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The New Consensus from a Traditional Keynesian and Post-Keynesian Perspective

A worthwhile foundation for research or just a waste of time?

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The New Consensus from a Traditional Keynesian and Post-Keynesian Perspective

A worthwhile foundation for research or just a waste of time? [§]

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Abstract

This paper examines in how far the DSGE model which is often dubbed the New Keynesian Consensus is compatibel with a Post-Keynesian or traditional Keynesian understanding of the economy. It is argued that while at first sight DSGE models seem to include a lot of traditional Keynesian or even Post-Keynesian elements such as endogeneous money or the need for an active central bank, the mechanisms at work are completely incompatible with a traditional or Post-Keynesian understanding of the working of the macroeconomy.

Keywords: DSGE, New Keynesian Consensus, Monetary Policy, Fiscal Policy, endogenous money

JEL classification: E00, E10

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1 Introduction

Seldom was a proclaimed consensus in macroeconomics so short-lived as the acceptance of the so called 'New Consensus Model'. As late as 2007, the Journal of Economic Perspective run a special issue on this supposed convergence in macroeconomic thinking towards an adoption of the model class which is in more technical terms refered to as DSGE (for *Dynamic Stochastic General Equilibrium*). Just about two years later, this model class has come under fierce attack by part of the profession including such well-known names as Paul Krugman, Paul de Grauwe, Barry Eichengreen and Willem Buiter as well as popular media such as the *Economist* (in its July 18, 2009 issue).

The issues at stake are already evident in the terminology. The term 'New Neoclassical Synthesis' – another term used for the 'New Consensus' model – tries to draw a parallel to the original neo-classical synthesis which had dominated textbook in the discipline over decades. In this original neo-classical synthesis, researchers of Keynesian origin such as Paul Samuelson or Franco Modiglani tried to find a compromise between the IS-LM model which only focused on aggregate demand without allowing for supply constraints and the old neo-classical macroeconomic model which only focused on the supply side without allowing for situations in which aggregate demand falls short of aggregate supply. Just as the old consensus tried to include both neo-classical and Keynesian elements in its analysis, the New Consensus tried to pull together the microfoundation and dynamic tools of (new classical) real-business-cycle (RBC) models and the work of New Keynesians on the role of labour and product market frictions and staggered price- and wage-setting. A typical DSGE model thus is based on utility-maximising representative agents with rational expectations (elements from the RBC-tradition) and includes some staggered price-setting and monopolistic competition (which are traditionally seen as New Keynesian element).

In this tradition of uniting a vast range of economists on one theoretical and methodological platform, Blanchard (2008, p. 7) in a paper called 'The State of Macro' explicitely relates the developments of the decade until 2008 to Samuelson's quote from 1955 that 90 percent of economists at that time bought into the neo-classical synthesis:

> I would guess we are not yet at such a corresponding stage today. But we may be getting there.

A few pages later (p. 24), Blanchard illustrates more in detail which importance DSGE models had by then attained in the profession:

> DSGE models have become ubitous. Dozens of teams of researchers are involved in their construction. Nearly every central bank has one, or wants to have one. They are used to evaluate policy rules, to do conditional forecasting, or even sometimes to do actual forecasting.

In fact, Blanchard did not exaggerate. What he did not mention is that even today (and possibly more so just prior to the crisis), a large share of macroeconomic articles in the 'Top 5'-journals actually include some kind of DSGE model. For the now – and still, even if increasingly criticised – standard approach of modern central banking, inflation targeting, DSGE models provide the theoretical foundation. When the American Economic Association launched a new journal on macroeconomics, called *American Economic Journal: Macroeconomics* in 2008, almost a third of the articles in the issue dealt explicitely with DSGE models.

Even a number of traditional Keynesian and Post Keynesian have at least partly moved towards the DSGE model and have tried to work with the model or at least started accepting it as the standard tool for macroeconomic analysis even if they remained critical of parts of the framework[1], an attention which the RBC-models never managed to get. Obviously, in their eyes, the set-up and policy conclusions of DSGE models had been a clear progress over earlier approaches to modeling central banking such as the monetarist approach which in the end advocated money supply targeting as an optimum policy.

However, the consensus obviously was not as broad or stable as Blanchard and others had thought. With the eruption of the US subprime crisis and its transformation into a global financial and economic crisis compared to the Great Depression, the convergence towards this model class has come under harsh fire from economists inside and outside academia. Buiter (2009) calls them 'a costly waste of time', Krugman (2009) clearly includes them into his description of macroeconomic work of the past decades as 'spectacularly useless at best, and positively harmful at worst'. The Economist voices its unease with these models which have neither been able to predict the crisis, been able to forecast its depth or trajectory nor to give useful policy guidelines on how to overcome the crisis. Consequently, the journalists propose implicitely to start again from scratch for building a useful macroeconomic model.

[1] See i.e. Fontana (2009), Arestis, ed (2007) and contributions in that volume or alternatively the contributions in Fontana and Setterfield, eds (2009).

While these critics can still be cast aside as mavericks of the profession, with such prominent voices trashing the DSGE models, one can hardly talk about a 'consensus model' anymore. What is quite evident is, that – should DSGE models ever again be accepted as a macroeconomic consensus – they need to be seriously repaired and extended. What is less clear is whether these models actually *can* be repaired and extended so that they again can become the basis for a broad consensus or if they have flaws which make them permanently unaccaptable to part of the economics profession.

