How much progress has the mainstream made? Evaluating modern DSGE models from a Post-Keynesian perspective

Sebastian Dullien, HTW Berlin – University of Applied Sciences[1]

- Preliminary version, May 2017 -

Abstract:

This paper evaluates recent advances in the formulation of dynamic stochastic general equilibrium (DSGE) models against the criticism raised against this model class from Post-Keynesian authors. A specific focus is put on the modelling of the effects of fiscal policy, of involuntary unemployment and the role of the financial sector in the economy. It is found that despite improvements in the empirical fit and the plausibility of propagation methods in DSGE models, the underlying structure of these models remains highly problematic from a (Post-)Keynesian perspective.

Keywords: Post-Keynesian economics, DSGE, austerity, financial sector

JEL codes: A11, B50

1 Introduction

There has been a long-standing dispute among Post-Keynesians in how far they should interact with more orthodox economists and their ideas. Lee (2012) and Vernengo (2010), for example, argue against this notion and call for Post-Keynesians to rather invest their time and effort into the development of their own theoretical edifice instead of wasting time interacting with mainstream economists. In contrast, David Colander has repeatedly urged heterodox economists to engage more with the mainstream and present their ideas in modelling frameworks used by mainstream

[1] Sebastian.dullien@htw-berlin.de

economists (Colander, 2010; Colander et al., 2010). Fontana and Gerrard (2006) also call for the use of up-to-date and rigorous mathematical models usually used by the mainstream.

Linked to this strategic debate is the more limited question on how to deal with dynamic stochastic general equilibrium (DSGE) models, the mainstay of modern macroeconomics (also sometimes dubbed as "New Consensus Models"). DSGE models are nowadays widely used by central banks and international organizations, and despite some recent heated debate among mainstream economists of their merits (Blanchard, 2016; Krugman, 2009; Romer, 2017; Solow, 2010; Wickens, 2014; Wren-Lewis, 2016), a majority of mainstream macroeconomist still follow the "useful aphorism" brought forward by Chari (2010) that "[i]f you have an interesting and coherent story to tell, you can tell it in a DSGE model. If you cannot, your story is incoherent."

Again, along the lines of the more general debate on dealing with the mainstream, some of the Post-Keynesians have tried to actively engage with the "New Consensus Model" and have tried to look for common ground between Post-Keynesians and New Keynesians using DSGE models. The collected volume by Fontana and Setterfield (2010) and some of its contributions is a prime example for this approach. In contrast, other Post-Keynesians have been rather critical towards DSGE models. King (2012, p.3) for example calls DSGE models "in fact a travesty of Keynes, eliminating the principle of effective demand failures". Dullien (2011) uses the image of a Trojan horse in the context of DSGE models and their representation of Keynesian ideas and Lavoie (2016) concludes that, just as the new classical framework, the DSGE framework "just has not survived to the test of time. It must go away."

These harsh conclusions might seem surprising, as, at the same time, when it comes to policy conclusions, DSGE models have converged towards Post-Keynesian arguments: For example, while early DSGE models were not able to mimic traditional Keynesian effects of government spending on output, private consumption and employment, modern versions which combine households following rules-of-thumb in their consumption decision with financial market imperfections now predict austerity to be clearly harmful to economic output and employment (Rannenberg et al., 2015), and some DSGE models now even are able to predict negative effects of growing income inequality (Grüning et al., 2015).

Hence, the relevant question from a Post-Keynesian perspective is whether these new advances in the DSGE world might actually make them more acceptable and render the conclusions from Dullien (2011), King (2012) and Lavoie (2016) at least partially invalid.

This paper is trying to answer this question. This paper is structured as follows: In section 2, it will review the problems of first-generation DSGE models from a Post-Keynesian perspective. Section 3

will then present some of the more recent improvements of DSGE models. Section 4 will evaluate these advances and section 5 concludes.

2 Problems with first-generation DSGE models

In order to understand what the merits of DSGE models are, one needs to have a basic understanding of the underlying structure and mechanisms. The following subsection is summarizing the most relevant equations and features without going too much into the mathematical details. These can either be found in one of the standard expositions of DSGE models such as Galí (2008) or in the more critical discussion by Dullien (2011).

