Journal of Economic Dynamics & Control 53 (2015) 37–46

Contents lists available at ScienceDirect

Journal of Economic Dynamics & Control

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

Near unit root small open economies

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ARTICLE INFO

Article history:
Received 26 September 2014
Received in revised form
24 January 2015
Accepted 26 January 2015
Available online 7 February 2015

JEL classification:
F41

Keywords:
Perturbation
Stationarity
Small open economy
Incomplete asset markets

ABSTRACT

The marginal utility of wealth in incomplete markets small open economy models follows a unit root process. I study the nonlinear properties of devices often used to remove the unit root and I find that they generate different dynamics when matching emerging markets. Models with endogenous discount factors reinforce consumption response to shocks and increase the countercyclicality of the trade balance to output ratio. Conversely, models with debt frictions ameliorate the responses of consumption and trade balance. Hence, to generate dynamics similar to those in emerging economies, the debt frictions need to be small, inducing a near unit root behavior in their Euler equations. This difference across models is hidden when matching developed economies because of consumption smoothing and the mild countercyclicality of the trade balance.

1. Introduction

Since the seminal contribution by Mendoza (1991), the real business cycle small open economy model became the workhorse in the study of dynamic economies that have strong links with the world economy but do not affect international prices nor quantities due to their shares of global markets. Standard small open economy models are populated by firms, households and the rest of the world, who plays the passive role of financing current account imbalances. Additional assumptions include adjustment costs to capital accumulation and incomplete international asset markets.

Due to the incomplete asset markets assumption, the marginal utility of wealth follows a unit root process.[1] This is not a desirable property of the model because it prevents us from calculating statistical second-order moments, such as volatility and correlations. Hence, to resolve the implications of this feature, authors have proposed different model specifications to induce stationarity; these specifications are usually referred to as "closing devices".

The central objective of this paper is to highlight the main issues that researchers face when closing small open economy models. To this end, this paper compares a variety of closing devices using nonlinear solution methods in a model calibrated to match certain Argentinean stylized facts.[2] There are two main reasons for going beyond linear approximations and for

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[1] In Section 2.1, I present the benchmark model and equilibrium conditions to clarify the sources of non-stationarity.

[2] I focus the core analysis of the paper on the basic RBC small open economy model as in Mendoza (1991) because this is the workhorse model that a large part of international macroeconomics builds on. Moreover, this model is the same model studied in Schmitt-Grohe and Uribe (2003), although they focus on log-linear solutions for a model calibrated to Canada, which exhibit very different statistical properties, as will be shown later. In a second step, I review the findings observed in the baseline economy using richer models that include preference and volatility shocks. The results for these exercises are available in an online appendix.

http://dx.doi.org/10.1016/j.jedc.2015.01.005
0165-1889/

studying emerging economies' facts. First, it has been shown that nonlinear solution methods provide accuracy gains at minor computational costs.[3] Moreover, there are a number of research objectives and macroeconomic questions that require departures from the certainty equivalent solution, for instance, the effect of volatility shocks or welfare comparisons.[4] Additionally, studying these models calibrated for emerging markets highlights a variety of interesting economic dynamics that are absent in developed economies. Specifically, they are more volatile than developed economies; the volatility of consumption is larger than the volatility of output (excess consumption volatility); and additionally, the trade balance to output ratio exhibits significant countercyclical behavior. As a result of these differences, studying the behavior of closing devices in this environment provides a great deal of information regarding closing devices' transmission channels.

In a recent paper, Schmitt-Grohe and Uribe (2003), using a log-linear solution with a calibration to match Canadian data, find that different closing devices generate similar dynamics. Contrary to these findings, I show that different closing devices have first and higher-order differences when models are calibrated to match emerging economies.[5] In particular, models with endogenous discount factors reinforce consumption responses to TFP shocks while models with debt frictions tend to ameliorate them. The intuition behind this finding goes as follows. In the small open economy real business cycle model with persistent (but transitory) TFP shocks, a positive productivity shock increases consumption. When discount factor is endogenous, the increase in consumption increases the households' impatience, which induces agents to substitute tomorrow's consumption for today's consumption. This accelerates the response of consumption to a persistent productivity shock and boosts debt level while the current account deteriorates. When consumption, trade balance and the current account are volatile, as in the case of emerging markets, this mechanism helps the model to fit the data.

