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Closing international real business cycle models with restricted financial markets

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A B S T R A C T

Several authors argue that international real business cycle (IRBC) models with incomplete financial markets offer a good explanation of the ranking of cross-country correlations. This conclusion is suspect, because it is based on an analysis of the near steady state dynamics using a linearized system of equations. The baseline IRBC model with incomplete markets does not possess a unique deterministic steady state and, as a result, its linear system of difference equations is not stationary. We show that the ranking of cross-country correlations is robust to modifications that ensure a unique steady state and a stationary system of linear difference equations. We find, however, that the modifications affect the quantitative predictions of the model.

1. Introduction

The international real business cycle (IRBC) model with incomplete international financial markets is successful at reconciling predicted business cycle moments with empirical moments. In particular, the IRBC model with trade in a one-period bond driven by shocks that are highly persistent and that do not spill over international boundaries solves the *quantity anomaly*. This anomaly, coined by Backus et al. (1995), refers to the inability of the IRBC model with complete markets to correctly predict that the cross-country correlation of output is larger than the cross-country correlation of consumption.

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Baxter and Crucini (1995) argue that the IRBC model with incomplete markets solves the quantity anomaly because of an important differential wealth effect. In the complete markets model, a rise in home productivity generates a small increase in wealth at home and a large increase in wealth abroad. This arises because complete international financial markets ensure perfect risk sharing. The result is that home and foreign consumption fluctuations are highly correlated. In the incomplete markets model, however, the rise in home productivity generates a large increase in wealth at home, but only a small increase in wealth abroad. This arises because financial markets do not ensure perfect risk sharing. The result is that home and foreign consumption fluctuations need not be highly correlated.

Unfortunately, these conclusions are suspect because they are generated from an analysis of the model's near steady state dynamics. That is, most studies use a linear approximation method similar to that of King et al. (2002). The method requires that the system of equations that characterizes the equilibrium be linearized around the deterministic steady state, and that the resulting system of linear difference equations be solved. The problem is that the deterministic steady state of the baseline IRBC model with trade in a one-period bond is not unique. As a consequence, the resulting system of linear difference equations is not stationary. At first glance, the non-stationarity is a serious flaw: it undermines the study of near steady state dynamics.

Our objective is to verify whether the ability to solve the quantity anomaly is robust to specifications of the model that resolve the non-uniqueness of the deterministic state and the resulting non-stationarity of the system of linear difference equations. The stationary models add a stationarity inducing modification of the baseline non-stationary model. Although not our objective, it is also possible to verify the robustness by using alternative approximation methods, as in Kehoe and Perri (2002) and Kim et al. (2003). Note as well that the flaw applies not only to IRBC models, but to all dynamic, stochastic, multi-agents general equilibrium models with incomplete financial markets.

Our analysis is related to that of Kim and Kose (2003) and Schmitt-Grohé and Uribe (2003). They study the dynamics of non-stationary and stationary small open economy real business cycle models. Our analysis, however, focuses on two-country IRBC models and leads to a different conclusion. They show that the different stationarity inducing modifications do not affect the quantitative predictions regarding the behavior of key macroeconomic variables. Thus, they conclude that researchers should select the modification based solely on computational convenience. In contrast, we find that the different modifications have important effects on the quantitative predictions.

We proceed as follows. In Section 2, we present the baseline two-country IRBC model with trade in a one-period bond and its calibration. We show that the model's deterministic steady state is not unique and that the linearization method yields a non-stationary system of linear difference equations. For completeness, we also show that the non-uniqueness and non-stationarity do not occur in the complete markets IRBC model.

In Section 3, we present five incomplete markets IRBC models that generate a unique steady state and a stationary system of linear difference equations. The first model assumes that the consumer's subjective discount factor is endogenous. The second model also assumes that the consumer's subjective discount factor is endogenous. In this case, however, the consumer does not internalize the effects of his choices on the discount factor. The third model assumes a debt elastic supply of international assets. The fourth model assumes that consumers face quadratic portfolio costs. Finally, the fifth model assumes that consumers directly care about their asset holdings.

In Section 4, we present our numerical results. First, we document that baseline and stationary incomplete markets models driven by shocks that are highly persistent and that do not spill over international boundaries solve the quantity anomaly. The models driven by shocks that spill over international boundaries, however, do not solve the quantity anomaly. Second, we find that the business cycle moments and impulse responses generated by the different models differ, and more so when shocks are persistent and do not spill over. Thus, the quantitative predictions differ when the models solve the quantity anomaly. Third, for our calibration, we find that the endogenous discount factor model outperforms the other stationary models in the sense that they generate business cycle moments that match the empirical moments more closely. Fourth, we find that baseline and stationary models generate a similar wealth effect, but dissimilar price (interest rate) effects. Finally, we show that the ability to solve the quantity anomaly relies on the ability to change the supply of physical