Journal of Economic Dynamics & Control 69 (2016) 375–408

Contents lists available at ScienceDirect

Journal of Economic Dynamics & Control

journal homepage: www.elsevier.com/locate/jedc

Agent based-stock flow consistent macroeconomics: Towards a benchmark model

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ARTICLE INFO

Article history:
Received 26 June 2015
Received in revised form
11 February 2016
Accepted 5 June 2016
Available online 16 June 2016

JEL classification:
E03
E32
O30

Keywords:
Agent based macroeconomics
Stock flow consistent models
Business cycles
Bank regulation

ABSTRACT

The paper moves from a discussion of the challenges posed by the crisis to standard macroeconomics and the solutions adopted within the DSGE community. Although several recent improvements have enhanced the realism of standard models, we argue that major drawbacks still undermine their reliability. In particular, DSGE models still fail to recognize the complex adaptive nature of economic systems, and the implications of money endogeneity. The paper argues that a coherent and exhaustive representation of the inter-linkages between the real and financial sides of the economy should be a pivotal feature of every macroeconomic model and proposes a macroeconomic framework based on the combination of the Agent Based and Stock Flow Consistent approaches. The papers aims at contributing to the nascent AB-SFC literature under two fundamental respects: first, we develop a fully decentralized AB-SFC model with several innovative features, and we thoroughly validate it in order to check whether the model is a good candidate for policy analysis applications. Results suggest that the properties of the model match many empirical regularities, ranking among the best performers in the related literature, and that these properties are robust across different parameterizations. Second, the paper has also a methodological purpose in that we try to provide a set or rules and tools to build, calibrate, validate, and display AB-SFC models.

1. Is the economic crisis a crisis for macroeconomics?

More than eight years since the onset of the global financial crisis we are still assessing how the crisis should change our view about macroeconomics. The crisis cast serious doubts on the plausibility of standard macroeconomic models – in particular of dynamic stochastic general equilibrium (DSGE) models – and their ability to provide effective policy advices to prevent the occurrence of large-scale economic turmoils, and to tackle their consequences.

In a nutshell, the anatomy of the standard DSGE model presents an economy composed of different types of representative agents, such as households and firms, maximizing in a infinite lifetime horizon an objective function subject to an inter-temporal budget constraint. The first order conditions yield a fully state-contingent plan for the representative agents

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http://dx.doi.org/10.1016/j.jedc.2016.06.001
0165-1889/

choice variables (e.g consumption/saving and hours dedicated to work/leisure for the consumer) looking forward from the planning date into the foreseeable future, depending on agents' expectations. Rational expectations are assumed, implying that representative agents know the "true model" of the economy, thereby having an optimal plan in response to exogenous shocks that may buffet the economy.[1]

To reduce the computational burden, models are usually solved using log-linearization, allowing to approximate a system of nonlinear equations into a system which is linear in terms of the log-deviations from steady state values of the associated variables (see Zietz, 2008).

One of the strongest criticisms risen against this framework in the aftermath of the crisis was centered on its alleged inability to deal with non-linearities characterizing real world behaviors and economic dynamics. In particular, the common practice of using log-linearization around the steady state forcibly imposed a stability condition on the system which eliminates the possibility of multiple equilibria, sudden state transitions, and tipping-point phenomena (Rubio-Ramirez and Fernandez-Villaverde, 2004).[2] Furthermore, since the quality of the log-linearized approximation deteriorates as we move away from the steady state (Amisano and Tristani, 2007; Brunnermeier and Sannikov, 2014), this hinders its efficacy in assessing the consequences of big shocks.