To answer this question, this paper will take a deeper look at the underlying mechanics of the DSGE model from a traditional Keynesian and Post Keynesian perspective. The Post Keynesian perspective is included explicitely into this analysis as at least some of the Post Keynesian literature in the form of Hyman Minsky's writings on crisis phenonema have gained new prominence during the crisis, while other authors from this school of thought had moved towards (at least partly) accepting the DSGE models prior to the crisis.

This paper will not dwell much on the standard – and often voiced (Buiter, 2009; Spaventa, 2009) – criticism such as that DSGE models abstract from financial intermediaries and do not allow for asset price bubbles. This criticism is well accepted even by (some of) the DSGE proponents and is increasingly tackled by adding some ad hoc financial sector formalisation to the standard model. Instead, the paper will focus more on question such as the determination of income and employment as well as the transmission mechanisms of monetary and fiscal policy to the economy in DSGE models. In doing so, it will tackle two questions: First, it will try to give an explanation why the DSGE model has come so close to being an accepted consensus. Second, it will try to answer whether it is worthwhile for traditional Keynesians and Post Keynesians to proceed with the DSGE research agenda.

The paper will start with describing the basic elements of a standard DSGE model and its origins. In a second step, it will try to find out why the DSGE model and its cousins have found so much approval among traditional Keynesians and Post-Keynesians. Section 4 will then point out some problems of DSGE models from a traditional Keynesian and Post-Keynesian perspective. Building on this analysis, section 5 will have a look at the DSGE models from a policy evaluation perspective and section 6 will conclude.

2 Main elements of DSGE modeling

While literally hundreds of DSGE models exist today with different details in the formulations, 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[2] 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: An 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 market are always in equilibrium. As we will see later, this is a crucial characteristic.

When used as a tool for policy evaluation (i.e. for determining which monetary policy function is preferable), DSGE models are usually applied in a four-stage process:

1. Appropriate optimization conditions for firms and households are chosen

2. For analytical simplicity, the reaction of households and firms around the steady state are formulated by log-linearization of the optimization problems

3. 'Deep' parameters (i.e. for time preference) for the model are chosen. Two approaches are in use: Originally, there seemed to be a preference for some 'calibration', setting the parameters in a way that the general outcome of the model fits well with real-world data, using human intuition after starting from some 'priors', parameters widely accepted in the DSGE literature. In recent years, however, calibration has made place for the application of complex econometric procedures such as the generalized method of moments (GMM), maximum likelihood or Bayesian estimation methods which are now mostly used for setting the parameters[3]

[2]Note that some DSGE models now allow for heterogeneous agents.

[3]See for an accessible discussion of the question of calibration vs. estimation Tovar (2008) or for a more technical discussion Bierens (2007).

4. In a computer simulation, different policy reaction functions are exposed to stochastic shocks, analysing which of the policy functions minimizes a social loss function

More technically, a typical DSGE model has the following elements:

2.1 Household utility maximisation

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, $u\left(.\right)$ as the (positive) utility derived from consumption, $v\left(.\right)$ as the utility derived from holding real balances and $\gamma\left(.\right)$ 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 C_t, N_t and M_t under the intertemporal budget constraint:

$$\begin{aligned} Y_t P_t + M_{t-1}^n + B_{t-1}^n \left(1 + i_{t-1}\right) &= C_t P_t + M_t^n + B_t^n & (2) \\ Y_t P_t &= N_t W_t + \Pi_t & (3) \\ t &\in [0, \infty) & (4) \end{aligned}$$

with B_t denoting the amount of bonds held by the individual in period t, W_t the wage in period t and Π_t profit income.

In order to make sure that the individual does not continously increase her debt, a Non-Ponzi-condition is added, saying that the present value of future savings must not be negative:

$$\lim_{T \to \infty} \left(\frac{B_T^n}{\prod_{s=0}^{T} \left(1 + i_s\right)} \right) \geq 0 \tag{5}$$

This maximisation gives us the following optimality conditions for the relationships between C_t and M_t, B_t, N_t:[4]

$$u'(C_t) = \beta E_t \left[u'(C_{t+1}) \frac{P_t}{P_{t+1}} \right] + v' \left(\frac{M_t^n}{P_t} \right) \tag{6}$$

$$u'(C_t) = \beta E_t \left[u'(C_{t+1}) \frac{P_t}{P_{t+1}} (1 + i_t) \right] \tag{7}$$

$$u'(C_t) \frac{W_t}{P_t} = \gamma'(N_t) \tag{8}$$

One can now log-linearize (6) around the steady-state in order to get the optimum relationship between C_t and C_{t+1}. Defining c_t and c_{t+1} as the log deviation of consumption from steady-state consumption, we get:[5]

$$c_t = E_t c_{t+1} - \frac{1}{\sigma} (i_t - E_t \pi_{t+1} - \rho) \tag{9}$$

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 $\rho \equiv -\log \beta$.

2.2 Firms' price setting

Firms in standard DSGE models are monopolistically competitive as has been proposed by Dixit and Stiglitz (1977). This result is based on modelling aggregate consumption C_t in the utility function as the consumption of a continuum of goods indexed by $i \in [0, 1]$ which are only imperfect substitutes, but have a constant elasticity of substitution.[6] Consumption is thus often written as[7]

$$C_t = \left(\int_0^1 C_t(i)^{1-\frac{1}{\varepsilon}} di \right)^{\frac{\varepsilon}{\varepsilon-1}} \tag{10}$$

[4]Note that we have chosen a general exposition here rather than using a clearly defined functional form of the utility function as has been done in Galí (2008). However, our exposition can easily be transformed in something similar to the Galí-exposition.

