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**‘Exchange Rates, Numéraires and Real Exchange
Rates in Global Computable General Equilibrium
Models’**

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Abstract

The analyses in this paper explore the properties and roles of numéraire, real and nominal exchange rates in the context of comparative static global CGE models. The arguments are illustrated using variants of the R23 (McDonald, et al., 2014) and GLOBE 2 (McDonald et al., 2013) CGE models, where these models have been extended to encompass the numéraire settings found in the GTAP (Hertel et al., 2007) family of models. How the concept of a real exchange rate operates within CGE models is explored in the context of both single country and global CGE models. The analyses are then extended to demonstrate that all global CGE models must include exchange rates, whether or not they are explicitly recognised. The analyses and results demonstrate that all global CGE models require exchange rates and $(r+1)$ numéraire. It is also demonstrated that, unlike the case of single country models, the choice of numéraire settings impacts on the results for real variables in the models and that this can be traced back to the role of exchange rates in the model. It is therefore argued that global CGE models need to recognise the role of exchange rates, whether or not they are explicitly identified, when interpreting the results produced by the models.

1. Introduction

The rationale for and/or the role of exchange rates and numéraire in global computable general equilibrium (CGE) models is contentious and is reflected in the contemporaneous existence of models that are apparently without and with explicit exchange rates and with single and multiple numéraire. The analyses reported in this paper demonstrates that all global CGE model in fact have exchange rates and multiple numéraire whether or not this is explicitly recognised. More importantly it is demonstrated that the results generated are influenced by the treatment, implicit or explicit, of exchanges rates and numéraire.

The definition of the real exchange rate has evolved but since the late 1970s/1980s there has been a coalescence around a definition based on the relative price of tradable to non-tradable commodities; as such the real exchange rate has obvious appeal to economists using CGE models and variants of the Salter-Swan model (Salter 1959, Swan 1960). Within the macroeconomic literature a substantial proportion of the interest has been on the crucial role played by exchange rates in the determination of the external position of economies. In particular it is argued that the long run external position of an economy, i.e., its external (current/capital) account balance, will be affected by the real rather than the nominal exchange rate. Since all (known) comparative static and global CGE models ‘allow’ for the existence of external account imbalances, these models must, in the context of the macroeconomic literature, presume the existence of some set of equilibrium real exchange rates, that are to some extent at least determined outwith the comparative static CGE model. This conclusion derives from the fact that these models provide no rationale for why some regions would be willing to forego current consumption in favour of some undefined promise to repay the ‘loan’ at some future date.

How the concept of a real exchange rate operates within CGE models is explored in the context of both single country and global CGE models. The analyses for the single country model case developed by Devarajan *et al.*, (1993) in the context of the 123 model is reviewed, and the analyses are then extended to the an $R23$ model where R is the number of regions. The analysis demonstrates that the exchange rate has the properties of a standard ‘macroeconomic’ variable in a CGE model that operates as an equilibrating variable but is not a ‘financial’ variable since CGE models lack financial assets. Moreover while the exchange rate is not a direct argument in the decisions by agents it can be observed and is critical to the valuation of trade balances and cross regional transfers in terms of the relative prices of tradeables to

nontradables. The analytical focus is on the valuation of cross border transactions and the treatment of (implied) future claims on the exports of regions that run current account deficits.

The analyses are then extended to demonstrate that all global CGE models must include exchange rates, whether or not they are explicitly recognised. This is demonstrated using variants of the *R23* (McDonald, *et al.*, 2014) and *GLOBE 2* (McDonald *et al.*, 2013) CGE models where these models have been extended to encompass the numéraire settings found in the GTAP (Hertel *et al.*, 2007) family of models: the GTAP model was chosen because it is the only global model without explicit exchange rates for which the computer code is fully accessible and, as far as can be ascertained, all derivatives of the GTAP model use the same (implicit) treatment of exchange rates and numéraire. The variants of the *R23* and *GLOBE 2* models demonstrate that the differences between the two numéraire settings can be reduced to differences in the macroeconomic closure settings. Since the choice of macroeconomic closure settings has long been known to be important to the determination of model outcomes, it is evident that the treatment of exchange rates and numéraire is important.

The analytical analyses are complemented by a series of stylised simulations. For many of the poorest countries in the world aid transfers represent a major component of government income, but these income flows are typically denominated in the currency units of the source regions and therefore subject to variations when trade, and/or other, policies are varied. The stylised simulations consider the cases of (a) unilateral trade liberalisation by a developing region where trade taxes and aid remittances are major sources of government income and domestic tax replacement instruments are used to maintain the internal balance, and (b) changes in the aid policies of the developed regions. The simulations are conducted using the *R23* and *GLOBE* CGE models with and without exchange rate variables.

The results demonstrate that the choice of numéraire settings does impact upon the results for real variables in the models and that this can be traced back to the role of exchange rates in the model. It is therefore argued that global CGE models need to recognise the role of exchange rates, whether or not they are explicitly identified, in determining and interpreting the results achieved in their models.

2. Numéraire in CGE Models

3. Real and Nominal Exchange Rates

4. Real Exchange Rates in Comparative Static CGE Models

4.1 Single Country CGE Models

4.2 Global CGE Models

5. Model Specification: Adding the GTAP numéraire settings to the R23 and GLOBE models

6. Simulations

7. Results

8. Closing Comments

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