.[9] But in its moneyless state the New Keynesian model is a real business cycle model that has nothing to say about monetary policy. Using the model with a CIA constraint or equation of exchange attached creates 'monetary frictions' and is contra common sense (not to mention logic). How it is possible to conduct standard welfare analysis with such a model is never explained. At best the *ad hoc* attachment of a monetary equation to a Walrasian general equilibrium system confuses the neutral money doctrine with a 'money irrelevance' doctrine. At worst it introduces a role for monetary policy into a model where no such role is required.[10] Consequently the analysis is reduced to story-telling parading as rigorous theory. Unfortunately, it appears that this is what we are now expected to take on trust by exponents of the 'science' on New Keynesian monetary policy.

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[8] Woodford (2003) seems to be the leading offender here but he is not alone. Recall McCandless (2008).

[9] Hoover (1995) and Summers (1991) raised concerns about the calibration methodology.

[10] For those who are not already convinced, Wallace (2004) shows why it is impossible to find a role for a central bank in a 'cashless' (means moneyless) Arrow-Debreu economy.

3 New Keynesian Walrasian micro-foundations for a theory of monetary policy

Galí (2008, p. 1) introduces his book as an attempt to provide the reader with an overview of modern monetary theory from a New Keynesian perspective. The New Keynesian monetary framework provided by Galí has a core structure that corresponds to a real business cycle model on which a number of Keynesian elements are superimposed. The key New Keynesian elements are the introduction of nominal rigidities (based on the introduction of monopolistic competition) as this is seen as sufficient to overcome the limitations of the RBC model that generally predicts neutrality of monetary policy.[11] Keynesians (old and New) are keen to demonstrate what they call the short-run non-neutrality of money. They all accept the long-run neutrality of money as the economy (model?) adjusts to its (unique?) natural equilibrium. But this way of proceeding to construct a theory of monetary policy, be it New Keynesian or anything else, is bound to fail because it commits all of the conceptual mistakes made by Patinkin (1965), plus some. Before we consider those in detail consider how Galí moves from what he calls classical monetary theory to his New Keynesian framework.

Classical monetary theory is said to apply to a world of perfect competition and fully flexible prices in all markets. Although this model is known to generate counterfactual predictions it is nevertheless treated by Galí as a useful 'benchmark to be applied when some of its strong assumptions are relaxed'. It is never explained how a model that makes 'counterfactual predictions' could be used as benchmark. Nevertheless, following the practice of the recent literature Galí begins by restricting the role of money in his competitive model of classical

[11] What New Keynesians have overlooked here is that the RBC model does not 'predict' the neutrality of money but the irrelevance of monetary policy. The RBC model as a variant of the Walrasian general equilibrium model has no role for money or monetary policy. Money is irrelevant to a RBC model; not neutral. The model has nothing to say about the neutrality of money which is a claim about the properties of a monetary economy

monetary theory to that of the *numeraire* or unit of account only.[12] But the only model where such assumptions are possible is the Walrasian general equilibrium system or its variants, where the Walrasian auction provides a short-cut around the need to model money, any institutional detail or market behaviour.

The representative household is modelled in contemporary fashion with the household maximising an objective function

$$E_0 \sum_{t=0}^{\infty} \beta^t U(C_t, N_t) \qquad (1)$$

subject to a budget constraint

$$P_t C_t + Q_t B_t \leq B_{t-1} + W_t N_t - T_t \qquad (2)$$

and a solvency or no bankruptcy constraint[13]

$$\lim_{T \to \infty} E_t \{ B_t \} \geq 0, \forall t. \qquad (3)$$

The variable C_t represents the quantity consumed of a single consumption good, P_t is said to be *the price* of the consumption good, W_t the *nominal wage*, and B_t represents the quantity of one-period, nominally riskless discount bonds purchased in period *t* and maturing in period *t + 1*. Each bond is said to pay *one unit of money* at maturity and its price is, Q_t. Finally, T_t is a lump-sum transfer (from or to the government) said to be *expressed in nominal terms*. Deriving the intertemporal optimising conditions (Euler equation) and taking a linear approximation to the condition involving the bond price, consumption and 'prices' in periods *t* and *t + 1*, under a particular form of the utility function, Galí derives the condition:

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[12] Patinkin (1965), McCallum (1985) and Buiter (1999) all provide clear explanations of how to interpret the role of a *numeraire* in a moneyless model. As Buiter (1999) notes, in such a model the *numeraire* need not exist so could be something like phlogiston – a non-existent substance once thought to cause combustion.

[13] Goodhart (2004) points out that including (3) precludes bankruptcy and thereby eliminates one of the primary concerns of regulators.

$$c_t = E_t\{c_{t+1}\} - \frac{1}{\sigma}(i_t - E_t\{\pi_{t+1}] - \rho) \qquad (4)$$

Lower case variables correspond to the natural logs, i.e. $c_t = \log C_t$ and $\pi_t = \log P_{t+1} - \log P_t$, $\rho \equiv -\log \beta$ while $i_t \equiv -\log Q_t$ is described as the nominal rate of interest, Galí (2007, footnote 2 p. 18).

