Whither the Microeconomic Foundations of Macroeconomic Theory?

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Jacob Viner: "Economics is what Economists do" (quoted by Backhouse and Medema, 2009)
Niels Bohr: "But you are not thinking. You're just being logical" (quoted by Leijonhufvud, 2009)

The debate on the future of macroeconomic theory is in full swing. Uneasiness about mainstream macroeconomics, and more in particular the ubiquitous DSGE line of research, could already be heard in some circles well before the Credit Crunch and the ensuing economic crisis, but those who had voiced their criticism found themselves very quickly at the margin of the discussion. And even, to some extent, continue to be found there at present. Patricia Cohen, in her *New York Times* afterthoughts on the 2009 meeting of the AEA (the title of Cohen's article is 'Ivory Tower Unswayed by Crashing Economy', NYT, 5/3/2009), cites Robert Shiller who blames 'groupthink', i.e. "the tendency to agree with the consensus. People don't deviate from the conventional wisdom for fear they won't be taken seriously. (…) Wander too far and you find yourself on the fringe. The pattern is self-replicating. Graduate students who stray too far from the dominant theory and methods seriously reduce their chances of getting an academic job."

Nevertheless, the severity and, above all, the unexpected nature of the economic crisis has now prompted more and more prominent scholars, some of them Nobel laureates, to express their concern about the relevance of mainstream macroeconomic research. The ranks of the 'usual suspects' like Krugman, Roubini, Shiller and Stiglitz have now been joined by distinguished macroeconomists such as Akerlof, Atkinson, Buiter, De Grauwe, DeLong, Eichengreen, Benjamin Friedman, Howitt, Goodhart, Gordon, Laidler, Leijonhufvud, Mankiw, Mirrlees, Rodrik, Sachs, Shleifer, Solow and many others.

The criticisms on the ruling research paradigm, in nearly all cases, focus on the particular type of micro-foundations underlying the macroeconomic models that are presently used.

In section 1 we trace back the history of the call for micro-foundations. Section 2 examines these micro-foundations in more detail. Section 3 deals with the economic crisis and the crisis in (macro)economic theory. In section 4 we try to identify possible alternative approaches and paradigms. We conclude in section 5.

1. What came before the 2007-2009 crisis

It is probably fair to say that in the immediate post-war era the dominant macroeconomic paradigm was the so-called Keynesian-neoclassical synthesis, associated with the names of economists like Samuelson, Hicks, Modigliani, Tobin and others. The great majority of theorists and policy-makers were convinced that the free-market economy was in need of continuous stabilization and regulation in order to achieve a socially acceptable equilibrium.

Parallelly however, in the tradition initiated by Walras and Cassel, a small number of economic theorists and mathematicians were pursuing the so-called 'general equilibrium' (GE) line of research, examining the conditions under which a competitive equilibrium would exist and would be stable. The models the properties of which were examined came to be known as models of the Arrow-Debreu type (Arrow and Debreu, 1954). The GE line of research was however at the time not seen to be in conflict with ruling Keynesianism. By the time that Debreu published his *Theory of Value* (1959), in the words of Blaug, GE theory was defended "as a purely formal presentation of the determination of economic equilibrium in a decentralized competitive economy, having no practical value except as a benchmark with which to evaluate other hypothetical models of the economy" (Blaug, 1992, p. 162-168).

Another parallel research programme, explicitly macroeconomic this one, but equally not conflicting with the ruling Keynesian paradigm, related to Solow's development of the neoclassical growth model, and the Ramsey-Koopmans-Cass extension of it to optimal economic growth (Solow, 1956; Ramsey, 1928; Koopmans, 1965; Cass, 1965).

At the end of the 60s, and even more clearly from the end of 1973 onwards (the first oil shock and its aftermath), the situation changed. 'Stagflation' and the concomitant shifts of the Phillips curve found Keynesian economists, with their emphasis on the importance of demand shocks, ill-equipped to find the right answers. The 'accelerationnist'

re-interpretation of the Phillips curve by Friedman and Phelps, highlighting the role of inflationary expectations in a context of rational decision making by workers and employers gained the upper hand. The publication of the volume edited by Phelps, *Microeconomic Foundations of Employment and Inflation Theory* (Phelps, 1970), sealed the paradigm shift. Solow (1986) neatly sums it up: "one of the reasons for the breakdown of the post-war Keynesian consensus was its apparent inability to provide a quick satisfactory analysis of the stagflation following the first OPEC oil-shock. That failure was soon repaired. The most popular intermediate macro-texts now do a fine job of it. Too late: the tide had turned" (p. 198). From that period onwards indeed, so-called 'new-classical' economists start to dominate the macroeconomic research scene.

The emphasis, from the early 70s onwards, is on the necessity for macroeconomic models to have 'proper' microeconomic foundations. 'Proper' in this context means that all economic agents are rational (i.e. maximise some kind of intertemporal objective function (utility or profit) and form their expectations about the future in a rational way), and that all markets clear (i.e. there is price and wage flexibility). Lucas' monetary misperception model of the business cycle (Lucas, 1975) was already a specimen of this approach, but was quickly superseded by Lucas himself, Kydland and Prescott, and Long and Plosser (as the most influential authors) through development of 'real business cycle' (RBC) theory (Kydland and Prescott, 1977 and 1982, Lucas and Prescott, 1979; Long and Plosser, 1983).

All of these contributions started from the neoclassical growth model, which is turned from a long-run into a medium- or even short-run concept, and lead to the same conclusions and policy recommendations: an instantaneous 'natural' rate of unemployment and policy neutrality (only 'surprises' matter).The 'surprise' aggregate supply function becomes the cornerstone on which these conclusions are built. Business cycles are produced by technological shocks and seen as 'natural' reactions of a system that remains in equilibrium. The basic mechanism operating in RBC models reminds one of Robinson Crusoe's situation: a storm over the sea leads the latter, on the one hand, to substitute leisure time for work time and, on the other hand, within the time allotted to work, to substitute work time dedicated to investment goods (mending fishing nets) for work time devoted to

final goods (fishing), while continuing to maximise his utility. There is no involuntary unemployment. Buiter (1980) calls this the macroeconomics of Dr. Pangloss ([1]).

Although the early RBC papers already, implicitly or explicitly, use the representative agent formalism (Robinson Crusoe is the archetype of the representative agent), it will only be after the integration of the Arrow-Debreu GE results that that one can speak of an emerging DSGE ('Dynamic Stochastic General Equilibrium') model. The Arrow-Debreu properties of the model and the choice for a representative agent specification are intimately linked. We will expand on that further on.

The new-classical prototype DSGE model is by Kydland and Prescott (1982). The prototype papers for the new-Keynesian variant are, arguably, Obstfeld and Rogoff's so-called 'redux' paper of 1995 and Rotemberg and Woodford (1997). New-Keynesian and new-classical DSGE models differ from each other by the introduction in the former of monopolistically competitive markets (as opposed to perfectly competitive ones) and of rigidities in price setting an wage formation.