2.1 Basic structure of DSGE models

While literally hundreds of DSGE models exist today with different details and degrees of complexity, they all have a number of characteristics in common, some of them are even reflected in the very term. First, DSGE models are *dynamic*. In the tradition of RBC models, they usually start from the individual utility function of a rational, representative agent who tries to maximise his utility over an infinite horizon varying labour supply and demand for consumption goods in each period. Second, DSGE models contain a *stochastic* element: A usual research approach is to check how the model behaves (and finds back to its equilibrium) after it is hit by a stochastic shock. Third, DSGE models are *general equilibrium models*: All markets, including the labour and goods markets, are always in equilibrium. As we will see later, this is a crucial characteristic.

More technically, the representative agent is usually considered to have a utility function in the form of

$$E_t\left\{\sum_{t=0}^{\infty}\beta^t\left[u\left(C_t\right)+v\left(\frac{M_t^n}{P}\right)-\gamma\left(N_t\right)\right]\right\}\Rightarrow \max \tag{1}$$

with β as the discount factor, $u(.)$ as the (positive) utility derived from consumption, $v(.)$ as the utility derived from holding real balances and $\gamma(.)$ as the disutility from working. C_t denotes consumption in period t, M_t the nominal money holdings, P_t the price level and N_t the individual labour supply in period t.

The utility function is maximised varying consumption, labour supply and money holdings under a temporal budget constraint and a non-Ponzi conditions. Optimising and log-linearizing around the

steady-state gives us the following path for consumption over time (with c_t and c_{t+1} as the log deviation of consumption from steady-state consumption):[2]

$$c_t = E_t c_{t+1} - \frac{1}{\sigma}\left(i_t - E_t \pi_{t+1} - \rho\right) \tag{2}$$

i_t here denotes the log of the gross yield on a one-period bond that can be interpreted as the nominal interest rate for reasonable low values of the interest rate (Galí, 2008, p.18). ρ is the rate of time preference and defined as $\rho \equiv -\log \beta$.

Firms in standard DSGE models are monopolistically competitive as has been proposed by Dixit and Stiglitz (1977), based on a constant elasticity of substitution utility function. Given that the household thus values variety and only sees the different goods as imperfect substitutes, firms have some pricing power. Each firm is thus faced with a downward-sloping demand curve.

In addition to monopolistic competition, DSGE models usually contain some kind of staggered price setting. Usually, the approach used by Calvo (1983) is applied. In each period, a firm is only allowed with a certain probability to reset its price. Given the knowledge of this restriction, firms are now trying to set their prices in a way that maximises profits over an infinite price horizon, trying to get their expected price close to the expected profit-maximising price as defined above. Inflation in this context appears because those firms able to reset their prices will do so which results in a change of the aggregate price level. As Galí (2008, p.45) derives, one gets for the price equation around the zero-inflation steady state as a mark-up over (weighted) current and expected future nominal marginal costs plus an inflation-expectation component:

$$p_t^* = \mu + \left(1 - \beta\theta\right) \sum_{k=0}^{\infty} \left(\beta\theta\right)^k E_t \left\{ mc_{t+k|t} + p_{t+k} \right\} \tag{3}$$

with β again denoting the discount factor, μ being defined as the log of $\frac{\varepsilon}{\varepsilon - 1}$ and mc being defined as the log of marginal costs.

To the above equations, the assumptions of constant market-clearing is added, both in the goods and in the labour market. Since there is no capital investment and no government sector in the baseline model, market clearing for the goods market requires that consumption demand equals production,

[2] For details on the process of log-linearization, see Galí (2008, 35ff).

giving one an equation showing the deviation of current output from steady state output, which can be rewritten in terms of the output gap y_t and the natural rate of interest r_t^n:

$$y_t = E_t y_{t+1} - \frac{1}{\sigma}\left(i_t - E_t \pi_{t+1} - r_t^n\right) \tag{4}$$

This is what is often referred to as the New Keynesian IS-curve and is one of the three central reduced-form equations of the DSGE models.

Adding the assumption for market clearing in the labour market, after a few mathematical manipulations[3] one gets for the inflation dynamics:

$$\pi_t = \beta E_t \pi_{t+1} + \kappa y_t \tag{5}$$

This equation is also often referred to as the *New Keynesian Phillips Curve* or NKPC. It is the second of the three central equations of the DSGE models.