Of course, with only the *numeraire* function of 'money' the model does not contain any nominal values so at this point Galí is at least guilty of the loose use of language. As there is no money in the model represented by equations (1) to (3) there can be no nominal rate of interest and as there are no nominal or money prices inflation cannot be defined. What Galí is doing here is attributing real world properties to his model when such properties are not defined in the model. What is going on here is reminiscent of what Fritz Machlup dubbed '*the fallacy of misplaced concreteness'*. At worst, failure to interpret expression (1) correctly inevitably leads Galí into deeper conceptual muddles.

The use of money and nominal values is however belatedly introduced when Galí suggests that it will sometimes be convenient to include an *ad hoc* money demand equation with a log-linear form:

$$m_t - p_t = y_t - \eta i_t \qquad (5).$$

In expression (5) which can be interpreted as the equation of exchange, demand for money equation or a variant of the CIA constraint, m_t is the log of the quantity of money, p_t the log of the price level, y_t is the log of output, i_t is the nominal rate of interest and η is said to be the nominal interest semi-elasticity of money demand. Clearly nominal magnitudes can now be defined in the model but that ability has come at the expense of the contradiction that money is a friction in the model.

Money is converted into a friction because appending (5) to expressions (1) to (3) imposes a CIA constraint on agents that is not required under the Walrasian auction that is *necessary* to write down equation (1) to (3). Expression (5) means that agents in the model must use money to make exchanges although no such action is required under the Walrasian auction. Thus, expression (5) is a concession to naive realism that is not required by Walrasian general equilibrium theory. Galí's New Keynesian model therefore embodies what Patinkin (1951, 1965) called the 'invalid classical dichotomy' – the practice of attaching expression (5) to the otherwise real equations of a Walrasian general equilibrium system. By adopting Walrasian general equilibrium micro-foundations in expressions (1) to (3) there is little alternative. Unfortunately this means that the degree of conceptual dissonance rises significantly when New Keynesian elements are added to this classical monetary model.

Galí objects to the neoclassical monetary model, not on the conceptual and logical grounds sketched above, but because it does not 'predict' the short-run non-neutrality of money. The short-run non-neutrality of money is taken as gospel by New Keynesians so Galí follows contemporary practice by introducing two distortions that lead to inefficient equilibria relative to the efficient or optimal equilibria of classical monetary theory. This vision itself reflects distortions in the thinking of contemporary monetary theorists as neutrality is not a concept that has any meaning in Walrasian general equilibrium theory. In Walrasian general equilibrium theory money is irrelevant although it may be an inessential addition to the model.[14] Also, optimal policy is defined solely with reference to the efficient allocation of resources, as it must be in Walrasian general equilibrium theory where the notion of involuntary unemployment and

[14] Many contemporary monetary theorists that employ Walrasian general equilibrium foundations seem to be deceived by what Hahn (1973a, b) called the 'inessential' nature of money in Walrasian general equilibrium theory. Money is said to be an inessential addition to a model if money is incorporated without disturbing the real equilibrium solution. All contemporary monetary models based on Walrasian general equilibrium microfoundations have this property. See Rogers (2006).

un-utilized resources is not defined.[15] A model constructed on Walrasian microfoundations is essentially all about the 'efficient allocation' of resources and has nothing to say about unemployed resources.

Galí's (2008, chapters 3-4) basic New Keynesian model consists of two sectors; the non-policy sector and the policy sector. The latter consists of some form of interest rate rule, as in equation (9) below which is a simple Wicksell Rule. Formally, the non-policy sector contains a New Keynesian Phillips curve that is said to incorporate expectations of future inflation and an output gap between the natural and actual allocations (or levels) of output; a dynamic IS equation (DIS) that relates the actual output gap to the expected output gap and the gap between the Fisherian real rate of interest and the natural rate; and, the natural real rate determined by the time preference and productivity (productivity and thrift for short) and expected productivity shocks that drive the natural rate. Note here that the term 'output gap' can be misinterpreted if it is thought to imply unemployment. In the New Keynesian Walrasian micro-foundations there is no unemployment; just inefficiently allocated labour. The 'output gap' refers to an inefficient allocation of resources relative to the Pareto efficient allocation.

