Dynamic Stochastic General Equilibrium Models and Their Discontents*

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The papers in this session all feature dynamic stochastic general equilibrium (DSGE) models that combine theory and empirics in a tractable manner. These models are an impressive response to the Lucas critique that reduced-form models cannot accurately respond to changes in fundamental behavior. However, because of the need to integrate many theoretical insights, DSGE models have some general characteristics that need to be taken into account when using the results in policy analysis. One concern is that it is difficult to move these models far from equilibrium because agents are highly forward looking and policymakers do the right thing, which makes it difficult to explain the length and depth of the current recession. This high degree of foresight also complicates the analysis of fiscal policy, as it tends to reduce the impact of Keynesian demand effects compared with classical supply responses. Finally, international spillovers are often underestimated, as these mainly come through financial links that are not well articulated in DSGE models. None of this implies that DSGE models should be abandoned, but it does suggest that their results should include a health warning.

JEL Codes: E32, E37, E62, F15.

1. Introduction

At first blush the papers in this session appear to be on quite different topics. The papers analyze fiscal issues (how effective are employer labor tax cuts in a currency union?), financial issues (can interbank markets explain real spillovers?), and monetary policy (the

*These views do not necessarily represent the views of any organizations to which I am affiliated.

effectiveness of forward guidance at the zero lower bound). To be sure, all three papers discuss important policy issues. But that alone would hardly be sufficient to justify including them in one session.

Rather than subject matter, the common link in this session is technique. All three papers come under the general rubric of dynamic stochastic general equilibrium models—DSGE models for short. More specifically, they all start from a theory-based model of the macroeconomy that involves maximizing consumers, producers, etc. These models have become extremely popular over time. The owe their origins to the original "Lucas critique" of the previous generation of more ad hoc models in which reduced-form equations were put together to create a description of the economy.[1] As Lucas correctly pointed out, reduced-form models have the disadvantage that if the nature of the deep shocks changes, then the responses of agents to those shocks may be wrong, as they ignore the deeper links implied by theory.

The Lucas critique spurred a huge intellectual effort to create theory-compatible models, including the three presented in this session. DSGE models are an astonishing intellectual achievement that have been built steadily over a long period.[2] They have evolved from the initial "real business cycle" models, which focused on economies with flexible prices and now more commonly include "New Keynesian" characteristics that acknowledge the existence of sticky prices. Indeed, the New Keynesian models have become a bedrock of large parts of monetary analysis as well as analysis other issues. They incorporate rational expectations, many agents (consumers, producers, governments, etc.), and deep theoretical parameters.

While I realize that the core DSGE models used in each of these papers are slightly different (for example, with regard to habit formation, rule-of-thumb consumers, etc.), I regard them as sufficiently similar to count them as coming from one root. In this commentary, I am therefore going to avoid concentrating on the specifics of the three papers presented in this session and instead discuss DSGE models in general. In particular, I am going to concentrate on three characteristics of these models which give me some concern. Slightly

[1]Lucas (1976).

[2]I was involved in supervising the creation of one of these models in the early 2000s. See Pesenti (2008) and Bayoumi et al. (2004).

unfairly, since I think all of the papers in this session are well done and make sensible points, I am going to use each paper as an example of my concerns.

My point of departure is that general equilibrium models produce results that involve all of their characteristics. That is their strength, but it is also their weakness. In particular, some of the general characteristics of such models need to be taken into account when using the results on specific policy issues.

2. Are DSGE Model Too Close to the Steady State?

My first concern is the speed at which a typical DSGE model comes back to its steady state. A (slightly jaundiced) way of describing the typical DSGE model is as follows. Everyone in the model understands perfectly how the economy works, the rules that policymakers follow, and that the economy will continue to work in the same way in the future.[3] In addition, because everyone understands the world perfectly, they discount the future very slowly (often at the real interest rate). Policymakers are following sensible rules that respond to the one major distortion in the economy (or economies), namely sticky prices. Since sticky prices are a relatively temporary phenomenon, it follows that sensible policy rules are extremely effective at driving the economy back to steady state in large part because low discount rates mean that future policy actions have a major impact on present behavior.

