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The New Keynesian Microfoundation of Macroeconomics

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## Abstract

New Keynesian Macroeconomics (NKM) obeys to the new dogma that macroeconomics should be firmly grounded in First Principles of micro theory. Households are assumed to run an intertemporal optimization calculus with respect to leisure and consumption by making use of perfect financial markets. The supply side is organized so that full employment prevails. Macroeconomic coordination problems between saving and investment are absent. In order to make model predictions more compatible with empirical facts, NKM chooses "ad hoc" microfoundations: utility functions and market structures are designed arbitrarily to allow for persistence of macro variables. NKM's reduced hybrid macro model, with lags and expectational leads, is a useful "work horse", compatible with various micro reasoning. However, NKM's insistence on the representative agent obstructs an understanding of heterogeneous beliefs and learning.

*Keywords:* Representative Agent, Ramsey Saving, Calvo Pricing, Sticky Information, Rational Expectations, Heterogeneous Beliefs

*JEL classification:* B22, E12, E2, E3, E44

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"Macroeconomics is now firmly grounded in the principles of economic theory."

*Varadarajan V. Chari / Patrick J. Kehoe (2006: 3)*

"Modern macro is today an application of micro theory, no different in that respect from labor, IO, international, or public finance. [...] The creation of a micro-foundation for macro means that it is now an applied field, no longer central."

*Daniel S. Hamermesh (2008: 409)*

"If a person has a hammer, everything looks like a nail and if an economist has modern tools, then every issue looks like a chance to apply these tools."

*Mark Blaug (2001: 152)*

## ***Introduction***

New Keynesian Macroeconomics (NKM) have replaced the venerable *IS-LM* model, but also the New Classical streamlining of monetarism. The economic profession thus has reached a "consensus model" that consists of a consumption function, depending on future expected income and the real interest rate; a goods supply function, depending on expected future inflation and the output gap; and an interest-rate reaction function on the part of the central bank, aiming to eliminate inflation and output gaps.<sup>1</sup> The purported strength of NKM is its firm anchoring in micro decisions; competing theories that introduce macro variables without direct derivations from utility maximization are excluded from the Econ Tribe<sup>2</sup> on account of using "ad hoc" theories without "proper microfoundations".

This paper argues that the methodological principles of NKM, which at first glance might appear as neutral with regard to its contents, provide a strong bias in the direction and substance of economic theory. Markets are depicted in a way that rules out the very kind of coordination failures, which called for the invention of macroeconomic analysis in the 1930s. Stabilization policy has to tackle minor shocks in a regime of rigid prices, but financial markets are assumed to work perfectly. Besides the risk of misleading the economic-policy debate, further critical points can be raised:

- NKM's insistence on microfoundations as an indispensable precondition of macro theory is

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<sup>1</sup> A useful representation of NKM on a textbook level is Carlin/Soskice (2006).

<sup>2</sup> A nice picture of this population of economic scientists once was given by Leijonhufvud (1981).

itself but an "ad hoc" axiom that cannot grant any scientific pre-eminence to NKM.

- NKM's reference to microfoundations is opportunistic and hypocritical as suitably modified micro-theoretic elements are chosen afterwards, only to provide a better fit to the facts.
- The presentation of microfoundations is a pointless exercise and hardly adds to a better understanding of macro processes. Economists from various camps can agree on hybrid reduced macro models with lags and expectational leads.
- Whereas NKM's emphasis on the forward-looking character of private expectations has to be accepted without reservation, its basic components, namely the fictitious representative agent and his straightforward optimization calculus, impede an access to the stabilization problem of heterogeneous beliefs.

### ***Roots of New Keynesian Theory***

Actually, Keynes is to blame for all the mess. He bequeathed to the profession a new kind of "macroeconomic" theory, derived from the interaction of goods and money markets, which leads to a quasi-equilibrium with some level of (un-) employment that, strangely enough, would basically not be modified by adding a labour market with *flexible* wages. After all, this was the result of the analysis in Chapter 19 of the "General Theory": changes of nominal wages in a state of unemployment induce adjustment processes with an uncertain overall sign. One is tempted to interpret effective wage rigidity as reflecting some kind of rational expectation on the part of workers with regard to the imponderability and futility of wage reduction in times of crisis.<sup>3</sup> However, after Keynes, linking unemployment to flexible wages and prices appeared unthinkable for the majority of economists<sup>4</sup>, which inevitably made "Keynesian" theory a synonym for fix-price models.

Keynes's message was that essential First Principles of economic theory are suspended most of the time in a market system. Instead of reflecting fully-fledged optima, macro variables were forced to settle at second-best corner solutions. First of all, this holds for prefer-

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<sup>3</sup> "Thus it is fortunate that the workers, though unconsciously, are instinctively more reasonable economists than the classical school, inasmuch as they resist reductions of money-wages" (Keynes 1936: 14).

<sup>4</sup> "In the absence of wage rigidities one must [sic!] start from full employment, and then an increase in money cannot lead to an equilibrium at higher output" (Mayer 1984: 128). Apart from Tobin (1975) and Hahn (1977), few economists insisted on the possibility of involuntary unemployment in spite of flexible wages.

ence-based labour supply. For many people, weighing up consumption and leisure in a given period or in an intertemporal perspective is no relevant topic if the labour market is dominated from the demand side. Another issue is the saving decision. Its importance is diminished, compared to the neoclassical model of intertemporal allocation, firstly because people are constrained to dispose of their life-time income. Secondly, in a monetary economy, a saving decision does not at all comprise a provision of finance for investment.<sup>5</sup>

All this does not mean that considerations on logic and motives of individual behaviour are absent in Keynes's work. According to a widespread saying, 70 % of the "General Theory" consists of micro theory (Kirman 2006): wage claims are viewed from the perspective of *relative* income distribution among wage earners; money demand and investment decisions are said to be strongly biased by subjective assessments of market uncertainty. But all these considerations are more suitable to emphasize perceived market imperfections, than to pave the way to a full-employment equilibrium. Accordingly Keynesianism, as a theory of macro relations, was developed into an approach of demand management where political agencies act as benevolent representatives of individuals, because markets are incapable to transmit and process their preferences.

