

The DSGE models and the Lucas Critique. A Historical Appraisal

Francesco Sergi*

16^{ème} Colloque International de l'Association Charles Gide
Strasbourg, 14-16 avril 2016

Abstract

This contribution to the history of the economic thought aims at describing how “Econometric Policy Evaluation: A Critique” (Lucas, 1976) was interpreted as a methodological prescription about macroeconomic modeling and, then, how it was implemented through four decades of debates. This historical appraisal clarifies how this prescription is understood and discussed in contemporary dynamic stochastic general equilibrium (DSGE) approach. The article emphasizes the influence, on the current debate, of the long-standing tension between two interpretations of the Lucas Critique. On the one hand, the real business cycle (RBC) approach understood the Lucas Critique as a prescription about the needed relation between models and theory, through the use of a specific kind of microfoundations. On the other hand, new Keynesian macroeconomists interpreted the Lucas Critique as prescription about the empirical verification of the stability of the model parameters.

Introduction

According to the standard view of the history of macroeconomics, “Econometric Policy Evaluation: A Critique” (Lucas, 1976) or “the Lucas Critique” had two consequences. First, it provided an ultimate criticism of the macroeconomic models *à la* Klein and Goldberger (1955). As Robert Hall puts it, this macroeconomic approach—which was dominant in the 1960s—was

*Université Paris 1 - Centre d'Économie de la Sorbonne (CES). Francesco.Sergi@univ-paris1.fr.

“devastated by the theoretical and empirical force of the [Lucas] critique” (Hall, 1996, p.38). Second, Lucas (1976) set in motion a new research program for macroeconometric modeling. According to Preston Miller, “the Lucas Critique was fatal and new approaches had to be developed” (Miller, 1994, p.xv).

Today, the “New Neoclassical Synthesis” modeling practices, i.e. dynamic stochastic general equilibrium (DSGE) models, are supposed to be the achievement of this quest for “new approaches”. Moreover, DSGE modelers see the Lucas Critique as a fundamental methodological prescription, and not as mere “critique”. DSGE modelers seem to understand Lucas (1976) as addressing the following methodological question: How to build macroeconomic models which provide reliable quantitative evaluation of the effects of alternative rules for economic policy? DSGE modelers consider that the answer suggested by Lucas (1976) is: In order to perform policy evaluation, macroeconomic models should specify aggregate relations as the result of the optimizing, forward-looking individual behavior of economic agents with respect to changes in their environment, especially with respect to changes in policy rules. In one word, models should specify dynamic, optimal decision rules of rational individuals, or “microfoundations”.¹ When the microfoundations are correctly specified, then the behavioral parameters ruling the model are “structural” or “policy-invariant”, i.e. such parameters have a stable value across different policy regimes. Hence, this interpretation of Lucas (1976) as a methodological prescription for macroeconomic modeling can be synthesized in this way: using microfoundations is a necessary condition for performing econometric policy evaluation. Michael Woodford, a key figure in the New Neoclassical Synthesis, endorses this view:

a model [...] with clear foundations in individual optimization is important, in our view, for two reasons. One is that it allows us to evaluate alternative monetary policies in a way that avoids the flaw in policy evaluation exercises using traditional Keynesian macroeconomic models stressed by Lucas (1976).

(Woodford, 2003, p.13)

Moreover, many central banks (and some other policy institutions, as the IMF) justify the use of DSGE models for policy evaluation arguing that

¹ I will precise in Section 1 that this kind of microfoundations should be understood as very specific to the Lucasian research program: to be precise, we should talk about “Lucasian microfoundations”. For now, I will use the term microfoundations generically, as it is standard in the DSGE literature.

these models are not vulnerable to the Lucas Critique *because* they are micro-founded. Three different examples of technical reports about DSGE models (from the Bank of Israel, the Swiss National Bank and the Central Bank of Chili) illustrate this kind of argument:

Being micro-founded, the model enables the central bank to assess the effect of its alternative policy choices on the future paths of the economy's endogenous variables, in a way that is immune to the Lucas (1976) critique.

(Argov et al., 2012, p.5)

[The DSGE] approach has three distinct advantages in comparison to other modelling strategies. First and foremost, its microfoundations should allow it to escape the Lucas (1976) critique.

(Cuche-Curti et al., 2009, p.6)

The main advantage of [DSGE] models, over more traditional reduce-form macro models, is that the structural interpretation of their parameters allows to overcome the Lucas (1976). This is clearly an advantage for policy analysis.

(Medina and Soto, 2006, p.2)

So, thanks to microfounded DSGE models, everything is fine and well in nowadays macroeconomic modeling? If it was true, as the above quotations suggest, we could just celebrate for the 40th anniversary of the publication of "Econometric Policy Evaluation". But, as often with the history of macroeconomics told by macroeconomists, things are far more complex.²

In a recent interview, Lucas himself argues, siblylline: "I think [the Lucas Critique] has been tremendously important, but it is fading." (Snowdon and Vane, 2005, p.282). Do Lucas think that his Critique is losing importance because all macroeconomists are aware of it, or it is because they forgot the importance of the Critique? Charles Plosser, a key figure of the real business cycle (RBC) approach in the 1980s, also argues:

In my view, the current rules of the game of New Keynesian DSGE models run afoul of the Lucas critique—a seminal work for my generation of macroeconomists and for each generation since.

(Plosser, 2012, p.5)

² About historiographical problems in contemporary macroeconomics see (Sergi, 2015a).

A quick overview of the most recent articles mentioning Lucas (1976)—such as, for instance, Hurtado (2014); Lubik and Surico (2010) or Chang et al. (2010)—confirms Plosser’s view: all these contributions claim that DSGE models are *vulnerable* to the Lucas Critique. Remarkably, such criticisms come from the *inside* of the DSGE approach.

The present article puts in a historical perspective the current state of this debate about the DSGE and the Lucas Critique. My purpose is to describe how Lucas (1976) was interpreted as a methodological prescription about macroeconometric modeling, and then how this prescription was implemented during four decades of debates.³ Analyzing these debates means answering two questions: (1) How the 1980s-1990s macroeconomic models, especially those in the RBC and new Keynesian approaches, interpreted and assessed the Lucas Critique as a methodological prescription? (2) How this reception influenced the present DSGE approach, and the debate about its vulnerability to the Lucas Critique?

My historical appraisal will explore these two questions with a simple framework, relying on the claim that Lucas (1976) can be understood as a methodological prescription for macroeconometric modeling. Such a prescription will be summarized as: microfoundations are a necessary condition for performing econometric policy evaluation. The first section of this article will discuss this interpretation and its limitations in respect of a broader view of Lucasian methodology.

I will argue that both RBC and new Keynesian macroeconomists share the interpretation of Lucas (1976) as a methodological prescription for macroeconometric modeling. However, starting from this common understanding, the RBC approach and the new Keynesian approach took two divergent paths to the assessment of the Lucas Critique. In the second section of this article I will illustrate these two divergent paths. On the one hand, RBC modelers, following an hypothetico-deductive methodological approach, consider that specifying microfoundations is a necessary *and sufficient* condition for policy evaluation. Hence, for RBC modelers, the Lucas Critique is a prescription about the theory to be used in specifying the model. On the other hand, new Keynesians, following an inductive methodological approach, claim that specifying microfoundations is *not a sufficient condition* for policy evaluation. In their understanding, the Lucas Critique is an empirical prescription about verifying stability of parameters across different policy regimes. Following this interpretation, New Keynesian modelers run different econometric tests, leading to different conclusions: in some cases, microfoundations could be

³ A similar perspective was adopted in Goutsmedt et al. (2015), which analyzes the “Keynesian” responses to Lucas (1976) in the immediate afterward of its publication.

however a necessary condition (even if not sufficient) for policy evaluation; in some other cases, microfoundations are *neither* a necessary, nor a sufficient condition.