The result is that, even when hit by a large shock, the economy rapidly reverts to equilibrium. The paper in this session by Arce, Hurtado, and Thomas on the responses to prolonged deleveraging in the euro-area periphery is a good example of this property. The authors are interested in the impact of the zero bound on the euro-area economy. To do this, they hit the region with a shock about equal to that seen over the 2008/9 crisis. Notice, however, that in their base case the zero bound only holds for four quarters. And in the case where the monetary authorities extend the zero bound to support activity, this only lasts two quarters. Hence, even with good

[3]Indeed, such assumptions are basically a requirement of such a model because if this is not true, then it would be very difficult for agents to create rational expectations of the future.

policies, the zero bound is exited after six quarters. In the face of a large crisis (this paper is, after all, about responses to the euro-area crisis) the model comes out of the zero lower bound very fast. Also, the impact on activity in the core economies is small—although, to be fair, there is a prolonged impact on the periphery because of their addition to the standard DSGE setup of binding collateral constraints in the periphery.

Compare this model with the world we actually see. The U.S. Federal Reserve, the European Central Bank, the Bank of Japan, and the Bank of England were stuck at the zero bound for seven years. In addition, while the Federal Reserve has implemented one small hike and the Bank of England may lift rates soon, the other two major central banks look destined to stay at the zero bound for much longer. Turning to activity, in addition to a GDP slowdown in the periphery, there is also a marked slowdown in the core. While one could argue that other policies not included in the paper have put further downward pressure on output—budget cuts, possibly tighter financial regulation—it seems equally valid to point to policies that have supported output—quantitative easing and fiscal stimulus in the early days. In any case, it would take a huge policy shock to overcome the difference in timing at the zero bound between the real world and the model simulations.

So what went wrong? The answer is surely that in the real world people do not know exactly how the economy works now or in the future and in consequence are not sure of how policymakers will respond. Certainly, recent work by Del Negro, Giannoni, and Patterson (2012) suggests that ten-year bond yields had a more muted response to announcements of forward guidance than would be expected, consistent with future uncertainty. This points to issues such as bounded rationality and responses under uncertainty. All of these would be very difficult to put in a DSGE model that is built on rational expectations and policy rules. However, there would be one fix that could be tried, namely adding a higher discount rate of the type suggested by Blanchard (1985) and Yaari (1965).

Typically, even if such discount rates are applied, they follow the original paper in assuming that the additional discount rate reflects the likelihood of actual death and is therefore relatively small. However, it may be of interest to examine significantly higher discount rates, say in the range of 15 percent or so. This is the order of

magnitude seen on credit card debt, the main source of unsecured lending for consumers which seems to be the equivalent to the discount rate in the Blanchard-Yaari model. A large discount rate of this type would create a much less forward-looking model, which might return to steady state more slowly. While this modification is difficult, it is not impossible (see Devereux 2010 for an application of the Blanchard-Yaari framework in a DSGE model) and the outcome could be much more realistic model characteristics.

3. Do DSGE Models Always Generate Sensible Behavior?

My second concern is that theory may not always produce sensible behavior. At first blush this sounds surprising. Wasn't the point of the Lucas critique that theory is a better guide to behavior than reduced forms? This is of course true in the abstract. However, when putting together a large theory-compatible model with multiple sectors, there can be significant constraints imposed by the need to use simple functional forms with simple solutions. A good example of this is the use of constant elastisticity of substitution for consumer preferences, which links the parameter on risk aversion with the parameter on intertemporal substitution. Similarly, monopolistic competition is modeled using a constant percentage markup because it is an easy functional form to manipulate. This is also why most DSGE models use representative consumers and producers, which makes consideration of financial intermediation—the essence of which is the transfer of resources from savers to borrowers—extremely difficult.

The paper in this session by Kaszab highlights another questionable theoretical property, namely Ricardian consumers and flexible wages. The paper notes that the earlier DSGE modeling has come up with the counterintuitive results that in the face of an asymmetric shock in a currency union, labor-tax cuts on employees can reduce activity. The reduction in taxes lowers consumption, as employees are Ricardian, so that there is no impact on aggregate demand, and the downward pressure on wages raises the real interest rate. In addition, firms that cannot cut prices in the face of lower wages are less competitive and reduce labor demand and output. The paper

then shows that simply breaking Ricardian equivalence using rule-of-thumb consumers lowers but does not eliminate the downward impact on output in their model. It is also necessary to make wages sticky to produce the surely correct result that a cut in employee labor taxes will stimulate the economy.

The paper does a very nice job of creating the intuitive result. However, one has to wonder why such an odd result came out of such models in the first place and how many sophisticated "add-ons" to the core DSGE model are needed to create a "sensible" result. It might even lead one to think that a simpler reduced-form model that assumed that consumption was related to income, that post-tax wages rise by part of the cut in taxes, and that investment is related to profits might well be a better approximation to reality than typical core DSGE models—at least for this experiment.