Since the 1960s, neoclassical monetarism attacked this state of affairs in two ways. Firstly, the starting point of economic-policy considerations tacitly was moved back to full employment: Friedman's "natural" rate of unemployment (and Keynesian policies were presented as if they aimed for over-employment). This was a remarkable, though less discussed, change of view because General Equilibrium Theory had not succeeded to prove the existence and stability of a full-employment equilibrium under non-Walrasian conditions, i.e. in a market transaction system not controlled by the Auctioneer.<sup>6</sup> Secondly, given this new scenario, it was obvious to re-establish the supremacy of the individual agent. As market conditions now

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<sup>5</sup> "The *ex ante* saver has no cash, but it is cash which the *ex ante* investor requires. [...] For 'finance' is essentially a revolving fund. It employs no savings. [...] If there is no change in the liquidity position, the public can save *ex ante* and *ex post* and ex anything else until they are blue in the face, without alleviating the problem in the least – unless, indeed, the result of their effort is to lower the scale of activity to what it was before. This means that, in general, the banks hold the key position in the transition from a lower to a higher scale of activity. [...] There will be always *exactly* enough *ex post* saving to take up the *ex post* investment and so release the finance which the latter had been previously employing. The investment market can become congested through a shortage of cash. It can never be congested through a shortage of saving. This is the most fundamental of my conclusions within this field" (Keynes 1937: 219, 222).

<sup>6</sup> Therefore Hahn (1980; 1982) never tired of accusing Friedman and New Classical Macroeconomics of a lack of seriousness.

appeared better to comply with private interests, the troublemaker role was passed on to the state. Hence, the theory of stabilization policy focused on the task to defend individual welfare against discretionary policy interventions, which were said to have benevolent intentions (possibly), but deplorable outcomes. In the early 1980s, this line of reasoning culminated in the theory of time inconsistency that proposed strong regulations to preclude central banks from following their alleged inclination to run a "surprise inflation".<sup>7</sup>

The following period was marked by a triad in macro theory:

- New Classical Macroeconomics favoured market clearing and rational expectations, i.e. agents are assumed to know and to believe in a simple monetarist macro model, so that predictable policy changes would cause private responses (validating the Lucas Critique). Anticipated monetary impulses cease to have any real impact also in the short run.
- The Theory of Real Business Cycles considered monetary and credit aggregates as endogenous and of limited importance, and propagated the influential image of intertemporally optimizing agents who adapt their paths of employment and consumption to an endless sequence of real shocks; booms and recessions appear as processes in equilibrium that do not need any economic policy control.<sup>8</sup>
- Opposed to these two paradigms, Neo Keynesian contributions emphasized that wage and price setting deviate from the ideal of perfect flexibility for various reasons that are well understood from a microeconomic point of view (menu costs, fairness, hysteresis etc.).

With rigid prices, monetary policy remains powerful also in a neoclassical macro model.

Taylor's (1993) discovery of an interest-rate reaction function, which allowed to grasp the behaviour of many central banks, paved the way for a synthesis of the three aforementioned paradigms: New Keynesian Macroeconomics<sup>9</sup> lends itself to an analytical background for the new consensus in the theory of monetary policy, according to which the main instrument of

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<sup>7</sup> Although awarded the Nobel Prize, this approach was assessed to be a "non-problem in the real word" and "absolute nonsense" on the part of highly-ranked economists with practical central-bank experience (Blinder 1997: 13; Goodhart 2003: 45).

<sup>8</sup> Thus, the Great Depression of the 1930s is viewed as a minor deviation from the Steady State, and, in case of the UK, is described as the labour-supply function merely shifting to the left (for a critique see Pensieroso 2007). Temin (2008: 684) accuses this example of Real Business Cycle theory of suffering from epistemological incompetence, ignorance and inconsistency: "Actors in models have rational expectations, but the economists formulating the rational-expectations models [...] do not. They do not make use of all available knowledge, ignoring the research of economists and economic historians [...]. They also do not make use of the underlying history."

<sup>9</sup> The notion "New Neoclassical Synthesis" (Goodfriend 2002) would give a better fit to the basic ideas, but it is not often used.

central banking is not the quantity of money, but rather the (short term) rate of interest. At first sight, the interest-rate reaction function of the new model emphasizes the practical content of NKM; but the more fundamental reason for presenting central-bank behaviour as changing interest rates, and not quantities of monetary aggregates, is to be found in the neo-classical intertemporal core of NKM. Its basic model does not even contain a quantity of money in any meaningful sense. Market agents react to (relative) price signals, i.e. the real rate of interest, which can be controlled by the central bank, provided that there is some rigidity of inflation.

The theory of Real Business Cycles delivers the basis of NKM, because it embodies in a rigorous way the methodological norm, according to which a macro theory not only should be built from preference-based micro theory, but also should flow directly from an aggregation of individual acts of choice. Besides this axiom of microfoundation, forward-looking expectations give the second constituent of NKM; this serves to grasp, in a precise analytical form, agents' responses to suspected actions of economic-policy institutions. The third element is some nominal price rigidity, which is necessary to preclude that shocks and central-bank interventions do not go beyond mere price effects.

These three components create an image of an economy, which is characterized by a representative household performing an optimization calculus that integrates labour supply, consumption demand and portfolio choice.<sup>10</sup> Minor exogenous shocks, emanating from Mother Nature's throwing a dice, are benevolently stabilized by a central bank that is endowed with the private agents' true preferences. But running any autonomous policy strategies leaves no traces in the economy, because this is neutralized by appropriate responses on the part of private agents who are assumed to be in equilibrium beforehand.<sup>11</sup> Two features of this scenario that are praised also by central banks' staffs give cause for concern:

- "One prime characteristic of such models is the rigorous consideration of the principle that

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<sup>10</sup> Macroeconomics is deduced "from a model in which a single immortal consumer-worker-owner maximizes a perfectly conventional time-additive utility function over an infinite horizon, under perfect foresight or rational expectations, and in an institutional and technological environment that favors universal price-taking behavior. [...] Basically this is the Ramsey model transformed from a normative account of socially optimal growth into a positive story that is supposed to describe day-to-day behavior in a modern industrial capitalist economy. It is taken as an advantage that the same model applies in the short run, the long run, and every run with no awkward shifting of gears" (Sowell 2008: 243).

<sup>11</sup> "In an intertemporal equilibrium, the effects of most expected demand-based policy wash out as individuals adjust their actions to take expected policy into account" (Colander 2006: 6).



the development of the economy as a whole is the result of the actions of its individual decision-makers" (Deutsche Bundesbank 2008: 33). Yes, but what has become of the formerly-taught wisdom that a specific branch of *macro* economics is needed because the performance of an economy *cannot* be explained alone by looking at, and adding up, individual choices?