The equations in the New Keynesian Framework are:

Non-policy sector:

$$\pi_t = \beta E_t\{\pi_{t+1}\} + \kappa\bar{y} \qquad (6) \qquad \textit{New Keynesian Phillips Curve}$$

$$\bar{y} = E_t\{\bar{y}_{t+1}\} - \frac{1}{\sigma}(i_t - E_t\{\pi_{t+1}\} - r_t^n) \qquad (7) \qquad \textit{Dynamic IS equation}$$

$$r_t^n \equiv \rho + \psi_{ya}^n E_t\{\Delta a_{t+1}\} \qquad (8) \qquad \textit{Natural rate of interest}$$

Policy sector:

[15] Patinkin's (1965, chapter 13) analysis of Keynesian 'involuntary unemployment' represented another failed attempt to square this aspect of the circle by introducing a Keynesian concept into a model where it is not defined.

$i_t = r_t^n$ (9) *Interest rate rule*

Expressions (6) to (9) are representative of the microfoundations underpinning the consensus model of monetary policy and as nominal magnitudes are included, the model has attached the *ad hoc* money demand equation, expression (5), despite the fact that it implies that money is a friction in the model.

The variables are defined as follows: $\pi_t = \frac{P_{t+1} - P_t}{P_t}$ is inflation; $\bar{y}_t$ is the 'output gap' defined as, $y_t \neq y_t^{nNK}$; i_t is the nominal rate of interest; and r_t^n is the natural; rate of interest, and E_t is the expectations operator. The parameters in the model are determined by the assumptions made about tastes (the utility function) and technology (the production function). The parameter $\kappa \equiv [\frac{(1-\theta)(1-\beta\theta)}{\theta}][\frac{1-\alpha}{1-\alpha+\alpha\varepsilon}]$ in the New Keynesian Phillips curve, expression (6), depends on the degree of price stickiness as measured by the parameter θ. However, note that κ is not defined for $\theta = 0$ and inflation appears to be unbounded as $\theta \to 0$.

The two distortions introduced into the classical 'monetary' model to produce the New Keynesian model are captured by the parameters μ, which represents the degree of competition, and θ which represents the degree of price flexibility. Galí (2008, p. 48) then argues that "…when $\mu = 0$ (perfect competition) the natural level of output corresponds to the equilibrium level of output in the classical economy". And, in the limiting case of no nominal rigidities, $\theta = 0$ Gali (2008, p. 44) describes this situation as the desired or *frictionless* mark-up. Thus the New Keynesian model can be in various states depending on the values taken by these parameters.[16] In particular also note that the model can always be

[16] The relationship between price-setting agents (firms) and the auctioneer running the Walrasian auction is never explained. In the case where $\mu = 0$ there are no price setters and the model reverts to a complete Walrasian auction. The

placed in the moneyless, frictionless state or cashless limit when it is convenient, by dropping expression (5). Of course, when this is done there are no nominal values, no inflation, and no nominal interest rate rule. Effectively the New Keynesian Phillips curve then vanishes, as does the Fisherian real rate of interest in expression (7) and the policy sector, expression (9), leaving a simple real business cycle model.

To make this clear it is apparent that when the parameter values $\mu = \theta = 0$ are imposed the model collapses to the classical 'monetary' model and in that state the model can readily be placed in the moneyless, cashless or frictionless limit by conveniently dropping the money demand equation, (5). That establishes the New Keynesian model as an exercise in Walrasian general equilibrium theory that incorporates the dichotomy of classical monetary theory. It also illustrates that money, expression (5) is an inessential addition to the model in the sense of Hahn (1973a, b).

In the case of flexible prices under imperfect competition ($\theta = 0$ and $\mu > 0$) Galí (2008, section 3.2.2) shows that marginal cost is constant and given by, $mc = -\mu$. These conditions then define the natural level of output in the New Keynesian model. That is, the natural level of output in the New Keynesian model is defined with imperfect competition but flexible prices. Thus imperfect competition introduces a distortion into the classical model by depressing the natural level or efficient allocation of output. So in the New Keynesian model the new natural level of output is derived as[17]:

$$y_t^{nNK} = \psi_{ya}^n a_t + \vartheta_y^n \qquad (10)$$

where $\psi_{ya}^n \equiv \dfrac{1+\varphi}{\sigma(1-\alpha)+\varphi+\alpha}$ and $\vartheta_y^n \equiv -\dfrac{(1-\alpha)(\mu-\log(1-\alpha))}{\sigma(1-\alpha)+\varphi+\alpha}$.

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case where $\theta > 0$ and $\mu = 0$ is reminiscent of the Walrasian fix-price models of the 1980s.

[17] For the derivation see Gali (2008, section 3.3).

The only difference between this result and the equivalent derivation for the classical model is the presence of μ in the term ϑ_y^n and as Gali (2008, p. 48) notes, the introduction of imperfect competition has the impact of reducing output uniformly relative to the classical model so $y_t^{nNK} < y_t^{nC}$ without changing its sensitivity to technology shocks. So when $\mu > 0$ market power distortions exist in the New Keynesian model but when the parameter $\mu = 0$ the distortion of imperfect competition is removed and the New Keynesian natural level of output collapses to the classical natural level of output; $y_t^{nNK} = y_t^{nC}$ - the Pareto efficient allocation.