Finally, the third section of this article analyzes the ongoing controversy about the DSGE and the Lucas Critique. I will claim that DSGE models of the New Neoclassical Synthesis embody a unstable compromise between the RBC “necessary and sufficient condition” assessment of the Lucas Critique and the New Keynesian “not sufficient condition” assessment. I will show how contributions that “Lucas-criticize” DSGE models can be easily sort in one of this two categories.

1 The Lucas Critique as a methodological prescription

Lucas (1976) was formulated as a “critique” of the dominant approach to macroeconometric modeling of its time. According to Lucas, models in this approach, issued from the tradition of Klein and Goldberger (1955)—explicitly targeted in Lucas (1976, p.19)—are not “structural”. Lucas claims that their behavioral parameters are supposed to be stable across time, but, actually, they are changing along with changes in policy rules (or, more generally, in exogenous variables). As a consequence, such models “provide no useful information as to the actual consequences of alternative economic policies” (*ibid.*). Such a criticism is far from being new—even Lucas himself recognizes this point(*ibid.*, p.19, fn.3).⁴

What is new in Lucas (1976) is the diagnosis of the problem. Indeed, Lucas is arguing that macroeconometric models *à la* Klein and Goldberger (1955) are not structural because

the individual decision problem: “find an optimal decision rule when certain parameters (future prices, say) follow arbitrary paths” is simply not well formulated

(Lucas, 1976, p.26).

⁴ The stability of parameters in macroeconometric models was indeed a main concern for econometricians since the 1930s. For instance, Ragnar Frisch “critique” (Frisch, 1938) against Tinbergen’s first macroeconometric model for the League of Nations is based upon the same argument than the Lucas Critique. Frisch pointed out that the relationships used by Tinbergen in his model were not stable (not “autonomous” in Frisch’s words). Even if Frisch’s notion of “autonomy” of macroeconometric models was quickly abandoned (Qin, 2014), the econometricians still took the underlying problem seriously, as in Tinbergen (1956, Chap.5), Marschak (1953, p.8;p.25) and Haavelmo (1944, p.27).

According to Lucas, the individual decision problem will be “well formulated” if it was derived, in an hypothetico-deductive perspective, from “microeconomic theory”, i.e. Walrasian general equilibrium approach. Lucas criticizes the mainstream macroeconomic approach for relying on econometric induction instead of using “microeconomic theory”:

[the] micro-economic role for theory [to rationalize individual econometric relationship] abdicates the task of describing the aggregate behaviour of the system entirely to econometricians.

(*ibid.*, p.23)

This leads inevitably macroeconomic models to produce predictions that are contradictory with those made by “microeconomic theory”: the trade-off between inflation and output postulated by the econometric approach to modeling is, for Lucas, the perfect illustration of such an “obvious fallacy” (*ibid.*) with respect to theory. In a nutshell, Lucas’s diagnosis is that the mainstream macroeconomic approach is not useful for policy evaluation because it lacks of “microfoundations”, i.e. because it don’t specify macroeconomic relationships in terms of individual decision rules deduced from the hypotheses of the “microeconomic theory”. In Lucas understanding, microfoundations consist in describing macroeconomic (aggregate) behavior as consistent with individual (microeconomic) behavior, this latter being formulated in the terms of Walrasian general equilibrium. A macroeconomic model can be considered as microfounded since it relies on (i) intertemporal optimization of individuals, (ii) endogenous, forward-looking expectations of individuals and (iii) market-clearing (all the individual plans are compatible).⁵

The logical implication of the Lucas Critique is that macroeconomic models can perform policy evaluation if their behavioral equations are microfounded. Hence, the Lucas Critique can actually be interpreted as a methodological prescription: even if the initial question addressed by Lucas (1976) is more likely to be resumed as “how *not* to build macroeconomic models for policy evaluation” (i.e. as a “negative” prescription), the “how to build it” question (i.e. a “positive” prescription) is clearly addressed in the conclusions of the article. Lucas suggests indeed that macroeconomic microfounded models should be formalized as a system of two difference

⁵ Such “Lucasian microfoundations” must be distinguished from other, competing “microfoundational programs” sharing the same goal but not the same definition of microfoundations. About microfoundational programs, see Hoover (2012). Even if this precision is quite important, hereafter we will use the term “microfoundations”, in short, instead of “Lucasian microfoundations”.

equations:

$$y_{t+1} = F(y_t, x_t, \theta(\lambda), \epsilon_t) \quad (1)$$

$$x_t = G(y_t, x_{t-1}, \lambda, \eta_t) \quad (2)$$

Equation (1) describes the law of motion of the economic system, y_t being the endogenous variables, x_t the exogenous variables (including policy) and θ a vector of individual decision rules. Equation (2) represents the evolution of the exogenous variables, with λ a vector of parameters (including for instance policy rules); ϵ, η are i.i.d disturbances. The Lucas Critique targeted models that use fixed behavioral parameters θ , instead of using decision rules $\theta(\lambda)$, taking into account the evolution of exogenous variables. Moreover, relying on the examples exposed in his paper, Lucas argues that modeling the decision rules is “while scientifically more demanding, completely operational.” (Lucas, 1976, p.45).⁶

Lucas (1976) can be definitively regarded as much more than a simple “critique”: as discussed above, this article provides a clear methodological prescription, which can be synthesized as “microfoundations are a necessary condition for policy evaluation”. But do Lucas consider that this condition is also a *sufficient* one? In other words, do microfoundations always implies the stability (the policy-invariance) of parameters? Lucas’s answers in further work is “no”. It is true that theoretical arguments (the use of microfoundations) are the core of the Lucas (1976)’s prescription; however, if one takes a broader look on Lucas’s work, the need of empirical investigation of the stability of parameters appears to be an important corollary to the need of microfoundations. Lucas and Sargent, in their famous “After Keynesian Macroeconomics”, did insist about the stability of parameters (then, the use of models for policy evaluation) being an empirical question, and not only a theoretical one:

“[there is] a number of theoretical reasons for believing that the parameters identified as structural by the methods which are in current use in macroeconomics are not structural in fact. That is, there is no reason, in our opinion, to believe that these models have isolated structures which will remain invariant across the class of interventions that figure in contemporary discussions of economic policy. Yet the question of whether a particular model is structural is an empirical, not a theoretical, one.

⁶ Note that, according to Lucas, only changes in *rules* can be predicted: evaluation of discretionary policies is “beyond the capability not only of the current-generation models, but of conceivable future models as well” (*ibid.*, pp.41-42).

(Lucas and Sargent, 1979, p.56).

Moreover, they admit that the Lucas Critique, as a theoretical prescription about the use of microfoundations, can possibly be refuted empirically (even if they don't think this is actually the case): "If macroeconomic models had compiled a record of parameter stability, particularly in the face of breaks in the stochastic behavior of the exogenous variables and disturbances, one would be skeptical as to the importance of prior theoretical objections of the sort we have raised" (*ibid.*).