- "A second major characteristic of DSGE [Dynamic Stochastic General Equilibrium] models is the coherent formulation of the interaction between the individual decision-makers and the economy as a whole" (Deutsche Bundesbank 2008: 34). Yes, but if the market system is conceived of as *coherent* interaction of individual choices, does that rule out the emergence of *involuntary* behaviour by assumption?

Strangely enough, this kind of "macro" modelling nowadays serves to calculate, neatly after starting with the European and US representative agent's utility function, the welfare effects of a co-operation of ECB and Fed, precisely up to several decimal places... (Adjemian et al. 2008)

### ***The Fundamentalist Breaching of the Gap between Micro and Macro***

NKM has not been "discovered", and particularly not by means of testing empirical hypotheses. It has been *constructed*, in order to reach preferred research targets by making use of selected theoretical components. This becomes clear by regarding the element of Calvo Pricing that provides an elegant way of formalizing the desired result of inflation rigidity: Calvo's (1983) model more or less had remained unnoticed for many years, but then it became helpful. Stating the "fabrication" of NKM, however, in no way means to raise a critique; all essential contributions to the history of economic thought were made by *putting up a paradigm* (in rivalry to others). Concomitant theoretical controversies generally cannot be settled by econometric exercises: observations often are compatible with several competing analytical views; moreover, alternative paradigms often exhibit a different conceptional architecture and give qualitatively different predicates.<sup>12</sup>

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<sup>12</sup> "In economics the model is the formal core of a paradigm. [...] Compared to a research practise of putting up and testing empirical hypotheses, the analysis of models allows an explication of the normative essence of economic reasoning. [...] The pioneering steps in the history of economic thought as the foundations of mercantilist, neoclassical or Keynesian theory, and also the corresponding research on detailed topics, do not rest on the falsification of some hypotheses, rather they flow from reflecting the socio-economic relevance of the models' premises. [...] The postulate of falsification therefore remained a mere verbalism without significant impact on the main lines of research" (Riese 1975: 38-9, 29, my translation; cf. Summers 1992).

*Internal consistency* of a paradigm, i.e. the analytical compatibility of its components and their correspondence with its key principles of discovering knowledge, thus is more important than its *external consistency*, i.e. the correspondence of single hypotheses with the data. "Under this view, a model that is internally inconsistent is simply incorrect (and should be rejected), while a model that is externally inconsistent can be tolerated, at least until a better model is found." Wren-Lewis (2007: 49) states this principle, however, with a critical intention; he complains about the "imperialistic" practise of NKM adherents, who now represent the mainstream of economics, to exclude contributions from further debate, which differ in contents, style and jargon from the currently fashionable story of the optimizing agent. Particularly younger fellows of the scientific community, behaving like Iranian custodians of revolution, are said to keep an eye on the desired "purity" of published papers in the Journals' review procedures. Already in the early 1990s, Blanchard (1992: 126) criticized "the quasi-religious insistence on micro foundations", by which adherents of competing theories were branded as heretics.

Wren-Lewis (2007) and Blanchard (2008a) point to the striking similarities of the structure of NKM papers, in which well-known model equations pedantically are derived from First Principles although this has been carried out times before in already published work. Perhaps this is useful for checking the papers' internal consistency more easily; but probably Solow's presumption of an obsessive conformism captures the core of the matter.<sup>13</sup> This has a strong resemblance to the uniform pattern of Marxist papers in the 1970s where even studies tackling practical questions were to be built from a Hegel-like spiel of deriving the categories commodity, labour, capital, exploitation etc., in order to prove the writer's affiliation to one of the various left-wing scientific camps.

The new fundamentalism calls for a substantial consistency and methodological equivalence of different types of economic models (Woodford 2008a): labour supply and portfolio choice, business cycles and growth, production and trade etc. At first sight, this imperative

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<sup>13</sup> "Something is being put over on us, by ourselves. Why do so many of those research papers begin with a bow to the Ramsey model and cling to the basic outline? [...] The bow to the Ramsey model is like wearing the school colors or singing the Notre Dame fight song: a harmless way of providing some apparent intellectual unity, and maybe even a minimal commonality of approach. That seems hardly worthy of grown-ups, especially because there is always a danger that some of the in-group come to believe the slogans, and it distorts their work. [...] There has always been a purist streak in economics that wants everything to follow neatly from greed, rationality, and equilibrium, with no ifs, ands, or buts. [...] The theory is neat, learnable, not terribly difficult, but just technical enough to feel like 'science'" (Solow 2008: 244-5).

appears reasonable (particularly for any layman). In post-classical history of economic thought however, two schisms had come up:

- The method of analysis can be partial or general, i.e. consequences of individual decisions on the system of all markets (and corresponding repercussions on the individual agent) can be excluded or explicitly included.
- The content of analysis can be a single topic within a household, firm or market, or may address the economy as a whole (micro vs. macro).

*The Two Schisms in Economics*

<i>topic</i>	<i>method</i>	<i>general</i>	
		<i>n agents</i>	<i>representative agent</i>
<i>micro</i>	Marshall	Walras	Woodford
<i>macro</i>	$C(Y)$	$IS-LM$	NKM

Marshall focused on partial-equilibrium analysis and was very cautious when it came to draw conclusions for general equilibrium. Walras aimed at an image of interdependence between all agents, but the execution of this general-equilibrium analysis for a long time seemed to be an insoluble calculation task. With the Keynesian Revolution, functional relationships like the consumption function, built on simple behavioural assumptions, were taken as basic components for a theory of macro equilibrium analysis. Hicks (1937) offered a Walrasian interpretation of the  $IS-LM$  model, emphasizing the consistent relations between the number of markets and endogenous variables.<sup>14</sup> This helped to enhance the overall acceptance of this model, which was also used by monetarists and New Classicals. This in turn was irritating in the view of Hahn (1980a: 5), because the  $IS-LM$  model emphasizes current income and suppresses the individuals' intertemporal optimization. "Behind the  $IS-LM$  story there must be a

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<sup>14</sup> Taking up this bow to Walras, Clower later laid the foundations of his theory of rationing. If the Auctioneer is absent, transactions may occur at false, i.e. non-equilibrium, prices. As a consequence, agents at the "long" side of markets suffer income losses that spread through the whole economy and may stabilize a low-employment equilibrium. However, this approach did not catch on because it failed to offer systematic reasons for price rigidities and to clarify the relationships between goods and asset markets. "If Clower wishes to buy Champaign, he is able to signal this to Champaign producers by buying on the basis of a consumer credit, which is paid off by increasing his labour effort afterwards" (Streibler 1983: 464, my translation).

non-Walrasian story of thwarted actions."