The introduction of imperfect competition alone is therefore of no particular significance as it leads only to a re-definition of a less efficient New Keynesian natural level of output relative to the classical model.[18] Resources including labour may be inefficiently allocated but they are not unemployed, i.e. left idle. What is important in the New Keynesian vision is the role of nominal rigidities as it is these that are the key to producing an additional distortion between the actual and New Keynesian natural level of output. The distortion due to staggered nominal price setting is introduced in the form of Calvo (1983) constraints on firms resetting prices. In this case the parameter θ is the measure of price stickiness and when $\theta = 0$ prices are said to be perfectly flexible (for perfect flexibility read Walrasian auction). But with Calvo constraints in place, i.e. with nominal rigidities, $0 < \theta < 1$, a further distortion occurs because some firms will produce an output other than that consistent with y_t^{nNK} as they cannot charge for or produce their profit maximising output. Nominal rigidities imposed on price-setting firms then produce output distortions such that, $y_t \neq y_t^{nNK}$.

The 'output gap' in the New Keynesian model therefore arises because binding Calvo constraints on some firms means that shocks to marginal cost, induced by shocks to the productivity of labour (see equation (8)), will force those profit maximising firms to produce an output that differs from the New Keynesian

[18] It is never explained how market power originates or how this power is reconciled with the rest of the model which remains under a Walrasian auction.

natural level as defined in expression (10). To understand what is happening here note that as firms have some market power they determine prices as a mark-up over marginal cost where the mark-up is determined by the elasticity of the demand curve. That is, $P_t = M \frac{W_t}{MPN}$ where M is the mark-up over the marginal cost, W_t / MPN_t, and $M \equiv \frac{\varepsilon}{\varepsilon - 1}$ where ε is the elasticity of the demand curve. Gali (2008, p. 44) describes M as the desired or frictionless mark-up.

Gali (2008, pp, 72-74) also explains how it is possible to eliminate the two distortions by using an efficient employment subsidy and, ignoring another source of price distortion, proposes that the task of optimal monetary policy is to achieve the state, $M_t = M$; the average mark-up must equal the frictionless mark-up. For in that case there is no incentive for firms to change price and inflation will be zero. Unfortunately there is no mechanism in the model by which the average mark-up can be brought into equality with the frictionless mark-up by monetary policy. To confirm this conclusion consider the following properties of the New Keynesian model.

4 The scientific illusion of the New Keynesian model

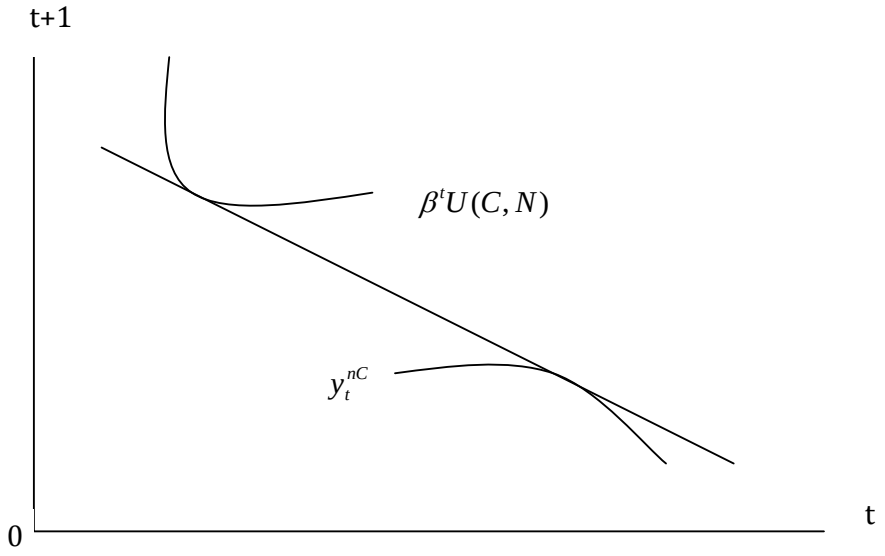
The essential point to be made here is that New Keynesian monetary theory presented by Galí (2008) requires either that we accept that a moneyless model can provide the foundations for a theory of monetary policy, or that money is a friction. Neither of these choices is attractive but these are the only choices available to exponents of attempts to find a role for money in models with Walrasian general equilibrium micro-foundations. The embrace of such micro-foundations by New Keynesian monetary theorists effectively empties their model of all the issues of relevance to policy makers. In addition the New Keynesian model contains numerous logical slips and examples of conceptual dissonance which raise serious doubts about its relevance in numerically

calibrated simulations.[19] The logical slip in Gali's, and all other similar analysis, arises when the money demand equation in expression (5) is added to the model as it perpetuates what Patinkin (1951, 1965) called the invalid classical dichotomy, and it represents an inessential addition to the model in the sense of Hahn (1953, 1965, 1973a,b). This means that money and all nominal magnitudes have no influence on the equilibrium solution to the model – either in the short or the long run. In fact it is not clear what the latter distinction means in the New Keynesian framework.

