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Productivity, commodity prices and the real exchange rate: The long-run behavior of the Canada–US exchange rate

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ABSTRACT

The paper examines the Canada–US real exchange rate since the early 1970s to test two popular explanations of the long-run real exchange rate based on the influence of sectoral productivities and commodity prices. The empirical analysis finds that both variables exert a significant long-run effect. However, the relation for the real exchange rate has shifted as the effect of each variable has become stronger and a positive trend is present since 1990. The effect of productivity, moreover, is opposite to that predicted by the standard Balassa–Samuelson theory. An explanation of these findings is suggested based on a general-equilibrium model that includes differentiated traded manufactures and homogeneous commodities.

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1. Introduction

There has been much interest in identifying the long-run determinants of the real exchange rate. A basic hypothesis based on the purchasing power parity asserts that the real exchange rate is constant in the long run. For many trading partners, however, the long-run real exchange rate appears to be time varying. Two explanations of this behavior have emerged. One explanation links the real exchange rate to the relative price of commodities (e.g., Chen & Rogoff, 2003). The other explanation based on the well-known Balassa–Samuelson hypothesis relates the real exchange rate to home-foreign ratio of productivity in traded relative to nontraded goods.

As Canada is an important producer of commodities and its productivity performance is significantly different from that of the US, the evidence for the Canada–US real exchange rate provides a useful test of the two explanations. Relevant previous research includes Helliwell, Ramzi, and Lafrance (2006); they find that both real non-energy commodity prices and Canada–US productivity ratio for manufacturing relative to the ratio for the whole economy are significant long-run determinants of the real exchange rate.[1] Contrary to the Balassa–Samuelson hypothesis, however, higher productivity in manufacturing (a proxy for the non-commodity traded-goods sector) in Canada causes an appreciation of the real value of the US dollar in their model. A possible explanation of these results is suggested by Benigno and Thoenissen (2003), who use a DGE model where (unlike the Balassa–Samuelson model) traded goods are differentiated and productivity improvement in the home traded goods sector worsens the terms of trade by increasing the relative supply of these goods. The negative effect on the real value of the home currency via this

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[1] For earlier work linking the Canada–US real exchange rate to commodity prices, see Amano and Van Norden (1993, 1995). Also see Issa, Lafrance, and Murray (2008) who explore the influence of energy prices on the Canadian dollar.

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channel can potentially offset the positive Balassa–Samuelson effect arising from an increase in the relative price of nontraded goods.[2] Their model, however, does not include homogeneous traded goods such as commodities, and it is not clear how the presence of such goods would affect the terms of trade adjustment.

The present paper extends this literature on both empirical and theoretical fronts. Our empirical analysis examines the robustness of a long-run relation between the real exchange rate and indexes of real commodity prices and productivity ratios since early 1970s. The empirical evidence suggests that a long-run relation between these variables does not exist for the whole period unless some important shifts are incorporated in the relation since 1990. The effects of both the commodity-price and productivity indexes are stronger in the period after than before 1990. Moreover, a significant positive trend is present in the post-1990 but not the pre-1990 period. There are also other differences between the two periods. Energy prices, for example, are an important component of the appropriate commodity price index after (but not before) 1990.[3] The Canada–US manufacturing productivity ratio has a significant effect on the real exchange rate in each period, but the productivity ratio in manufacturing relative to all sectors (an index suggested by the Balassa–Samuelson model) does not exert a significant effect, especially during the second period. The estimated relation for both periods confirms the paradoxical result that higher manufacturing productivity in Canada is associated with a stronger real value of the US dollar.

Our theoretical analysis explores whether the empirical evidence discussed above can be coherently explained using a well-specified general-equilibrium model. To introduce a role for both commodity prices and the terms of trade, we modify the Balassa–Samuelson framework to allow traded goods to consist of differentiated manufactured goods and homogeneous commodities, and the production of commodities to depend on natural resources. A 3-country framework is used to let conditions in the rest of the world (that is, excluding United States and Canada) determine the real price of commodities. We calibrate the model to Canadian and US data and examine whether it is capable of explaining key facts about the long-run behavior of the real exchange rate.

In the model, the elasticity of substitution between Canadian and US manufacturing products is a key determinant of the effect of the manufacturing productivity ratio on the real exchange rate.[4] We show that values of this elasticity within the range suggested in the literature can explain the signs and the magnitudes of the estimated effects of the productivity ratio in both periods. The effect of the commodity price index on the real exchange rate in the model is also shown to depend on the substitution elasticity. An interesting implication of the model is that a decrease in the elasticity strengthens the impact of both the productivity and commodity–price indexes on the real exchange rate. This result suggests that changes in the coefficients of the two indexes in the real exchange rate in the recent period could be due to a decrease in the substitutability between Canadian and US manufactures. Arguably, such a decrease may have resulted from specialization induced by trade liberalization and technological change in the 1990s.

We also examine the effects of changes in nontraded goods productivity in the model, although the empirical analysis does not adequately explore these effects due to data limitations. An interesting result of the model's analysis is that given the asymmetries between Canada and the United States, the effect of a productivity improvement in nontraded goods on the real exchange rate is stronger for Canada than for the United States. This result implies that similar productivity growth in the nontraded goods sector in the two countries would lead to an appreciating Canadian real exchange rate. This implication suggests a potential explanation of the presence of a positive trend in the real exchange relation that omits productivity indexes for nontraded goods.

Empirical evidence is presented in Section 2. Section 3 summarizes the model, and undertakes quantitative analysis of the model to examine how well it explains the evidence. Section 4 concludes the paper.

2. Empirical evidence

The behavior of the real exchange rate since 1970 and its relation to indexes of productivity differentials and commodity prices is explored in Figs. 1 through 5 (see Appendix A for variable definitions and data sources). Correlations between the different series are shown in Table 1. Fig. 1 examines the relation between the log of Canada–US labor productivity ratio in Manufacturing (*lpm*) and the log of real exchange rate (*rer*), defined as the real value of US dollar using GDP deflators.[5] In the standard Balassa–Samuelson model, higher traded goods productivity in Canada would lead to a depreciation of the real value of US dollar, and thus the two variables would be negatively related. These variables would, however, be positively related if traded goods are differentiated and the terms of trade effect is strong enough to more than offset the conventional Balassa–Samuelson effect (via the relative price of nontraded goods). No clear pattern emerges from the figure, which suggests a positive association between the two variables from mid-1970s to 1990 and after 2000, but a negative association during the 1990s (for the total period, the correlation coefficient for these series in Table 1 is small and negative). The figure also shows that the manufacturing productivity

[2] Indeed, calibrating their model to UK–Euro area, Benigno and Thoenissen (2003) find that an increase in the UK traded-goods productivity leads to a sufficient deterioration in the UK terms of trade to bring about a decrease in the real value of Sterling. The terms of trade response can be reversed under certain conditions. See, for example, Corsetti, Dedola, and Leduc (2004), who develop a model (calibrated to the US economy) in which higher productivity in the traded goods sector in fact improves the terms of trade.

[3] This result is consistent with the findings of Issa et al. (2008) that the influence of energy prices on the exchange rate has become stronger in the recent period.

[4] See Choudhri and Schembri (2010) for a discussion of the role of the elasticity of substitution in determining the effect of traded-goods productivity improvement on the real exchange rate.

[5] We follow the previous literature, which considers the GDP-deflator-based real exchange rate (in which the price indexes is based on the production mix) a more useful measure than the consumption-based real exchange rate (in which the price indexes are based on representative consumption baskets).

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