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

[6]This consumption function is hence often refered to as a constant elasticity of substitution or CES-consumption function.

[7]See i.e. Galí (2008, p. 41).

Given that the household thus values variety and only sees the different goods as imperfect substitutes, firms have some pricing power.

As there is a continuum of goods, there is also a continuum of firms $i \in [0, 1]$ which each produces the corresponding good. They all use identical technology and have thus an identical production function:

$$Y_t = A_t N_t (i)^{1-\alpha} \tag{11}$$

If we maximise the consumption index C_t given the prices for the continuum of goods $P_t(i)$ and a given level of expenditure as the budget constraint, we get for each of the firms a demand function of the following form:[8]

$$C_t (i) = \left(\frac{P_t (i)}{P_t} \right)^{-\varepsilon} C_t \tag{12}$$

The demand for each firm's product is thus a negative function of the product's relative price and a positive function of total expenditure. Given the production function above and the demand function, a firm can maximise its profits by applying a markup of $\frac{\varepsilon}{\varepsilon - 1}$ over (nominal) marginal unit labour costs MC_t as is known from the literature on monopolistic competition. Note that all firms apply the same price as they are symmetrical. This yields an equilibrium price level in the case of perfect price flexibility of:

$$P_t^* = \frac{\varepsilon}{\varepsilon - 1} MC_t \tag{13}$$

In addition to monopolistic competition, however, DSGE models usually contain some kind of staggered price setting. Usually, the approach used by Calvo (1983) is applied. According to this approach, in each period, a firm is only allowed with the probability of $1 - \theta$ to reset its price. Thus, θ can be interpreted as a measure of price stickiness. 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 the 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

[8] Again, this is derived in Galí (2008). For a more general and atemporal exposition of monopolistic competition, see Blanchard and Fischer (1989).

$$p_t^* = \mu + (1 - \beta\theta) \sum_{k=0}^{\infty} (\beta\theta)^k E_t \left\{ mc_{t+k|t} + p_{t+k} \right\} \tag{14}$$

with β again denoting the discount factor, and μ being defined as the $log\frac{\varepsilon}{\varepsilon-1}$ and mc being defined as the log of the marginal costs. Hence, firms set prices at a level at which they expect to achieve their desired mark-up over (weighted) current and expected future nominal marginal costs.

2.3 The results: Three macroeconomic equations

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:

$$Y_t = C_t \tag{15}$$

Using this condition and equation (9), one gets an equation showing the deviation of current output from steady state output:

$$y_t = E_t y_{t+1} - \frac{1}{\sigma} (i_t - E_t \pi_{t+1} - \rho) \tag{16}$$

One can substitute the discount term ρ by some natural interest rate r_t^n and rewrite the equation in terms of the output gap $\widetilde{y}_t$:

$$\widetilde{y}_t = E_t \widetilde{y}_{t+1} - \frac{1}{\sigma} (i_t - E_t \pi_{t+1} - r_t^n) \tag{17}$$

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[9] one gets for the inflation dynamics:

$$\pi_t = \beta E_t \pi_{t+1} + \kappa \widetilde{y}_t \tag{18}$$

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

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:

$$i_t = r_t^* + \varphi_\pi \pi_t + \varphi_y \widetilde{y}_t \tag{19}$$

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 $i_t = r_t^* + \alpha_\pi (\pi_t - \pi_t^*) + \alpha_y (y_t - y_t^*)$.

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 $\log\left(\frac{M_t}{\overline{M}}\right)$ 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:

$$m_t^S = -\frac{1}{v}(i_t - E_t \pi_t + 1) \tag{20}$$

3 DSGE's appeal to (some) (Post-)Keynesians

Many Keynesians and Post-Keynesians struck the emergence of the New Keynesian Synthesis and the DSGE models as a progress over New Classical macroeoconomic models in the tradition of Lucas (1972). For example, Arestis, ed (2007) and Fontana and Setterfield, eds (2009) have published collections in which the New Keynesian Synthesis is approached, applied and extended (and – to be fair – of course also been criticised[10]) from traditional Keynesian and Post-Keynesian points of view.

[10]Especially Arestis has criticised the New Keynesian Synthesis or New Consensus Model quite extensively. See i.e. Arestis (2009) and his references to his former works on the topic.

A number of reasons might be at the heart of the symphathy of even prominent Keynesians and Post Keynesians towards the DSGE models. First, monopolistic competition is one of the central beliefs in Post-Keynesian economics. Building on the insights of Robinson (1933), Post Keynesians generally refute the notion of perfect competition and thus allow for some mark-up-pricing.[11] Traditional Keynesianism also used to follow the notion of imperfect competition, yet as macroeconomic models became more formalized, this notion fell into disregard until Dixit and Stiglitz (1977) propozed a way to formalize monopolistic competition. Thus, a macroeconomic model such as the DSGE model which includes monopolistic competition as a main building block might have struck some chords with traditional Keynesians and Post-Keynesians.

Second, the new IS-curve from equation (17) at first sight looks very familiar to a traditional IS curve which is usually presented in the following form:

$$Y = C_0 + cY + I\left(i\right) + G \tag{21}$$

with C_0 as autonomous consumption, c as the marginal propensity to consume, I as investment demand, i as the interest rate and G as government expenditure. While of course the economic meaning differs between a traditional IS-curve from Hick's IS-LM model and the new IS-curve in the DSGE model (we will come to this point further down), one could at first sight believe that the mechanisms at work are similar.

