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Solving the real business cycles model of small-open economies by a sample-independent approach

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Abstract

One hallmark of small-open economy models with a time-separable preference assumption is the non-uniqueness of their steady states. Following King et al. (J. Monetary Econ. 21 (1988) 195–232), most studies compute a log-linear approximation solution to their small-open economies around the sample means of the corresponding variables. The resulting reliance of the outcome on a particular sample may lead to different implications about the business cycles properties of a small-open economy. This paper proposes a sample-independent approach to solving this kind of model and shows its superiority over a sample-dependent method through some simulation results. © 2002 Elsevier Science B.V. All rights reserved.

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1. Introduction

Studies on real business cycles in a closed economy endeavor to replicate the main features of the economy's macro time series. Based on the existence of a unique steady state, most studies adopt a log-linear approximation method proposed in King et al. (1988) to characterize a stochastic competitive equilibrium. However, works on real business cycles in small-open economies are relatively scarce, with one fundamental reason being attributable to the non-uniqueness feature of the steady state implied by most small-open economy models. Facing an exogenous world interest rate,

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consumption of a small-open economy will be permanently changed by a temporary shock, and hence its steady state is consistent with any level of net foreign asset holdings (cf. Mendoza, 1991; Correia et al., 1995; Turnovsky, 1997, p. 55). This unpleasant feature of small-open economy models makes applying the approximation method of King et al. (1988) more difficult when one aims to analyze the business cycles of a small-open economy. This paper intends to develop a new approach which does not rely on a unique steady state when applying the log-linear approximation method and which can generate business cycles statistics at the same standpoint as those obtained in closed economies.

Efforts made along this line to resolve the non-stationary implication of small-open economy models include imposing an assumption of non-separable preferences or a finite horizon. For example, Mendoza (1991) endogenizes the subjective time preference rate, while Cardia (1991) and Feve and Langot (1996) consider a probability of death. On the other hand, some studies simply take the non-unique steady-state balance of trade or net holdings of foreign assets as a deep parameter to conduct a log-linear approximation. Correia et al. (1995) and Harjes (1997) further assume such a deep "parameter" to coincide with its sample mean in performing a numerical simulation. However, such an additional assumption is not only inconsistent with the non-stationary implication of the models, but also in contrast with the time-series characteristics. Furthermore, to assume that a time-varying steady-state variable is constant and is equal to its sample mean makes the simulation results of a small-open economy sample dependent and is likely to result in incorrect evaluations on the business cycles properties of the economy.

This paper proposes a sample-independent approach to solving the real business cycles model of small-open economies. We log-linearize the model around its conditional expectations of a steady state. The conditional expected steady state is consistent with the model's long-run properties, and can be solved recursively under the rational expectations assumption with the help of the model's intertemporal budget constraint. Aside from the certainty equivalence that many studies in this field assume to hold, our method does not make any additional assumption. Employing our method to analyze real business cycles of a small-open economy makes the application of King et al. (1988) method straightforward and not sample dependent. Thus, our method can generate the economy's genuine data. Moreover, the calibration results of a small-open economy model by using our method are expected to gain a higher degree of accuracy than those obtained by other methods that are sample dependent in nature.

The remainder of the paper is organized as follows. Section 2 studies a simple small-open endowment economy and its steady state, whereby we describe a non-uniqueness feature of the steady state. We then present some empirical evidence to confirm the non-stationary feature of the model. Section 3 introduces a sample-independent approach to our simple model and describes its solving procedure. Section 4 extends the simple model to including capital in production and conducts simulation experiments to support our method's superiority over a sample-dependent method by comparing impulse response results of these two methods. A sensitivity analysis with different sample means also shows the weakness of the statistics obtained from the sample-dependent method. Section 5 concludes.