8 Some scattered thoughts on DSGE models

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In recent years, a number of commentators have raised concerns and expressed their criticism over the extensive use of dynamic, stochastic, general equilibrium (DSGE) models in macroeconomics.[1] The critics' concerns seem aggravated, in their view, by the fact that such models have not been completely ignored by central banks, many of which have developed their own in-house DSGE models and have used them in forecasting and policy evaluation exercises.[2] While some of the criticisms are clearly misplaced, and reflect a lack of knowledge of recent developments in the field, the prominence of some the critics and the attention paid by the media to their views, combined with the widespread public scepticism on the usefulness of economics, have triggered some soul-searching among macroeconomists.[3] The present note offers a sample of my (evolving) views on some of these controversies.

What characterises DSGE

Let me start with a question: is there anything inherently wrong about the use of DSGE models in macroeconomics? Given the nature of macroeconomic phenomena and, in particular, of economic fluctuations, it is only natural that the models developed to explain them are dynamic, stochastic and general equilibrium. Static models would necessarily have to abstract from all intertemporal links, and could not deal with central concepts like the interest rate, investment, or budget deficits.

1 See, e.g., Krugman (2009), Stiglitz (2011), and Romer (2016), among others.

2 See, e.g., Smets *et al*. (2010)

3 See, e.g. the symposium on ""Macroeconomics after the Financial Crisis," in the Fall 2010 issue of the *Journal of Economic Perspectives.*

While the literature contains some examples of deterministic models of economic fluctuations, the nature of those models' predictions stands in the face of observed fluctuations, which have a clear unforecastable component. Finally, the widespread reliance on general equilibrium analysis follows naturally from the recognition that macroeconomic phenomena involve, by their very nature, the interaction of a large number of agents, operating simultaneously in several markets (goods, labour, financial). To put it differently, if the models developed at the frontier of macroeconomics were largely static models (or deterministic, or partial equilibrium), wouldn't that fact constitute a (natural) target of all criticisms?

Under the general heading of "DSGE models" one can find a large variety of frameworks, ranging from the early, utopian, RBC models to more recent efforts to incorporate financial frictions, heterogeneity, or learning in a baseline New Keynesian model. Anyone opposing the DSGE approach to macroeconomic modelling, understood in that broad sense, will be at pains to offer an alternative approach to become the central methodology of macroeconomics. However, it is clear that any particular model or modelling choice may be subject to criticism. That criticism, whether focused on a model's counterfactual empirical predictions or on the implausibility of some its assumptions, should remain the engine of progress in macroeconomics. Needless to say, such criticism will be particularly welcome if it is accompanied by constructive proposals to replace the elements of the model that are viewed as flawed, though this requirement is certainly not an indispensable one.

The infinitely-lived representative agent

Let me next offer a dose of criticism of my own. There are two features of standard formulations of DSGE models that I personally see as unpleasant straitjackets: (i) the assumption of an infinitely-lived representative household, and (ii) the stationarity hardwired into most existing models. Next I offer some brief thoughts about them as well as references to some recent efforts to overcome their restrictive implications.

Most macroeconomists have long viewed the assumption of an infinitely-lived representative household, which is pervasive in the literature, as both convenient and innocuous, at least so long as issues pertaining to income distribution or inequality are not the object of study, as is the case in much research on economic fluctuations.

Yet, and motivated by the extreme monetary policies observed in many advanced economies, a wave of recent papers has introduced different forms of household heterogeneity (combined with incomplete financial markets), in order to analyse a variety of issues that lie outside the scope of representative household models. They include the study of the distributional effects of monetary policy (Gornemann *et al*. 2016), the role of heterogeneity in the transmission of monetary policy (Kaplan *et al*. 2016), and its ability to explain the forward guidance puzzle (McKay *et al*. 2016), to mention only three well known examples. The ability of calibrated versions of those models to account for many dimensions of the observed distributions of income, wealth and portfolio holdings is quite impressive. The case made in those papers for the presence of a non-negligible interaction between that heterogeneity and the effects of monetary policy interventions is also pretty convincing. On the negative side, the heavy computational requirements associated with the analysis of those models and the consequent black-box nature of some of their predictions may constitute a hurdle to their widespread adoption, both in the classroom and in policy circles. An interesting avenue of research, in my view, would consist in assessing whether stylised representations of heterogeneity (e.g. in the form of two-agent models, as in Galí *et al*. 2007) might be capable of approximating the positive and normative predictions of richer models, without their heavy computational burden.