It is exactly at this junction where NKM takes great pains to derive goods demand from a fully-fledged model that shows the optimal distribution of individual life saving over time. The trick that allows to pass – or better: eliminate – the frontier between micro and macro consists in creating a representative agent, the actions of which coincide with market movements. Whereas the variables in *IS-LM* depict an (average) group behaviour, with only vague hints to microeconomic decision foundations that also do not have to be uniform, the NKM model is consistent, simply because micro and macro levels coincide. This appears to be a remarkably elegant solution of the micro-macro schism, particularly as the recently suggested alternative of Agent Based Computational Economics, namely starting from empirical behaviour of all  $n$  individuals and working one's way through highly complex, non-linear math towards the macroeconomy (Colander et al. 2008), does not look too attractive.

### ***The Economics of the Representative Ramsey Saver***

The architecture of NKM restores the supremacy of the "homo oeconomicus" that had been undermined during the interregnum of autonomous macro theory. Many critics, professional and others, had felt and expressed unease with regard to that famous figure before. Repeatedly it was argued that the assumption of strict rational utility maximization seemed to be at odds with other social-science findings about actual economic behaviour of human beings (Rothschild 1988). Recently, the new branch of experimental economic research has extended this critique by undertaking explorations into the field of "neuro economics" (i.e. studies of human brains during times of decision making).

The justification of this line of critique and the fruitfulness of these new research approaches is questionable. Their background is given by the premise that the subject of economic science is the "economic behaviour of human beings". Maybe this is a misunderstanding: economics is no behavioural science, but rather a discipline that studies the functioning of a specific social *system*, in which market laws determine the scope of individual actions and the movement of macro aggregates. Economics achieves its independence and demarcation in opposition to sociology and psychology by endowing artificial agents, living within models, with a very simple utility function.<sup>15</sup> The only task of the latter is to create sufficient

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<sup>15</sup> "The assumption that humans are driven by greed is a very simplifying assumption. But it works very well. For instance the symmetry of the substitution effects and the possibility of distinguishing the substitution effect from the income effect are interesting outcomes of the analysis. But it is true

energy of motion to make models "live" so that they can be compared with each other. If a particular phenomenon is to be explained, e.g. temporary occurrence of asset-price bubbles, it is the very research programme of economics, not to look for changes in the people's minds and preferences (although not denying that these may occur), but rather to explore changes in market conditions that let prices explode in specific circumstances. The mark of quality and the criterion of scientific progress is the models' ability to replicate patterns of economic experience by means of theoretical reasoning.

The standard reproach of modern neoclassical theory, raised against approaches that lack a "proper microfoundation", is that the latter employ mere "ad hoc" assumptions on the behaviour of market agents. Colander et al. (2008: 236) turn this reproach back against its creators: "Nothing could be more ad hoc than the standard microfoundations." The idea of utility maximization is a presupposed axiom, gained from introspection, but not from empirical research. But it is precisely for this reason that the claim, propagated by Colander and many others, that novel behaviouristic findings ought to be used to modify these old axioms, clutches at thin air: non-empirical predicates cannot be countered by means of observed experience. To come to the point at issue: if actual consumption and saving behaviour fails to meet the predicted pattern of intertemporal optimization, i.e. reacts "too strong" in relation to current income (Akerlof 2007), this does not necessarily imply that individuals prefer a less rational allocation of their life-time income.<sup>16</sup>

The crucial point however is: market conditions, which are presupposed in the model of intertemporal choice, are not given in reality. Distributing consumption optimally over time depends on the possibility of individuals to lend money on their permanent income, if temporary periods of low market income are to be bridged. Because this perfect financial market does not exist<sup>17</sup>, consumption behaviour necessarily depends strongly on current income. Consum-

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of course that we get a characterisation of human agency that is not descriptive of any particular person's behaviour. But it is a very good theory, because it is useful. I am not saying that this is what happens in the world. But I am saying that it is a very good assumption because it allows us to get on this job" (Hahn 2005; cf. Stigler/Becker 1977).

<sup>16</sup> A further example of alleged low rationality is the hypothesis of money illusion, which seems to follow from the fact that workers show less resistance to real-wage losses resulting from inflation, compared to the case of personal (nominal) wage reductions (at constant prices). But this does not prove any lack of rationality. In the second case, real-wage lowering is accompanied by a direct signal on the part of the employer that the worker and his peer group might interpret as a judgement about the worker's individual qualification and performance; such a judgement impairs his personal welfare and his market position.

<sup>17</sup> "This assumption, of complete financial markets, lends itself admirably to the construction of solu-

ers know that their future expected income is distorted by spells of unemployment, the occurrence of which is hard to predict though; these quantity constraints are important also for firms (Arrow 1978).

Obviously, professional modern economics suffer from schizophrenia as in the field of financial-market economics all these deviations from the utopian ideal market are well known (information asymmetries etc.), which are stubbornly ignored when it comes to talk about macroeconomics in NKM. The assumption of complete markets means that all agents' intertemporal budget constraints always are satisfied, bankruptcies and insolvency are impossible. The NKM world is populated by agents "who *never* default. This latter (nonsensical) assumption goes under the jargon term as the transversality condition. This makes *all* agents perfectly creditworthy. Over any horizon there is only one interest rate facing *all* agents, i.e. no risk premia. All transactions can be undertaken in capital markets; there is no role for banks. Since all IOUs are perfectly credit-worthy, there is no need for money" (Goodhart 2008: 13). Basically, NKM designs a non-monetary economy.<sup>18</sup> Asset prices are governed by fundamentals and – although drawing their market value from an infinite time horizon – are not prone to speculative manias and unfounded expectations, as if a "friendly auctioneer at the end of time" guarantees terminal boundary conditions. Buiter (2009) thus concludes that models with this features "are not models of decentralised market economies, but models of a centrally planned economy". Questions regarding financial instability cannot be answered within this models, they cannot even be asked.<sup>19</sup>

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ble models with 'rigorous' micro-foundations of optimisation within a general equilibrium system. The problem, of course, is that the assumption has no connection with the real world" (Goodhart 2007: 19).