To make these points consider first that correct interpretation of expression (1). Expression (1) means that a technology exists to which the household can apply labour, which generates disutility, but which transforms present into future consumption. Households compare present with future consumption taking into account the discount rate, which embodies their subjective time preference, and a perfectly competitive inter-temporal market (the Walrasian auction) allows consumers to trade consumption in period t for consumption in period $t + 1$, for all t. The equilibrium solution to the problem in expression (1) to (3) is, of course, nothing more than a description of Fisher's (1907) triple equality that is usually reflected in contemporary dress as the Euler equation. The marginal rate of transformation between present and future consumption is equated with the rate at which consumption can be traded (often mistakenly called the rate of interest) and equated with the marginal rate of substitution between discounted future consumption and present consumption. The model is entirely non-monetary as the assumption of 'perfect competition', the perfect market for inter-temporal trade in consumption goods, is isomorphic with the Walrasian auction - recall Samuelson (1967). The state of the model is illustrated in Figure 1.

[19] Wallace (2001) recently drew attention to the 'hidden inconsistencies' that lurk in wait for the unwary in these models.

Figure 1 The classical (Fisherian) non-monetary solution to Gali's model.



Note: The case illustrated here does not include the 'monetary friction' implied by equation (5). Such a 'monetary friction' is welfare reducing as McCandless (2008) explained. Also note that the productivity shocks fed into equation (8) will cause the optimal solution to oscillate producing the equilibrium 'real business' cycle.

The fact that the nominal rate of interest is an inessential addition to the core Walrasian microfoundations in expressions (1) to (3) then leads to problems with the interpretation of expression (7) - the dynamic IS curve (DIS). The DIS represented by equation (7) states that, given the expected 'output gap' is zero, the actual 'output gap' is a function of the gap between the Fisherian real rate and natural rate of interest. But from the micro-foundations of the model sketched by Gali the 'output gap' is not generated by the interest rate gap but by the interaction between productivity shocks, represented by fluctuations in the natural rate of interest, and the Calvo constraint that prevents firms from responding to the shock and producing the natural level of output. As some firms are always restrained each period under a Calvo constraint this means that even the New Keynesian natural level of output or allocation cannot be achieved. But there is no role for the nominal rate of interest in this process.

Thus the DIS represented by equation (7), which is derived from the optimising behaviour of households via expression (4), is the origin of the inability of monetary policy in the model to achieve the condition, $M_t = M$. The conversion of the equilibrium condition in equation (4) to the 'output gap' form where the 'output gap' is $\bar{y}_t \equiv y_t - y_t^{nNK}$ introduces the Fisherian real rate of interest in equation (7) but carries over the redundant role for the nominal rate of interest from the classical 'monetary' model.[20] *Hence the redundant nominal rate of interest introduced by equation (4) has been incorporated in the DIS but there is nothing in the micro-foundations of the model to explain why anything other than the natural rate is needed*.

The rate of interest that appears in the Euler equation in any Fisherian interpretation of the model is the natural rate – there is no need for a nominal rate or Fisherian real rate as the inflation adjusted nominal rate. The term $i_t - E_t\{\pi_{t+1}\}$ in expression (7) is thus an inessential addition to the model in the sense of Hahn (1973a, b). There is nothing we can say about the equilibrium of the model with this term that could not be said without it. In other words, there is no need for the nominal rate in expression (7) for the same reason that there is no need for expression (5) under the Walrasian or Arrow-Debreu auction that enables us to write expression (1). Making the inessential addition of the nominal rate is the logical flaw that was inherited from the classical 'monetary' model and it is not resolved by introducing sticky nominal prices in the New Keynesian model. This aspect of Galí's story is pure illusion.

To confirm this conclusion note that from expression (8), fluctuations in the natural rate of interest cannot be avoided. When the natural rate changes the average mark-up in the model with binding Calvo constraints will differ from the frictionless mark-up and there is nothing the monetary authority can do about it. The monetary authority can move the nominal rate of interest all over the place but it will not restore the condition, $M_t = M$. In particular the condition $i_t = r_t^n$ does not imply $M_t = M$ as Galí (2008, cha 3 & 4) often suggests when

[20] To derive the DIS equation subtract Gali's (2008, chapter 3) equation (20) from equation (19) and apply the definition of the natural rate.

discussing optimal monetary policy. In a model with active Calvo constraints $M_t \neq M$ under expression (8) and that is the end of the matter. There is nothing monetary policy can do because money and nominal magnitudes have no influence on the real equilibrium solution of the model even when that equilibrium has been distorted by the illicit introduction of price setting agents into a model based on a Walrasian auction. That was the essence of the old classical dichotomy that carries over to the New Keynesian dichotomy.

