The Importance of Nontradable Goods' Prices in Cyclical Real Exchange Rate Fluctuations

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Abstract

Changes in the price of nontradable goods relative to tradable goods account for roughly 50 percent of the cyclical movements in real exchange rates.

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1. Introduction

A classic question in international macroeconomics is whether fluctuations in the real exchange rate (RER^{cpi}) constructed using the consumer price index (CPI) are primarily associated with movements in the relative price of tradable goods across countries or with fluctuations in the relative price of nontradable to tradable goods. Engel (1999) and Chari, Kehoe, and McGrattan (2002) conclude that fluctuations in the real exchange rates of developed economies are almost exclusively driven by changes in the relative price of tradable goods across countries. Their evidence suggests it is not important to distinguish between tradable and nontradable goods to understand cyclical real exchange rate fluctuations.

We argue that fluctuations in the relative price of nontradable to tradable goods are an important source of RER^{cpi} movements. We use an approach proposed by Engel (1999) and decompose the variance of RER^{cpi} into the variance of the relative price of tradable goods across countries, the variance in the relative price of nontradable to tradable goods, and a covariance term. To implement this decomposition we must take a stand on how to measure prices of tradable goods. A standard approach in the literature is to use retail prices. Unfortunately, retail prices are heavily contaminated by the cost of nontradable distribution services such as retailing, wholesaling, and transportation (see Burstein, Neves, and Rebelo (2003)). One approach to dealing with the distribution cost issue is to measure tradable goods' prices using the producer price index (PPI). However, a problem with the PPI is that it generally excludes import prices (IMF(2004)) and, for roughly one third of OECD countries, it also excludes export prices (Maitland-Smith (2000)). For this reason, we focus on the prices of pure-traded goods at the dock, i.e. the price of goods that are actually traded exclusive of distribution costs.[1] We measure the relative prices of pure-traded goods across countries using a weighted average of import and export price indices. We use quarterly data for 11 OECD countries for the period 1971 to 2002. We find that, for the median country, variations in the price of nontradable goods relative to the price of pure-traded goods account for over half the movements in RER^{cpi}.[2]

This finding depends critically on our measure of the price of tradable goods. To substantiate this statement we use U.S. data to decompose the variance of RER^{cpi} using two alternative measures of the price of tradable goods: the retail price of tradable goods and a weighted average of import and export prices. The first price measure implies that the relative price of nontradable to tradable goods accounts for virtually none of the variance of RER^{cpi}. In sharp contrast, the second price measure implies that the relative price of nontradable to tradable goods accounts for at least 55 percent of the variance of RER^{cpi}. Using the retail price of tradable goods leads one to overstate the fraction of cyclical RER^{cpi} fluctuations that are due to changes in the price of pure-traded goods across countries.

Viewed overall, our results suggest that a successful theory of real exchange rate fluctuations must incorporate changes across countries in the relative price of nontradable goods to pure-traded goods. At the same time, our results are consistent with the view that there are significant fluctuations in the relative price of pure-traded goods across countries. These fluctuations could reflect a variety of factors such as sticky prices and endogenous changes in real markups. In addi-

[1] In addition to including distribution costs, CPI-based retail prices differ from import and export prices because the former includes "local goods." These are goods that are produced solely for the domestic market and are not traded.

[2] Betts and Kehoe (2005) argue that movements in nontraded goods prices are important in explaining real exchange rate fluctuations. Their analysis is based on real exchange rates constructed using gross output deflators. These deflators are available only at an annual frequency, and they do not include the price of imported final goods.

tion, different countries import and export different baskets of goods. Therefore, changes in the relative price of these goods lead to changes in the relative price of traded baskets and in the measured real exchange rate. Assessing the plausibility of these alternative hypotheses is an important objective of ongoing research.

The remainder of this paper is organized as follows. Section 2 describes the method that we use to decompose RER^{cpi} movements. We report our empirical results in Section 3. Section 4 concludes.

2. Decomposing Real Exchange Rate Fluctuations

We define the CPI-based real exchange rate as:

$$RER_t^{cpi} = \frac{P_t}{S_t P_t^*}. \tag{2.1}$$

Here S_t denotes the geometric-trade-weighted nominal exchange rate of the home country defined as units of local currency per unit of geometric-trade-weighted foreign currency. The variables P_t and P_t^* denote the level of the CPI in the home country and the geometric-trade-weighted CPI of foreign countries, respectively.