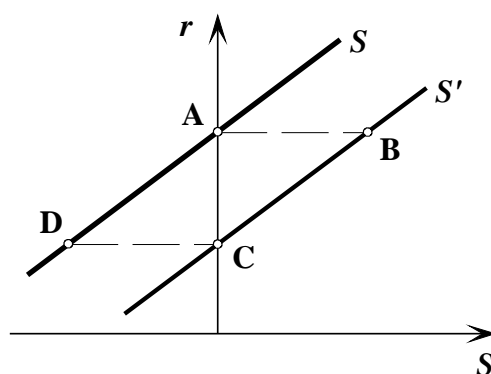
<sup>18</sup> This conclusion also might be drawn from an inspection of Woodford's (2003) vision of a "cashless society" (McCallum 2005; Boianovsky/Trautwein 2006; Spahn 2009).

<sup>19</sup> Whereas Woodford (2008a) happily proclaims that policy makers refer to modern, i.e. micro-founded NKM theory when explaining decisions, Buiter (2009) unveils that central banks during the recent turmoil could not find any useful support from highly-trained young economists. "The typical graduate macroeconomics and monetary economics training received at Anglo-American universities during the past 30 years or so, may have set back by decades serious investigations of aggregate economic behaviour and economic policy-relevant understanding. [...] Most mainstream macroeconomic theoretical innovations since the 1970s (the New Classical rational expectations [...] and the New Keynesian theorizing [...]) have turned out to be self-referential, inward-looking distractions at best. Research tended to be motivated by the internal logic, intellectual sunk capital and esthetic puzzles of established research programmes rather than by a powerful desire to understand how the economy works – let alone how the economy works during times of stress and financial instability."

It has to be conceded that also *IS-LM* is a fair-weather model as it does not deal with defaults and bankruptcies; but it offered a simple way of analyzing the macro consequences of, say, an increased liquidity preference on the part of individual agents in times of financial stress by shifting the *LM* curve. In NKM, this cannot be simply replicated. The basic point is not that one has to work through all the corresponding microfoundations first, rather, it makes hardly any sense to model a spell of liquidity preference in the basic framework of the representative-consumer economy. The preference for liquidity can only arise in an interactive transaction system with uncertain payment flows. The perception that decisions of other market agents might impose constraints on one's own future room for manoeuvre leads to a – at times very volatile – demand for financial assets, including money, used as buffer stocks.<sup>20</sup>

In its basic version, NKM does not reach a degree of complexity where liquidity problems occur: *one* all-embracing agent consumes a bundle of differentiated goods produced under conditions of monopolistic competition. Disregarding optimal Ramsey growth, net investment and net saving are zero in equilibrium. The per-period saving function shifts due to expectational or other shocks ( $S \rightarrow S'$  or  $S' \rightarrow S$ ), causing excess supply or demand on the goods market (AB or CD, respectively). Central banks seek to compensate shock-induced by interest-rate-induced changes of saving, aiming to keep  $S = 0$ .

*Goods Market and Saving in NKM*



There is no finance involved in the process. Interest-rate policies work by changing incentives. Often, the production function contains only labour input (Goodfriend 2002). Then the

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<sup>20</sup> "The knowledge that the outcome of individual action depends upon the actions taken by others and is by them has important repercussions on individual behavior itself. Individuals prepare in advance [by demanding liquid assets] for the likelihood of making forecasting errors and consequently of making decisions later revealed as suboptimal" (Streibler 1977: 120).

NKM story can best be understood as picturing a "service" economy without capital, where output cannot be stored. In the limit, if the representative agent is conceived to consist of singles who share the same utility function, we arrive at a "no-trade system" where each individual owns its firm and consumes its own product; it is the world of Say's Law (Arestis/Sawyer 2008). The economic problem left is the optimal reaction to minor shocks, but not to cope with large-scale coordination failures. "What makes macroeconomics a separate field of study is the complex properties of aggregate behavior that emerges from the interaction among subjects. Since in a complex system aggregate behavior cannot be deduced from an analysis of individuals alone, representative-agent models fail to address the most basic questions of macroeconomics" (Colander et al. 2008: 236).

NKM faces an uncomfortable trade-off. On the one hand, General Equilibrium Theory has shown that preferences and behaviour of heterogeneous agents cannot simply be aggregated. Variances between individuals matter! The Sonnenschein-Mantel-Debreu problem states that choices may not be transitive; the representative agent's ranking differs from individual rankings; reactions to shock may be different (Streißler 1977; Kirman 1992). On the other hand, if people are assumed to be identical, NKM may keep the representative agent, but as a consequence the model has no interaction of agents, no distribution problems, no asymmetric information and no meaningful stock market.<sup>21</sup>

The critique so far may appear as unfair as it neglects the various refinements that were proposed in order to develop and improve the basic model set-up. One line of research is to add "financial frictions". Canzoneri et al. (2008) let households finance a long-term consumption good by way of periodical loans from banks, and attach liquidity premia to bank deposits and even government bonds; but simulation results are "remarkably similar" to Woodford's (2003) no-bank model. Cúrdia and Woodford (2008) introduce different types of households and consumption loans between them. Neither of these approaches however allows for any crucial income risk on the part of households, as it would arise from downgrading the market relevance of permanent income and from letting investment-saving imbalances determine current income.<sup>22</sup> Hence, these extensions of NKM – due to the Walrasian method – yield many

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<sup>21</sup> "I have no objection to the assumption, at least as a first approximation, that individual agents optimize as best they can. That does not imply – or even suggest – that the whole economy acts like a single optimizer under the simplest possible constraints. So in what sense is this 'dynamic stochastic general equilibrium' model firmly grounded in the principles of economic theory?" (Solow 2008: 244)

<sup>22</sup> Blanchard (2008b) resumes in a critical comment: Cúrdia and Woodford "focus on intermediation



precisely-looking results, as, e.g., the amount of labour time that households devote to the production of banking services (Goodfriend/McCallum 2007), but do not grasp the impact of bank credit on goods demand, market income and employment in a typical monetary economy.

### ***The Supply Side: Firms as the Households' Servants***

The model builders' intention to preserve the dominant market position of the representative household is also felt on the supply side of NKM. Here, the first question is how to explain a less-than-perfect flexibility of prices. "Nominal rigidities matter" (Blanchard 2008a: 5). In general, the debate on this issue serves to describe a market economy as a *deviation* from a hypothetical auction-type market order where prices adjust with infinite velocity – because the process of production is interrupted during auctions.

The more natural alternative is to view production and consumption as a process in historical, instead of logical, time (Kahn 1977; Robinson 1980); then it appears likewise more natural that prices and, in particular, wages are kept fixed for certain time intervals, in order to reduce transaction costs and to render economic relations – for households, within firms and partial markets – more calculable. Nominal and real spheres of economic life cannot be disentangled. Rigidity of wages and/or prices is endogenously determined and does not necessarily indicate inefficiency or market failure (Hahn 1980b; Solow 1980).