Less discussed, but equally important, are, in my opinion, the strong implications of the representative household assumption for the kind of phenomena that can (and cannot) be accounted for by standard DSGE models, beyond the inequality dimension emphasised in the abovementioned papers. Let me briefly discuss two such implications. First, the representative household's Euler equation implies a tight link between the real interest rate and the consumer's time discount rate along a balanced growth path. That relation all but rules out the possibility of a persistently negative natural rate of interest, with the consequent challenges that the latter would pose on a price-stability oriented monetary policy, due to the zero lower bound (ZLB) on nominal interest rates. Second, the assumption of an infinitely-lived representative household rules out the existence of rational bubbles in equilibrium. The reason is that the presence of such bubbles would violate the household's transversality condition, given that, in equilibrium, bubbles (i) would have to be growing at the rate of interest and (ii) would have to be held by the representative household (since there is nobody else around to hold them!).

Given the evidence on the important role played by asset price booms and busts, likely driven by bubbles, as a factor behind financial crises, it is somewhat surprising that standard models are not suitable for the analysis of such phenomena and its interaction with monetary policy.

Two recent papers provide examples of models that can speak to such issues by introducing overlapping generations of finitely-lived individuals in sticky price DSGE models. As shown in Eggertsson and Mehrotra (2014), such a framework makes it possible to analyse the implications for monetary policy of a persistent liquidity trap, resulting from a (potentially permanent) decline in the natural rate well into negative territory as a result of a deleveraging shock or a drop in population growth, among other possibilities. Using a similar framework, Galí (2014) shows that asset price bubbles may emerge in equilibria, with their fluctuations causing welfare-reducing volatility even in the absence of fundamental shocks. In that context one can analyse the implications of alternative monetary policy rules on fluctuations and welfare, since the evolution of bubbles is not independent to that of interest rates.

Departures from the assumption of an infinitely-lived representative household may have implications that go beyond the two aspects mentioned above. Thus, Del Negro *et al*. (2015) study the impact of finite-lived consumers on the so called forward guidance puzzle. Another potentially interesting research avenue, which as far as I know remains unexplored, has to do with the consequences of an overlapping-generations framework on the fiscal theory of the price level, given that, under certain assumptions, such a framework would allow for the possibility of permanent debt roll-overs in equilibrium (or, in other words, the absence of a well defined transversality condition in the government intertemporal budget constraint).

Stationarity

Let me next turn to my second concern. Standard analyses based on DSGE models generally focus on equilibria that take the form of stationary linear fluctuations driven by exogenous shocks. This is also the case in variants of those models that allow for financial frictions of different kinds and which have become quite popular as a result of the financial crisis (e.g. Bernanke *et al*. 1999, Christiano *et al*. 2014).

The introduction of financial frictions in those models often leads to an amplification of the effects of non-financial shocks. It also makes room for additional sources of fluctuations related to the presence of financial frictions (e.g. risk shocks in the reference above). Yet, the kind of fluctuations generated by those models tend to rule out, by construction, some of the more interesting macroeconomic phenomena which are associated with financial crises and which are inherently non-stationary and/or non-linear. Those phenomena include the economic and financial boom that often precedes financial crises, with a gradual build-up of financial imbalances leading to an eventual "crash" characterised by defaults, sudden-stops of credit flows, asset price declines, and a large contraction in aggregate demand, output and employment. By contrast, existing models of "financial crises" generally trace the latter to a *large exogenous shock* that impinges on the economy unexpectedly and triggers a large recession, possibly amplified by a financial accelerator mechanism embedded in the model.

A recent effort to get rid of the linearity *cum* stationarity straitjacket, albeit in the context of a real model, can be found in Boissay *et al*. (2016). In that paper the authors analyse a model with asymmetric information in the interbank market, in which a sequence of small shocks pull an economy towards a region with multiple equilibria, including equilibria characterised by a freeze in the interbank market, a credit crunch and a prolonged recession. Needless to say, I believe this is an area where a lot of work remains to be done, ideally in the context of monetary models, and possibly in conjunction with the abovementioned efforts to introduce asset price bubbles.

In his recent piece on DSGE models in this volume[4], Olivier Blanchard concludes that while "there are many reasons to dislike current DSGE models…[but] they are eminently improvable and central to the future of macroeconomics." I wouldn't know how to disagree.

4 Blanchard (2016)

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