To implement Engel's (1999) approach, we assume that P_t is computed as a geometric average of the price of tradable goods (P_t^T) and the price of nontradable (P_t^N) goods:

$$P_t = (P_t^T)^{1-\omega}(P_t^N)^{\omega}.$$

Similarly, we assume that the foreign CPI is given by:

$$P_t^* = (P_t^{T*})^{1-\omega^*}(P_t^{N*})^{\omega^*},$$

where P_t^{T*} and P_t^{N*} denote the foreign price of tradable and nontradable goods, respectively. The variables ω and ω^* represent the share of tradable goods in the domestic and foreign CPI baskets.

We denote the logarithm of RER_t^{cpi}, RER_t^T, and RER_t^N by rer_t^{cpi}, rer_t^T, and rer_t^N, respectively. We decompose rer_t^{cpi} as:

$$rer_t^{cpi} = rer_t^T + rer_t^N. \tag{2.2}$$

The first component, rer_t^T, is an index of the extent to which the price of tradable goods is different across countries:

$$rer_t^T = \log[P_t^T / (S_t P_t^{T*})].$$

The second component, rer_t^N, reflects the between-country difference of the relative price of nontradable goods to tradable goods:

$$rer_t^N = \omega \log(P_t^N / P_t^T) - \omega^* \log(P_t^{N*} / P_t^{T*}).$$

Using (2.2) we can decompose the variance of rer_t^{cpi} as:

$$var(rer_t^{cpi}) = var(rer_t^T) + var(rer_t^N) + 2cov(rer_t^T, rer_t^N). \tag{2.3}$$

We construct empirical measures of rer_t^{cpi} and rer_t^T and compute rer_t^N as a residual, using the identity (2.2). We estimate the individual elements of equation (2.3). We compute a lower bound, L^N, on the importance of movements in rer_t^N by attributing the covariance term to fluctuations in the price of tradable (nontradable) goods when the estimated covariance is positive (negative):

$$L^N = \begin{cases} \frac{var(rer_t^N)}{var(rer_t^{cpi})} & \text{if } cov(rer_t^T, rer_t^N) > 0, \\ \frac{var(rer_t^N)}{var(rer_t^{cpi})} + \frac{2cov(rer_t^T, rer_t^N)}{var(rer_t^{cpi})} & \text{if } cov(rer_t^T, rer_t^N) < 0. \end{cases} \tag{2.4}$$

We compute an upper bound, U^N, on the importance of movements in rer^N by attributing the estimated covariance term to fluctuations in the price of nontradable (tradable) goods when the estimated covariance is positive (negative):

$$U^N = \begin{cases} \frac{var(rer_t^N)}{var(rer_t^{cpi})} + \frac{2cov(rer_t^T, rer_t^N)}{var(rer_t^{cpi})} & \text{if } cov(rer_t^T, rer_t^N) > 0, \\ \frac{var(rer_t^N)}{var(rer_t^{cpi})} & \text{if } cov(rer_t^T, rer_t^N) < 0. \end{cases} \quad (2.5)$$

A key empirical question in implementing (2.2) is: how should we measure P_t^T? The most common approach in the literature is to measure P_t^T using CPI-based retail prices of tradable goods. In contrast, we measure the price of tradable goods using the price of pure-traded goods at the dock. Specifically, we use an equally weighted geometric average of import and export price indices.[3] These indices have two important advantages relative to retail prices and the PPI. First, import and export indices measure the prices of goods that are actually traded. Second, these indices are much less contaminated by nontradable components such as distribution costs.

We use quarterly data covering the period 1971.Q1 to 2002.Q3 for 11 countries: Australia, Canada, Denmark, Finland, Germany, Italy, Japan, the Netherlands, Sweden, UK, and the U.S. All price series (nominal exchange rates, consumer price indices, import and export price indices) are from the IMF's International Financial Statistics. We measure S_t, P_t^* and P_t^{T*} as trade-weighed averages of the individual country price series.[4] To isolate cyclical frequencies we detrend the

[3] We use import and export price indices when possible, and unit values when price indices are not available. For Denmark, where only import price indices are available, we assume that the export price index is equal to the import price index.