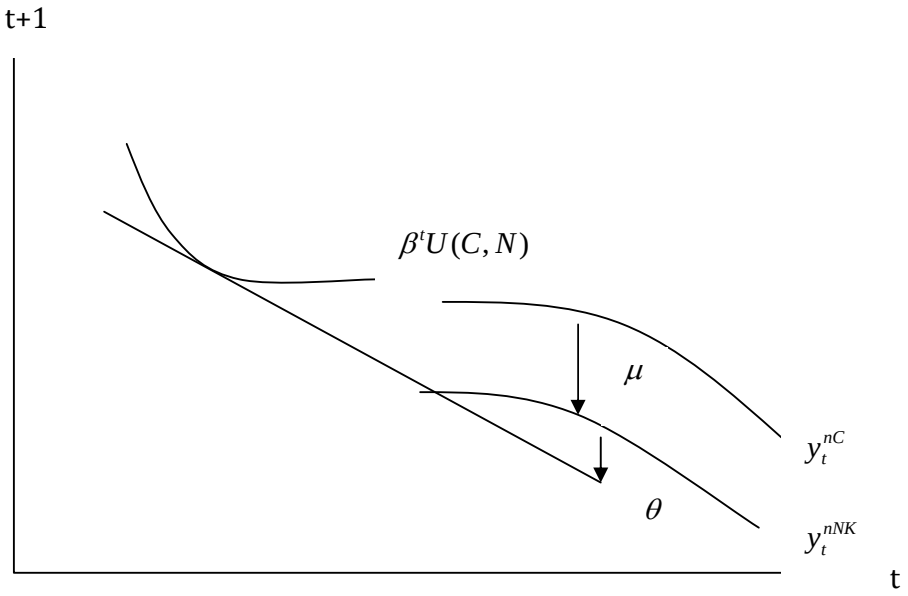
The inability of the nominal rate of interest to influence the average mark–up also means that it cannot influence inflation in the New Keynesian model. Inflation in the New Keynesian 'monetary' model occurs when productivity shocks change the price and output decisions of firms. Gali (2008, p. 44) makes that clear:

"The previous equation makes clear that, in the present setup, inflation results from the fact that firms re-optimizing in any given period choose a price that differs from the economy's average price in the previous period. Hence, and in order to understand the evolution of inflation over time, one needs to analyse the factors underlying the price setting decisions of firms."

The nominal rate of interest does not appear anywhere in Gali's analysis of the price-setting behaviour of firms and therefore can have no influence over inflation in the New Keynesian model.

In view of these properties of the New Keynesian model it makes no sense to claim that monetary policy is non-neutral in the short-run. Money and monetary policy continues to be irrelevant in the model. The imposition of Calvo constraints on agents in an otherwise RBC model results in an inefficient outcome relative to the efficient classical outcome that would occur if these additional and *ad hoc* constraints did not exist. The New Keynesian version of the model is illustrated in Figure 2 where imperfect competition depresses the production transformation curve below that of the classical solution and, in addition, the Calvo constraints on some firms force the model to operate below the New Keynesian production transformation frontier, y_t^{nNK}.

Figure 2 The New Keynesian inefficient allocation outcome.



Note: When $\mu = \theta = 0$ the New Keynesian model reverts to the classical solution illustrated in Figure 1.

Throughout this exercise there is no change to the discount factor or the rate of time preference, ρ so the natural rate as defined by expression (8) remains unaltered.

Therefore, the only way to eliminate inflation in the sticky-price version of the New Keynesian model is to eliminate fluctuations in the natural rate of interest; but this would obviously be incompatible with the RBC core of the model. In addition, the notion of short and long run has no time dimension in a model with Walrasian general equilibrium foundations. In the context of the New Keynesian model the short-run describes the state where Calvo constrains are interacting with fluctuations in the natural rate. There is no long run unless this process of interaction ceases.

To confirm these conclusions from a different angle consider the model in a 'monetary' state where there are no market power or Calvo price-setting distortions; i.e., $\mu = \theta = 0$. If $\theta = 0$ there are no Calvo distortions and all firms can reset their prices and there can be no 'output gap' relative to the New Keynesian 'efficient' allocation, y_t^{nNK} and therefore no inflation in the NKPC equation (1). When $\theta = 0$ it is also apparent that the parameter κ on the 'output gap' is not defined and the NKPC breaks down. If $\mu = 0$ there is no market distortion from market power and the classical efficient allocation results so aggregate level of output is always, y_t^{nC}. See Figure 2. In this case the model collapses back to Figure 1. In either case, moving the nominal rate of interest rate around according to any form of interest rate rule in equation (9) has no impact on this result in the model so it is tempting to describe the interest rate rule as neutral. But this is to confuse neutrality with irrelevance. There is nothing we can say about the real equilibrium of New Keynesian model with money that could not be said about the model without money so nominal interest rate rules are irrelevant; NOT neutral.