In response to these limitations, several DSGE models started to incorporate different types of non-linearities in their models, while an increasing number of contributors have adopted non-linear solution methods (see Borogan Aruoba et al., 2006 for a review of these methods): non-gaussian shocks (Andreasen et al., 2013), "smooth" non-linearities (Borogan Aruoba et al., 2013) based on curved and asymmetric decision rules, and "piecewise" non-linearities arising from kinks in decision rules (e.g. zero lower bound on nominal interest rates) are some of the expedient adopted in the recent literature. However, efforts to take the lesson of the crisis on board have mainly gone in the direction of including in the models a financial sector and "financial frictions" Brunnermeier et al. (2012) in the wake of the seminal contributions of Bernanke and Gertler (1989) and Kiyotaki and Moore (1997). Formally, financial frictions emerge when trade in certain assets cannot take place because markets are incomplete. This may happen because there is no market at all for certain state-contingent assets, or because parties are not willing to engage in certain contracts because of agency problems, arising from limited enforcement power or information asymmetries (Quadrini, 2011). In both cases, agents are unable to anticipate/postpone spending (for consumption or investment), or insure against uncertain events (to smooth consumption or investment), thus being unable to enforce their optimal state-contingent plan.

The bulk of DSGE models dealing with financial frictions typically focus on some credit constraint, limiting the amount of debt financing on the base of borrowers' collateral value, or equity constraint (Brunnermeier and Sannikov, 2014). Financial frictions can limit the flow of funds among agents, in particular towards productive "expert" agents who must borrow to pursue their investment plans. An initial small shock to expert agents' net worth can be amplified through endogenous feed-backs if productive agents are forced to fire-sell their capital thus triggering a vicious loop between drops in assets prices and drops in collateral value, which feed instability.

There is no doubt that modern DSGE models are far more complex than usually thought and that the literature on financial frictions has greatly improved their ability to mimic non-linearities and to account for episodes of financial fragility. Nonetheless, we feel that this stream of literature is still affected by major drawbacks which, if not sufficient to argue in favor of a complete demise of DSGE models, justify the quest for alternative approaches to macroeconomic modeling.

On the one hand, the new remedies do not solve, nor address, many of the old pathologies plaguing the DSGE literature: the "olympic rationality" assumption underlying rational expectations; the reduction of agent' behaviors' to a problem of inter-temporal optimization based on technology and idle homothetic preferences (Simon, 1976); the flaws in the empirical and theoretical definition of the CES utility function and the Cobb–Douglas production function (Shaikh, 1974); the restrictive hypothesis applied to preferences and technology in order to find an internal solution to the agents' optimization problem. These are some of the unresolved issues undermining the very foundation of DSGE models. All in all, the representative agent approach at the base of DSGE models is still inherently affected by the "fallacy of composition" in taking that what is true for individual agents must also be valid for the whole economic system (Delli Gatti et al., 2010a).

Even apart from these criticisms, there is another fundamental reason to depart from the DSGE literature: though being now able to mimic non-linear dynamics, DSGE models still rely on external shocks to explain the origin of those non-linearities. Admittedly, financial frictions DSGE models still fail to understand the inherent nature of finance and money (Werner, 2014, 2015). Most of these models either assume that banks are totally absent and all lending is direct, or adopt the loanable funds approach which reduces the role of financial institutions to mere intermediaries, accepting deposits of pre-existing real resources from savers and lending them to borrowers. In reality banks do not intermediate, but rather create additional means of payment ex-novo by granting loans to non-bank customers. Every new loan recorded on the asset side of the bank's balance sheet is immediately offset by a matching liability in the form of a new deposit, so that the loan creation process corresponds to an expansion of the bank's balance sheet.

[1] Although this framework was common to both RBC and New Keynesian DSGE models, the latter diverge in admitting that prices may not immediately adjust to clear the market, due to market imperfections (i.e. prices rigidities and monopolistic competition) and information asymmetries, possibly leading to market failures and sub-optimal social configurations.

[2] Indeed, a by-product of the log-linearization approximation of a DSGE model is that, whenever a shock hit with an additive random disturbance, the system behaves in either a strong stabilizing manner or in a totally explosive way. The common practice is then suggested to simply rule out the unstable paths from the linearized model.