In a general way, as emphasized for instance by De Vroey (2015), Lucas's methodology put emphasis on empirical corroboration of models (essentially through corroboration of their predictions). Hence, to be consistent with this broader perspective on Lucas's methodology, the prescription of Lucas (1976) about "how to build models for policy evaluation" should be reformulated. Microfoundations are *a priori* a necessary condition for policy evaluation, but their implications, i.e. stability of parameters, should be *empirically corroborated*.⁷

But how this empirical corroboration should be produced? This crucial question is quite absent in Lucas (1976); although, it was addressed by new Classical econometrics. As summarized by Lars Hansen and Thomas Sargent in their emblematic contribution, this approach involves "estimating agent's decision rules jointly with models for stochastic processes they face, subject to cross-equation restrictions implied by the hypothesis of rational expectations" (Hansen and Sargent, 1981, pp.7-8). In other words, the specification of the decision rules of economic agents should be rigorously derived from theory, following an hypothetico-deductive process. Therefore, new Classical econometrics rejects the so-call "ad hoc" restrictions of the mainstream macroeconomic approach, i.e. specification derived from by econometric induction. In the same vein, cross-equation restrictions should replace the equation-by-equation estimation, and Granger-causality test should be use systematically to test the exogeneity of variables. Using the above notation, the scope of new Classical econometrics is (1) to specify the decision rules $\theta(\lambda)$ (equation 1), (2) to identify the parameters λ that govern the exogenous process in the economy (equation 2) and (3) to identify the "deep" parameters of the decision rules. Therefore, new Classical econometrics should be regarded as the consistent extension of the Lucas Critique as a methodological prescription. This approach aims indeed at implementing econometric

⁷ Although empirical corroboration alone are not a sufficient condition for a valid model: "the unquestioned success of the forecasters should not be construed as evidence for the reliability of the structure proposed in that theory" (Lucas, 1976, p.24).

procedures for specification and identification of models that respect the Lucas Critique.⁸

In this section, I discussed to which extent Lucas (1976) should be regarded as a methodological prescription of the kind: microfoundations are a necessary condition for econometric policy evaluation. I established that this interpretation might be consistent with Lucas (1976) in itself, but that it is not fully consistent with a broader conception of the Lucasian methodology and with the econometric developments of the new Classical macroeconomics. In particular, according to Lucas, microfounded models also need an empirical corroboration and, furthermore, such corroboration should be obtained following precise econometric procedures. We can then conclude that, globally, Lucas's methodological prescription about econometric policy evaluation, beyond Lucas (1976), should be intended as follow: microfoundations are *a priori* a necessary condition for stability of parameters (and, then, for policy evaluation), but this implications should be *empirically corroborated* by econometric tests.

2 Two alternative assessments of the Lucas Critique

How the 1980s-1990s generation of macroeconomic models, especially in the RBC and new Keynesian approaches, took into account the Lucas Critique as a methodological prescription? The present section aims at answering this question.

I will show that RBC and new Keynesians share a common understanding of Lucas (1976), which is the one discussed in the previous section. Hence, the Lucas Critique is interpreted as a methodological prescription for macroeconomic modeling, advocating that microfoundations are a necessary condition for performing policy evaluation. I will argue that, starting from this common understanding, RBC and new Keynesians took two divergent paths in the assessment of the Lucas Critique. On the one side, the RBC approach supports an hypothetico-deductive methodology, which leads them to assess microfoundations as an a priori necessary and sufficient condition for policy evaluation. On the other side, new Keynesians follow an inductive methodology: they claim that microfoundations are not a priori a sufficient condition

⁸ This approach is resumed by *Rational Expectations and Econometric Practice* (Lucas and Sargent, 1981). For an extensive account about new Classical macroeconometrics and Lucas's methodology, see Sergi (2015b).

for policy evaluation, and that these hypotheses need to be empirically corroborated.

2.1 The RBC assessment of the Lucas Critique

The RBC assessment of the Lucas Critique is rooted in Kydland and Prescott (1977), where the authors endorse the criticism of mainstream macroeconometrics for its lack of microfoundations:

Standard practice is to estimate an econometric model and then, at least informally, to use optimal-control-theory techniques to determine policy. But as Lucas (1976) has argued, since optimal decision rules vary systematically with changes in the structure of series relevant to the decision maker, any change in policy will alter the structure of these rules.

(Kydland and Prescott, 1977, p.474)

Kydland and Prescott also extend the Lucas Critique, arguing that “bad” models lead to “bad” policy recommendations (here, stabilization policies) and, finally, to “perverse” economic outcomes⁹:

[Thus, we found that] stabilization efforts have the perverse effect of contributing to economic instability. [...] In effect the policymaker is failing to take into account the effect of his policy rule upon the optimal decision [sic] rules of the economic agents.

(*ibid.*)

In order to avoid this problem, Kydland and Prescott seem to consider that the Lucas Critique provide a useful methodological prescription: specifying microfoundations (using “economic theory” *ibid.*, p.487) is a necessary condition for models performing policy evaluation. In addition, they claim that a model can be used for policy evaluation only if it provides corroborated (“tested”) predictions:

a tested theory of economic fluctuations [is] something which is needed before policy evaluation is undertaken. The implication of [our] analysis is that, until we have such a [tested] theory [of economic fluctuations], active stabilization may very well be dangerous and it is best that it not be attempted.

(*ibid.*, p.487)

⁹ This is what Snowdon (2007) calls the “idea hypothesis”. For a discussion about this interpretation of Lucas (1976), see Goutsmedt et al. (2015, pp.18-20).

Kydland and Prescott draw here a distinction between two steps of macroeconomic analysis: 1) providing a “tested” theory of the business cycle; 2) use this “tested” theory for policy evaluation. This distinction constitutes a crucial turn in the development of the RBC assessment of the Lucas Critique.

Indeed, policy and policy-makers are simply not formalized in the seminal contribution to the RBC approach (Kydland and Prescott, 1982).¹⁰ Kydland and Prescott’s purpose in this article is to verify if “a general equilibrium model”, with no policy interventions, is capable of “fit the U.S. quarterly data for the post-war period” (*ibid.*, p.1345). Therefore, the parameters in the model (preferences and technologies) are assumed to be policy-invariant, structural parameters. The empirical corroboration of the model predictions allows the authors to corroborate *indirectly* this assumption.¹¹ As a result, these microfoundations are a sufficient condition for escaping the Lucas Critique, even if the relation between private behavior and policymakers is not explicitly specified and tested:

Models such as the one considered in this paper could be used to predict the consequence of a particular policy rule upon the operating characteristics of the economy. As we estimate the preference-technology structure, our structural parameters will be invariant to the policy rule selected even though the behavioral equations are not.

(ibid., p.1369).

The RBC assessment of the Lucas Critique consists in first indirectly corroborating the policy-invariance of microfounded parameters, in a framework without policy and then using these microfoundations for policy analysis. Hence, the RBC understand Lucas (1976) as a theory-driven methodological prescription: their interpretation relies on the idea that microfounded parameters such as preferences and technologies are a priori policy-invariant, and that there is no need to provide direct empirical evidence about stability. In a nutshell, Kydland and Prescott promote the idea that microfoundation are a sufficient condition for policy evaluation.

Note also that the empirical corroboration method of Kydland and Prescott, the “calibration” method, relies entirely on this conception of microfoundations as a priori policy-invariant parameters. Indeed, as the values of parameters are supposed to be stable across time (and across policy regimes),

¹⁰ The same remark applies to Long and Plosser (1983) and to Black (1982).

¹¹ Formally, reporting this assumption to equations (1 – 2), they suggest that preferences and technologies are parameters in the vector θ that are fixed and independent from the policy components of λ .

the possible values can be picked up (once-for-all) from different sources: (i) a set of evidences produced outside the model (for instance in microeconomic literature); (ii) a “plausible” value, plausible to the subjective judgment of the modeler and to the expected results; (iii) a set of calibration values in other RBC models.¹² At any time the chosen values can be tested *directly*: indeed, for RBC, the only pertinent test is about the simulated results of the model.