In the crudest new-Keynesian DSGE models money is either absent or introduced by means of a so-called 'money-in-the-utility-function', the economy is closed, and labour is the only primary factor. The base-line version of the new-Keynesian DSGE model has however in recent years been adapted and extended in a number of directions.

- Physical capital as a second primary input. Capital is owned by households and rented to the firms. The capital accumulation equation adds to the dynamics of the model. Capital income is assumed to equal marginal productivity of capital, which becomes an endogenous variable in the model (see e.g. Christiano *et al.*, 2005). Some authors consider also fixed costs in the production sphere (e.g. Adolfson *et al*., 2007).
- Households can invest part of their wealth in government bonds at an interest rate that is set by the central bank. Monetary policy is in that case modelled by means of a Taylor reaction rule. This option is chosen in many papers.

[1] Dr. Pangloss is Candide's teacher in Voltaire's *Candide*. His motto is 'Tout est pour le mieux dans le meilleur des mondes' (Everything is best in the best possible of worlds).

- Variable capacity use of capital and labour. Galí (1999), for instance, considers the disutility from work in the utility function as a positive function both of hours worked and effort supplied. Christiano *et al*. (2005) and also Smets and Wouters (2003, 2007) include the rate of capital utilisation, next to the investment decision, in the decision set of the representative household.
- Habit formation in the consumption function (e.g. Smets and Wouters, 2003, 2007).
- Wage stickiness modelled either through the intermediate role of a monopolistic trade union or through a Nash bargaining process between a union and a representative firm, possibly combined with Calvo-type rigidity (e.g. Smets and Wouters, 2007), or through the use of a search friction model (Gertler *et al*., 2008).
- Open economy aspects. Adolfson *et al*. (2005) extend the Christiano *et al*. (2005) model to a small open economy. Other contributions in this field include Galí and Monacelli (2005) and Lindé *et al*. (2008). Two-country new-Keynesian DSGE models are analysed in Lubik and Schorfheide (2005) and Rabanal and Tuesta Reátegui (2006). Galí and Monacelli (2008) examine monetary and fiscal policy in a currency union.
- In open economy models, incomplete markets are introduced by considering transaction costs for undertaking positions in the foreign bonds market, and by gradual exchange rate pass-through, i.e. import prices do not immediately reflect prices on the world market expressed in domestic currency (see e.g. Adolfson *et al*. (2007), Lindé *et al*. (2008) and Benigno (2009)).
- Additional types of shocks. The Smets and Wouters paper of 2007 is one that goes far along this path: they consider shocks on technology, investment relative prices, intertemporal preference, government spending (including net exports), monetary policy, the price mark-up and the wage mark-up. Rabanal and Tuesta Reátegui (2006), in their 2-country modellisation, consider also country-specific technology shocks and UIP shocks.

The new-Keynesian DSGE models were seen by many as the expression of a new synthesis, and presented, as late as 2009 (see e.g. Woodford, 2009), as the pinnacle of

modern macroeconomic insight. Goodfriend and King (1997) use the term 'New Neoclassical Synthesis' (see also Goodfriend, 2007). A definite ring of self-congratulation was in the air (the term is Mankiw's, 2006).

Nevertheless, a number of serious flaws in the theoretical setup, undermining the very basis of the paradigm, were already apparent, well before the outbreak of the crisis, and were underlined by a number of renowned economists, albeit from the sideline. We discuss now what we see as the most blatant ones.

2. The fundamental flaws in the micro-foundations

2.1. The representative agent

The choice of the formalism of the 'representative agent' is inevitable if one wishes to start from Arrow-Debreu type of micro-foundations to end up at the aggregate level. The reason for this are the so-called Sonnenschein-Mantel-Debreu results, already established in the early 70s.

Sonnenschein (1972, 1973) and Debreu (1974), starting from strong constraints on the characteristics of the individual utility functions, concluded, with respect to the aggregate excess demand functions Z, that no other restrictions can be obtained for the latter than the following three:

- $Z(\mathbf{p})$ is continuous for all strictly positive prices,
- $Z(\mathbf{p})$ satisfies Walras' law, i.e. $\mathbf{p}Z(\mathbf{p}) = 0$,
- $Z(\mathbf{p})$ is homogeneous of degree 0, i.e. $Z(\lambda\mathbf{p}) = Z(\mathbf{p})$ for $\lambda > 0$.

What this basically means is that one cannot say anything useful about aggregate demand functions (e.g. that they are monotonously decreasing), even if one wants to build them up from the level of well-behaving and rational individual households. The aggregation procedure has, in other words, have no virtue over specifying behavioural macro-equations straight away.

Mantel (1976) strengthened the negative results obtained by Sonnenschein and Debreu by demonstrating that even stronger assumptions about individual behaviour (like homotheticity of the utility functions) did not remove the arbitrary character of the aggregate excess demand functions. Neither did additional constraints on the skewness of the income distribution, at least not if one confines the analysis to an economy with an arbi-

trary but finite number of agents (see Hildenbrand (1983) for results for an infinite economy; see also Kirman (1989) for a very readable synthesis of the whole issue).

DSGE modellers, making use of the Arrow-Debreu formalism, had therefore no other choice – in order to avoid the Sonnenschein-Mantel-Debreu aggregation issue – than to opt for households that are all identical to each other. Aggregation to the macro level could then take place without problems. But the other side of the coin is of course that all real life macro issues that follow from agent heterogeneity and from an unequal income distribution are swept under the table. Perhaps even more problematic is the fact that interaction between these 'clones' is of course also ruled out (no conflict, no collusion, no herding behaviour, etc.).

The fallacy of composition implied by the Sonnenschein-Mantel-Debreu results also renders the quest, in order to circumvent the Lucas Critique, for so-called 'deep parameters' present in microeconomic reasoning problematic for macroeconomic purposes.
As an example we mention the systematic use of the, otherwise elegant, Dixit-Stiglitz formalism in modelling the utility of the representative household at the level of individual consumer goods. Gross substitutability is expressed by choosing a uniform elasticity of substitution between each pair of goods. This may very well be a useful shortcut when it comes to the construction of highly stylised growth models, but falls dramatically short when one wants to estimate a workable short- or medium-term macroeconometric model, where the said elasticity would then be a 'deep' parameter to be estimated.

Finally, in this context of Arrow-Debreu GE models, it should also be pointed out that, regardless of Sonnenschein-Mantel-Debreu aggregation problems, the existence and stability itself of a GE solution is not always warranted. Once one diverges from perfect competition and non-increasing returns to scale, convex consumption sets and market clearing are no longer sufficient. The GE paradigm can only accommodate increasing returns to scale in a minority of industries, and a 'modest' degree of monopolistic competition. Oligopoly and externalities in consumption and production destroy the paradigm (see e.g. Blaug (1980) for a detailed discussion).