Third, monetary policy in the DSGE models is conducted by a central bank changing interest rates, and the money supply is endogenous. This is something Post-Keynesian authors have long argued in favor of. One of the central tenets of Post Keynesian economics has always been the assumption of endogenous money (Moore, 1988; Wray, 1990). According to this view, the central bank cannot well control the amount of base money in circulation nor wider monetary aggregates as it depends on the demand for loans from the private sector and the willingness of the banking sector to expand the money supply. The main instrument for monetary policy in Post Keynesian theory is hence the central bank interest rate.[12] Again, at first sight, this looks very similar to the approach taken by the DSGE model-builders. In the DSGE models, the relevant variable for monetary policy is the central bank

[11] See for a thorough description of Post-Keynesian approaches to pricing Lavoie (2001).

[12] For an up-to-date exposition of the mechanisms of endogenous money creation in Post Keynesian theory, see Dullien (2004).

interest rate which is directly set by the central bank. The money supply in contrast is only determined endogenously, in a stark contrast to monetary macroeconomic models in the tradition of Lucas (1972) or Taylor (1980) in which money is injected into the economy as it was dropped by a helicopter, to use the famous Friedman parable.

In addition to these theoretical arguments, DSGE models seem to come to (at least some) policy conclusions which are very much in line with Post-Keynesian or traditional Keynesian thinking. First, there is no self-stabilizing of the system thanks to a real balance effect in DSGE models anymore. In models based on the old neo-classical synthesis, a fall in the price level would always lead to a self-stabiliziation even without policy reaction: Given a certain stock of (nominal) money in the economy, a fall in the price level in the old model leads to an increase in aggregate demand as the individuals' wealth increases which leads to more consumption (the Pigou effect) or more lending (the Keynes effect). Thus, even faced with a large demand shock (i.e. as a consequence in the shift in preferences), the economy would find quickly back to full employment given flexible prices as a falling price level would increase the real aggregate demand for consumption and investment goods. In the DSGE world, this is different: A deflationary shock is well able to keep output below steady-state output (or – in the way the term is used in the DSGE literature – the output gap positive) for an extended period of time as Eggertsson and Woodford (2003) show. The reason is that due to the zero bound of nominal interest rates, the central bank cannot lower nominal interest into negative territory and might therefore be unable to keep short term real interest rates low enough to increase economic activity to the point where the output gap closes. Hence, in contrast to the monetarist conclusion that the central bank should target a slightly negative inflation rate (Friedman, 1969), DSGE models usually come to the conclusion that in order to prevent a long period of sub-trend growth in the aftermath of a deflationary shock, the central bank should aim at a moderate positive rate of inflation.

Moreover, an optimal central bank reaction function in a DSGE model usually includes a reaction to both the deviation from the inflation target as well as the output gap. Again, this is something Keynesians can generally relate to. In general, most traditional Keynesians believe in monetary policy's ability of influencing economic activity[13] and hence are in favor to use the short-term interest rates to bring output close to full-employment output –

[13]This holds true even if they also believe that their might be cases in which monetary policy alone cannot bring the economy back to full employment and hence suggest fiscal policy to be applied.

in contrast to Monetarists and New Classical Economists who either reject monetary policy activism either because of their scepticism in the central bank's ability to monitor and predict business cycle fluctuations or because of their general belief in macroeconomic policy ineffectiveness due to the private sector's rational reactions to government action. Thus, compared to Friedman's money supply rule which did not see any role for activist monetary policy, DSGE models at first sight seemed like a progress from the traditional and Post-Keynesian perspective.

4 Problems with DSGE from a (Post-) Keynesian perspective

However, on closer inspection, some of the underlying mechanisms in DSGE models are completely different from what traditional Keynesians or Post Keynesians believe about the workings of the real-world economy. In fact, the DSGE models' links of causation are so different from a traditional Keynesian or Post-Keynesian understanding of macroeconomics that one can wonder how there can be any scope to reconcile the two positions.

4.1 Unemployment and the Output Gap

The first issue is the output gap. In Keynesian models (and a traditional Keynesian understanding of the economy), the output gap would be the gap between potential output and current output. The existence of such a gap is explained with aggregate demand falling short of potential supply and thus preventing the economy from producing at potential output. Of course, Keynesian economists from Post-Keynesian and a more traditional Keynesian provinence might differ about the question why aggregate demand falls short of potential output over an extended period of time. While Post-Keynesians would argue that uncertainty and fluctuations in the firms' animal spirits might keep investment demand too low to guarantee full employment, Keynesians more closely aligned with the (old) neo-classical synthesis would argue that sticky nominal wages due to labour market rigidities might play a role as they keep real wages from falling and hence business investment depressed. However, both would agree that in the case of a negative output gap and hence employment below the (however defined) level of full employment, some people in the economy would like to work at the given wage rate, but are unable to find employment (the definition of involuntary unemployment

Keynes (1936) has given).