However, the NKPC and the New Keynesian IS-curve by themselves do not form a stable system. In order to keep the system from exploding paths in case of a shock, a central bank reaction function has to be added which relates the short-term interest rate to inflation and the output gap. Usually, a rule of the following form is chosen:

$$i_t = r_t^* + \varphi_\pi \pi_t + \varphi_y y_t \tag{6}$$

This monetary policy reaction function is the third of the three central equations of a DSGE model. This function can be easily rewritten to have the functional form of a traditional Taylor rule for monetary policy which is often presented as:

$$i_t = r_t^* + \alpha_\pi \left(\pi_t - \pi_t^*\right) + \alpha_y \left(y_t - y_t^*\right) \tag{7}$$

Thus, many DSGE models depict the actions of a central bank only by the short-term interest rate. An explicit money supply, in contrast, is not included. However, one can easily introduce a money supply into the model. In this case, m_t^S is defined as the log deviations of money holdings from the steady state and one gets the money supply as being an endogenous function of the utility derived from holding money, the nominal interest rate set by the central bank and the expected inflation:

$$m_t^S = -\frac{1}{\nu}\left(i_t - E_t \pi_t + 1\right) \tag{8}$$

[3] We do not go into the algebraic steps for this part but again refer to Galí (2008) for details.

To apply this model, the model equations are log-linearized around the steady state. Next, the model is calibrated to fit empirical time series data. In this process the underlying parameters of the model (including microeconomic parameters of the utility function or the price-setting process) are chosen in a way that the time series the model outputs (and especially their correlations) have a reasonable resemblance to empirically observed time series. In a final step, if used for policy analysis, policy shocks are included in the model to evaluate the relative merits of alternative policy rules.

2.2 Advantages over New Classical and Monetarist approaches

Those among the Post-Keynesians who have argued in favour of getting into a dialogue with DSGE/New Consensus researchers and who have tried to link their own research to it have usually claimed that these models are a step forward compared to models in the New Classical or Monetarist traditions and hence deserve a more positive reception than the former. In fact, some of the elements of the DSGE models seem much closer to Post-Keynesian beliefs than elements of New Classical models.

For example, DSGE models had incorporated a monetary policy framework similar to that which many Post-Keynesians had argued in favour of for a significant time: That the central bank does not set the money supply, but manipulates the short-term interest rate in order to influence aggregate demand in the economy. Also, transmission of monetary policy in DSGE models runs (mainly) through interest rates influencing individual behaviour, not through real balance effects as in a number of monetarist and New Classical models. The endogeneity of the volume of the money supply in DSGE models also might have proved as an appealing feature, even if the money supply process has not been modelled in a Post-Keynesian way (see below).

Related to this, in DSGE models, actually an active central bank is necessary to stabilize the model. Without a monetary policy rule as described in (6) and significantly large parameters φ_π and φ_y , the system would become unstable – also a stark departure from traditional Monetarist and New Classical models which often had prescribed central banks to remain passive in the wake of shocks to the economy.

Finally, some of the Post-Keynesians might have felt a certain familiarity with some of the reduced-form macroeconomic equations coming out of the micro-foundations of the model. For example, at first sight, the “New Keynesian IS curve” in (4) looks similar to a traditional IS-curve, even though it is economically something completely different, as this New Keynesian version does not relate final aggregate demand to current income, but to *future* income and is therefore more of a representation of the permanent income hypothesis than of a Keynesian consumption function which link consumption to current income.

2.3 Problematic features

One of the key criticisms from the Keynesian and Post-Keynesian side brought up against DSGE models has been that the underlying mechanisms which leads to fluctuations in employment is rather implausible and is not at all compatible with a traditional Keynesian or Post-Keynesian understanding of business cycle fluctuations.[4] In (first-generation) DSGE models, the labour market always clears. Fluctuations in employment (which the models mimic due to the calibration process) are entirely a result of household decisions to vary their labour supply due to changes in the real wage, which in turn varies strongly over the cycle due to fluctuations in the nominal wage (while prices are relatively stable). If real wages increase from their steady state value, households decide to temporarily work longer hours, hence pushing up equilibrium employment. When real wages fall, households temporarily enjoy more leisure. They hence substitute labour in the current period against leisure time in the future. Involuntary unemployment in the Keynesian sense is not possible in these models.

While by itself, for Post-Keynesians, the conclusion that all unemployment is voluntary is already hard to swallow, this modelling approach is linked to two more problems: First, some of the "deep" parameters in the model (e.g. the parameters of the utility function) are usually far away from anything one can find in microeconometric studies. This is especially problematic for the assumed intertemporal elasticity of labour supply (which determines how much individuals vary their labour supply from period to period in reaction to fluctuating real wages). As Chetty et al. (2011) argue, quasi-experimental estimates of intertemporal substitution extensive margin elasticities (that is on the decision whether to supply labour at all or not) are around 0.25 while DSGE models usually assume elasticities around 2.[5] While of course, evidently wrong assumptions are often made in economic models, it is problematic that you need an assumption so blatantly wrong at a point in the model which is crucial for explaining one of the central features of macroeconomic fluctuations. (Would you trust a physical model which researchers use to explain cloud formation, but which needs to assume that water freezes at 100 degrees Celsius?)