2.2. Rational expectations,'complete markets' and market clearing

The representative household and firm are not only rational in the sense that they maximise some intertemporal utility or profit function, but also because they form rational expectations about the future, i.e. their expectations coincide with the mathematical expectation of the 'true' model of the economy, given the known probability distribution of all the variables involved. It follows that the expectation will always be equal to the actual outcome, but for a forecast error that is pure white noise.

For this to be possible as a matter of principle, the market economy needs to be 'complete' and all markets have to clear. A complete system of markets is one in which there is a market for every good, in every possible contingency. In other words a market should exist for every good, at every moment of time, on every point of space. That this modellisation is taken seriously is witnessed by the following citation of Lucas, when he describes the development of contemporary macroeconomics: "(…) by the Arrow-Debreu model, which shows how you can take what seems to be a static general equilibrium model and talk about markets for contingent claims, talk about any kind of dynamics you'd like, coming right out of the economics. (…) We didn't know this theory existed back in 1960, although it did. But now its potential is getting realized. It has completely succeeded in taking over growth theory, most of public finance, financial economics. Now it's coming in use in macroeconomics with real business cycle theory (Lucas, 2004, p. 23)."

Buiter (2009) has a much more reasonable point of view. He looks at the 'complete markets' proposition from the angle of contract enforcement, which is of course a very acute problem in trade over time. He states – and we cannot but agree – that in the spectrum between 'no trade' and 'complete markets' as opposite extremes, reality is much closer to 'no trade' than to the other extreme. Only a very small subset of voluntary exchange-based transactions, relative to the universe of all potential transactions, whether they are self-enforcing or enforced by some external third party, will ever take place. The 'complete markets' hypothesis assumes away these contract enforcement issues.

In order to see why, in a general equilibrium model, where every variable relates to every other variable, rational expectations necessitate markets to be complete and to clear at each moment of time, consider the situation of the representative household maximis-

ing the expected value of its intertemporal utility. In order to make a rational forecast of future income, even if the maximisation is over a finite time span, it needs to know the probability distribution of future real incomes. These real incomes will depend on asset prices in that period, which most likely, in turn will depend on the next period price of this and other assets, which will in turn will depend on the prices two periods ahead, etc. The household will have to be able to model the trajectory of every variable into the indefinite future. Obviously this will require the existence of much more markets for contingent claims (i.e. derivative instruments) than one can reasonably think of ([2]).

The fact that there is a library full of studies from the experimental economics literature that shows that people very often do not make decisions in a rational way, as this is understood by DSGE modellers, and that they certainly do not form expectations along the lines of the rational expectations hypothesis, does not prevent the latter hypothesis to have momentous implications for the stability of a possible long-run equilibrium. We refer to the required saddle-path quality of the stable trajectory of models with rational expectations. We come back on this important issue in section 3.5.

Arthur (2006) remarks that by assuming that households and firms have a coherent and clear picture of the future, DSGE models are populated by agents that solve, in essence, a static optimisation problem. Real-life dynamics that oblige agents to reconsider at each step their decisions are absent.

2.3. The 'Efficient Market Hypothesis'

In the original version of the Efficient Market Hypothesis (EMH) Fama, one of its founders, defined it as follows: "competition… among the many [rational] intelligent participants [would result in an] efficient market at any point in time [in which] the actual price of a security will be a good estimate of its intrinsic value" (Fama, 1965, p. 56).

With rational expectations added, this relatively loose wording was turned, from an empirically testable conjecture into an axiom: asset prices fully reflect all available information, only randomly diverge from 'fundamental' values and therefore provide proper signals for resource allocation.

[2] Colander *et al*. (2009) observe that this theoretical result on the necessity of complete markets lies at the basis of the fact that many renowned economists (including the chairman of the Fed) in pre-crisis circumstances favoured the multiplication of markets for new derivatives in order to facilitate the formation of rational expectations.

In the meantime, after the meltdown of the financial markets in 2007 and 2008, the remaining proponents of the EMH in the so-called 'freshwater' universities in the US have abandoned this strong version and retreated to a much weaker one, but continue to call it the 'best-tested hypothesis in all the social sciences'. Cochrane (2009) for instance re-interprets the EMH as saying that, given that prices incorporate all available information, you cannot beat the market. For Scholes, in an equally weakened interpretation, it is the belief that markets tend to return prices to their efficient equilibrium when they move away from it that gives the EMH its continuing relevance (*The Economist*, 18/07/2009, p. 71).

More than anything else the EMH is exemplary of the divide that separates (macro)economists between those that believe that the free market economy does not need to be regulated and stabilised in order to attain an equilibrium that is socially acceptable, and those that do not believe this. Buiter belongs to the last category and calls the EMH the most notable empirical fatality of the financial crisis and, by implication, 'complete markets' the most prominent theoretical fatality (Buiter, 2009).

2.4. The role of money

Although optimal monetary policy decisions are one of the main focuses of the large majority of (new-Keynesian) DSGE models, the concept of money is nearly always only weakly defined. In the much cited papers of Smets and Wouters (2003, 2007), for instance, a so-called 'cashless limit economy' is considered. Money as such is absent in the model, even if there is a central bank pursuing a monetary policy in the form of a Taylor interest rule. The background of this modelling choice is again the Walras and Arrow-Debreu general equilibrium concept of an economy under perfect competition. These models, that surely had no pretence to describe reality, were insufficiently detailed to deal with the ways in which people pay for goods, otherwise than by saying that they had to stay within the borders of an intertemporal or static budget constraint. If these models wanted to tell something meaningful about the money supply or monetary policy, they had to make simplifying assumptions like the 'cash-in-advance' hypothesis that states that each economic agent must have the necessary cash available before buying goods.

Another simplifying option is the one that Woodford chooses in his 'neo-Wicksellian' approach (cf. Woodford (1998) and Woodford's magnum opus *Interest and Prices*, 2003). Woodford – Smets and Wouters and a number of other authors follow in his suit – observing that paper and metal currency is gradually losing importance, assumes that the limit case where paper and metal money have disappeared and only electronic money remains, continues to yield in their DSGE models a meaningful solution for the nominal price level and the nominal rate of interest. Buiter (2002) strongly objects. He states that "Woodford's cashless limit is simply the real equilibrium solution to an accounting system of exchange to which money or credit, be it cash (in-advance or in-arrears) or electronic transfer, is an inessential addition". Woodford implicitly interprets 'cashless limit' economies as pure exchange economies. Cashless limit economies in the sense of Woodford produce an equilibrium by means of the computing power of the auctioneer in an Arrow-Debreu auction, and should not be confused with an electronic money system in the real-life economy of the future (see also Rogers, 2006). Cashless limit models in the sense of Woodford may have pedagogical merits, but are unable to describe what is going on in a modern, highly monetised economy, let alone to say something meaningful about the way in which the central bank should act.

This is not to say that DSGE models that do include a monetary supply variable are much more realistic. The basic problem remains that in DSGE models savers and investors are united in the same economic agent, the 'representative' household. This implies frictionless financial markets, and also no hierarchy of interest rates. The single interest rate set by the central bank is at the same time the rate of return on capital, the rate of return earned by firms and households on savings, and the rate paid by borrowers. There is no place, and no need for a commercial bank sector that acts as intermediary.