The key point is: there would have been lots of microeconomic reasons for sticking to the traditional approach in macro theory where nominal wages adjust periodically and prices are free to move in principle, but actually behave also sluggishly because unit labour costs are stable. With fixed nominal wages, firms adjust to changing market conditions by varying employment. This implies involuntary unemployment<sup>23</sup> on the part of the single worker (al-

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between households, rather than between households and firms. Thus, a failure of intermediation makes some households consume more and work less, others consume less and work more. There is no direct effect on production. It is clear, however, that much intermediation is between households and firms. Suppose that production takes time, and firms need to borrow in order to buy inputs. Then less intermediation directly translates into less production. Or suppose, more conventionally, that financial intermediation is between saving and investment. Then, less intermediation implies less investment today, and thus less production in the future. In both cases, we are not talking about the net outcome of distribution effects, but with a direct effect on production. Can these effects be large? I suspect they can be."

<sup>23</sup> One caveat should not go unnoticed: additional arguments (e.g. heterogeneous workers) are needed to make a variation of the number of employees a more efficient adjustment compared to a variation of working hours.

though his union voluntarily has signed the fixed-wage contract).

But such a state of affairs would have seriously undermined the alleged market position of the representative agent. What is the use of all these Euler Equations if agents cannot avoid being *off* their labour supply curve from time to time? If the optimization logic of the simultaneous choices between labour and leisure, on the one hand, and consumption today and tomorrow, on the other, is to be maintained, a state of full employment should prevail. Therefore nominal wages have to be assumed to be flexible, which leads to the "striking (and unpleasant) characteristic of the basic NK model [...] that there is no unemployment! Movements take place along a labor supply curve" (Blanchard 2008a: 12). Accordingly, prices have to be assumed to move more sluggishly compared to nominal wages, so that the real wage varies positively with effective employment.<sup>24</sup>

In case of a negative demand shock, the wage bill shrinks, but due to constant prices, profit per unit of output is increased. If the profit mark-up is interpreted as a tax driving a wedge between consumption prices and marginal costs, and between labour's marginal product and the real wage, it is easy to understand that a shock-induced higher mark-up causes consumption and labour supply to fall (Goodfriend 2002). Keeping in mind that firms are owned by the representative household, lower wage income is cushioned somewhat<sup>25</sup> by distributed "taxes", i.e. profits – and thus the consequences of a demand shock appear tolerable because NKM generously ignores distributional issues.

The justification of assuming inflation rigidity is somewhat more subtle. A simple reference to menu costs surely would not have met the high-brow analytical standards of NKM. Instead, again a combination of Mother Nature and an optimization calculus (Calvo 1983) looks much more promising. The core idea, according to which ever-changing conditions of competition on the goods market open up opportunities for changing prices on a random basis, sounds convincing in itself. Firms calculate optimal prices, given the degree of competition and the strength of demand. But when setting prices, they have to take into account that prices cannot be changed in the future at will; one has to wait for the occurrence of a convenient market opportunity – this is the Sticky Price theory of the NKM model.

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<sup>24</sup> The implicit full-employment assumption of NKM also sheds some light on its dubious welfare-theoretic recommendations: "Social welfare functions tend to share the characteristic that inflation dominates the output gap in importance. However, this may not be surprising, given that nearly all micro-founded models ignore unemployment" (Wren-Lewis 2007: 52).

<sup>25</sup> With lower output, of course, the sign of the variation of total profits is uncertain. But profit income undoubtedly act as a stabilizing factor.

A minor question comes up in the case of positive trend inflation. The literature says that "firms are not allowed to change their prices unless they receive a random 'price-change signal'. [...] Prices of firms that do not receive a price signal are indexed to last period's inflation rate" (Smets/Wouters 2003: 1133; cf. Woodford 2008b). But even "indexing" also necessitates to change a price on the market, which is not allowed by assumption. Why, given trend inflation of 3 %, should a firm be restricted to increase its price by 2 %, if that was calculated to be the optimal step? Also the general message of the model: changes in macro activity during the cycle come about by firms being forced to adjust their profit margins, does not sound like a First Principle behaviour. After all, unfavourable conditions to change prices from the perspective of the goods market are as bad for profits as internal wage pressure; hence it is a *decision* to refrain from changing prices – it is not prohibited by Mother Nature.

Therefore, it is questionable whether the Calvo constraint to adjust prices really is compatible with the general flavour of NKM. The new Phillips Curve shifts the reason of less-than-perfect monetary neutrality simply into some unexplained market constraints on price setting, but fails to recognize that these are also endogenous. "It is clear [...] that such a restriction comes from outside the logic of the model. In a world where everybody understands the model and each other's rationality, agents would want to go immediately to the optimal plan using the optimal price. They would not want to accept such a restriction" (De Grauwe 2008: 34; cf. Sims 2008). What is startling also, is the conspicuous contrast between the "divine" character of the perfect financial market and the "realistic" description of the monopolistic goods market. There are also microfoundations available to have it the other way round. In other words: the choice of microfoundations in NKM is "ad hoc". "Adding some realistic frictions does not make it any more plausible that an observed economy is acting out the desires of a single, consistent, forward-looking intelligence" (Solow 2008: 243).

### ***Calibrating NKM's Microfoundations: "The Stories We Tell..."***

Actually, there is a lot of persistence in output and inflation, which cannot easily be reproduced by NKM. The basic model is "wildly counterfactual" (Mankiw 2001) because it predicts a boom in times of disinflation.<sup>26</sup> What is to be done if macro data unanimously show a

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<sup>26</sup> "The first two equations of the [NK] model are patently false (more obviously so than those in the more loosely specified IS-LM model)... The aggregate demand equation ignores the existence of investment, and relies on an intertemporal substitution effect in response to the interest rate, which is hard to detect in the data on consumers. The inflation equation implies a purely forward looking behavior of inflation, which again appears strongly at odds with the data" (Blanchard 2008a: 9; cf.

pattern that is not compatible with NKM's prediction? Fortunately, this lack of external compatibility can conveniently be overcome by adding further doses of appropriately-chosen microfoundations. Again, the choice of central-bank staff's wording unmasks an opportunistic dealing with First Principles: "The inclusion of various types of market frictions and inertia [...] have proved to be necessary [!] so that the empirically observed relationships and actual developments of the time series can be better replicated with the DSGE models. Lagged adjustments are especially necessary in order to be able to give a realistic description of the observed behaviour of prices, consumption and investment" (Deutsche Bundesbank 2008: 35). In order to give some "deep" foundation of these lagged adjustments, an operation on the representative agent's utility function turns out to be unavoidable: "It is assumed that households have a propensity not to let their consumption fluctuate too much after changes in income (the 'habit persistence' hypothesis). This assumption ensures [!] that the comparatively low level of volatility in consumption observed in the empirical time series can be captured by the model" (ibid. 38).