Conversely, in debt friction models as the "debt elastic interest rate" model, a technology shock also increases consumption and debt. However, in this case an increase in debt raises the cost of intertemporal trade, inducing consumption response to ameliorate. Hence, these devices have negative impact on debt accumulation and on the variability of the current account. Consequently, a calibration of this model to match the current account to output ratio volatility of the endogenous discount factor model would need small costs of issuing debt, generating a near unit root in the Euler equation. This is the key difference among different closing devices that has not been addressed by the existing literature.

The previous reasoning depends on the excess consumption volatility. Consequently, we should not observe differences in the dynamics generated by different closing devices when matching small consumption volatility as in developed economies, for instance in Canada. Hence, I show in Section 6 that the findings in Schmitt-Grohe and Uribe (2003) are robust to the use of higher order solution method. Moreover, higher order terms are relatively unimportant as the dynamic properties of the model are mainly driven by the log-linear terms. This is a key finding as it implies that even though different closing devices generate intrinsically different dynamics, these differences are noticeable when we force the models to capture the high consumption volatility and the strong countercyclicality of trade balance to output ratio in emerging markets.

These findings stress a key point in modeling small open economies. Statistical moments of small developed economies, such as Canada, might not contain information to evaluate testable restriction for choosing between different closing devices. Even though a study of the empirical plausibility of different closing devices is out of the scope of this paper, it is important to highlight that emerging markets data – in particular the excess consumption volatility – contain information about which closing device might be more empirically plausible for this type of economies.

I study the robustness of my findings with two variations of the baseline models. Specifically, I show that the findings for the workhorse small open economy also hold for larger models, including models with preference shocks and volatility shocks.[6]

This paper is closely related to Schmitt-Grohe and Uribe (2003), Kim and Kose (2003), Boileau and Normandin (2008) and Bodenstein (2011). However, this paper is the first to compare the dynamics of small open economy models with different closing devices using nonlinear solution methods and emerging market dynamics.[7] Additionally, this paper is also related to Lubik (2007), who discusses the existence of equilibrium for debt elastic interest rate models with and without internalization, and to Airaudo (2014) who studies determinacy properties in monetary small open economy models with currency substitution.

The remainder of the paper proceeds as follows. In Section 2, I introduce notation and present alternative model specifications. I first present a simple RBC model of a small open economy without a closing device, i.e., the non-stationary

[3] As shown by Schmitt-Grohé and Uribe (2004) and Fernandez-Villaverde et al. (2006).

[4] See Fernández-Villaverde et al. (2011).

[5] The reason behind attempting a different calibration instead of a sensitivity analysis, i.e., moving one parameter at a time, lies at the core of the model comparison exercise. The comparison requires that models are approximated around the same steady state. Hence, parameters that affect steady state should be the same across models. Instead, the other parameters accommodate to match the same current account to output ratio volatility. This means that if we change any parameter that affects the steady state, both the steady state values and the volatility of the current account to output ratio would change. Changing the same parameters in all of the models will make the steady states across models equal again, but it will not undo the differences in the current account to output ratio volatility. To equalize them, we also need to calibrate the parameter that does not affect the steady state. In this way, the exercise of changing one parameter at a time would violate the model comparison exercise by introducing too many degrees of freedom and inducing trivial differences across models.

[6] Due to space limitations, the results for these robustness checks are available in an online appendix.

[7] Kim and Kose (2003) studies the role of discount factors and compares endogenous and exogenous discount factor models for small open economies. However, they calibrate the linearized model to match the Canadian business cycle and do not study the implications for calibrations more appropriate to the dynamics of emerging economies. Boileau and Normandin (2008) consider two country models and show that the correlations among countries' variables depend on the closing device. In this paper, however, I consider small open economy models, that is, I focus on economies that do not affect international prices. Bodenstein (2011) instead studies indeterminacy issues in incomplete market open economy models and the differences stemming from the closing devices using linear solution methods.