The awkward position (or the absence) of money in many new-Keynesian DSGE models had led to another characteristic of these models that is seen by a growing number of economists as an incongruity. The so-called 'Fiscal Theory of the Price Level' (FTPL) consists, in the absence of a money supply variable in the model, in treating the government's period budget constraint as an equilibrium condition that determines the general price level rather than as a relation that is identically true. The causal reasoning behind this is problematic, to say the least. The FTPL is obviously an mathematically inspired

expediency to close the model formally, and to have an inflation and expected inflation variable that can be used in the Taylor Rule equation determining the official discount rate (which, for that matter is identical to the general rate of interest in the economy) (see Niepelt, 2004; and also Buiter, 2002, 2005).

2.5. Price stickiness

Although new-classical DSGE models at least maintain a high standard of logical consistency, this cannot be said of new-Keynesian DSGE models. These models distinguish themselves, among other things, by the introduction of price and wage stickiness through overlapping contracts. The, usually Calvo-type of, stickiness is inserted into the model as a '*deus ex machina*'. This leads to a logical contradiction, albeit not a mathematical one. On the one hand, households, maximising their intertemporal utility, stay on their labour supply curve. On the other hand, only part of the firms (those that get a 'green light' in the sense of Calvo), set prices in function of their profit-maximising objective. The result, although hidden in the formalism of the representative household and the representative firm (which often, for that matter, coincide), is that there is rationing on some markets, but this rationing is not made explicit (see e.g. Laidler, 2009, and Gordon, 2010).

3. The Economic Crisis and the Crisis in (Macro)economic Theory

Mainstream macroeconomic theory was not prepared for the financial crisis and the economic recession that followed. As has already been repeatedly said, the members of the macroeconomic profession did not see it coming, once it was there, could not agree on its causes, and remain at odds with each other as to the way to manage it. In the previous section we dealt with the fundamental weaknesses in the micro-foundations of mainstream macroeconomics in general, and with DSGE modelling in particular. In this section we concentrate on the specific characteristics and problems of DSGE models and of the way they are used in forecasting and simulation that are especially troublesome in periods of crisis (for a more detailed analysis, see Meeusen, 2009):

- the heterogeneity issue,
- the treatment of the financial sector in DSGE models,
- the unknowability of the future,

- the issue of involuntary unemployment,
- the process of linearisation,
- the empirical validation.

3.1. The heterogeneity issue

Representative agents, as we have seen, is a formal expediency to get around the Sonnenschein-Mantel-Debreu criticism. But does this make representative agents an acceptable scientific concept? The answer is 'no' if one uses the traditional argument as voiced by Atkinson (2009) that in the real world people have different, often conflicting, interests and aspirations and that by neglecting these differences, one rules out the most interesting welfare economic problems. After all, as noted by Solow (2008, p. 243), "a modern economy is populated by consumers, workers, pensioners, owners, managers, investors, entrepreneurs, bankers, and others, with different and sometimes conflicting desires, information, expectations, capacities, beliefs, and rules of behaviour".

It is certainly again 'no' if we realise that individual agents that are clones of each other act on their own, and therefore do not interact. This is what is called the 'agent coordination problem'. Macroeconomics is different from microeconomics in the sense that it should study the complex properties of the whole that emerge from the interaction of individual agents. The whole is not equal to the sum of its parts. Representative agent models fail to address this very basic macroeconomic reality.

We will not be able to understand what is going on in a complex modern economy if we do not take account, in our modelling, of the basic differences in behaviour of a large number of different types of economic agents.

3.2. The treatment of the financial sector

The last conclusion is particularly acute for the modelling of the financial sector. We already discussed the role of money in DSGE money. Either money is absent (see e.g. the much cited Smets and Wouters papers (2003, 2007)), obliging modellers to seek refuge in the so-called 'Fiscal Theory of the Price Level' to obtain a mathematically closed expression for the price level and thus for inflation, or it is modelled in an unsatisfactory stylised way, without financial intermediaries such as commercial banks.

Real life questions about massive insolvency and illiquidity in the financial sector not only cannot be answered by modern mainstream macroeconomic models. These models do not even allow these questions to be asked.

In DSGE models allocative and expectational rationality indeed holds and market prices reflect market fundamentals. Add to this the assumption made by DSGE modellers that intertemporal budget constraints are always satisfied, and one gets an Arrow-Debreu-like 'economy' in which there are no contract enforcement problems, no funding or market illiquidity, no insolvency, no defaults and no bankruptcies.

Recently, some timid attempts have been made to try to fill the vacuum. In Cúrdia and Woodford (2008), an (exogenous) credit friction is introduced, allowing for a time-varying wedge between the debit and credit interest rate, but in the continuing absence of commercial banks (see also De Graeve *et al*., 2008).

The comments of LSE's Goodhart, former member of the Monetary Policy Committee of the Bank of England, are devastating: "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 creditworthy, there is no need for money. There are no credit constraints. Everyone is angelic; there is no fraud; and this is supposed to be properly microfounded!" (Goodhart, 2008).

3.3. The unknowability of the future

With respect to the formation of expectations, there is more to it than the failure of economic agents to make rational expectations. The issue is foremost one of the unknowability of the future as a result of so-called 'Knightian uncertainty'. Knight made the difference between 'risk' and 'uncertainty', risk being randomness with a known probability distribution and therefore insurable, and (Knightian) uncertainty being randomness with an unknown or even unknowable probability distribution and therefore uninsurable. Phelps (2009), discussing the financial meltdown, argued that risk management by banks related to 'risk' observed as variability over some recent past. This was understood as variability around some equilibrium path, while the volatility of the 'equilibrium' path itself was not considered.

An illuminating angle to approach this unknowability problem is therefore to see that on the micro as well as the macro scale there is most of the time path-dependency of the long-run dynamics. Examples of hysteresis have been well documented in international trade, industrial innovation, localisation of industries, consumer behaviour, economic development, the functioning of labour markets and consequently in the determination of the long-run rate of economic growth itself (see Cross (2008) on DSGE modelling and hysteresis). DSGE modellers have obviously not taken hysteresis into account, and seem to have neglected the important insights offered by the numerous contributions to endogenous growth theory that imply some form of path-dependency. Instead they have regressed to the old Solow-Ramsey-Koopmans-Cass growth model used by the first RBC theorists ([3]).

When DSGE modellers introduce stochasticity into their models, implicitly modelling Knightian 'risk' as opposed to 'uncertainty', they do so, in the large majority of cases, by adding independently distributed normal disturbances to their equations.
The normality assumption is however particularly unwarranted in the case of financial markets. De Grauwe (2009a) computes that the 10.88% fall of the Dow-Jones Industrial Average on October 28th 2008, if you would assume an underlying normal distribution with an historically computed variance, would take place only once every 73,357,946,799,753,900,000,000 years, which exceeds of course the age of the universe by a very large margin.

