E C O N O M I C S   B U L L E T I N

Real variables and the real exchange rate: The importance of traded goods in the transmission mechanism

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Abstract

I find that real variables affect the real exchange rate almost entirely through the relative price of traded goods. This finding casts doubt on the theoretical literature that postulates that real shocks propagate only through the relative price of nontraded goods.

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1. Introduction

The seminal work of Balassa (1964) and Samuelson (1964) on productivity shocks in the tradable sector, and Dornbusch (1980), Edwards (1989), and Neary (1988) on terms-of-trade shocks has generated a large literature examining the impact of real variables on the real exchange rate. This literature postulates that real variables affect the real exchange rate only through the relative price of *nontraded* goods. However, this transmission mechanism can be questioned in the light of the results presented in Engel (1999). Engel finds that the other component of the real exchange rate, the relative price of *traded* goods, almost entirely accounts for persistence and volatility of U.S. real exchange rates.

A possible interpretation of Engel's results is that nominal shocks, which propagate through the relative price of traded goods, are more important than real shocks that are supposed to propagate through the relative price of nontraded goods. Consequently, an implication of Engel's results for those wishing to model the real exchange rate is that real variables such as productivity and terms of trade are unlikely to be important. This paper examines the contribution of real shocks to the relative prices of traded and nontraded goods. I develop a VAR model that includes real variables and use Forecast Error Variance Decompositions (FEVDs) to address this issue with Canada-U.S. data. I find that real shocks identified in the model propagate to the real exchange rate almost entirely through the relative price of traded goods.

2. Methodology

Engel (1999) decomposes the log real exchange rate q into the log relative prices of traded x and nontraded goods y according to:

$$q = x + y \tag{1}$$

where

$$x = s + p_T^* - p_T \tag{2}$$

$$y = \alpha^*(p_N^* - p_T^*) - \alpha(p_N - p_T) \tag{3}$$

and s is the log of the nominal exchange rate (home currency price of the foreign currency), p is the log of the home price level, and p^* is the log of the foreign price level. Subscripts T and N indicate the price index for traded and nontraded goods respectively. α and α^* indicate the share of nontraded goods in the overall price index at home and abroad.

Since Engel (1999) finds that the null hypothesis that x and y are independent random walks cannot be rejected, the decomposition of the variance of $q_t - q_{t-n}$ assumes that $x_t - x_{t-n}$ and $y_t - y_{t-n}$ are uncorrelated at different horizons n. Thus, the contribution of $x_t - x_{t-n}$ to the variance of $q_t - q_{t-n}$ at different horizons n is calculated according to:

$$\frac{var(x_t - x_{t-n})}{var(x_t - x_{t-n}) + var(y_t - y_{t-n})}$$

Engel (1999) reports that the relative price of traded goods accounts for at least 95 percent of the variance of the real exchange rate for different measures of x_t and y_t, different horizons and different U.S. exchange rates.[1]

Engel's approach cannot be used directly to investigate the transmission mechanism of real shocks affecting the real exchange rate. In order to determine the channels by which real shocks are transmitted to the real exchange rate, I develop a VAR model in first differences.[2] The model includes four lags of the relative prices of tradables and nontradables, and four real variables. The real variables are chosen to capture the key sources of commodity and productivity shocks.

The Cholesky decomposition is used to identify structural shocks with the following ordering of the six variables: the real price of energy commodities, real price of nonenergy commodities, relative productivity in tradables, relative productivity in nontradables, relative price of tradables, and the relative price of nontradables. The Appendix describes the

[1] Engel (1999) also constructs the decomposition that takes the comovement between x_t and y_t into account. This decomposition gives similar results because comovements of x_t and y_t are small. In addition, Engel uses decompositions that take persistence into account. Since I look at forecast error variance decompositions later in this section, I discuss only those results of Engel that rely on variance decompositions.

[2] I fail to reject the null hypothesis that each variable is nonstationary. I also fail to reject the null hypothesis that the variables are not cointegrated. Under such circumstances, a VAR in first differences is the appropriate model to estimate FEVDs. The results of the tests are available upon request.

construction of the data.

I use this model to decompose forecast errors up to $s = 20$ steps ahead. This allows me to obtain contributions of real shocks to the forecast error variation of x and y. The forecast errors s periods into the future $\Delta x_{t+s} - \Delta \hat{x}_{t+s|t}$ and $\Delta y_{t+s} - \Delta \hat{y}_{t+s|t}$ are functions of the structural shocks. I need to calculate the mean squared error for $\Delta q = \Delta x + \Delta y$ and decompose this error into contributions from the relative price of traded goods and the relative price of nontraded goods, and ultimately into contributions from the structural shocks. I assume that the forecast errors for x and y are uncorrelated, and estimate the contribution of x according to:

$$\frac{MSE(\Delta \hat{x}_{t+s|t})}{MSE(\Delta \hat{x}_{t+s|t}) + MSE(\Delta \hat{y}_{t+s|t})} \tag{4}$$

This approach, unlike Engel (1999), provides decompositions conditional on real variables. This allows me to evaluate the importance of the relative prices in the transmission mechanism.

3. Forecast Error Variance Decompositions

Table 1(a) reports mean square errors of 20-period ahead forecasts for x and y.[3] By using (4), I find that the structural shocks propagating through the relative price of traded goods account for 96% of the mean square error for the real exchange rate. This result that x accounts for at least 96% holds at any horizon up to s=20. x accounts for at least 92% at horizons up to s=20 if a VAR in levels is used. The 96% figure is consistent with Engel's (1999) unconditional variance decomposition finding that the relative price of traded goods account for at least 95% of volatility in the real exchange rate. I find that conditional on the real variables the structural shocks identified in the VAR model propagate through the relative price of traded goods to the real exchange rate.