Second, the first-generation DSGE models have turned the fixed-wage assumption of the neoclassical synthesis on its head and have made it even less plausible: In the framework of the neoclassical synthesis, it was sometimes assumed that wages are fixed and hence changes in the price level lead to changes in real wages. In the (basic) DSGE models now, prices are usually only adjusted with a delay while nominal wages are flexible, leading to a pro-cyclical movement of real wages. Again, this

[4] See i.e. Dullien (2011), Lavoie (2014) or King (2012).

[5] While there have been a number of attempts to model the labour market slightly differently to match the assumed elasticities with those empirically observed, all of these attempts are generally been regarded as not satisfactory. See Kelly/Warren (2015).

runs counter to the empirical observation that usually wage contracts run much longer and wages are less often adjusted than prices (Druant et al., 2009).

A further major issue about the early DSGE models is the effect of fiscal policy. In principle, some of the conclusions from first-generation DSGE models on the impact of debt-financed deficit spending would be in line with Post-Keynesian thinking: In contrast to the conclusions from New Classical models (which often came to the conclusions that fiscal policy was completely ineffective in influencing output and employment), in the first-generation DSGE models, debt-financed increases in government spending generally lead to an increase in output and employment. The problem is again that the mechanism by which this happens is highly questionable, as the effect does not come through an income multiplier known in traditional Keynesian models. Instead, these models feature a *drop* in private consumption as a reaction to an increase in government spending. The mechanism behind this is similar to early attempts to introduce fiscal policy into the RBC models as that by Baxter and King (1993). As individuals have infinite horizons and rational expectations and the government is forced to respect its inter-temporal budget constraint, any debt-financed increase of government spending leads to higher taxes in the future. This in turn is seen by individuals as a reduction of their lifetime income, to which they react by cutting back both their consumption and their enjoyment of leisure time. Hence, they supply more labour which – by the assumption of labour market clearing – leads to more employment and more output (but less consumption expenditure).

In addition, while the money supply in DSGE models is technically endogenous in the sense that it is not set exogenously by the central bank, the mechanism is completely different from that usually discussed in the Post-Keynesian tradition: In DSGE models, the money supply is just set so that the desire for the holding of real balances by the households is satisfied at the central banks' target interest rate. Post-Keynesian theory, in contrast, usually sees endogenous money as a result of the complex interaction of the financial system, households and central banks in the money creation process (Lavoie, 2014).

Finally, the lack of convincing modelling of asset price bubbles in DSGE models has been criticized. As Miao (2016) points out, DSGE models usually feature a unique deterministic steady state. Combined with rational expectations of investors, it is extremely difficult to model why asset prices should for an extended period of time deviate from their fundamental value. It is hence not very surprising that attempts to model asset price bubbles convincingly in this model class have so far failed.[6] The lack of any possibility for asset price bubbles is especially problematic from a Post-Keynesian perspective as

[6] It is no coincidence that the contributions in the 2016 special issue on „Bubbles, multiple equilibria, and economic activities" of the journal *Economic Theory* generally use non-DSGE approaches for modelling bubbles.

irrational developments in financial markets have long been a central tenet of Post-Keynesian theory (Lavoie, 2014).

3 Advances in DSGE-modelling

Especially since the global financial and economic crisis of 2008/9, DSGE modellers have made a lot of effort expanding their models to address some of the criticism. By now, DSGE models manage to gauge much more of the effects of fiscal policy, and a large number of papers is concerned with financial sector issues. The following subsections will briefly outline in how far these changes alter the above discussed criticism.[7]

3.1 Making fiscal policy relevant: Rule-of-thump-consumers

The standard method of making fiscal policy having a larger impact on output and employment in DSGE models is the introduction of rule-of-thumb consumers who do not have access to financial markets and hence cannot save or borrow, but also spend all their current income for consumption. As Galí et al. (2007) show, if a significant share of individuals is of this type, the DSGE models' results get closer to the traditional Keynesian conclusion of both output and private consumption moving in sync with debt-financed government spending. The mechanism here is as follows: If the government increases government spending and borrows, now only the rational consumers cut back on their private consumption. The rule-of-thumb consumers in contrast continue to spend all their income on consumption. What is more, the additional demand by the government leads to increasing labour demand and hence higher nominal (and real) wages. Households react to this wage increase by supplying more labour, hence pushing up output and employment.