The mechanism in DSGE models is fundamentally different. Here, one has to remember that labour markets *always clear* (at least in the basic models without additional elements such as a monopoly union which might prevent wages from adjusting). This assumption has been used for deriving the New Keynesian Phillips curve and it is at the heart of the adjustment mechanism how a DSGE model adjusts to shocks.[14] To understand this issue, one has to take a closer look at the individuals' utility function in equation (1). Maximisation of the individuals' utility takes place by variations of the paths of their consumption demand, their labour supply and their money holdings over time. These paths only deviate from their steady-state value if interest rates or real wages deviate from their respective steady state values. Lower interest rates lead to more money holdings and more present consumption (as the opportunity costs both of holding money and consuming more in the present period fall) which in turn influences the real wage via higher demand in the goods and labour markets (see below for more on this mechanism). The central variation in output, however, is caused by variation of labour supply. If the real wage deviates from the steady state value, individuals reoptimize their labour supply and hence hours worked and output produced in the economy. Real wages higher than in the steady state case cause them to increase their labour supply, real wages below the steady state value cause them to lower their labour supply. Higher labour supply then leads to higher output which is consumed as households can afford to do so thanks to higher wages.

Fluctuations in employment in the DSGE models are hence always an *optimal reaction* of households to changes in labour market conditions. A temporary increase of employment above the steady-state level is thereby caused by an increase in the real wage to which the households react by cutting back their leisure and supplying more working hours in the labour markets. Similarly, a fall of employment below the steady-state level in the DSGE model is caused by a fall in the real wage. Households then react to the lower real wage by cutting back their labour supply. Hence, there is no involuntary unemployment in DSGE models, just voluntary unemployment as a reaction to changes in the wage or to changes in lifetime income. Or, to put it in more graphic ways: Those who seem unemployed are just enjoying

[14] As many of the textbooks on DSGE models drown this mechanism in the mathematical derivation of the model equations and it is quite difficult to see this issue clearly at first sight in the dynamic equations, it is sometimes helpful to take a look at a simpler two-period model with a similar set-up as the dynamic DSGE models. Chapter 6 in Heijdra and van der Ploeg (2002) is a good option to do so.

more leisure this year because they expect their real wages to be higher next year when they are in consequence going to work longer hours then.

Changes in the interest rate also work exactly in this way: While in traditional Keynesian thinking, a cut in interest rates might induce either firms to invest more in their physical capital or households to buy more consumer durables, thus increasing aggregate demand and bringing formerly involuntarily employed workers into new jobs, the causal chain in DSGE models is completely different: A cut in interest here makes consumption today relatively more attractive than consumption tomorrow. Hence, households will try to shift some of their lifetime consumption towards the current period. As both the goods market and the labour market were already clearing before the interest rate cut (hence everyone who wanted to work at the going wage rate had a job and all goods were sold and consumed), this increase in consumption leads to excess demand. As firms try to hire new workers to satisfy this demand, nominal wages increase. As prices are (partly) sticky thanks to the Calvo pricing, this additional consumption demand leads to an increase in real wages and a compression of profits. Higher real wages in turn lead the households to offer more labour (substituting leisure for work) which in turn leads to a new (higher employment) temporary equilibrium in the labour market.

The reason for fluctuations in output and employment in DSGE models is hence not that wages are sticky and therefore an adjustment of real wages to shocks cannot take place (as it has been in the fixed-wage version of the old neo-classical synthesis) nor is it that aggregate demand can just fall short of supply because of a lack of an inherent tendency to full-employment output (as claimed by the Post-Keynesians). Instead, the reason for fluctuations is that nominal wages are flexible, but prices are not and hence demand shocks change nominal and real wages more quickly than prices which leads to high-frequency changes in the labour supply.[15] The DSGE model is a model in which nominal wages and quantities adjust instantaneously while nominal prices can only adjust with a lag. When putting it this way, one wonders how many traditional Keynesians or Post-Keynesians would actually sign up for this explanation of unemployment.

[15]In addition to the question whether this mechanism is compatible with more traditional Keynesian thinking, one could also ask in how far these assumption have any plausibility for a reasonable description of real-world goods and labour markets. To our knowledge, there is no empirical evidence which could claim that prices are less flexible than nominal wages especially as nominal wages exhibit usually a downward stickiness. In fact, Bils and Klenow (2004) report that prices are changed on average every four months, while wage negotiations in most countries take place annually.

4.2 Endogenous Money

The second issue is the question of endogenous money. In the Post-Keynesian tradition, there is a broad and deep discussion on why and how money is endogenous. Usually endogenous money is used to model the interaction between a central bank and the real economy which Post-Keynesians often feel has been abstracted away in more mainstream approaches. First, it is often argued that the broad money supply is endogenous as it does not only include base money (which can be created by the central bank), but also inside credit money which is created by the banking sector. The willingness and the ability (measured in the availability of equity capital or other regulatory constraints) of the banking sector is a necessary condition for the expansion of the money supply. Moreover, to expand the money supply, there must be enough firms in the economy which are willing to borrow money for profitable investment projects so that the banking sector has enough good-risk potential borrowers.

In addition, it is often argued that even base money is not exogenous, but endogenous to the central bank's actions (Dullien, 2004, p. 73ff). Three arguments can be made here: First, the commercial banks do not need to engage in the sale of securities with the central bank thus making open market operations futile. Second, as the money supply has proved to be unstable in many countries, central banks nowadays often set the short-term interest rate and accommodate whichever amount of base money commercial banks would like to hold. Third (very important especially in the light of the recent financial crisis), central banks might have inherent interest in securing the stability of the banking system. As a shortage of liquidity in the financial system might lead to a banking crises, they are thus forced to supply the amount of base money commercial banks are demanding, thus making the money supply endogenous.