Policy evaluation exercises in further RBC literature illustrate this view. Contributions like Cooley and Hansen (1989) and Greenwood and Huffman (1991) provide two good examples.¹³ Cooley and Hansen (1989) try to evaluate the effects on welfare of different levels of inflation volatility (corresponding to different monetary policy), using a RBC model with cash-in-advance transaction functions. Greenwood and Huffman (1991) run a similar welfare analysis for different fiscal policies. The most complete synthesis of this line of work is Chari et al. (1995), addressing directly the question of optimal monetary policy rules. All these authors addressed the policy evaluation following the Kydland and Prescott assessment of the Lucas Critique: specifying microfoundations, i.e. specifying preferences and technology, is a sufficient condition for escaping the Lucas Critique. Therefore, models are built assuming that preferences and technology are policy-invariant parameters, and their values are calibrated using values of previous RBC models.¹⁴

This modeling practice was criticized inside and outside the RBC approach, especially from the perspective of calibration method (and the underlying assumption that preferences and technologies are structural parameters). For instance, Pierre Danthine and Donaldson (1993, p.17) wonder “to what extent do the benchmark stylized facts used in the literature depend upon the selection of time periods or variations in policy regimes”. Outside the RBC approach, the criticisms are more radical than that. In “Post-econometric Policy Evaluation: A Critique”, Beth Ingram and Erich Leeper argue that RBC models repeat “the ‘Keynesian ’ errors that Lucas (1976)

¹² An insightful comment about this is Kydland and Prescott claim that “because the language used in these business cycle models is the same as that used in other areas of applied economics, *the values of common parameters should be identical across these areas and typically have been measured by researchers working in these other areas*” (Kydland and Prescott, 1991, p.170, my emphasis).

¹³ Another strain of works in RBC approach, which I will not analyze here, studies policies (tax policies or government spending) as additional sources of the business cycles (Braun, 1994; Christiano and Eichenbaum, 1992; McGrattan, 1994).

¹⁴ Note that, in these works, Lucas (1976) is never quoted in bibliography, and the expression “Lucas Critique” is also absent. The more noticeable absence of Lucas (1976) is in the synthesis of RBC research provided by Cooley (1995).

noted in its influential critique” (Ingram and Leeper, 1990, p.1). According to the authors, this is mainly due to two errors: first, the fact that all RBC literature on policy evaluation uses parameters’ values for calibration that are borrowed from previous RBC models, with no policy considerations; second, the fact that RBC models don’t specify explicitly how individual decision rules depends on policy. In extenso:

Frequently, RBC modelers transport the parameter values Kydland and Prescott used in their model without policy to the new model with policy. [...] Kydland and Prescott’s model assume that policy doesn’t affect private decision rules. There is no policy evaluation to perform. Alternatively, if policy does affect private behavior, then the parameters Kydland and Prescott calibrate *are reduced-form parameters for some underlying model embedding monetary and fiscal policy*. Thus, if there is any policy evaluation left to perform, Kydland and Prescott’s calibrated parameters must be functions of policy behavior and should change systematically with policy. When RBC modelers evaluate alternative policies, however, the calibrated parameters are held fixed.

(*ibid.*, pp.3-4, their emphasis)

To resume, Ingram and Leeper re-interpret Lawrence Summers’s famous description of the RBC as “a big loose tent flapping in the wind” (Summers, 1986, p.24). If Summers meant that there were weak empirical evidence in favor of the values chosen by RBC theorists, Ingram and Leeper criticize calibrated parameters for “flapping” in the “wind” of the policy regime changes.

2.2 The new Keynesian assessment of the Lucas Critique

The label “new Keynesian” is far more generic than the “RBC” label: indeed, it covers a wider range of modeling practices, all inspired from very different seminal contributions.¹⁵ This heterogeneity makes quite difficult to provide, in this section, an exhaustive account of the interpretations of the Lucas Critique in the whole new Keynesian literature in the 1980s-1990s. Despite this intrinsic limitation, some significant examples allow to illustrate that the new Keynesian assessment of the Lucas Critique can be resumed to the following question: Should the methodological prescription presented in

¹⁵ I focus here on the “first generation” of new Keynesians, covering the period between the end of the 1970s and the mid of the 1990s: for a synthesis of this approach, see for instance Romer (1993) and, for a more complete overview, Mankiw and Romer (1991). For an extensive account of new Keynesian methodology, see Sergi (2016).

Lucas (1976) be applied? New Keynesians answer this question by investigating if the parameters drift suggested by the Lucas Critique is corroborated by the evidences. Then they interpret the Critique as an empirical question about the stability of non-microfounded parameters. Alain Blinder is quite representative of this view when he argues

All you have to do in this country [...] right now is scream mindlessly, “Lucas critique!” and the conversation ends. That is a terrible attitude. The Lucas critique may be correct, but I have seen no persuasive evidence in any sphere to indicate that it is empirically important. The empirical case is yet to be made.

(Blinder in Klammer, 1984, p.166)

The new Keynesian assessment of the Lucas Critique, which will be analyzed in this section, relies on the idea that microfoundations are not a *sufficient* condition for macroeconometric modeling. Moreover, microfoundations are neither *a priori* a necessary condition. New Keynesians consider that, to be used for policy analysis, a macroeconometric model should be built upon empirically corroborated, “realistic” assumptions. The role of induction, and especially based on traditional econometric methods, is crucial for establishing corroboration. This methodological principle applies also to microfoundations.

Are non-microfounded parameters non-structural, i.e. are non-microfounded parameters really drifting along with changes in policy? The first strain of new Keynesian literature under our investigation answers this question. In other words, as Blinder put it, this literature asks if the Lucas Critique is “empirically important”. The implication of this test is the acceptance or the rejection of the prescription “microfoundations are a necessary condition for policy evaluation”.

The most important illustration of this approach is Olivier Blanchard’s “The Lucas Critique and the Volcker Deflation” (Blanchard, 1984).¹⁶ In this paper, Blanchard investigates two traditional macroeconomic relationships—the Phillips curve and the term structure of interest rates—in a context of change in policy regime—namely, the U.S. monetary policy after 1978. The Phillips Curve and the term structure analyzed in the paper are those used in macroeconometric models *à la* Klein and Goldberger (1955), both specified with backward-looking expectations, so non-microfounded in the Lucasian sense.¹⁷ The purpose of his empirical study is to find out if these relationships

¹⁶ Similar studies are Englander and Los (1983) and Taylor (1984).

¹⁷ The Phillips Curve is taken from the DRI model used by the Congress Budget Office, and the term structure from the MPS model of the Federal Reserve Board.

are empirically stable despite the change in policy regime. The result of the test is that the Lucas Critique is very much likely to be applied to the term structure, but not to the Phillips Curve.

This inductive approach in the new Keynesian literature shares a common perspective with the econometric program of Christopher Sims. Sims (1980) is indeed suggesting that macroeconomic models should not rely on a priori hypotheses deduced from economic theory, but on hypotheses inducted from the econometric evidence. About the Lucas Critique, Sims (1982) provided a quite complete answer to Lucas (1976), arguing that microfoundations are not a necessary condition for policy evaluation to the extent 1) that this solution is limited to the case of changes in rules, which represent a very negligible aspect of actual policy-making; 2) that traditional macroeconomic models actually perform very well for econometric policy evaluation. In one word, Sims is also defending the view that the Lucas Critique, both as a critique and as a prescription, is not empirically corroborated. Many econometricians will also endorse this skepticism about the Lucas Critique, especially the literature developed around the notion of “superexogeneity” (Ericsson and Irons, 1995).

The results in Blanchard (1984) suggests that, for some cases, microfoundations are however a necessary condition for models performing policy evaluation, to the extent that non-microfounded parameters are proof to be non-structural. Hence, New Keynesians accepted to formulate their models, at least partially, under the form of optimizing, forward-looking behavior of the economic individuals. The main aspect of this obedience to microfoundational program should be found in the formalization of price and wage rigidities. This hypothesis is inducted from observed characteristics of the “real world” (see for instance Ball and Mankiw, 1994, p.131), but it is then formalized following the Lucasian microfoundational program and clearly advocating the Lucas Critique as the methodological prescription guiding this choice.