3.4. The treatment of involuntary unemployment

The full employment implication of, specifically new-Keynesian, DSGE models is another sore point. The reason for this feature is of course the symmetry in the continuum of households. Each household is 'representative' in its own right. If one household finds employment, all do; they all move along their own supply curve of labour. No involuntary unemployment can occur, only voluntary movements in hours of work or intensity of effort, i.e. movements on the 'intensive' margin. This remains true regardless of the particular form taken by wage or price rigidity.

[3] Solow is very much aware of this and distances himself from the use by DSGE modellers of his own growth theory (Solow, 2008).

Both Blanchard and Galí (2008) and Gertler *et al.* (2008) provide examples of new-Keynesian DSGE models in which there are movements in employment along the extensive margin ([4]). They do so by redefining the representative household as consisting of family members with and without a job, and combining this feature with a wage bargaining process. Gertler *et al.* also consider the probability of finding a matching between unemployed workers and vacancies. We note in passing that both models are of the 'cashless limit' type.

3.5. The process of linearisation

Even the baseline DSGE model, and *a fortiori* of course the extensions of it, are highly non-linear. In order to be able to have a workable and estimable version of them, it is a current procedure to (log)linearise the model around the equilibrium path and to reduce stochasticity in the model to well-behaved additive normally distributed disturbances with a given distribution ([5]). In the determination of the optimal time-paths (in levels) of the different variables of the model it is assumed that the transversality conditions are satisfied. This, in principle, should rule out explosive behaviour of these variables, but, since these transversality conditions actually do not intervene in the actual Euler derivation of the optimal time-paths (most DSGE modellers do not even bother to mention them), saddle path stability of the long-run equilibrium is not automatically ensured. The latter is however a necessary condition for the long-run equilibrium to be meaningful in the presence of rational expectations.

To this end the linearised version of the model is subjected to the so-called Blanchard-Kahn test. This test requires that (for discrete time systems), in order for the model to yield a unique and stable future path, the number of eigenvalues of the linearised system smaller than 1 in absolute value should be exactly equal to the number predetermined endogenous variables, and the number of eigenvalues with absolute value larger than 1 should be equal to the number of anticipated variables (Blanchard and Kahn, 1980). Only in this case will the model have the so-called 'saddle-path equilibrium' property, a neces-

[4] Blanchard and Galí start their analysis by noting that the absence of involuntary unemployment was viewed as one of the main weaknesses of the RBC model (see e.g. Summers, 1991), but was then 'exported' to new-Keynesian DSGE models.

[5] Some authors have started to experiment with second-order Taylor expansions as an alternative to linearisation (see e.g. Schmitt-Grohé and Uribe, 2004).

sary requirement whenever rational expectations about the future are involved. The problem of course is that this test, in nearly all cases, can only be carried out when the parameters of the model are known, either through calibration of the model, or through econometric analysis (see section 3.6).

The linearisation takes place around the steady state solution of the model. But this steady state, by its very nature, does not refer to average situations, but to the extreme situations of full capacity use, zero average inflation, purchasing power parity (in open economy models), etc. A good illustration of this is the point that is conceded by Christiano *et al.*, when they make the following comment on the fact that they take zero profits as the steady state value: "Finally, it is worth noting that since profits are stochastic, the fact that they are zero, on average, implies that they are often negative. As a consequence, our assumption that firms cannot exit is binding. Allowing for firm entry and exit dynamics would considerably complicate our analysis" (Christiano *et al.*, 2005, p. 14). Perhaps zero profits are an interesting benchmark, but it can hardly be a steady state value in a monopolistically competitive environment.

Combined with the requirement that shocks in a linearised version of a non-linear model have to remain small, one cannot but conclude that, *in the very best of cases*, new-Keynesian DSGE models can only describe what happens in the immediate neighbourhood of a state of blissful tranquillity.

Fundamentally, stripping a non-linear model from its non-linearities may very well mean – the more so if you consider the interaction of these non-linearities with uncertainty – that you delete from the model everything that makes the dynamics of reality interesting: threshold effects, critical mass effects, switching of regimes points etc. If there is one thing that recent economic history has made clear, then it is that economic systems can be tranquil (i.e. 'stable') for some time, but that, once in a while, unforeseen events push the system out of the 'corridor of stability'. Linear systems, by their very nature, cannot have this corridor property (see e.g. Leijonhufvud (2008, 2009) who forcefully makes this point).

The nature of stochasticity in linearised DSGE models is another sore issue. Firstly, linear models with independently distributed disturbances have the 'certainty equivalence' property. Linearising, as far as the mean of the solved time path goes, reduces in

actual fact the model to a deterministic one. Secondly, as we already mentioned, if one assumes that the disturbances are normally distributed, as DSGE modellers traditionally do, one dramatically misses one of the essential aspects of, in particular, movements of prices on asset markets.

Moreover, by dumping the massive effects associated with the basic nonlinear character of the model and with misspecification into the residual terms, one causes their variances to be very large. This has important consequences for the power of empirical tests, which leads to a low ability to reject the model, even if it poorly fits the data.

Finally, one should in this context stress again the implicit use of the ill-understood heritage by new-classical and new-Keynesian DSGE modellers of Frank Ramsey's optimal savings problem, such as it is incorporated in the Solow-Ramsey-Koopmans-Cass growth model. Ramsey's model actually was a model for a social planner trying to determine the long-run optimal savings rate. The mathematical programming problem to be solved by the central planning agency only leads to a meaningful solution if this agency, at the same time, also makes sure that terminal boundary conditions (the so-called 'transversality conditions'), that preclude explosive time-paths, are met. These conditions express the necessity that the influence of the present on what happens in an infinitely distant future vanishes.

DSGE modellers transplant the social planner's programming problem to the 'real life' situation of a 'representative' individual, expecting to describe in this way, not only his long-run behaviour, but also his behaviour in the short and the medium run. Only, in a decentralised market economy, there is no such a thing as a mathematical programmer that imposes the necessary terminal conditions. There is no real life counterpart in DSGE models to the transversality conditions imposed on Ramsey's social planner. Panics, manias and crashes do happen, and are not confined to the nearly cataclysmic events of the Credit Crunch. Post-war economic history abounds with examples. Only in the period since the Stock Exchange Crash in New-York of October 1987, we have had, successively, the Mexican Crisis (1994), the Asian Crisis (1997), the LTCM Crisis (1998 to early 2000), the burst of the dot-com bubble (2000-2001), and the threatening panic following 9/11/2001.

De Grauwe (2009b) contents that DSGE models, with their rational expectations, are actually the intellectual heirs of central planning models. Surely not because the objective of the households is to plan the whole, but because, like the central planner, the agents in these models understand the whole picture.