As the first generation DSGE models were widely off the mark in predicting the multipliers of fiscal policy in the economic crisis of 2008/9, by now, most of the state-of-the-art DSGE models include such rule-of-thumb-consumers and hence include larger fiscal multipliers. However, even when assuming that a large share of the households is of the rule-of-thumb-variety, by itself this usually is not sufficient to match the models' data output to empirical observation. For example, Rannenberg et al. (2015) assume that about half of the households are of the rule-of-thumb variety and still need to add a financial accelerator (see also below) in order to get realistic reactions of their models to fiscal policy.

[7] In fact, fully-fledged modern DSGE models used for policy evaluation such as Christoffel et al. (2008) usually include a host of other elements and complications, such as imperfect wage adjustment, production with imported and foreign intermediate goods and explicit modeling of capital stock dynamics. In this section, I will focus on the rule-of-thumb-consumers and the formulations of financial market frictions as they are more relevant for the Post-Keynesian critique.

3.2 Involuntary unemployment

Some recent contributions such as Galí et al. (2012) have tried to counter the criticism of the absence of involuntary unemployment by refining the labour market modelling in the model. Specifically, they introduced differentiated types of labour, and staggered wage setting and combined this with unions negotiating wages for specific types of labour. The result is that under such formulations, real wages can end up above the market-clearing level which in turn leads to unemployment.

In Galí et al. (2012), labour is heterogenous, and each (large) households has a member of each type of labour. Income within the households is shared between the members. Only part of the wage contracts can be reset each period, and unions set wages for each type of labour, maximising household utility. As unions have market power, they set the wage too high for market clearing. As labour can only be varied in the model by assumption in the extensive margin (that is, only by the number of people working, not by the number of hours), part of the population ends up unemployed.

While this approach introduces something which the authors call "involuntary unemployment" into a DSGE model, it has been heavily criticised in the DSGE community itself. Christiano (2012) for example criticises that in the model, the utility of unemployed within a household is higher than that of household members who work, contradicting the empirical experience of unemployment being related with unhappiness and even psychological problems. Moreover, depending on the specific detail of the household labour supply process, it is questionable whether anyone will actually be unemployed in the sense that they are actually looking for a job. Finally, applied to U.S. data from the 1960s onwards, the model would explain the increase of unemployment in the 1970s and 1980s with an increase of union wage setting power, while during this period, union density in the U.S. actually fell.

3.3 Including the financial sector

Since the onset of the global financial crisis in 2007, the literature on financial sector frictions in DSGE models has proliferated.[8] By today, most modern DSGE models include some kind of financial frictions. The most widely used approach is a so-called "financial accelerator" based on Bernanke and Gertler (1995) and Bernanke et al. (1999). In this approach, businesses might need to obtain funds from financial intermediaries if they plan to invest more than what they can by using internal funds. As there is information asymmetry between financial intermediaries and these businesses, external finance is more expensive than internal finance, and the risk premium for external finance varies with available collateral. On the microeconomic level, in situations in which profits fall, the firms' value

[8] For a good survey, see Brázdik et al. (2012).

and hence the value of available collateral falls, making external finance gets more expensive. In the case of an (economy-wide) negative shock, the net present value of the business sector as a whole falls. As this depresses its collateral available, the risk-premium for external finance increases, making investments less attractive. The risk-premium hence becomes counter-cyclical, increasing in a recession and falling in a boom, leading to amplified investments in a boom and depressed investments in a period of weak economic activity. Adding an additional delay to investment and some price stickiness, Bernanke et al. (1999) show that investment and output now shows a much stronger reaction to shocks and that these reactions now fit better stylized facts found in empirical business cycle data.

Another important approach has been proposed by Gertler and Karadi (2011). The two authors model an information asymmetry between depositors and financial intermediaries. As a consequence, financial intermediaries can only obtain funds easily as long as they present adequate collateral. A shock which lowers the quality of their portfolio can lead to a shortage of collateral, a fire-sale of assets causing a further depressing capital value and as a consequence depressed lending and hence capital investment, pushing the economy into a deep recession. Building on this approach, but adding the assumption of (partial) illiquidity of certain assets, Gertler and Kiyotaki (2011) come to similar conclusions, showing how a DSGE model can exhibit strong reactions to negative shocks to the balance sheets of financial intermediaries as well as to changes in the liquidity of certain assets.