[4] The trade share of country i from country j is calculated as 0.5 exports$_j^i$ / exports^i + 0.5 imports$_j^i$ / imports^i, where exports$_j^i$ and imports$_j^i$ denote total exports and imports of country i, respectively, exports$_j^i$ denotes exports of country i to country j, respectively, and imports$_j^i$ denotes imports of country i from country j, respectively. We obtain import and export data from the IMF's Direction of Trade Statistics. Export and import shares are computed as simple averages using annual data from 1980 to 2002. For each country in our sample we choose the set of 20 countries with which this country has the highest trade share. We then eliminate those countries for which we do not have import and export price indices. The remaining 17 countries are: Australia, Canada, Denmark, Finland, Germany, Greece, Italy, Japan, Korea,

logarithm of all time series using the Hodrick-Prescott filter using a smoothing parameter of 1600.

Despite their advantages, there are three caveats about import and export price indices that are worth noting. First, some of the import and export prices used in the construction of these indices can reflect transfer prices within multinational corporations instead of market transactions. Second, import and export indices include investment, intermediate goods, and raw materials as well as consumption goods.[5] Finally, for Denmark, Italy and Germany, import and export price indices are based on unit value indices (UVIs) computed from trade statistics as the ratio of the local currency value of exports or imports to volume (weight or quantity). A potential problem with UVIs is that they are affected by shifts over time in product composition.

3. Empirical Results

Figure 1 displays the time series of $\log(S_t)$, rer_t^{cpi}, and rer_t^T for 11 countries. We normalize the level of these variables to zero in 1972the beginning of the sample. It is evident that rer_t^{cpi} and rer_t^T behave quite differently. These differences are particularly pronounced for Australia, Italy, Japan, the Netherlands, and Sweden.

The first panel of Table 1 displays summary statistics of the data. We compute three statistics for both rer_t^{cpi} and rer_t^T: the standard deviation, the correlation with $\log(S_t)$, and the elasticity with respect to $\log(S_t)$. The latter is the slope of a linear regression of the logarithm of either rer_t^{cpi} or rer_t^T on $\log(S_t)$. These elasticities do not have a causal or structural interpretation. However, they are a convenient way to summarize the quantitative relation between rer_t^{cpi}, rer_t^T, and

Mexico, Netherlands, Spain, Sweden, Switzerland, UK, U.S., and Venezuela. For the median country, our trade weights account for 57 percent of total imports and exports.

[5] See Burstein, Eichenbaum, and Rebelo (2005) for a discussion of the second caveat.

nominal exchange rates.

Consistent with Mussa (1986) we find that there is a very strong correlation between the logarithm of the nominal exchange rate and rer_t^{cpi}. The median correlation between these two series is -0.96. The volatility of these series is also very similar. The median value of the ratio of the standard deviations of rer_t^{cpi} and $\log(S_t)$ is 1.03. The median value of the elasticity of the rer_t^{cpi} and rer_t^T with respect to $\log(S_t)$ is -0.99. Taken together our summary statistics suggest a very tight relation between rer_t^{cpi} and $\log(S_t)$. One widely held interpretation of this tight relation is that it reflects the pervasiveness of sticky prices, with no distinction being made between tradable and nontradable goods.

Next we consider our summary statistics for rer_t^T. The median correlation between rer_t^T and $\log(S_t)$ is -0.69, while the median value of the ratio of the standard deviations of these two series is 0.62. Finally, the elasticity of rer_t^T with respect to $\log(S_t)$ is only -0.41. Clearly, the relation between rer_t^T and $\log(S_t)$ is substantially weaker than the relation between rer_t^{cpi} and $\log(S_t)$.

We now examine the role of tradable and nontradable goods prices in accounting for movements in the real exchange rate. The last two columns of Table 1 report the lower and upper bounds for the importance of movements in nontradable goods prices as sources of rer_t^{cpi} fluctuations, defined in (2.4) and (2.5). The median values of these bounds are 52 and 68 percent. We redo our calculations measuring the price of pure-traded goods using only the price of imported goods. In this case we find that the median values of L^N and L^U are 49 and 82 percent, respectively. We infer that movements in the price of nontradable goods relative to tradable goods are important, accounting for more than half of the fluctuations in rer_t^{cpi}.

This finding stands in sharp contrast with the results in the literature obtained using retail prices to measure P_t^T and P_t^{T*} (see Engel (1999) and Chari, Kehoe, and McGrattan (2002)). We illustrate the contrast by estimating the lower and upper bounds defined in (2.4) and (2.5) for the U.S. using two alternative measures of tradable goods' prices.