3.6. Empirical validation

In older DSGE models, in line with what was common in new-classical RBC models, parameters were a-prioristically chosen so that the dynamic qualities of the solution, in terms of the lower moments of the underlying distributions, conformed with what was observed. This 'calibration' approach, as opposed to a traditional econometric approach, was preferred because of the complicated, highly non-linear nature of the models, and presumably also because RBC theorists and early DSGE modellers – unconsciously or not – did not wish to confront directly their very sketchy and unrealistic models with the data. Solow (2008) is very caustic on this practice.

In more recent DSGE models one usually follows a mixed strategy, but the inauspicious heritage of calibration lingers on. It does so in two ways. Firstly, part of the often numerous parameters are still calibrated. Secondly, another part is estimated with Bayesian procedures in which the choice of priors, whether or not inspired by calibrated values taken from previous studies, by the very nature of the Bayesian philosophy, heavily biases the ultimate (posterior) estimates.

One of the reasons to opt for Bayesian estimation techniques is that likelihood functions of DSGE models often show numerous local maxima and nearly flat surfaces at the global maximum (see Fernandez-Villaverde, 2009). Traditional maximum likelihood estimation strategies therefore often fail. But, rather than choosing for the flight forward and reverting to Bayesian techniques, this should perhaps warn one that DSGE models do not marry well with real life data.

In the frequently cited Christiano *et al.* paper, the estimation strategy is, to be sure, more careful, in the sense that the authors in a preparatory step use an unrestricted VAR procedure to estimate the impulse response of eight key macroeconomic variables of the model to a monetary policy shock, in order, in a second step, to minimise a distance measure between these estimated IRFs and the corresponding reaction functions implied

by the model. However, eight other very crucial parameters are fixed a priori (among which the discount factor, the parameters of the utility function of the households, the steady state share of capital in national income, the annual depreciation rate, the fixed cost term in the profit function, the elasticity of substitution of labour inputs in the production function, and the mean growth rate of the money supply). This implies of course that the remaining 'free' parameters are highly restricted and thus remain heavily biased.

In the case of normality, when the variance-covariance matrix of the disturbances is known, the posterior mean can be written as a matrix weighted average of the prior mean and the least-squares coefficient estimates, where the weights are the inverses of the prior and the conditional covariance matrices. If the variance-covariance matrix is not known, as is nearly always the case, the relation between prior and posterior values of the parameters is of course more complicated, but the general picture remains valid (see e.g. Greene, 2003, ch. 16).

The conclusion is that the practice of calibration is still widespread. Bayesian statistical techniques produce a particular kind of hysteresis effect. Parameter values, once fixed by an 'authoritative' source, live on in the priors of subsequent studies, which in turn perpetuate possible errors. Blanchard, although himself author of a few new-Keynesian DSGE papers, worries that "once introduced, these assumptions [about the priors and a priori fixed parameters used in models] can then be blamed on others. They have often become standard, passed on from model to model with little discussion" (Blanchard, 2009).

4. Alternative approaches

Scholes was quoted in a recent number (18/07/2009) of *The Economist*, devoted to the crisis in macroeconomic theory, in saying that "to say something has failed you have to have something to replace it, and so far we don't have a new paradigm to replace efficient markets" (p. 72). We find it difficult to agree with this. Imagine that we would have been able to disprove that the earth is flat, but have not yet been able to prove that the earth is either in the form of a sphere, an apple, a pear or a doughnut. That would cer-

tainly not allow us to stick to the old theory. Open-ended searching is the very essence of scientific activity.

Fortunately, the present situation is not one where the choice is between DSGE modelling and the void. In this section we will discuss the following existing alternative approaches to macroeconomic theorising:

- De Grauwe's introduction of agent heterogeneity and adaptive learning into the DSGE model,
- Microeconomically founded macroeconomics with interacting agents,
- Agent-Based Computational Economics (ACE),
- 'Data first' vs 'theory first': CVAR econometrics,
- Mankiw's 'engineering' approach to macroeconomics.

4.1. De Grauwe's alternative DSGE model

De Grauwe's approach is explorative (De Grauwe, 2009b). He does not aspire to realism. His purpose is to examine the effects in DSGE models of changing the rational expectations assumption for a non-rational alternative. He starts from the three-equation log-linearised reduced form of the basic DSGE model:

$$y_t = a_1 \tilde{\mathrm{E}}_t y_{t+1} + (1-a_1) y_{t-1} + a_2 (r_t - \tilde{\mathrm{E}}_t \pi_{t+1}) + \varepsilon_t \qquad [1]$$

$$\pi_t = b_1 \tilde{\mathrm{E}}_t \pi_{t+1} + (1-b_1) \pi_{t-1} + b_2 y_t + \eta_t \qquad [2]$$

$$r_t = c_1 (\pi_t - \pi^*) + c_2 y_t + c_3 r_{t-1} + u_t \quad , \qquad [3]$$

in which he has replaced the mathematical expectation operator E by one that expresses non-rational expectations $\tilde{\mathrm{E}}$. y is the output gap, r is the nominal interest rate and π is the inflation rate. ε, η and u are white noise disturbances.

Equation [1] is the aggregate demand equation. Aggregate supply is represented by a new-Keynesian Phillips curve (equation [2]); the lagged inflation rate enters the right-hand side as a result of Calvo-pricing. Equation [3] is a Taylor rule.

The non-rational expectations are modelled as follows. One part of the agents follows a fundamentalist rule (f): they estimate the steady state value of the output gap (normal-

ised at 0) and form their forecast accordingly. The other part of the agents follows a simple extrapolative rule (e) they have no knowledge about the steady state output gap ([6]).

$$\tilde{\mathrm{E}}_t^f y_{t+1} = 0 \qquad [4]$$

$$\tilde{\mathrm{E}}_t^e y_t = y_{t-1} \qquad [5]$$

$$\tilde{\mathrm{E}}_t y_t = \alpha_{f,t}\tilde{\mathrm{E}}_t^f y_t + \alpha_{e,t}\tilde{\mathrm{E}}_t^e y_t = \alpha_{e,t} y_{t-1} \qquad [6]$$

$$\alpha_{f,t} + \alpha_{e,t} = 1 \quad . \qquad [7]$$

$\alpha_{f,t}$ and $\alpha_{e,t}$ are the probabilities that agents use a fundamentalist or extrapolative rule. These probabilities are assumed to be determined in function of the mean squared forecasting errors *U*, with geometrically decreasing weights, in an adaptive learning context. Discrete choice theory (see e.g. Brock and Hommes, 1997) suggests that these probabilities take the following form:

$$\alpha_{f,t} = \frac{\exp(\gamma U_{f,t})}{\exp(\gamma U_{f,t}) + \exp(\gamma U_{e,t})} \quad . \qquad [8]$$

γ is a parameter between 0 and infinity that measures 'choice intensity'.

The impulse response functions obtained by De Grauwe, with calibrated parameters borrowed from the DSGE literature, reveal striking differences between the RE version of the model and the 'heuristic' version. The latter shows correlations in belief that generate waves of optimism and pessimism and produce endogenous cycles that are reminiscent of Keynesian 'animal spirits'. An important policy implication that can be read from the impulse response functions is that monetary policy in the latter case, as applied through the Taylor rule, has different effects depending on the state of the economy, more in particular on whether there is a wave of optimism or pessimism. In other words, inflation-targeting is no longer always the best policy.