In short, Post-Keynesian theory uses endogenous money to show the complexeties of the financial system in the transmission of monetary policy.

Moreover, endogenous money in Post-Keynesian thinking is a way to transfer purchasing power from surplus units (which save) to deficit units (which spend more than their cash flow) in the economy. As usually households are surplus units and firms are seen as deficit units, it is also possible of thinking of endogenous money as a means to transfer purchasing power from risk-averse, less entrepreneurial individuals to more risk-seeking, more entrepreneurial individuals which use the purchasing power for the creation

of fixed assets.[16]

Again, the logic of money supply in DSGE is fundamentally different, even if it seems similar at first sight. Most DSGE models do not include a financial sector.[17] In fact, this is one of the very reasons why this class of models has lately received a lot of criticism even from papers like the *Economist*.

Further, money in DSGE models is not used to transfer purchasing power, neither between units or between periods. As all individuals are identical (being a result of the representative agent approach) at least in the baseline DSGE models, there are no surplus and no deficit units. Everyone is just consuming what she is earning. By logic of aggregation and also embedded in the market clearing assumption for the goods market $C_t = Y_t$, this means that macroeconomically, there are also no savings in the simple DSGE model. While the baseline model – as we have done with equation (2) usually introduces a capital market (at which the interest rate i is paid), no agent is borrowing and no agent is lending in this market as the adjustment always runs via the goods and labour market. The holding of bonds is just 0 in these models in all periods.[18]

In consequence, the money supply is not determined (as in Post-Keynesian thinking) by the private sector's willingness to incur debt and by the financial sector's willingness to extend loans, but by the individuals' willingness to hold money for liquidity services. As we see from the money supply equation (20), the individuals' utility from money holdings v plays a central role for the determination of the money supply with the interest i_t and the expected rate of inflation $E_t\pi_{t+1}$ having a negative effect as the individuals balance the opportunity costs of holding cash with the utility from doing so. Thus, the central bank in DSGE models just provides money by some unspecified process until the public's desire to hold money is satisfied at the targeted interest rate.

4.3 Government spending

Another issue which shows the fundamental differences between the DSGE models and traditional or Post-Keynesian thinking is the question of the

[16]For more on this argument, see Tobin (1998) or Dullien (2004).

[17]The question in how far these problems of DSGE models can be mitigated by recent extensions is covered later in this paper.

[18]Of course, this changes if one introduces a government sector which finances expenditure by borrowing. See below.

effect of government spending on economic activity. The basic DSGE model presented in this paper so far does not yet include a government sector. However, one could easily include government activity into the model. The simplest way to do so would be to introduce a lump-sum tax to be paid by households with which government expenditure is financed. This would mean that the households' budget contraint (3) is altered by including the tax term on the right-hand side and that also the goods market clearing condition is expanded by government expenditure. In addition, we assume for a moment that the government does not borrow, but finances all its current expenditures with current tax revenue:

$$Y_t P_t = N_t W_t + \Pi_t - T_t \quad (22)$$
$$Y_t = C_t + G_t \quad (23)$$
$$T_t = G_t \quad (24)$$

If government activity is introduced in this model in this way, a change in government spending has the following effects: A tax-financed increase in government spending leads first to a negative income effect of the single household as the tax money is taken away while the household does not have any utility from government spending. As a reaction, the household will cut back both on its consumption of goods and on its leisure time (as both consumption and leisure enter as incomplete substitutes into the utility function). The result is that the single household is supplying more labour to the labour market. Firms demand this additional labour as they are faced with higher aggregate demand in the goods market (due to the additional government purchases). As the labour market and the goods market always clear in the DSGE model, the households have no problem supplying more work. The labour market thus clears at a higher level of employment (since labour supply has increased). The goods market clears at a higher level of production, but with lower private consumption than before.[19]

This basic mechanism also holds if we drop the restriction that the government has to finance all current expenditure from current tax revenue (equation 24) and instead introduce an inter-temporal budget constraint and a non-Ponzi condition for the government which requires the public sector

[19] Also note that the increase in government spending has lowered the households' utility even though output and employment has increased. If one takes the individual utility serious as a measure of economic welfare, there would be a strong case against such a fiscal policy.

not to engage in explosive borrowing trends. In this case, a debt-financed increase of current government spending has the following effect: As households now expect that they have to pay higher taxes in the future (to service the government debt), they perceive the increase in government spending as a fall in their lifetime income and hence total wealth. Due to this negative wealth effect, they again cut back on current consumption as well as on current leisure, meaning that they supply more labour to at least partly make up for the taxes they have to pay. In contrast to the case described above without the government sector, these households now save. They hold government bonds exactly with the present value of their future tax liabilities caused by the government debt. As in the case for tax-financed government expenditure, output and employment increases while private consumption falls.[20] The DSGE model hence incorporates Ricardian equivalence as it does not make any difference whether additional government spending is paid for by new taxes or new government debt.

Again, this whole mechanism is completely different from traditional Keynesian or Post-Keynesian understanding of the effects of fiscal policy (and – by the way – from the narrative that has been used by economists in the recent political debate on the stimulus packages passed in most industrialized countries). In the standard IS-LM equation, an increase in government spending leads not only to an increase of total output via the well-known multiplier effects, but also to an increase in private consumption. Moreover, the extent to which output is increased depends critically on the way how an increase in government expenditure is financed with debt finance leading to a higher multiplier.[21] In a situation of underemployment, the increase in output caused by the expansionary fiscal policy actually helps households to sell their labour supplied in the labour market. Thus, households are clearly better off as involuntary unemployment is reduced and their consumption increased.