In the first case we measure P_t^T using an equally weighted geometric average of U.S. import and export price indices. We measure P_t^{T*} using a trade-weighted, equally-weighted geometric average of import and export price indices for the following trading partners of the U.S.: Australia, Canada, Germany, Italy, Japan, Korea, Mexico, the Netherlands, Spain, Switzerland, UK, and Venezuela. Together these countries account for 64 percent of U.S. imports and exports for the period 1980 to 2001.

In the second case we measure P_t^T using the retail price of tradable goods in the U.S. We average monthly data on the retail price of tradable goods obtained from the Bureau of Labor Statistics to produce a quarterly time series. We construct P_t^{T*} as a trade-weighted average of the U.S. trading partners' consumer prices. For Canada, Italy, Japan, and Mexico we use the retail prices of tradable goods. These countries account for 43 percent of U.S. trade during the period 1980 to 2001. Due to data limitations, for Australia, Germany, Korea, the Netherlands, Spain, Switzerland, the UK, and Venezuela we measure the price of tradable goods using the CPI. The sample period, 1975.Q1 to 2002.Q3, which differs from that of the data used to construct Table 1, was dictated by the availability of retail prices of tradable goods for some of the U.S. trading partners. We report our results in Table 2.

Consistent with the results in Table 1, when P_t^T is measured using import and export prices fluctuations in nontradable goods prices account for well over half of the movements in rer_t^{cpi}. In sharp contrast, when P_t^T is measured using retail prices, these fluctuations account for 5 percent or less of the movements in the rer_t^{cpi}.

Taken together, our results make clear that the conventional view that movements in nontradable goods prices are unimportant as sources of cyclical RER^{cpi} fluctuations, depends critically on the questionable assumption that the price of tradable goods can be accurately measured using retail prices. Measuring the price of tradable goods using retail prices understates the importance of movements in the relative price of nontradable goods as a source of cyclical RER^{cpi} fluctuations.

4. Conclusion

Burstein, Eichenbaum, and Rebelo (2005) argue that in the aftermath of large devaluations, changes in the real exchange rate are overwhelmingly driven by movements in the price of nontradable goods relative to the price of pure-traded goods. This paper analyses the source of real exchange rate fluctuations at cyclical frequencies. We find that more than half of these fluctuations are accounted for by movements in the price of nontradable goods relative to the price of pure-traded goods. The remaining half are due to movements in the relative price of traded goods across countries. Understanding the sources of these latter movements has been the focus of a large literature. Our findings suggest that equal attention should be paid to modeling movements in the relative price of nontradable to pure-traded goods.

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TABLE 1

Quarterly Data, 1971.Q1-2002.Q3 (HP-Filtered)