4 Evaluation of these advances

So, how are these advances to be judged from a Post-Keynesian (or a traditional Keynesian) point of view?

Obviously, all the bells and whistles attached to the basic DSGE model have improved the empirical fit of the models to past data. However, the question is in how far these improvements in empirical fit actually make the model better models to explain the workings of real-world macroeconomies. One issue here is that it should be surprising if models which were explicitly adjusted to grasp the developments during the global financial and economic crisis were not exhibiting a decent fit for the time series of this historical period. Hence, a proper empirical test of these models can only be conducted over time, and preferably during the next recession and crisis.

In the meanwhile, the models need to be assessed against the theoretical criticism raised against the first generation of DSGE models discussed in section 2.3. Here, the judgement is not entirely positive. One fundamental problem is that fluctuations in output and employment in the modern DSGE models still mainly come from variations of households' labour supply to changes in the real wage. While initial shocks are amplified and propagated by information asymmetries in the financial sector,

the main mechanism how they lead to fluctuations in employment remain the same: These shocks usually lead to a fall in aggregate demand. This fall in aggregate demand translates to a fall in the demand for labour and a fall in nominal and real wages, which in turn induce households to cut back their labour supply.

When it comes to the working of fiscal policies, one needs to state that the parameters for the rule-of-thump households necessary to produce responses of output and employment in line with time-series observations seem way off anything observed empirically. While empirically, at least in developed countries, virtually no households exist without a bank account (in which there are no restrictions for saving money, even if some households might be credit-constrained), the standard DSGE models need to assume that about half of the households do not have access to financial markets and hence can neither save nor borrow.

Of course, one could interpret the fact that some households do not have access to financial markets as a metaphor for households just following a simple rule of adjusting consumption to current income, not permanent income. However, this approach again leads to consistency issues: First, why should households optimise precisely their intertemporal labour supply in reaction to small fluctuations in the real wage while they are always spending all their income in the period they receive it? Not being able to save makes the assumption of high elasticities of intertemporal substitution between labour and leisure usually used in DSGE models even more questionable, as individuals cannot use the additional income from an additional hour of labour supply to increase consumption at a time when the marginal value of consumption is maximised, in effect lowering the utility of additional labour income. This is issue is especially bothersome as the idea of DSGE models was to provide a rational micro-foundation for agents' behaviour, yet in these new variants of this model class, a certain behaviour is just proclaimed which even runs counter to standard microeconomic arguments (usually, one would assume significant adjustment costs of labour supply, but very few costs of smoothing consumption which should prevent agents from only optimising their labour supply decision without also optimising their consumption decision).

When it comes to the explanation of involuntary unemployment, the additions to the DSGE models discussed above do not seem as a large improvement from a (Post-)Keynesian perspective: Unemployment is now explained by unions exploiting their wage setting power. In addition to being more of a traditional classical explanation for unemployment, the resulting data also seems to be rather implausible when checked against other stylized facts known about the labour market. Moreover, while this formulation introduces some kind of involuntary unemployment into DSGE models, it still leaves the basic premise untouched that most of the fluctuation in employment in the model stems from households' reactions to changes in real wages.

When it comes to modelling the financial sector, again, clearly some progress can be stated. Information asymmetries as proclaimed by the recent DSGE contributions are clearly present in the real world, and most Post-Keynesians would probably agree that these information asymmetries can have *some* effect on both the behaviour of agents in financial markets and macroeconomic variables. However, the question is whether these additions really capture the most important dynamics of the financial sector. One problem is that many of the financial sector frictions modelled lead to *symmetrical* reactions of the model to exogenous shocks. For example, most of the work on external finance premium as those building on the financial accelerator by Bernanke et al. (1999) lead to a pro-cyclical magnification of aggregate demand: In an upswing, capital investment is much stronger than one would have expected in standard DSGE models while in a downturn, capital investment is much weaker. While these alterations make the overall movements of capital investments more realistic, they fail to capture the asymmetrical pattern usually observed in a business cycle, with many years of increasingly strong expansions, ended with a usually abrupt and rather strong fall in activity (what we usually call a recession). Some of the DSGE papers overcome this problem by demonstrating that in interaction with monetary policy at the lower zero bound for interest rates, the financial accelerator might produce asymmetric overall reactions of the economy to certain shocks. Yet, this solution is of limited persuasiveness, as the basic observation of asymmetric reactions of the financial sector in periods of upswing or downswings has been present in business cycles even when interests were in a safe distance from the zero lower bound.