[20]Note that the full dynamic of the effects of changes in government spending cannot be seen from the reduced form equations (the new IS-curve and the NKPC of the DSGE models as they only show deviations from the steady-state, but a change in government expenditure shifts the steady state. For a more in-depth discussion of the effects of government spending in this class of model, see the discussion in Galí et al. (2007) and in the literature cited there, especially Aiyagari et al. (1992) or Fatás and Mihov (2001). For a simple, non-dynamic exposition of this effect, see Heijdra and van der Ploeg (2002, chapter 13).

[21]This mechanism is described in most undergraduate textbooks such as Blanchard (2006).

4.4 Extensions in order to mitigate problems

To be fair to the DSGE literature, one has to report that a lot of the authors coming from a more Keynesian tradition (as compared to the authors coming from the real business cycle tradition) have tried to square the effects of government spending predicted by the DSGE models with a more traditional Keynesian thinking which also seems to be supported by the empirical literature.

The most widely cited attempt to do so is probably Galí et al. (2007). Here, the authors introduce two different kinds of households. A first type (dubbed 'optimizing') is behaving as in the standard DSGE model, maximising lifetime utility over an infinite horizon. A second type of households (dubbed 'rule-of-thumb' consumers) always spends all labour income on present period consumption. However, 'rule-of-thumb' does not mean that the households are not optimizing at all. They still optimize their present consumption against their present leisure time so that marginal utility from these two variables needs to be equal. They just do not have access to financial markets and can hence neither save nor borrow.[22]

If the share of rule-of-thumb consumers in an economy is large enough, the model presented by Galí et al. (2007) now shows a reaction which is more in line with the traditional Keynesian percention. An increase in government spending is now able both to increase output and private consumption.

However, even now, the mechanism is distinctly different from traditional and (Post-)Keynesian thinking. Now, given an debt-financed increase in government expenditure, only the optimizing households cut back on current consumption, while the rule-of-thumb consumers continue to spend whatever they earn. Thus, the demand for goods increases more strongly than in the DSGE model without 'rule-of-thumb' households. As firms react to this higher demand with increased production plans, nominal wages in the labour market are bid up. As a result, real wages increase as a consequence of sluggishness in prices. This increase in real wages leads to a substitution at the household level away from leisure towards more consumption as leisure gets relatively more expensive. Hence, the individuals supply more labour in

[22]In addition to the question in how far the mechanism described by the model actually fits a traditional Keynesian understanding of the economy, one can again doubt the plausibility of such an assumption: While in the real world there are surely a number of households which cannot borrow, it is hard to come up with reasons why households should not be able to save. This point is especially important as the rule-of-thumb households can hardly been interpreted as households just not optimizing as they are always optimizing present-period consumption against present-period leisure.

the labour market beyond the initial effect from the negative wealth effect caused by the increase in government expenditure.

While this outcome in the macroeconomic data now looks more like a traditional Keynesian result, the mechanism again is not: The reason for the increase in employment is an increase in the real wage and thus a larger willingness of individuals to work. Again, as in the simpler versions presented above, the fluctuation in employment due to the government activities is a reaction of the *labour supply*. All unemployment in this model necessarily remains voluntarily.

5 DSGE for policy evaluation

However, even if one does not like the way the model works in the microeconomic details, one might ask whether DSGE models might not be a useful tool for simulating the path of the economy given a specific shock, examining the consequences of different policy options and finally make policy recommendations? Unfortunately, upon closer examination, this turns out not to be the case.

To understand this issue, we need to take a look at the DSGE approach from a philosophy of science perspective: Assume that there are a number n of economic models to describe the working of the economy. Some might be based on microfoundations, some might be based on ad-hoc macroeconomic equations and some might include theoretically completely unfounded elements such as the sun-spot activity in a distant galaxy. If the number n is large enough, we will always be able to find a number of models from each subgroup which fits the real-world data (which has necessarily only a limited number of observations as national accounting only started relatively late in human history) within standard limits of statistical confidence intervals.

However, just that we have found a model which can explain the past economic activity well by relating it to the sunspot activity in Alpha Centaury does not mean that it is a useful model for future forecasting or policy advise. In fact, the mathematical economist William Stanley Jevons used sunspot activity successfully for some years in the 19th century to forecast stock market crashes, yet later failed clearly with this approach.[23]

This point might be also illustrated by a less far-fetched example. In the 1960s and 1970s, in the research for artifical intelligence, progress was often

[23]See Fox (2009, p. 16).

measured by the so called *Turing test*. According to this test, proposed by Turing (1950), a computer will be considered as intelligent if human beings cannot distinguish in communcation with the machine whether they are actually communicating with a machine or another human being. For a while, computer scientists tried to improve their software according to the turing test. The best-known example for this king of software is *Eliza*, a software which simulates a psychiatrist's dialogue with a patient.[24] Even though Eliza only reacted to key phrases, it was already able to fool some humans interacting with it. Nowadays, the software is much more elaborated. A.L.I.C.E. tries to simulate an online chat with a young lady in California. As readers can find out themselves,[25] the result is quite astonishing and it is rather hard to notice that you are not chatting with a fellow human being.