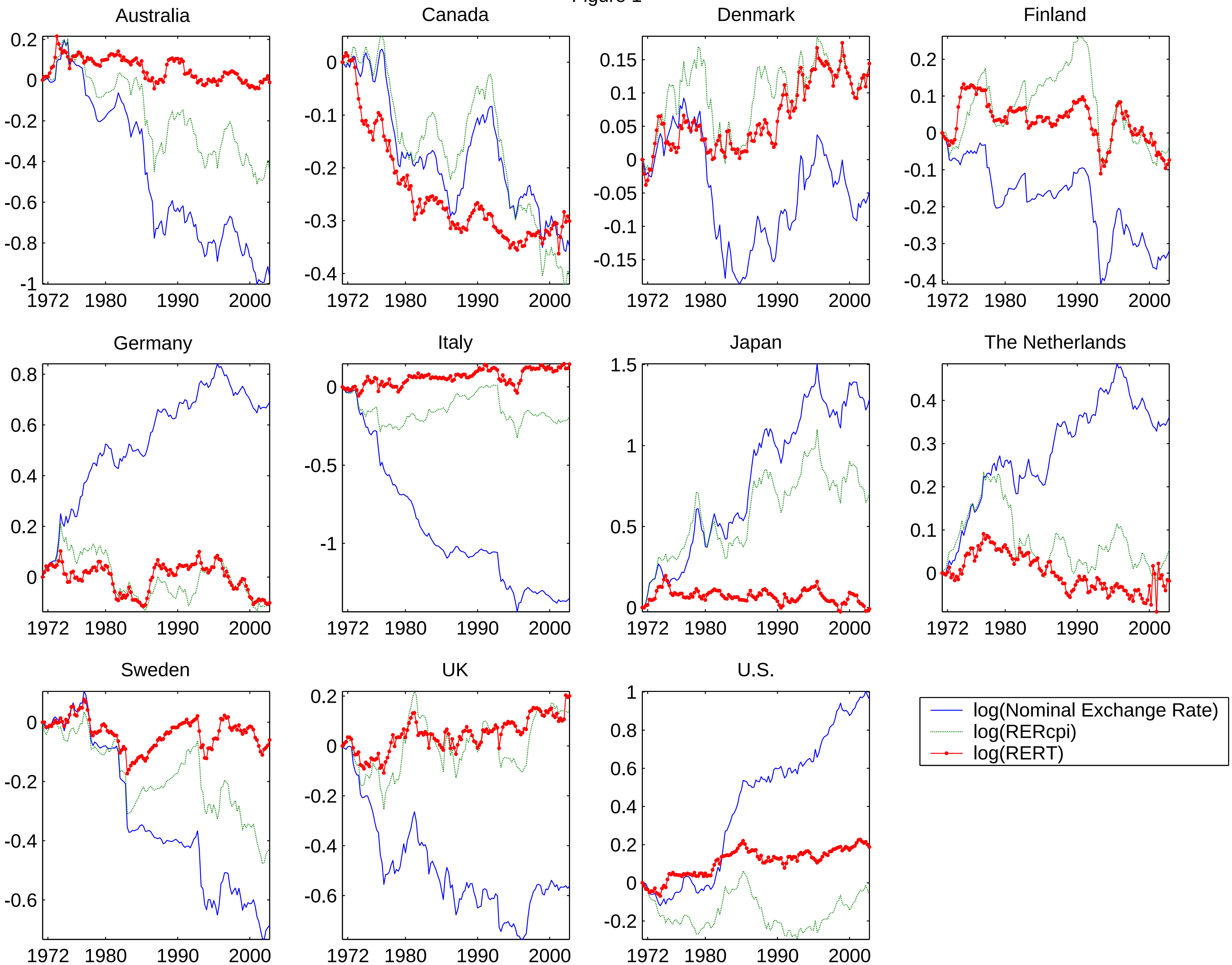
	Standard Deviations			Correlations with S		Elasticity of RER to S		Bounds on the Importance of Nontradables	
	std(S)	std(RER^{cpi})/std(S)	std(RER^{T})/std(S)	RER^{cpi}	RER^{T}	RER^{cpi}	RER^{T}	Lower Bound	Upper Bound
Australia	0.07	0.97	0.47	-0.97	-0.69	-0.94	-0.32	0.54	0.77
Canada	0.03	1.05	0.58	-0.96	-0.57	-1.00	-0.33	0.65	0.70
Denmark	0.02	1.03	0.77	-0.91	-0.65	-0.94	-0.50	0.45	0.68
Finland	0.04	1.06	0.75	-0.98	-0.84	-1.03	-0.64	0.37	0.49
Germany	0.03	1.11	0.97	-0.94	-0.81	-1.04	-0.78	0.24	0.43
Italy	0.04	0.95	0.69	-0.94	-0.64	-0.89	-0.44	0.45	0.47
Japan	0.08	1.01	0.37	-0.98	-0.69	-0.99	-0.25	0.62	0.87
Netherlands	0.02	1.13	0.77	-0.96	-0.29	-1.08	-0.22	0.54	1.13
Sweden	0.04	0.98	0.62	-0.96	-0.88	-0.94	-0.55	0.35	0.59
UK	0.05	1.11	0.57	-0.94	-0.73	-1.05	-0.41	0.52	0.74
USA	0.04	0.89	0.56	-0.87	-0.55	-0.78	-0.31	0.60	0.62
Median	0.04	1.03	0.62	-0.96	-0.69	-0.99	-0.41	0.52	0.68

TABLE 2

U.S. Quarterly Data 1975.Q1-2002.Q3 (HP-Filtered)

	Lower Bound on the Importance of Non-Tradables	Upper Bound on the Importance of Non-Tradables
P^T measured using Import and Export Prices	0.56	0.71
P^T measured using Retail Prices	-0.05	0.05

Figure 1


Australia
Canada
Denmark
Finland
Germany
Italy
Japan
The Netherlands
Sweden
UK
U.S.
log(Nominal Exchange Rate)
log(RERcpi)
log(RERT)