Another problem from the Post-Keynesian perspective is that the basic vision of the business cycle as the reaction of an economy in steady-state having been disturbed by an exogenous shock remains unaltered even in the new DSGE models. This vision is fundamental different from the ideas present in many Post-Keynesian works such as that of Minsky (1982; 1986) that the business cycle is a an *endogenous* phenomenon, driven by endogenous changes in investors' and financial intermediaries' animal spirits who become exuberant in the boom part of the business cycle and overly careful in the subsequent bust.

A final, but related problem is that so far, as mentioned above, no convincing modelling of asset price bubbles has been modelled for DSGE models. The problem here is that it is very difficult to come up with a convincing story for asset price bubbles if investors have rational expectations, and that investors having rational expectations and hence financial markets being efficient is one of the key building blocks of DSGE models.

5 Conclusions

By and large, DSGE models are hence now better in fitting their simulated time series to empirical observations. Many of the mechanisms proclaimed to be at work in new DSGE models at least seem to be partially plausible, and are certainly more so than the key mechanisms in place in first-generation DSGE models.

However, from a Post-Keynesian perspective, the fundamental problems of these models, mainly their focus on households' decision to intertemporally vary labour supply as the main mechanism to explain variations of employment over the business cycle and the central assumption of efficient financial markets, have not been addressed.

From a more general philosophy-of-science-perspective, one needs to ask whether the recent additions to DSGE models can really be seen as progress or rather has to be regarded as a step back. The improved empirical fit has been made at the expense of simplicity and the coherence of the model framework. Originally, the proclaimed advantage of DSGE models was that all the agents' decisions were soundly based on microeconomic utility optimization. The new models now have replaced this approach with a combination of some strictly optimising elements and some non-maximising elements. The mixture of maximising and non-maximising elements does not seem to follow any higher logic, but certain non-maximising features are declared ad hoc, even if they contradict empirical observation about the assumed structures of the economy. The only justification of these elements seems to be that their inclusion somewhat improves the overall empirical fit of the model.

Thus, despite all of the progress, the fundamental criticism of Dullien (2011), King (2012), and Lavoie (2016) remains valid and Post-Keynesian (and traditional Keynesian) researchers are well advised to keep a critical distance to DSGE models.

6 References

Baxter, M. and King, R.G. (1993) 'Fiscal Policy in General Equilibrium', *The American economic review*, Vol. 83, No. 3, pp.315–334.

Bernanke, B.S. and Gertler, M. (1995) 'Inside the Black Box: The Credit Channel of Monetary Policy Transmission', *Journal of Economic Perspectives*, Vol. 9, No. 4, pp.27–48.

Bernanke, B.S., Gertler, M. and Gilchrist, S. (1999) 'The financial accelerator in a quantitative business cycle framework', in , *Handbook of macroeconomics : {{}}*, Elsevier, Amsterdam [u.a.], pp.1341–1393.

Blanchard, O. (2016) *Do DSGE Models Have a Future?*

Brázdik, F., Hlaváček, M. and Maršál, A. (2012) 'Survey of research on financial sector modeling within DSGE models: What central banks can learn from it', *Finance a úvěr - Czech Journal of Economics and Finance*, Vol. 62, No. 3, pp.252–277.

Calvo, G.A. (1983) 'Staggered prices in a utility-maximizing framework', *Journal of monetary economics*, Vol. 12, No. 3, pp.383–398.

Chari, V.V. (2010) *Testimony before the Committee on Science and Technology, Subcommittee on Investigations and Oversight, U.S. House of Representatives, July 20, 2010*.

Chetty, R., Guren, A., Manoli, D. and Weber, A. (2011) 'Are micro and macro labor supply elasticities consistent?: A review of evidence on the intensive and extensive margins', *The American economic review*, Vol. 101, No. 3, pp.471–475.

Christiano, L.C. (2012) 'Comment', *NBER Macroeconomics Annual*, Vol. 26, No. 1, pp.361–380.

Christoffel, K., Coenen, G. and Warne, A. (2008) *The New Area-Wide Model of the euro area: a micro-founded open-economy model for forecasting and policy analysis*.

Colander, D. (2010) 'Moving beyond the rhetoric of pluralism: suggestions for an "inside-the-mainstream" heterodoxy', in Garnett, R.F. et al. (Eds.), *Economic pluralism*, Routledge, London, pp.36–47.