Yet, even if the software nowadays is rather sophisticated, the practical use of such software is extremely limited. Is it doubtful that one could sensibly simulate the reaction of human beings to any real-world problem with these tools. No one in his or her right mind would actually use these programs to simulate how their spouse would react if one wants to tell him or her about adultury or how their mother-in-law would react if one cancels the long-promised Christmas visit. Consequently, there are very few practical uses for this kind of software.

Not surprisingly, the Turing test has fallen out of fashion in the quest for artifical intelligence and in computer science. Software as Eliza and its successors are nowadays seen as a nice gimmick, but not more. As the *Economist* nicely put it in a recent survey on artificial intelligence, the turing test is now seen as a 'distraction from useful lines of research'.

Of course, DSGE models are not based on random relationships as the model relating economic activity on earth to sun spots in Alpha Centaury, but based on rigorous theoretical and assumptions priors (as those explained above). Yet, if one does not accept those priors (not as being unrealistic, but as being plainly wrong), one definitely must reject these models also for policy analysis. If one believes the fundamental workings of the model to be flawed, using the model nevertheless for policy analysis is nothing else than following a Turing approach to economic modelling. Any Keynesian who has trouble with the causalities at the heart of the model described above hence should be very wary to accept them for any use outside the classroom and academic journals.

[24] You can find the original version of Eliza at http://www-ai.ijs.si/eliza/eliza.html

[25] The internet address is http://www.pandorabots.com/pandora/talk?botid=f5d922d97e345aa1 .

In addition, there is even a certain parallel between the DSGE models and pursuing artifical intelligence with the Turing test if one philosophically accepts the supply side determination of output and employment of the model: The parameters in DSGE models are set (via calibration or estimation) to fit the real-world data reasonable well, that is to produce an output to the input of shocks that looks pretty much like the output of data of a real-world economy. The microeconomic parameters thus entered into the model often suffer from what An and Schorfheide (2007) call the 'dilemma of absurd parameter estimates': They are at odds with other knowledge economists have about their magnitudes. For example, the discount rate or the elasticity of the labour supply often are far off from what we usually take them to be given microeconomic studies.[26] Thus, even though researchers *know* that the microeconomic working of the model must be different from that of real-world economies, they try to mimic real-world data with the model. They accept the deviation of the microeconomic mechanics of the model from their beliefs of the microeconomic mechanisms of the real world in order to get their model to fit real world data reasonably well. This is essentially the approach of the programmers of Eliza and its successor programs: They tried to create an output which looks like human output even though they *knew* that human beings react to more than key phrases.

One should note here that one does not have to criticize DSGE models fundamentally to doubt their use for policy evaluations. Even authors generally in favor of the DSGE's modelling approach and its microeconomic mechanisms doubt their applicability for policy advise as in their present form, they contain too many degrees of freedom. For example, Chari et al. (2009) show that two fundamentally different calibrations of the DSGE with two fundamental different policy conclusions can lead to observationally equivalent data output at the aggregate level. They demonstrate their case by showing that a change on the wage mark-up in a more complicated DSGE than presented in this paper which seems to be needed to give the model a good fit on real-world data can either be caused by swings in the unions' bargaining power or by swings in the individuals' preference for leisure. While in the one case counteracting the fluctuations in output and employment with monetary policy would increase the individuals' utility, in the second case, it would just bring them out of their individual utility maximum, thus harming welfare. According to Chari et al. (2009), there is no possibility

[26] One can counter this problem if Bayesian estimation methods are used and 'priors' for the distribution of parameters are introduced. However, these methods are not completely without problems as the subjective choice of priors can change the estimation outcomes and hence parameters might be chosen which are not supported by the data (Tovar, 2008).

within standard DSGE methodology to distinguish which of the two model specifications is to be preferred.

6 Conclusion

In conclusion, one can say that the sympathy that some of the traditional and Post-Keynesian authors show towards DSGE models is rather hard to understand. Even before the recent financial and economic crisis put some weaknesses of the model – such as the impossibility of generating asset price bubbles or the lack of inclusion of financial sector issues – into the spotlight and brought them even to the attention of mainstream media, the models' inner working were highly questionable from the very beginning. While one can understand that some of the elements in DSGE models seem to appeal to Keynesians at first sight, after closer examination, these models are in fundamental contradiction to Post-Keynesian and even traditional Keynesian thinking. The DSGE model is a model in which output is determined in the labour market as in New Classical models and in which aggregate demand plays only a very secondary role, even in the short run.

In addition, given the fundamental philosophical problems presented for the use of DSGE models for policy simulation, namely the fact that a number of parameters used have completely implausible magnitudes and that the degree of freedom for different parameters is so large that DSGE models with fundamentally different parametrization (and therefore different policy conclusions) equally well produce time series which fit the real-world data, it is also very hard to understand why DSGE models have reached such a prominence in economic science in general.

At least from a traditional Keynesian or Post-Keynesian tradition, one can clearly confirm Buiter's claim that the models have been a 'waste of time'. In as far as they have shaped student's thinking about real-world economics, they might even confirm to Krugman's judgment as 'positively harmful'. Thus, from a Keynesian research perspective, the *Economist*'s implicit advise to the profession 'to start from scratch' seems to be warranted.

Whether the DSGE model will at some point in the future become at least a useful tool for policy analysis if one rejects Keynesian thinking but at least adhers to basic principles of scientific logic and will thus be acceptable to Chari et al. (2009) and the like, is a different question. It is well possible that the DSGE community will built more complicated and elaborate models which lower the degrees of freedom in the choice of parameters to at least

get clear policy conclusions. However, even this at the moment seems some years away.

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