On reflection the conclusions reached above are not surprising in view of the *ad hoc* attachment of the money demand equation to the New Keynesian model when it proves convenient. At the moneyless or cashless limit the New Keynesian model collapses to the classical RBC model as the *ad hoc* money demand equation is dropped taking with it all nominal values and the notion of a price level. At least then the model is logically consistent but unfortunately it has nothing to say about monetary theory or policy.

The ironic aspect of the New Keynesian reliance on Walrasian general equilibrium micro-foundations is that they are entirely redundant. There is nothing to stop anyone from simply writing down the model (6) to (9) without any reference to Walrasian microfoundations at all. Phillips and Taylor certainly didn't appeal to Walrasian micro-foundations so there is nothing to stop anyone calibrating and simulating a model just like that outlined in expressions (6) to (9) without any reference to the New Keynesian-Walrasian micro-foundations. There is an interesting question related to 'observational equivalence' here.

5 The failure of the New Keynesian 'approximation theorem'

Perhaps in anticipation of a critique along the lines sketched above, Galí (2008, p. 34) defends the practice of not including money explicitly in the analysis. He argues that in his analysis the *main role* played by money is that of a unit of account and "..that such model economies can be viewed as a limiting case (the cashless limit) of an economy in which money is valued and held by households. Woodford (2003) provides a detailed discussion and forceful defence of that approach".

This defence of the use of moneyless models (the cashless limit) by Woodford is simply crooked thinking as explained by Buiter (1999) and Rogers (2006) and outlined above. Woodford (1997, 1998) gave three reasons why it was sensible to ignore money when writing the Euler equations of which two are worth considering here, see Rogers (2006) for further discussion. Discounting the appeal to authority, Woodford argues that moneyless models are useful when:

(1) analysing an economy with a highly developed financial system, or,

(2) Because the cashless limit is a better reason for excluding money than the use of an additively separable utility function.

Neither reason withstands scrutiny. Reason (1) tacitly assumes that the monetary economy is converging on the moneyless model of the Walrasian auction. Although often expressed this belief is unfounded. The fact that the world is evolving to the use of electronic transfer and smart cards means only that the form of money is evolving; not that it is disappearing. The world is not converging on the properties of the Walrasian or Arrow-Debreu auctions. There is no degree of computing power that can or could acquire the information necessary to replicate a Walrasian or Arrow-Debreu auction. If such capability existed central planning would be a reality. Reason (2) is beside the point because under a Walrasian auction money has no utility in any form of the utility function.

The desire of New Keynesians to abandon the quantity theoretic vision clearly motivated Woodford's (2003, 2007) search for a post monetary-aggregate world.

But by embracing the non-monetary world of the Walrasian or Arrow-Debreu auction New Keynesians have abandoned not only monetary aggregates but monetary theory as well. They have slipped without noticing through the looking glass with Alice.

The New Keynesian blind-spot can also be explained by the failure to see that the cashless limit – the moneyless Walrasian general equilibrium system – cannot be interpreted as the limit of an economy in which money is valued. Take the monetary state of Galí's model. In that state, it was explained previously why money cannot be given any 'value' in the utility function under the Walrasian auction. Alternatively, if expression (5) is attached, money imposes an additional constraint on agents, one not required by the Walrasian auction, so it cannot be valued by households or anyone else. Money has become a friction. How can a friction have value in this context? For 'money' to have value under a Walrasian auction it must be a consumption-good. Thus it is simply incorrect to argue as Galí (2008, p.34) does that the moneyless state of his model is the limit of a model economy in which money has value. The cashless limit is in fact the moneyless Walrasian general equilibrium system that rests on the Walrasian auction that is necessary to write the micro-foundations represented by expression (1) to (3). Such a model exists in a 'space' orthogonal to a monetary economy. *It is not the cashless, mathematical or conceptual limit of a monetary economy.*

Embracing the micro-foundations represented by expressions (1) to (3) means that there is no need to introduce a role for money because all the functions of money are performed by the Walrasian auction. There is no money in Debreu's theory of value or the Arrow-Debreu model because none is required. Unfortunately the Walrasian or Arrow-Debreu auctions cannot be replicated in the real world as everyone concedes. But that also means that models based on those auctions cannot provide the foundations for monetary policy in a monetary economy. Money exists because the Walrasian or Arrow-Debreu auctions do not, Laidler (1990).