Early contributions to the new Keynesian literature support this view. According to Gordon (1990, p.1115, fn. 2), Michael Parkin was one of the first authors to label his own work as “new Keynesian”. In Parkin (1986, pp.200-201), he suggests that Lucas Critique is an important standard for assessing his work: “[My paper] extends earlier work on the microeconomic foundations of sticky prices [...] Hence, this paper is able to go much further in meeting the Lucas (1976) critique than earlier macromodels with price (or wage) rigidities”. Ben Bernanke, another key figure in the new Keynesian approach, supports that a “virtue” of a model consists in its robustness to the Lucas Critique:

[My model's] virtue is that it permits estimation to be based on the closed-form solution to a dynamic stochastic optimization problem, which leads to maximum efficiency in the use of the data. The estimation procedure employed here is not vulnerable, as those in some earlier studies are, to the criticisms made by Robert Lucas (1976).

(Bernanke, 1983, p.71)

Similarly, Blanchard and Wyplosz advocate for introducing “microfounded”, explicit expectation-formation mechanisms, of the type supported by Lucas (Blanchard and Wyplosz, 1981, p.1).

New Keynesian acceptance of Lucasian methodological prescription—and especially of the microfoundations injunction implicit in the Lucas Critique—were strongly questioned by RBC and new Classical authors. The new Keynesian microfoundations of price and wage rigidities were attacked from two perspectives. On the one hand, RBC and new Classical macroeconomists saw in this kind of microfoundations an aprioristic choice, intended to support old Keynesian results such as money non-neutrality and stabilization policies. In other words, new Keynesians were performing “successful marketing”, which “typically makes a product new and old at the same time” (King, 1993, p.67); namely, they were trying to provide “respectability” to the old Keynesian vision. New Keynesians were also accused of prioritizing “ideology” over “science”: as Lucas himself argues, commenting on Ball and Mankiw (1994), “For Ball and Mankiw, it is not more knowledge that we need, but better ideological choices” (Lucas, 1994, p.154). On the other hand, new Keynesian microfoundations were criticized because of their non-Walrasian microfoundations (partial equilibrium, imperfect competition, incomplete information). This choice is pointed out as inconsistent with the Lucasian microfoundation program. But none of these arguments introduced the Lucas Critique in the discussion. I will show in the next section that Lucas-criticizing the new Keynesian approach is a more distinctive characteristic of the current debate about DSGE models.

3 The DSGE models and the Lucas Critique

The previous section discussed the RBC and the new Keynesian assessment of the Lucas Critique. The RBC approach, following an hypothetico-deductive perspective, claims that microfoundations (intended as specifying preferences and technologies) were, a priori, a sufficient condition to perform econometric policy evaluation. The new Keynesian approach, following an

inductive perspective, argues that this condition was not sufficient (and in some cases, also not necessary).

My claim is that the current debate about DSGE models and the Lucas Critique originates from these two alternative assessments of Lucas (1976). This section will illustrate that one can easily identify two strain of the literature contributing to this debate. The first strain relies on the RBC interpretation of the Lucas Critique: indeed, this literature discusses if DSGE models are *enough* microfounded to be considered as correctly specified in terms of structural, policy-invariant parameters. The second strain of literature follows the new Keynesian interpretation of the Lucas Critique, since it discusses if microfoundations are “enough” to identify structural, policy-invariant parameters; in other words, this analysis investigates if “well” microfounded parameters are truly structural or if they are actually shifting in response to change in policies.

Note that the current debate about DSGE models and the Lucas Critique is frequently reviewed with different categories: Hurtado (2014) for instance classifies it in “theoretical” and “empirical” critiques; Inoue and Rossi (2008) distinguish between “specification” and “identification” critiques. These categories are consistent with those used in this section: on the one hand, the “theoretical” and “specification” critiques of the DSGE correspond to the hypothetico-deductive approach characterizing the RBC assessment of the Lucas Critique; on the other hand, “empirical” and “identification” critiques correspond to the inductive methodology of the new Keynesian assessment. The classification used in this paper relies on a historical appraisal of the reception of the Lucas Critique by RBC and new Keynesians: hence, it provides a broader perspective on the current debates than the simple “technical” categorization of the critiques as “theoretical” or “empirical”.

3.1 Are DSGE models “enough” microfounded?

Charles Plosser, a key figure in the RBC approach, recently pointed out how DSGE models are vulnerable to the Lucas Critique. According to Plosser, this weakness results from the new Keynesian elements of DSGE models, such as price and wage rigidities, which are not specified in terms of optimizing individual behavior:

When the real and nominal frictions of New Keynesian models do not reflect the incentives faced by economic actors in actual economies, these models violate the Lucas critique’s policy invariance dictum, and thus, the policy advice these models offer must be interpreted with caution.

(Plosser, 2012, p.5)

The underlying interpretation of the Lucas Critique is that microfoundations (i.e. specifying optimizing individual behavior) are a necessary and sufficient condition for policy evaluation, because microfoundations provide structural, policy-invariant parameters. Indeed, Plosser considers that, in order to preserve DSGE models from the Lucas Critique, “we should work to give the real and nominal frictions [...] deeper and more empirically supported structural foundations” (*ibid.*, p.6).

Like Plosser, many contributions in the current debate will follow this argument, which is inherited from RBC assessment of the Lucas Critique as we described it in sub-section 2.1. I will take here four examples (Lubik and Surico, 2010; Inoue and Rossi, 2008; Fernández-Villaverde and Rubio-Ramirez, 2007 and Chari et al., 2008) to illustrate this strain of the debate about the vulnerability of the DSGE to the Lucas Critique. The core argument of these contributions is that such a vulnerability result from unsatisfactory microfoundations of *some* parameters in the DSGE, especially price and wage rigidity and monetary policy rules. This features are considered as not “enough” microfounded, because they are not explicitly derived from an optimizing, forward-looking behavior. As a consequence, the resulting parameters are not structural. To solve the problem, these contributions suggest that one need to provide “more” microfoundations to DSGE models.

A preliminary remark about this first strain of literature about DSGE models and the Lucas Critique is about a radical change in corroboration method in respect of RBC approach. *Exit* the simulation of calibrated models and the rejection of traditional econometrics; *enter* the econometric test of the stability of the parameters. The new Keynesian perspective about testing “if the Lucas Critique is empirically important” seem to be now a common concern to all macroeconomists. Lubik and Surico (2010) is an illustration of this kind of contributions to the debate: in this paper, the authors try to check econometrically if non-microfounded models (using for instance backward-looking expectations) are non-structural. They argue 1) that new Keynesian and superexogeneity tests are econometrically not well formulated and 2) that, a “proper” econometric test “conclude that the Lucas critique is alive and well” (*ibid.*, p.179). The diagnosis of this empirical corroboration of the Lucas Critique follow the RBC assessment of the Lucas Critique: vulnerability to the Critique comes from unsatisfactory microfoundations. As a result, microfoundations are a necessary and sufficient condition for policy evaluation. The authors are quite clear about applying this methodological prescription to DSGE models, which seem, not adequately microfounded in

terms of policy rules.¹⁸

In a similar vein, “How Structural Are Structural Parameters?” (Fernández-Villaverde and Rubio-Ramirez, 2007) tries to verify empirically if the (assumed) structural parameters are stable over time: “how stable over time are the so-called “structural parameters” of dynamic stochastic general equilibrium (DSGE) models?” (*ibid.*, p.3). The results lead the authors to conclude that the main source of instability in DSGE parameters is the misspecification of the underlying economic relationships in terms of optimal decision rules. The main problem comes from the parameters describing price adjustment, and then from the way the price-setting behavior is specified in the model:

We consider our findings to be strong proof of the changing nature of the nominal rigidities in the economy and of a strong indication of model misspecification along the dimension of price and wage adjustment. Calvo’s price adjustment cannot capture the evolution of the fundamentals that determine the pricing decisions of firms and households.