This kind of argumentation illuminates that microfoundation in practical research boils down to attaching some appropriate preference-theoretic phrases *ex post*, aiming to enhance the scientific status of the model. Hence, the researcher does not simply allow for persistent demand shocks of whatever source, rather he assumes "that the preference shock [!] follows a first-order autoregressive process to represent the persistence in the data" (ibid. 37). With respect to the necessity of any useful model to show persistence in its basic variables, two points should be made here. One is that critics feel uneasy about the high importance of persistent shocks in NKM; they explain "too much" in an otherwise equilibrium-biased model. Fuhrer (2004) once resumed: it is like "adding epicycles to a dead model".

The second point is that NKM fails to give hysteresis effects a more prominent status. This is astonishing because in the more elaborate versions of NKM, which include investment and the capital stock, it is evident that shocks and monetary-policy reactions, by their impact on the supply side, leave persistent and maybe also permanent traces in the path of the economy, which also changes the equilibrium real rate of interest.<sup>27</sup> This recognition verifies that "present policies may irreversibly alter the future" (Arrow 1978: 166; cf. Lavoie 2004), but em-

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Ball 2005).

<sup>27</sup> "The equilibrium rate of return under flexible prices is no longer a function solely of current and expected future disturbances, but depends as well upon the capital stock, which is now an endogenous state variable (and so a function of past monetary policy [!], among other things, when prices are sticky" (Woodford 2003: 372; cf. Woodford 2008a).

phasizing that superneutrality of money is not given does not seem to correspond to the ideological outlook of NKM.

The practise of adding appropriate microfoundations to a beforehand chosen set of macro equations finally lends support to the heretical idea that the quarrels about preferences and First Principles simply might be superfluous. There is no need to embark on knotty epistemological questions whether it is mandatory to "reduce" economic phenomena; and whether this reduction must be downwards (from macro to micro) or upwards (from micro to macro). It suffices to acknowledge that a majority of economists today is ready to agree on a three-equation "work horse" macro model with lags and expectational leads. The "stories" that are told in order to depict this model differ, and so do the derivations undertaken to obtain it (and they may even be not existent<sup>28</sup>); but finally we end at the (empirical) question of giving numbers to the relative weights of these lags and leads. There are *many* reason for lags, e.g. transaction costs, learning, or slowly changing preferences; researchers should not be obliged to agree to a single one and to reproduce the utility-maximization exercise as an intro to each macro paper. The economics of research ought to obey to Occam's Razor: the principle to keep models as simple as possible (Streißler 1977; Krugman 2000; Blanchard 2008a).

### ***Rational Economists and Uninformed Agents?***

The consensus among economists also embraces the understanding that market agents build forward-looking expectations (that is what economics is all about), and this includes reactions to expected behaviour of policy institutions. Controversies revolve around the question how "rational" these expectations are. Any discussion of that issue should recall that, in a Walrasian-type General Equilibrium world, the only knowledge heterogeneous agents should have is the information about the vector of those prices that are relevant for their own individual economic plans. But after the dismissal of the Auctioneer, economic theory set out to transfer His all-embracing knowledge into the minds of individual market agents – at least, that was meant to be the criterion of rationality.

In imperfect markets, much more than just price information is needed for building expectations. A rational image of the economy implies and requires assumptions about how people

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<sup>28</sup> "Good science need not always be built up from solid microfoundations. Thermodynamics and chemistry, for example, have done pretty well without much micro theory. Boyle's Law applies directly to aggregates, much like the marginal propensity to consume. And the microfoundations of medicine are often very poor; yet much of it works. Empirical regularities that are formulated and tested directly at the macro level do have a place in science" (Blinder 1987: 135).

think about markets and models. Using all relevant information does not generally suffice to yield neoclassical results; it is also necessary that individuals assume that others behave accordingly. But do people really understand the kind of market(s) they are acting in? Indeed, if the world is as simple as the basic New Classical model once depicted – an expectation-enhanced Phillips Curve and the Quantity Equation – it is straightforward to claim that individuals quickly understand that inflation is pinned down by money growth and output does not diverge from the natural rate.

If the macro model is more complicated or, even worse, if competing models are available, the assumption that agents build "rational", i.e. model-consistent expectations, becomes ambiguous. One cannot but confirm Woodford's (2008a) dictum that it is essential to model expectations as endogenous (otherwise the agents' behaviour would be separated from their thinking) – but endogenous to what view of the world? The NKM image of households and firms, all being endowed with NKM theorists' view, is as naive as the former idea in the rational-expectations debate that differing beliefs about the economy among individuals over time, in a competitive struggle of survival of the fittest, would converge to the "one and only" theory – which at that time was the New Classical paradigm.

DSGE models make very strong assumptions about cognitive abilities of agents in understanding the underlying NKM model. The representative-agent model assumes a market order through choices of an omniscient agent. But the enduring debates about scientific fads and fashions in economics point to the fact that neither researchers nor agents might know the truth. "If we cannot assume that economists understand the economy, we cannot assume that agents understand the economy" (Colander 2006: 9; cf. Kirman 1992). To put it more moderately: the topic of uncertainty now is a key ingredient in any modern theory of monetary policy; but if it is admitted that central banks suffer from model uncertainty, we cannot keep the assumption that individual agents have a correct image of the true laws of the market.

In a critical review of the rational-expectations paradigm, Arrow (1978: 160) rightly cast doubt on its implicit hypothesis that "economic agents are required to be superior statisticians, capable of analyzing the future general equilibria of the economy". He also hinted to the fact that it is not a less-than-perfect mental ability of market agents as such, which might pose a problem; rather, the creation of expectations essentially is a decentralized process that does not lead to a homogenous stock of knowledge shared by all people. Therefore Arrow (1978: 164-5) disagreed "with the widely accepted proposition that econometric models should have expectations consistent with them. [...] It is the essence of the decentralized economy that individuals have different information. [...] Each agent ought rationally to base his anticipations

on all the information at his disposal and this may include a great many facts and observations not available to others. [...] Thus the anticipations of the different economic agents are not only not based on the same general economic model but they should in general differ considerably from each other."