[6] De Grauwe also reports on the results with an alternative approach, with 'optimistic' and 'pessimistic' forecasters.

4.2. Microeconomically founded macroeconomics with interacting agents,

Social interaction models and empirical studies based on them have already been used in a number of microeconomic contexts (welfare and public assistance, housing demand and urban development, contract determination, cigarette smoking, school performance, etc.), but aggregate phenomena have up to now been studied less frequently ([7]). Brock and Durlauf (2006) present a generic model that would allow this.

They consider a group of I individuals, members of a group *g*. Each individual *i* ($i=1,\ldots,I$) makes a choice ω_i.They distinguish four factors that determine individual and therefore also group behaviour: X_i (the individual-specific characteristics), ε_i (an individual-specific independent random influence), Y_g (predetermined group-level characteristics; the 'contextual effect') and $\mu_i^e(\omega_{g,-i})$ (a subjective probability measure capturing the beliefs of i about the behaviours of the others in the group; the 'endogenous effect'). An endogenous effect would e.g. be the expected average behaviour of others, while a contextual effect might consist of the average age of the others.

Brock and Durlauf admit that the difference between the two type of effects is a bit crude and may obscure actual, more specific social interaction effects like peer effects, information effects, role model effects, social norms etc.

Agents maximise some individual payoff function V:

$$\omega_i = \arg\max_{\omega\in\Omega_i} V(\omega, X_i, \varepsilon_i, Y_g, \mu_i^e(\omega_{g,-i})) \quad . \qquad [9]$$

The solution of this maximisation problem by all agents yields a set of conditional probability measures:

$$\mu(\omega_i | X_i, Y_g, \mu_i^e(\omega_{g,-i})) \quad . \qquad [10]$$

[10] describes how, on the one hand, observable individual-specific and contextual effects and, on the other hand, non-observable beliefs, influence the likelihood of a possible choice.

[7] Examples are Durlauf (1993), Föllmer *et al.* (2004) and Horst (2005).

Since the random influences are independent, the authors apply the simple product rule with respect to the conditional probability measures:

$$\mu\left(\omega_g \middle| Y_g, X_1, \mu_1^e(\omega_{g,-1}),..., X_I, \mu_I^e(\omega_{g,-I})\right) = \prod_i \mu(\omega_i | X_i, Y_g, \mu_i^e(\omega_{g,-i})) \quad . [11]$$

Brock and Durlauf close the model by specifying the way beliefs are formed. Rationality in this context would mean that the subjective beliefs obey

$$\mu_i^e(\omega_{g,-i}) = \mu\left(\omega_{g,-i} \middle| Y_g, X_1, \mu_1^e(\omega_{g,-1}),..., X_I, \mu_I^e(\omega_{g,-I})\right) \quad . \qquad [12]$$

Results from behavioural studies may of course suggest alternative specifications. Existence of solutions for the system in [9]-[12] have been examined in different papers (see Horst and Scheinkman (2006) for a recent and extensive contribution).

The most interesting model specifications for social interactions – like the models of co-ordination failures (Diamond, 1982, Cooper and John, 1988; Howitt, 2006) – exhibit strategic complementarities, i.e. the tendency to copy the behaviours of others. Very often in these cases there are multiple equilibria, phase transitions and social multipliers. Co-ordination failures and macro externalities also turn interactions between individual economic agents into constraints on labour and goods markets, preventing households to optimise working hours and firms to optimise production and sales (see e.g. Gordon, 2009).

Foley (2010), in this context, finds it unfortunate that the preoccupation of the profession with DSGE research has prevented the rapid development of macroeconomic models based on the idea that social coordination problems are central to macroeconomic dynamics. Mass market interactions inherently indeed produce important externalities that link the behaviour of the interacting agents outside their market transactions. There is an obvious relevance here to the understanding of the dynamics of financial markets.

4.3. Agent-Based Computational Economics

Agent-based Computational Economics models, or ACE models, take this remark at heart in their own way. ACE models are essentially micro-simulation models that yield emergent properties at the aggregate level. The rationale behind it is indeed that modern economies are seen as complex systems consisting of autonomous but interacting agents

with exogenously given (often experimentally or econometrically validated) behavioural rules. These complex systems are also adaptive in the sense that at least some of the reactions of the agents to their environment are directed at achieving built-in (or evolving) objectives.

As Howitt (2008) stresses, the term 'autonomous' is of crucial importance in the ACE approach. GE and DSGE models do "not allow people to act without knowing the equilibrium value of some variable, (…) someone must have computed that equilibrium value a priori. In such a model there is no way to describe out-of-equilibrium behavior, and the problem of reconciling peoples' independently conceived plans is assumed to be solved by some unspecified mechanism that uses no scarce resources". More specifically, representative agents with rational expectations act as a single body along a single, well-defined time-path. Such agents are 'non-autonomous'.

The basic methodological tool to simulate ACE models is object-oriented programming. C++ and Java are the favorite programming environments of ACE modelers. The different types of agents in the model correspond to separate 'objects'.

The ACE modeling field is in its infancy. Tesfatsion and Judd gave a strong impetus by publishing their *Handbook of Computational Economics* (2006) ([8]). Other important contributions are Howitt and Clower (2000) on the emergence of economic organisation, Howitt (2006) on an agent-based derivation of the Keynesian multiplier, Albin and Foley (1992) on decentralised and dispersed exchange on auctioneer-less markets, Dawid (2006) on agent-based models of innovation and technological change, and Nicolaisen *et al.* (2001) with an ACE application on the electricity market.

A different but equally important strand of research that may be able to contribute to the development of ACE modeling is contained in the body of work done under the behavioural and experimental economics heading (see the work done by economists as Thaler, Selten, Fehr, Lo and others).

[8] An interesting website monitored by Tesfatsion and containing pointers to ACE tutorials, software and research resource sites is www.econ.iastate.edu/tesfatsi/ace.htm .

4.4. 'Data first' vs 'theory first': CVAR econometrics

Recently a number of distinguished econometricians, like K. Juselius, M. Juselius, Bierens, Johansen and Hendry, all associated with the time-series approach to econometric modelling, echoing earlier scepticism expressed by Sims (1980) and Summers (1991), have criticised the econometric methodology (or the absence thereof) used by most present-day mainstream macroeconomists (Johansen (2006), K. Juselius and Franchi (2007), Bierens (2007), M. Juselius (2008), Clements and Hendry (2008), Hoover, Johansen and K. Juselius (2008), K. Juselius (2010)). Also in the circle of DSGE modellers themselves, Chari, Kehoe and McGratten (2009) and Tovar (2009) have voiced their scepticism on the possibility of current DSGE models to produce realistic policy advices (see also Mankiw, 2006) ([9]).