4. Do DSGE Models Have Sufficient Spillovers?

My final area of concern is on the size of international spillovers in DSGE models. I take as my starting point the fact that a significant international business cycle exists—which seems to be the strong empirical evidence from factor models. Indeed, most policymakers regard international interlinkages as a major and rising concern.

In most DSGE models, however, spillovers come primarily from trade relationships.[4] Simple back-of-the-envelope calculations make clear why this is unlikely to produce significant international spillovers. With the exception of a few special cases (Canada to the United States, Netherlands to Germany), bilateral trade between countries is a quite limited percentage of GDP. Let us say, for example, that a country trades 5 percent of its GDP with another country—which would in most cases be a generous number. Let us also say that the elasticity on activity for such exports is two, again a generous estimate. Even in this case, the impact of a dollar reduction in real GDP in the recipient of these exports on the exporting country is only ten cents (5 percent times two).

[4]To be fair, this is not limited to DSGE models but is also true of most international macroeconomic models.

An obvious alternative is to look at financial relationships, as is done in the paper in this session by Nuguer. This paper focuses on one particularly close financial relationship, namely that between Swiss banks and the U.S. markets. The author produces a very nice model that shows how the impact of losses in U.S. markets could have been a major force for instability in the Swiss economy over the crisis. I completely agree, but unfortunately I suspect the example does not generalize. As shown in figure 1 of the paper, the importance of Swiss banks in the interbank market was huge compared with the size of the Swiss economy—it is the financial equivalent of looking at Canadian trade to the United States to examine international trade spillovers.

This and similar models use a financial accelerator to produce spillovers across economies. As a general matter, I do not think this generates large enough spillovers for similar reasons as for trade. For simplicity, let's focus on overall international asset holding rather than focusing on the interbank market and let us suppose the private sector of a country holds 10 percent of GDP of U.S. assets. This compares with U.S. holdings of U.S. assets of several hundred percent of GDP.[5] So by a similar logic to that discussed above, it is difficult to see how financial accelerator links through losses in foreign asset holding can generate large spillover in real activity. Like trade, the pipe through which the spillovers move from one country to another is simply too narrow.

So what *does* explain the international business cycle? Traditionally, the answer has been to argue that it represents some sort of global shock—often, for example, an international productivity shock. Outside of energy prices, however, it is difficult to see where such a shock could come from.

A more promising avenue is to examine why international asset prices are so closely correlated. As argued in Bayoumi and Vitek

[5]The sum of federal, municipal, government-sponsored enterprise (GSE), and corporate bonds plus corporate equities as a ratio to GDP has averaged more than 300 percent of GDP since 2000 according to the U.S. Flow of Funds. Even if some of these ratios are inflated by non-market instruments (equities average 150 percent of GDP, which is almost double the capital capitalization of the Wiltshire index), the ratio is clearly still well into three digits.

(2013), while typical DSGE models cannot explain the correlation of output across countries, models that include high asset price correlations can. Day in and day out, for example, a 1 percent change in U.S. equity prices is associated with a 0.6 percent change in (say) German stocks, while a 1-percentage-point change in ten-year bond yields is associated with a 0.4-percentage-point change in German bond yields. Furthermore, similar relationships are present across a wide range of countries and for lower frequencies. Such links can cause a significant spillover across economies, since both equity prices and bond yields have significant effects on activity. Producing a convincing theoretical explanation for why international asset prices are so closely correlated thus seems to me to be the key to explaining large spillovers in activity.

5. Final Thoughts

A not unreasonable reaction might be to say that this is all true but that DSGE models are still a useful tool for macroeconomists. I would completely agree that, when used properly, DSGE models are a great tool. All models are abstractions that help us think about the world. The concern is when models become seen as embodying fundamental truths. I would argue that something of this type happened over the Great Moderation. Mesmerized by models built in their own institutions that found that monetary policy was extremely effective, central bankers felt they could take a narrow focus and look only at activity and inflation, since policy could quickly "mop up" unexpected macroeconomic shocks. Indeed, there may be something of this type going on again with the debate about whether central banks should react to financial risks by leaning against the wind or should leave financial stability to macroprudential tools.

DSGE models are a great tool for any macroeconomist. They can provide important insights on topical issues, as the three papers in this session demonstrate. Nothing I have written here should be construed as saying that such models are not useful. That would be throwing the baby out with the bathwater. But it is essential to acknowledge that there is bathwater there, not just baby.

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