Only if one conceives of a market economy as being populated by a representative agent, homogenous expectations might appear as a reasonable idea. A market society however is not only characterized by a division of labour, but also by a division of knowledge. As Hayek wrote long ago, one of the main functions of markets is gathering and creating information that single men do not have.<sup>29</sup> Models that stick to the fictitious representative agent rule out by assumption that people learn from each other and change their views in an evolutionary process of interaction. Beliefs are changing whenever new experience comes up, when individuals are confronted with new opinions, new market behaviour (shocks) or new policies. Finally, it is a myth that so-called "deep" parameters like time preference or market structures are invariant to policy moves.

Any theory of expectation that is set up to be incorporated into a macro model therefore should start with the twofold recognition that agents are heterogeneous with differing beliefs (Solow 2008) and that information-processing ability is scarce (Arrow 1978). Both items are jointly applied, e.g., in De Grauwe's (2008) model where two groups of agents, optimists and pessimists, employ simple rules of thumb to forecast inflation and output; these heuristics are adjusted according to their success in the past, making the weight of differing beliefs vary during the cycle, which emerges endogenously from the model's market forces.

In the Learning literature, market agents use more elaborate (econometric) ways of improving their view of the market process. The aim of producing persistence in an otherwise standard NKM model can be achieved by allowing that agents suffer from parameter uncertainty and continuously update their subjective estimate of function parameters by reacting to empirical evidence (Milani 2007). This route surely appears more convincing, compared to

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<sup>29</sup> "The peculiar character of the problem of a rational economic order is determined precisely by the fact that the knowledge of the circumstances of which we must make use never exists in concentrated or integrated form, but solely as the dispersed bits of incomplete and frequently contradictory knowledge which all the separate individuals possess. The economic problem of society is thus not merely a problem of how to allocate 'given' resources – if 'given' is taken to mean given to a single mind which deliberately solves the problem set by these 'data'. It is rather a problem of how to secure the best use of resources known to any of the members of society, for ends whose relative importance only these individuals know. Or, to put it briefly, it is a problem of the utilization of knowledge not given to anyone in its totality" (Hayek 1945: 519-20).

the above-mentioned exercise of introducing a habit-persistence hypothesis into the utility-theoretic framework, because it works without doses of questionable economic "psychology". The drawback of the adaptive-expectations approach is that individuals mostly are assumed to know the structure of the correct model of the world.<sup>30</sup>

A more promising idea is propagated by the Sticky Information approach where firms and households, although endowed with plenty of economic data, do not share a common *understanding* of the market process. Agents have different probability distributions of states of the world, and they differ in their ability to process information flows. This should not be read as an excursion to behavioural economics: individuals are not characterized by "bounded rationality", rather, they try to achieve decisions that are as rational as possible, but they are aware of various internal or external restrictions that preclude the attainment of "true knowledge".

It is important to notice that these limitations, at least in part, are endogenous. Agents filter data dependent of subjective wants; and they know that market signals cannot be observed without error. As a consequence, they *choose* the amount and direction of information-gathering activities. This includes the phenomenon of "rational inattention": people do no longer pay attention to institutions that do a good job, or to variables that have not moved too much in the past (Sims 2003; 2008). The Sticky Information theory thus delivers, compared to the Sticky Price story, a more conclusive explanation of inflation persistence. There are no external restrictions to set optimal prices, rather, firms assess the performance of their former expectations of today's events before they decide to take on a new look on the overall market situation. Only news and shocks that exceed certain thresholds induce fundamental supply-side adjustments. "For most people, it is easy to find out what the monetary authority is doing, but it is much harder to figure out what it means. [...] The real cost is the cost of thinking. [...] Because thinking is costly, people do it only once in a while and, at other times, continue with outdated plans" (Mankiw/Reis 2002: 1317).

### ***Concluding Remarks***

There can be no doubt that NKM presents an impressive and – at least at first glance – coherent paradigm. Its strength is to embed a modern and easy-to-handle macro model in a micro-economic "story", the intertemporal decision-making process of a representative agent, that constitutes a renowned component of economic theory for decades. It was no surprise that key

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<sup>30</sup> "The literature to date has usually taken as given is, first, that agents use least-squares learning to adapt their perceptions of the true economic structure, and second, that they know the correct linear or linearized form of the REE solution" (Tetlow/von zur Muehlen 2006: 13).



formal ingredients of NKM, namely optimization and rational expectations, met with disapproval on the part of those critics who never were ready to accept the "homo oeconomicus" as a personification of the economic-theory research programme, vis-à-vis other social sciences. Also, NKM is not to blame for giving a high ranking to the principle of internal consistency. However, the NKM model exhibits qualitative deviations from a typical monetary economy's empirical appearance to a degree that gives cause for concern. The general set-up rules out basic macroeconomic problems, namely the coordination between saving and investment and the independent status of household income, by assumption; consequently it is easy to declare macro theory redundant.

On a second and more closer look, it turns out that the demand and the supply side of NKM is inconsistent, in so far as the degree of "realism" in the design of asset and goods markets varies arbitrarily. Calvo's pricing algorithm was taken from the micro economists's store room for the only purpose to add some inflation rigidity to the model. Contrary to the facts, the burden of adjustment in the cycle is shifted to the firms' profit mark-up, for the only reason to maintain the autonomous status of households, as spells of involuntary unemployment would thwart the very core of NKM: the intertemporal choice of leisure and consumption. Contrary to its own principles, NKM is guilty of "ad hoc" theorizing, as the modification of household preferences only serves to present an ostensibly "deep" reason for output persistence.

NKM proponents fail to understand that there is no epistemological justification for imposing the claim for a microfoundation of macroeconomics upon the profession. In a way, this debate is superfluous as many economists accept the NKM reduced macro model, particularly the hybrid versions including lags, which can be explained by a bulk of reasonable microeconomic arguments. The particular choice of NKM's recommended microfoundation aims to force research activities into the Procrustean bed of a naive pure consumption economy. NKM pays a high price for insisting on this fundament, because the economics of the representative agent obstruct the way to an understanding of the evolutionary process of knowledge creation and expectation formation, growing out of an interactive and competitive learning process of heterogeneous individuals. After all, guiding differing beliefs in non-perfect markets seems to be one of the central banks' main challenges.

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