The main point made by K. Juselius a.o. is 1) that DSGE models perform badly when it comes to empirical validation; and 2) that one of the main reasons, although certainly not the only one, for this is that rational expectations models cannot, by definition, cope with structural breaks in the data.

The latter should be obvious, since economic agents with rational expectations all agree among themselves on a unique future path that is computed on the basis of known probabilities. The actual non-stationarity of many variables in the model and the persistence of unit roots, often a signal that self-referential actions and self-fulfilling prophesies are at work, imply that the usual VAR time-series techniques cannot be applied. Juselius argues that in such a case 'Co-integrated VAR' (CVAR) techniques have to be used instead.

Disregarding structural breaks and unit-root dynamics by DSGE modellers of course follows from the assumption made that there is a unique long-run equilibrium path, and from the ensuing practice to (log)linearise DSGE models around this supposedly existing unique path. The deviations from the path, very naturally, are then assumed to be stationary, which supposedly clears the way for VAR modelling. Ironically, it could be argued (see e.g. Beyer and Farmer, 2004), that DSGE modellers, although they insist on the ne-

[9] Aoki's criticises the econometrics of DSGE models from a different angle (Aoki, 2006). His point is 'misspecification', in the first place because of insufficient agent heterogeneity.

cessity to search for 'deep' parameters, are themselves subject to the Lucas Critique w.r.t. macroeconometric policy evaluation.

Clements and Hendry (2008) call these models EqCMs (Equilibrium Correction Models), rather than ECMs (Error Correction Models). They maintain that very often, misguidedly, econometricians assume that they are estimating ECMs in conditions where equilibria shift. In these cases the model apparently continues to converge to the built-in long-run equilibrium in circumstances where it in the meantime in reality has changed. These models will then be prone to systematic failure (see also Hendry and Mizon, 2009).

The choice for a CVAR approach should, in general, be seen in the context of the traditional 'Methodenstreit' between the defenders of a theory-led deductive approach and those favouring an empirically grounded inductive approach (see e.g. Uhlig, 2009). Juselius, Hendry and others obviously choose for the 'data first' above the 'theory first' approach. Juselius calls it the 'Sherlock Holmes attitude'.

4.5. Mankiw's 'engineering' approach to macroeconomics

Mankiw, in a much cited paper in the *Journal of Economic Perspectives* (2006), distinguishes four phases in the new-Keynesian reaction to the new-classical thrust of Lucas and his 'freshwater' colleagues. The first wave can be identified with the dis-equilibrium school associated with Barro and Grossman (1971) and Malinvaud (1977), who built on earlier work by Clower (1965) and Leijonhufvud (1968).

The second wave was meant to show that rational expectations are not incompatible with the absence of market clearing. More in particular, authors like Fischer (1977) and Taylor (1980) showed that however in such a case the new-classical policy neutrality result does no longer hold. As during the first wave, the micro-foundations of price and wage rigidities remained unclear.

The third phase of the new-Keynesian counterrevolution remedied this shortcoming: Mankiw himself with the 'small menu cost' hypothesis (Mankiw, 1985), Akerlof and Yellen (1986) with the efficiency wage approach to wage setting, Blanchard and Kiyotaki (1987) with their analysis of aggregate demand externalities resulting from the divergence between private and social incentives that follow from 'rational' price and wage stickiness.

The fourth wave is, to this day, the last one. It is the phase to be identified with new-classical and new-Keynesian DSGE modelling. The so-called 'New Neoclassical Synthesis' has been discussed at length in this paper. There is no need to expand on it again here. Suffice it to say that Mankiw looks upon this phase in a very critical way: "Yet the new-Keynesians can be criticized for having taken the new-classicals' bait and, as a result, pursuing a research program that turned out to be too abstract and insufficiently practical" (Mankiw, 2006, p. 39). "New-classical and new-Keynesian research has had little impact on practical macroeconomists who are charged with the messy task of conducting actual monetary and fiscal policy. It has also had little impact on what teachers tell future voters about macroeconomic policy when they enter the undergraduate classroom. From the standpoint of macroeconomic engineering, the work of the past several decades looks like an unfortunate wrong turn" (p. 44).

His main point, now joined by Solow (2008) and (in less diplomatic terms) by Krugman (2009), is that this last phase has therefore been a failure. In the view of these authors we should retreat to the previous phase of theorising and be more humble in our 'scientist' ambition. Instead a more 'engineering' type of approach is needed, in which one builds on the insights gained during the first three phases, turns to building macroeconometric models that take full account of agent heterogeneity, coordination and interaction issues and starts from a realistic view on the way people form their expectations. If, in the process one will not always be able to use proper micro-foundations, so be it. Better lesser or no micro-foundations than bad micro-foundations.

Incidentally, with regard to this last aspect, Solow (1986) remarks that Keynesian, neo-Keynesian and new-Keynesian macroeconomics always have had micro-foundations. Tobin's portfolio model of the speculative demand for money, Baumol's inventory approach to the transactions demand for money, Jorgenson's neoclassical investment theory, new-Keynesian third wave theories on the sources of price and wage rigidity, etc., all are micro-founded, albeit not embedded in a general equilibrium context in which economic agents necessarily have rational expectations. "The older rough-and-ready approach may be the best we can do, and not intolerable" (p. 197).

Howitt cites Leijonhufvud who once remarked that "the real problem of macroeconomics was [and is] to understand how order can arise from the interactions of people

following simple rules to cope with a complex environment", and contrasted it with "much of mainstream macroeconomics which postulates people using complex decision procedures to deal with a simple environment" (Howitt, 2008).

5. Conclusions

A growing body of distinguished macroeconomists feel today, in the wake of the severest economic crisis since the 1930s, that present 'mainstream' DSGE modelling is operating on a wrong track. General equilibrium Arrow-Debreu modelling was never meant to be applied in real-life situations. Solow-Ramsey-Koopmans-Cass optimal growth models were just that, not to be used in short- and medium-run real-life dynamics. Rational expectations models may, in periods of economic tranquillity, i.e. without structural breaks and phase transitions, be used as 'as-if' benchmarks for other, more realistic models. Market forms are anything but perfectly competitive. Sticky prices and wages are part of economic reality. Market externalities abound. Panics, euphoria and herd behaviour on financial markets are rules, rather than exceptions.

A truly scientific stance means that one tries to understand what is going on in the utterly complex environment of a modern economy. In the words of Mankiw, "the story is not one of deep thinkers and simple-minded plumbers" (Mankiw, 2006, p. 30). Hayek (not exactly an admirer of Keynes) in his Nobel speech puts it like this: "It seems to me that this failure of the economists to guide policy more successfully is closely connected with their propensity to imitate as closely as possible the procedures of the brilliantly successful physical sciences – an attempt which in our field may lead to outright error. It is an approach which has come to be described as the 'scientistic' attitude – an attitude which, as I defined it some thirty years ago, 'is decidedly unscientific in the true sense of the word, since it involves a mechanical and uncritical application of habits of thought to fields different from those in which they have been formed'" (Hayek, 1974).

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