6 Concluding remarks

This paper has outlined the consequences for New Keynesian macroeconomics and monetary theory of adopting Walrasian general equilibrium micro-foundations. The same conclusions apply to Walrasian microfoundations in their modern dress as dynamic stochastic general equilibrium models with a real business cycle core onto which some Keynesian distortions have been imposed. But such core RBC models are moneyless models of perfect barter as they all rest on the use of a Walrasian or Arrow-Debreu auction. Hence those who seek the micro-foundations of monetary theory in the moneyless Fisherian or Walrasian traditions face a dilemma. Either the model is logically consistent, but with no foundations for monetary theory, or an inessential monetary component can be 'added to' the real micro-foundations and logical inconsistency results because money has been imposed on a model where it is not required. Many contemporary monetary theorists opt for logical inconsistency.

The New Keynesian monetary model presented by Gali (2008) is an example of the choice for logical inconsistency (but Galí is not alone, there are many others). The New Keynesian model introduces arbitrary and contradictory constraints on firms that forces output to deviate from the efficient intertemporal allocation. Imposing arbitrary constraints on the ability of firms to set prices after they were explicitly introduced into the model to set prices is an example of the sort of inconsistency that results when the monetary sector is simply 'tacked-on' to the real sector of a Walrasian or Fisherian general equilibrium system. Furthermore, the New Keynesian model inevitably creates a New Keynesian version of the classical dichotomy. The relationship between the Fisherian and natural rates of interest cannot generate an 'output gap' as claimed by the dynamic IS equation in the model.

The New Keynesian 'output gap' is better described as an inefficient allocation and is generated in the model when firms face technology shocks that disturb their marginal costs but some are prevented from responding to this shock by changing their prices. The inefficient allocation is a function of the interaction of the natural rate of interest and the Calvo constraints, and is independent of the

nominal interest rate. Firms assumed to be profit maximisers are prevented from so acting by the imposition of an arbitrary Calvo constraint. In this respect the New Keynesian model is reminiscent of Patinkin's attempt to explain involuntary unemployment in a model where the concept is not defined by forcing households off their utility maximising labour supply curves. The only difference in the New Keynesian set-up is that firms, supposedly with some market power, cannot exercise that power and are forced away from their profit maximising price and output.

The logical and conceptual flaws then lead to an incorrect interpretation of the role of monetary policy in the model. Gali claims that in the New Keynesian model monetary policy is non-neutral in the short run and optimal nominal interest rate rules can be found that will ensure that the efficient allocation is attained as the unique equilibrium outcome. These claims are incorrect. Monetary policy is irrelevant to the 'short-run' equilibrium solution to the model irrespective of whether prices are sticky or flexible. Under flexible prices the nominal rate of interest and therefore monetary policy can have no impact on the real equilibrium. Under sticky prices, the Calvo constraint, it is fluctuations in the natural rate, and not the nominal rate of interest, that interacts with the Calvo constraints to cause the inefficient allocation.[21] The nominal rate of interest and the degree of nominal price stickiness have no influence on the natural rate as defined in the model. Consequently the micro-foundations of price stickiness do not support the inclusion of the nominal rate of interest in the dynamic IS equation. The nominal rate of interest is redundant as agents in the model already have access to the Fisherian perfect loan market for intertemporal exchange of consumption bundles at a rate equal to the natural rate. That is a consequence of the Walrasian auction that enables us to write down expressions (1) to (3) and the associated Euler equations. Consequently it is not possible to conclude anything about the properties of nominal interest rate rules in Galí's New Keynesian model. The properties of interest rate rules that do emerge are entirely independent of the Walrasian micro-foundations of the model as a

[21] This is another aspect of New Keynesian analysis that is reminiscent of the Walrasian fix-price models of the 1980s.

consequence of the New Keynesian dichotomy inherited from 'classical' monetary theory.

To avoid the dilemma of classical and New Keynesian 'monetary' theory it is necessary to abandon the dichotomy between the real and monetary sectors. The minimum changes required to take that step are to completely abandon Walrasian micro-foundations and to replace the natural of interest as generated by the RBC model with the Fisherian concept of the rate of return over cost or Keynes's marginal efficiency of capital. As Keynes (1936) noted, that will integrate money as a 'real factor' in the determination of equilibrium and resolve the classical dichotomy. The step will entail redefining the natural rate of interest as an independent forward-looking monetary variable. This approach has several advantages; it avoids the operational limitations that are typical of search theoretic analysis; it avoids the logical inconsistencies that arise from the use of Walrasian micro-foundations; it allows the application of much of the existing analytical technique and it allows for the reconciliation between theorists and practitioners – regulators and central bankers. In short it offers an approach to *aggregate* monetary theory that generalises existing theory and circumvents the inherent logical inconsistencies associated with the classical dichotomy and Walrasian micro-foundations. Those monetary theorists like Woodford (2003, 2007) or Galí (2008) who seek to avoid the use of monetary aggregates by embracing models with a cashless limit, or erecting some Keynesian structure on real business cycle models, succeed only in eliminating money and monetary theory.

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