(*ibid.*, p.32)

To resume, the vulnerability of the DSGE models to the Lucas Critique is, according to the authors, a consequence of the lack of microfoundations of the price-setting behavior *à la* Calvo (1983), which specify no endogenous decision about timing of price change.¹⁹ The authors argues that DSGE models, in order to escape the Lucas Critique, should be more rigorously microfounded, for instance by developing state-dependent decisions of price adjustment.²⁰

More explicitly than in Fernández-Villaverde and Rubio-Ramirez (2007), “New Keynesian Models: Not Yet Useful for Policy Analysis” (Chari et al., 2008) provide however the very same conclusion. First, the authors produce

¹⁸ “A deeper issue is whether DSGE models that are used for policy analysis are not themselves subject to the Lucas critique. Implicitly, Lucas’s argument rests on the notion that the information set of economic agents and their decision problems were not fully specified in traditional macroeconomic models. Yet, with the use of ad hoc monetary policy rules, that very issue surely comes up in DSGE models that do not include optimizing policy makers” (Lubik and Surico, 2010, p.192).

¹⁹ Fernández-Villaverde and Rubio-Ramirez (2007, p.33) also target, like Lubik and Surico (2010), the monetary policy reaction function *à la* Taylor (1993), as not derived from an explicit optimizing problem of the monetary authority.

²⁰ Inoue and Rossi (2008) provide a similar argument and conclusion, arguing that “the [unstable parameters] are the potentially misspecified features that require further theoretical modeling efforts” (Inoue and Rossi, 2008, p.2).

empirical evidences that many shocks and parameters (especially shocks on wage- and price-markup) are reduced-forms and not structural; then, they target the new Keynesian inductive perspective, not taking rigorously into account microfoundations:

Most of our disagreement stems from our different preferred traditions of model building and assessment. [...] The urge to improve the macro fit leads researchers in the [new Keynesian] tradition to add many shocks and other features to their models and then to use the same old aggregate data to estimate the associated new parameters. This tradition does not include the discipline of microeconomic evidence; so free parameters commonly abound in New Keynesian models.

(Chari et al., 2008, p.2)

Shocks on wage-markup for instance are reduced forms and not structural, to the extent there is any way of distinguish between two possible causes: a change in the value of leisure or a change in the bargaining power of workers. Hence, according to the authors, the lack of information about the optimization problem underlying markups is responsible for the vulnerability of DSGE to the Lucas Critique. Consequently, they suggest that the solution to the problem is to provide “more” microfoundations:

The primary change needed is obvious: to resist the urge to add parameters undisciplined by micro data simply because they help the model better fit the same old aggregate time series. This method is what makes the New Keynesian models unhelpful as tools of policy analysis. Processes of this kind will be slow and painful, but likely worth the trouble because they will help the profession avoid the unhappy outcomes of the Old Keynesian revolution.

(*ibid.*, p.24)

Note that this conclusion adds the Lucas Critique to the recurrent RBC and new Classical’s criticism against the new Keynesian approach, namely their “obedience” to the old Keynesian approach (*cf.* sub-section 2.2).

3.2 Are microfoundations “enough”?

The second strain of literature about DSGE models and the Lucas Critique follows the new Keynesian assessment of Lucas (1976): microfoundations are not a sufficient condition for a safe policy evaluation. As discussed in sub-section 2.2, new Keynesians endorse an inductive view of the

policy-invariant problem. In the current debate, we found many contributions following this assessment. As in the previous sub-section, I will take here only four examples of this view: Cogley and Yagihashi (2010); Estrella and Fuhrer (2003); Hurtado (2014) and Chang et al. (2010). The common core of these contributions to the debate is the idea that microfoundations (in the sense of Lucas) are not “enough” for preserving DSGE models from the Lucas Critique, or, with the usual formulation, that microfoundations are not a sufficient condition for policy evaluation (and, in some cases, neither a necessary condition). To support this conclusions, contributions in this strain of literature propose to test empirically if microfounded parameters of DSGE models are truly structural, i.e. if their value is stable across time and policy regimes.²¹

A preliminary remark is that the new Keynesian question about the practical relevance of the Lucas Critique is still present in the debate, even if it has evolved.²² “Are DSGE Models Approximating Invariant to Shifts in Policy?” (Cogley and Yagihashi, 2010) illustrate this evolution. Therefore, this article does not reject the empirical relevance of the Critique, to the extent it admits that shifts in non-microfounded parameters do occur. But it suggests that, even if parameters are not stable, their changes do not introduce a relevant bias in the quantitative policy evaluation (measured by the value of a loss function for the policymaker). Consequently, the authors conclude that a complete specification of microfoundations is quite unnecessary, because policy evaluation is “approximately” invariant of change in policies. This conclusion follows the new Keynesian assessment of the Lucas Critique in a quite traditional way, adding a pragmatic argument about the actual feasibility of the Lucasian methodological prescription: “we merely hope to put the Lucas critique in perspective and to reiterate Milton Friedman’s precept that the best (in this case, an unattainable ideal) should not be an enemy of the good” (*ibid.*, p. 29).

In a similar vein, “Monetary Policy Shifts and the Stability of Monetary Policy Models” (Estrella and Fuhrer, 2003) starts by accepting the vulnerability of non-microfounded models to the Lucas Critique as a pertinent argument. But it rejects the idea that this argument can provide any evidence that microfounded models are robust to the Critique:

²¹ An alternative assessment (Canova and Sala, 2009) consists in arguing that confidence interval of parameter values is too large, and that this result from a weak identification of DSGE models.

²² I will not comment here about few contributions, like for instance Rudebusch (2005), sharing the very same motivation and providing the very same results than those presented in section 2.2.

But just as the backward-looking models cannot be known to be subject to the Lucas critique a priori, neither can these optimizing models be known to be stable across policy regimes a priori.

(*ibid.*, p.95)

The aim of the article is then to provide an empirical test of the Lucas Critique, as in the new Keynesian literature analyzed in sub-section 2.2; but this empirical test will not concern non-microfounded models, but DSGE models, supposed to be firmly microfounded²³:

In this paper, we present evidence that shows that some monetary policy models from the recent literature, based on optimization and rational expectations, may be less stable in the face of monetary regime shifts than their better-fitting backward-looking counterparts.

(*ibid.*)

The authors claim that their results lead to the conclusion that microfounded DSGE models rely on non-structural parameters, to the extent the parameters values are drifting along with changes in policy regimes. In one word, DSGE models behave just as the traditional macroeconometric models criticized by Lucas (1976).

Similar conclusions are suggested in “DSGE Models and the Lucas Critique” (Hurtado, 2014). Hurtado provides evidences that most of the parameters in a benchmark DSGE model (Smets and Wouters, 2005), including those characterizing preferences and technologies, are actually not stable across time. To illustrate more clearly that this implies DSGE vulnerability to the Lucas Critique, Hurtado assess the DSGE performance in policy evaluation compared with traditional macroeconometric approach: do the Smets-Wouters model give a better policy advice than an “old-style” Phillips Curve? The test is run with 1970s’ data, a persuasive manner to compare the claim about an “econometric failure on a grand scale” (Lucas and Sargent, 1979, p.6) with the claim about DSGE robustness to the Lucas Critique.²⁴

²³ “By uncovering the structural parameters that characterize these fundamental behaviors, and by explicitly modeling expectations (usually assuming rational expectations), one may capture the (presumed) dependence of agents’ behavior on the functions describing policy” (*ibid.*, p.94).