[3]Table 1(a) also provides justification for dropping the covariance term in (4). Formally, MSE($x + y$)=MSE(x)+MSE(y)+2 MSE(x,y). The last term, the covariance of forecast errors is not zero since forecast errors are functions of structural shocks. However, as can be seen from the table, the MSE(x,y) is significantly lower than MSE(x) or MSE(y).

Table 1(b-c) shows the Forecast Error Variance Decompositions obtained from the model. Table 1(b) contains the unweighted contributions. If the Balassa-Samuelson model and terms-of-trade models are right in assuming that real shocks propagate only through the relative price of nontaded goods, we should see zero contributions of real shocks to x, and high contributions to y. However, both predictions are questioned in the table. First, the contributions for x are not zero and account for about 26% of forecast variance of x. Second, real shocks identified in the model account for only about 39% of forecast variance of y.

Table 1(c) uses the fact that the MSE for x contributes 96% to the MSE of q to weight the contributions from the structural shocks. Table 1(c) shows that real shocks affect the real exchange rate almost entirely through tradables. The total contribution of real shocks to the real exchange rate through the relative price of traded goods is around 25% while through the relative price of nontraded goods is minor 1.6%. This result is expected to be robust to different orderings of real variables.

Engel (1999) finds that the relative prices of traded x and nontraded goods y are independent random walks. I assume that forecast errors for Δx and Δy are uncorrelated. One may argue that if both relative prices are affected by real factors, the relative prices cannot be independent. Since I control for real shocks, I can address this issue. Table 1(b) shows the the relative price of tradables is driven by shocks to itself at the horizon considered. Since the relative price of tradables x is more volatile than the relative price of nontradables y, and is driven by shocks to itself, the correlation between these two variables may be low even if they are both affected by real shocks. Second, one may argue that if movements in the nominal exchange rate pass through to prices, the relative prices of tradables and nontradables cannot be independent. Table 1(b) shows that indeed there is some pass-through from x to y. But since y is not so volatile as x, this pass-through does not contribute a lot to the comovement of the two relative prices.

4. Concluding remarks

Engel's (1999) evidence combined with the evidence above indicate the importance of explicit modeling of the transmission mechanism. Real variables affect the real exchange rate almost entirely through the relative price of traded goods. This finding is opposite to the postulate underlying many theoretical models that real variables affect the real exchange rate exclusively through the relative price of nontraded goods.

Appendix

I construct the measures for the relative price of traded x and the relative price of nontraded goods y for the Canada-U.S. pair by using (2) and (3). The weights are estimated by running regressions of the overall price index on traded and nontraded components (all variables are in log-differences). The components of the CPI index are used to proxy prices of traded and nontraded goods: commodities are used to proxy traded goods, and services are used to proxy nontraded goods. This is one of the approaches to construct x and y used in Engel (1999).

I use the Bank of Canada indexes for energy and nonenergy commodity prices denominated in U.S. dollars and adjust them for U.S. inflation measured by the CPI to construct the real price of energy and nonenergy commodities. The relative Canada-U.S. productivity measures are constructed by dividing output measures by hours-worked. All variables are in logs and at quarterly frequency from 1972:1 to 2000:4.

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Table 1: Forecast Error Variance Decompositions and 95% confidence intervals

(a) Mean square errors of 20-period ahead forecasts

	x	y
x	0.5591×10^{-4}	0.0007×10^{-4}
y	0.0007×10^{-4}	0.0225×10^{-4}

(b) Unweighted contributions

	PENERGY	PCOM	RLPRM	RLPRS	x	y
x	0.068	0.078	0.071	0.047	0.683	0.053
	(0.035, 0.201)	(0.034, 0.219)	(0.029, 0.196)	(0.019, 0.173)	(0.395, 0.689)	(0.019, 0.155)
y	0.074	0.186	0.052	0.079	0.117	0.492
	(0.035, 0.213)	(0.061, 0.318)	(0.021, 0.194)	(0.023, 0.236)	(0.043, 0.252)	(0.266, 0.565)

(c) Weighted contributions of structural shocks to the real exchange rate

	PENERGY	PCOM	RLPRM	RLPRS	x	y
by x	0.065	0.074	0.068	0.045	0.656	0.051
	(0.034, 0.193)	(0.033, 0.210)	(0.028, 0.188)	(0.018, 0.166)	(0.379, 0.661)	(0.018, 0.149)
by y	0.003	0.007	0.002	0.003	0.005	0.020
	(0.001, 0.009)	(0.002, 0.013)	(0.001, 0.008)	(0.001, 0.009)	(0.002, 0.010)	(0.011, 0.023)

A VAR in first differences with the Cholesky ordering (PENERGY, PCOM, RLPRM, RLPRS, x, and y) is used to calculate FEVDs 20 quarters ahead. (a) Mean square errors for 20-period ahead forecasts for x and y. (b) Decompositions for x and y. (c) Decompositions for q, given that x contributes 96% of FEVD of q. 95% confidence intervals are given in the parentheses.

Variables: PENERGY is the log of the real price of energy commodities; PCOM is the log of the real price of non-energy commodities; RLPRM is the log of the relative Canada-U.S. labour productivity in manufacturing; RLPRS is the log of the relative Canada-U.S. productivity in services; x is the log of the relative price of tradables as defined in (2); y is the log of the relative price of nontradables as defined in (3).