Colander, D., Holt, R.P.F. and Rosser, J.B. (2010) 'How to win friends and (possibly) influence mainstream economists', *Journal of Post Keynesian Economics*, Vol. 32, No. 3, pp.397–408.

Dixit, A.K. and Stiglitz, J.E. (1977) 'Monopolistic competition and optimum product diversity', *The American economic review*, Vol. 67, No. 3, pp.297–308.

Druant, M., Fabiani, S., Kezdi, G., Lamo, A., Martins, F. and Sabbatini, R. (2009) *How are firms' wages and prices linked: survey evidence in Europe*.

Dullien, S. (2011) 'The new consensus from a traditional Keynesian and post-Keynesian perspective: A worthwhile foundation for research or just a waste of time?', *Economie appliquée : archives de l'Institut de Sciences Mathématiques et Economiques Appliquées ; an international journal of economic analysis*, Vol. 64, No. 1, pp.173–200.

Fontana, G. and Gerrard, B. (2006) 'The future of Post Keynesian economics', *BNL Quarterly Review*, Vol. 59, No. 236, pp.49–80.

Fontana, G. and Setterfield, M. (Eds.), (2010) *Macroeconomic theory and macroeconomic pedagogy,* Palgrave Macmillan, Basingstoke.

Galí, J. (2008) *Monetary policy, inflation, and the business cycle. An introduction to the new Keynesian framework,* Princeton Univ. Press, Princeton, NJ.

Galí, J., López-Salido, J.D. and Vallés, J. (2007) 'Understanding the Effects of Government Spending on Consumption', *Journal of the European Economic Association*, Vol. 5, No. 1, pp.227–270.

Galí, J., Smets, F. and Wouters, R. (2012) 'Unemployment in an Estimated New Keynesian Model', *NBER Macroeconomics Annual*, Vol. 26, No. 1, pp.329–360.

Gertler, M. and Karadi, P. (2011) 'A model of unconventional monetary policy', *Journal of monetary economics*, Vol. 58, No. 1, pp.17–34.

Gertler, M. and Kiyotaki, N. (2011) 'Financial Intermediation and Credit Policy in Business Cycle Analysis', in Friedman, B.M. and Woodford, M. (Eds.), *Handbook of monetary economics - Vol. 3*, North-Holland, Amsterdam u.a., pp.547–599.

Grüning, P., Theobald, T. and van Treeck, T. (2015) *Income inequality and Germany's current account surplus*.

King, J.E. (2012) *The microfoundations delusion. Metaphor and dogma in the history of macroeconomics,* Elgar, Cheltenham.

Krugman, P. (2009) *The Return of Depression Economics,* London.

Lavoie, M. (2016) 'Rethinking Macroeconomic Theory Before the Next Crisis'. https://www.ineteconomics.org/perspectives/blog/rethinking-macro-theory (Accessed 29 March 2017).

Lavoie, M. (2014) *Post-Keynesian economics. New foundations,* Elgar, Cheltenham.

Lee, F.S. (2012) 'Heterodox Economics and its Critics', *Review of Political Economy*, Vol. 24, No. 2, pp.337–351.

Miao, J. (2016) 'Introduction to the symposium on bubbles, multiple equilibria, and economic activities', *Economic Theory*, Vol. 61, No. 2, pp.207–214.

Minsky, H.P. (1986) *Stabilizing an unstable economy,* Yale Univ. Press, New Haven.

Minsky, H.P. (1982) *Can "it" happen again? Essays on instability and finance,* Sharpe, Armonk, NY.

Rannenberg, A., Schoder, C. and Strasky, J. (2015) *The macroeconomic effects of the Euro Area's fiscal consolidation*.

Romer, P. (2017) 'The Trouble With Macroeconomics', *The American Economist,* forthcoming.

Solow, R. (2010) *Building a Science of Economics for the Real World. Prepared Statement Robert Solow Professor Emeritus, MIT Prepared Statement for the House Committee on Science and Technology Subcommittee on Investigations and Oversight*.

Vernengo, M. (2010) 'Conversation or monologue? on advising heterodox economists', *Journal of Post Keynesian Economics*, Vol. 32, No. 3, pp.389–396.

Wickens, M. (2014) 'How Useful are DSGE Macroeconomic Models for Forecasting?', *Open Economies Review*, Vol. 25, No. 1, pp.171–193.

Wren-Lewis, S. (2016) 'Blanchard on DSGE'. https://mainlymacro.blogspot.de/2016/08/blanchard-on-dsge.html.