²⁴ “I will run a pseudo-real-time exercise, looking at the policy advice that a policymaker from the 1970s would have derived from the estimation of the Smets-Wouters model, and comparing that to the performance of an old-style Phillips Curve estimated using ordinary least square (as a representation of a worst-case scenario for the technology available to this hypothetical policymaker)” (Hurtado, 2014, p.15).

The result of this comparison confirms that microfounded DSGE and traditional macroeconometric models display the same weakness in terms of policy evaluation:

in terms of parameter invariance and its effect on econometric policy evaluation, the estimated DSGE model would not have done a lot better than the old-style Philips curve. [...] the lesson that policymakers would have drawn from Smets-Wouters are not fundamentally different from those they were extracting from their reduced-form models.

(Hurtado, 2014, pp.18-19)

Finally, “Labor-market Heterogeneity, Aggregation, and the Lucas Critique” (Chang et al., 2010) aims at dismissing *especially* the Lucasian microfoundations as a necessary condition for policy evaluation. Following the new Keynesian assessment of the Lucas Critique, the authors run an empirical test of the stability of microfounded parameters in DSGE models, such as preferences and technologies, supposed to be policy-invariant. The result, as in the previous contributions scrutinize *infra*, is that “preference and technology parameter estimates are not invariant with respect to policy changes” (Chang et al., 2010, p.1). The explanation of this vulnerability of DSGE models to the Lucas Critique addresses the representative agent hypothesis, a core assumption in current interpretation of Lucasian microfoundations. According to the authors, the “aggregative function”, i.e. the way of aggregating individual behaviors, is likely to be changing along changes in policy. Hence, the microfoundational program built upon the representative agent hypothesis is the reason of the observed instability: “We demonstrate that the representative agent model that abstracts from cross-sectional heterogeneity can potentially mislead fiscal policy predictions” (*ibid.*, p.28). Even if this result could be interpreted as an argument in favor of “more” microfoundations, the authors are quite in the line of the new Keynesian assessment of the Lucas Critique, arguing, that the solution of more microfounded models with heterogeneous agents is not “always possible” (*ibid.*).

Conclusion

The debate about the vulnerability of the DSGE to the Lucas Critique is still an open debate for macroeconomics. However, it is as an internal debate, developed in a “constructive” perspective—conversely to Lucas (1976). All the macroeconomists involved in this debate claim that their contributions

are not a pledge for abandoning DSGE models, but an encouragement to developing them: “We do not want our work to be interpreted as a sweeping criticism of the estimation of DSGE models, because it is not. [...] We ourselves have been engaged in this research agenda and plan to continue doing so.” (Fernández-Villaverde and Rubio-Ramirez, 2007, p.34); “Trying to perfect DSGE models [...] should be a top priority for the profession” (Hurtado, 2014, pp.20-21).

Will this debate find a satisfactory issue? This is not for sure. Indeed, this article showed how the contemporary debate inherited the conflicting assessments of the methodological prescription presented in Lucas (1976). These divergent assessments bring divergent solutions for building models as safe tools for policy evaluation: on the one side, developing microfounded models, in an hypothetico-deductive perspective, should be a sufficient condition for attaining this objective; on the other side, microfoundations will not be enough for that, to the extent this hypotheses should be empirically corroborated, in an inductive perspective. DSGE models, as the result of the New Neoclassical Synthesis between RBC and new Keynesians, are, for the moment, stuck in the middle of these conflicting methodological perspectives.

References

- Argov, E., Barnea, E., Binyamini, A., Borenstein, E., Elkayam, D., and Rozenshtrom, I. (2012). MOISE: A DSGE model for the Israeli economy. Technical Report 2012.06, Bank of Israel.
- Ball, L. and Mankiw, N. G. (1994). A sticky-price manifesto. In *Carnegie-Rochester Conference Series on Public Policy*, volume 41, pages 127–151. Elsevier.
- Bernanke, B. S. (1983). The Determinants of Investment: Another Look. *The American Economic Review*, 73(2):71–75.
- Black, F. (1982). General equilibrium and business cycles. Working Paper 950, National Bureau of Economic Research.
- Blanchard, O. J. (1984). The Lucas Critique and the Volcker Deflation. *The American Economic Review*, 74(2):211–215.
- Blanchard, O. J. and Wyplosz, C. (1981). An empirical structural model of aggregate demand. *Journal of Monetary Economics*, 7(1):1–28.
- Braun, R. A. (1994). Tax Disturbances and Real Economic Activity in the Postwar United States. *Journal of Monetary Economics*, 33(3):441–462.

- Calvo, G. A. (1983). Staggered prices in a utility-maximizing framework. *Journal of monetary Economics*, 12(3):383–398.
- Canova, F. and Sala, L. (2009). Back to square one: Identification issues in {DSGE} models. *Journal of Monetary Economics*, 56(4):431 – 449.
- Chang, Y., Kim, S.-B., and Schorfheide, F. (2010). Labor-market Heterogeneity, Aggregation, and the Lucas Critique. Technical Report 16401, National Bureau of Economic Research.
- Chari, V. V., Christiano, L. J., and Kehoe, P. J. (1995). Policy analysis in business cycle models. In Cooley, T. F., editor, *Frontiers of Business Cycle Research*, pages 357–391. Princeton University Press New Jersey.
- Chari, V. V., Kehoe, P. J., and McGrattan, E. R. (2008). New Keynesian Models: Not Yet Useful for Policy Analysis. Technical Report 14313, National Bureau of Economic Research.
- Christiano, L. J. and Eichenbaum, M. (1992). Current Real-Business-Cycle Theories and Aggregate Labor-Market Fluctuations. *The American Economic Review*, 82(3):430–450.
- Cogley, T. and Yagihashi, T. (2010). Are DSGE Approximating Models Invariant to Shifts in Policy? *The BE Journal of Macroeconomics*, 10(1):1–31.
- Cooley, T. F., editor (1995). *Frontiers of Business Cycle Research*. Princeton University Press, Princeton, NJ.
- Cooley, T. F. and Hansen, G. D. (1989). The Inflation Tax in a Real Business Cycle Model. *The American Economic Review*, 79(4):733–748.
- Cuche-Curti, N. A., Dellas, H., and Natal, J.-M. (2009). DSGE-CH: A dynamic stochastic general equilibrium model for Switzerland. Technical Report 5, Swiss National Bank.
- De Vroey, M. (2015). *A History of Modern Macroeconomics from Keynes to Lucas and Beyond*. Cambridge University Press, Cambridge (UK).
- Englander, A. S. and Los, C. A. (1983). *The Stability of the Phillips Curve and its Implications for the 1980s*. Federal Reserve Bank of New York, New York (NJ).

- Ericsson, N. R. and Irons, J. S. (1995). The Lucas Critique in Practice: Theory without Measurement. International Finance Discussion Papers 506, Board of the Governors of the Federal Reserve System.
- Estrella, A. and Fuhrer, J. C. (2003). Monetary Policy Shifts and the Stability of Monetary Policy Models. *Review of Economics and Statistics*, 85(1):94–104.
- Fernández-Villaverde, J. and Rubio-Ramirez, J. (2007). How Structural Are Structural Parameters? Technical Report 13166, National Bureau of Economic Research.
- Frisch, R. (1938). Autonomy of Economic Relations. Statistical versus Theoretical Relations in Economic Macrodynamics. in Hendry, D. F. and Morgan, M.S. (1995). *The Foundations of Econometric Analysis*, Cambridge University Press, Cambridge (UK).
- Gordon, R. J. (1990). What Is New-Keynesian Economics? *Journal of Economic Literature*, 28(3):1115–1171.
- Goutsmedt, A., Pinzon-Fuchs, E., Renault, M., and Sergi, F. (2015). Criticizing the Lucas Critique: Macroeconometricians’ Response to Robert Lucas. Documents de travail du CES 2015.59, Centre d’Economie de la Sorbonne (CES).
- Greenwood, J. and Huffman, G. W. (1991). Tax analysis in a real-business-cycle model: On measuring harberger triangles and okun gaps. *Journal of Monetary Economics*, 27(2):167 – 190.
- Haavelmo, T. (1944). The Probability Approach in Econometrics. *Econometrica*, 12(Supplement):iii–vi+1–115.
- Hall, R. E. (1996). Robert Lucas, Recipient of the 1995 Nobel Memorial Prize in Economics. *The Scandinavian Journal of Economics*, 98(1):33–48.
- Hansen, L. P. and Sargent, T. J. (1981). Formulating and Estimating Dynamic Linear Rational Expectations Models. In Lucas, R. E. and Sargent, T. J., editors, *Rational Expectations and Econometric Practice*, pages 91–125. George Allen and Unwin Ltd., London. First published in the *Journal of Economic Dynamics and Control* in 1980.
- Hoover, K. D. (2012). Microfoundational programs. In Duarte, P. G. and Lima, G. T., editors, *Microfoundations Reconsidered*, pages 19–61. Edward Elgar, Cheltenham (UK).

- Hurtado, S. (2014). DSGE models and the Lucas critique. *Economic Modelling*, 44(Supplement 1):S12 – S19.
- Ingram, B. and Leeper, E. (1990). Post Econometric Policy Evaluation: A Critique. Technical Report 393, Board of Governors of the Federal Reserve System.
- Inoue, A. and Rossi, B. (2008). Which Structural Parameters Are “Structural”? Identifying the Sources of Instabilities in Economic Models. Technical Report 08-02, Economic Department, Duke University.
- King, R. G. (1993). Will the New Keynesian Macroeconomics Resurrect the IS-LM Model? *The Journal of Economic Perspectives*, 7(1):67–82.
- Klamer, A. (1984). *The New Classical Macroeconomics. Conversations with the New Classical Economists and Opponents*. Wheatsheaf Books, Brighton (UK).
- Klein, L. R. and Goldberger, A. S. (1955). *An Econometric Model of the United States, 1929-1952*. North Holland, Amsterdam.
- Kydland, F. E. and Prescott, E. C. (1977). Rules Rather than Discretion: The Inconsistency of Optimal Plans. *Journal of Political Economy*, 85(3):473–491.
- Kydland, F. E. and Prescott, E. C. (1982). Time to Build and Aggregate Fluctuations. *Econometrica*, 50(6):1345–1370.
- Kydland, F. E. and Prescott, E. C. (1991). The Econometrics of the General Equilibrium Approach to Business Cycles. *The Scandinavian Journal of Economics*, 93(2):161–178.
- Long, John B., J. and Plosser, C. I. (1983). Real Business Cycles. *Journal of Political Economy*, 91(1):39–69.
- Lubik, T. A. and Surico, P. (2010). The Lucas Critique and the Stability of Empirical Models. *Journal of Applied Econometrics*, 25(1):177–194.
- Lucas, R. E. (1976). Econometric Policy Evaluation: A Critique. *Carnegie-Rochester Conference Series on Public Policy*, 1:19–46.
- Lucas, R. E. (1994). Comments on Ball and Mankiw. In *Carnegie-Rochester Conference Series on Public Policy*, volume 41, pages 153–155. Elsevier.

- Lucas, R. E. and Sargent, T. (1979). After Keynesian Macroeconomics. *Federal Reserve of Minneapolis Quarterly Review*, 3(2):49–82.
- Lucas, R. E. and Sargent, T. J. (1981). *Rational Expectations and Econometric Practice*. George Allen and Unwin Ltd., London.
- Mankiw, N. and Romer, D. (1991). Introduction. In Mankiw, N. and Romer, D., editors, *New Keynesian Economics*, MIT Press Readings in Economics, pages 1–26. MIT Press, Cambridge (MA).
- Marschak, J. (1953). Economic Measurement for Policy and Prediction. In Hood, W. C. and Koopmans, T. G., editors, *Studies in Econometric Method*, pages 1–26. Wiley, New York. Cowles Commission Monograph, nr. 14.
- McGrattan, E. R. (1994). The Macroeconomic Effects of Distortionary Taxation. *Journal of Monetary Economics*, 33(3):573–601.
- Medina, J. P. and Soto, C. (2006). Model for Analysis and Simulations (MAS): A New DSGE for the Chilean Economy. Technical report, Central Bank of Chile.
- Miller, P. J. (1994). *The Rational Expectations Revolution: Readings from the Front Line*. MIT Press, Cambridge (MA).
- Parkin, M. (1986). The Output-Inflation Trade-off When Prices Are Costly to Change. *Journal of Political Economy*, 94(1):200–224.
- Pierre Danthine, J. and Donaldson, J. B. (1993). Methodological and empirical issues in real business cycle theory. *European economic review*, 37(1):1–35.
- Plosser, C. I. (2012). Macro Models and Monetary Policy Analysis. In *Bundesbank-Federal Reserve Bank of Philadelphia Research Conference*. http://www.philadelphiafed.org/publications/speeches/plosser/2012/05-25-12_bundesbank.pdf.
- Qin, D. (2014). Inextricability of Autonomy and Confluence in Econometrics. *Economia. History, Methodology, Philosophy*, 4(3):321–341.
- Romer, D. (1993). The New Keynesian Synthesis. *The Journal of Economic Perspectives*, 7(1):5–22.
- Rudebusch, G. D. (2005). Assessing the Lucas Critique in Monetary Policy Models. *Journal of Money, Credit and Banking*, 37(2):245–272.

- Sergi, F. (2015a). L'approche (faussement ?) naïve à l'histoire des modèles DSGE. Documents de travail du CES 2015.66, Centre d'Economie de la Sorbonne (CES).
- Sergi, F. (2015b). Robert Lucas and the Twist of Modeling Methodology. On some Econometric Methods and Problems in New Classical Macroeconomics. Documents de travail du CES 2015.88, Centre d'Economie de la Sorbonne (CES).
- Sergi, F. (2016). When "Facts" Matter: New Keynesian Models and the "Real World". Communication at the Séminaire Quantitativisme Réflexif, Ecole Normale Supérieure de Cachan, 15/01/2016.
- Sims, C. (1982). Policy Analysis with Econometric Models. *Brookings Papers on Economic Activity*, 1982(1):107–164.
- Sims, C. A. (1980). Macroeconomics and Reality. *Econometrica*, 48(1):1–48.
- Smets, F. and Wouters, R. (2005). Comparing shocks and frictions in US and euro area business cycles: A Bayesian DSGE approach. *Journal of Applied Econometrics*, 20(2):161–183.
- Snowdon, B. (2007). The New Classical Counter-Revolution: False Path or Illuminating Complement? *Eastern Economic Journal*, 33(4):541–562.
- Snowdon, B. and Vane, H. R. (2005). *Modern Macroeconomics: its Origins, Development and Current State*. Edward Elgar, Cheltenham (UK).
- Summers, L. H. (1986). Some Skeptical Observations on Real Business Cycle Theory. *Federal Reserve Bank of Minneapolis Quarterly Review*, 10(4):23–27.
- Taylor, J. B. (1984). Recent Changes in Macro Policy and its Effects: Some Time-Series Evidence. *The American Economic Review*, 74(2):206–210.
- Taylor, J. B. (1993). Discretion versus policy rules in practice. *Carnegie-Rochester Conference Series on Public Policy*, 39(Décembre):195–214.
- Tinbergen, J. (1956). *Economic Policy: Principles and Design*. North Holland, Amsterdam.
- Woodford, M. (2003). *Interest and Prices. Foundations of a Theory of Monetary Policy*. Princeton University Press, Princeton.