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VECM estimations of the PPP reversion rate revisited: The conventional role of relative price adjustment restored

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ABSTRACT

Cheung et al. (2004) use a vector error correction model (VECM) for the current float nominal exchange rate and relative price data and claim that the sluggish purchasing power parity (PPP) reversion is primarily driven by the nominal exchange rate, not by relative price adjustment, which is at odds with the conventional sticky-price models. Our major findings are as follows. First, we suggest cases where VECMs are of limited usefulness, even when all the variables in the system are not weakly exogenous. Second, using century-long exchange rates, we find that the relative price plays an important role for PPP reversion when real shocks occur. Third, protracted hump-shaped responses of real exchange rates are frequently observed when there is a relative price shock, leading to sluggish adjustments toward PPP. Nominal exchange rate shocks generate humped dynamics much less frequently.

1. Introduction

In the tradition of Dornbusch (1976), conventional rational expectations sticky price models implicitly assume the same convergence rates for the nominal exchange rate and the relative price. In such models, real exchange rate deviations can be persistent as nominal prices slowly adjust to a new equilibrium. However, as pointed out by Rogoff (1996), the observed persistence of real exchange rate deviations is too high to be explained by such nominal rigidities. Chari et al. (2002) also show that an array of sticky price models fail to generate the observed persistence of real exchange rates.

Engel and Morley (2001) propose a state-space model that allows the nominal exchange rate and relative price to adjust at *different* speeds. A similar attempt was made by Cheung et al. (2004) who use a vector error correction model (VECM) of the nominal exchange rate and the relative price. Using the current float monthly data for five developed countries, they find that the reversion rate of the real exchange rate toward Purchasing Power Parity (PPP) is primarily driven by nominal exchange rate adjustment rather than relative price adjustment, which is at odds with the conventional view that addresses a dominant role of *nominal* prices (see, for example, Stockman, 1987; Rogoff, 1996; Obstfeld and Rogoff, 2000).

However, it is not clear if the relative price (price ratio) adjustment is directly linked to such nominal rigidities, because the relative price changes when economic fundamentals change disproportionately across countries. For instance, country-specific productivity shocks may result in changes in the relative price, and real exchange rates may inherit persistence of real shocks.

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This point is closely related to Steinsson's (2008) recent study. He shows that real shocks such as productivity shocks tend to generate hump-shaped dynamics of the real exchange rate, which in turn contribute to generate half-lives that match the observed persistence of the US real exchange rate. Monetary shocks fail to do that.[1] The present paper reports empirical findings that are roughly consistent with this claim.

The major contributions of this paper are the following. First, we point out there are cases when VECMs are of limited usefulness in regards to measuring persistence, even when all the variables in the system are not weakly exogenous. For example, VECMs provide the same *single* half-life (irrespective of the source of shocks) as that of the univariate method when the chosen number of lags is one.

Second, Using Taylor's (2002) century-long exchange rate data for 11 developed countries with the US dollar as a base currency, we find an important role of relative price adjustment in real exchange rate dynamics when real shocks occur, while we confirm the results of Cheung et al. (2004) when there is a nominal exchange rate shock.

Taylor's data (and other similar long-horizon data) includes both the fixed and the free float (post-Bretton Woods system) exchange rate regimes. We admit that this could be a potentially serious drawback because the variability of the nominal exchange rate during the fixed regime could be highly limited. However, it is also well-known that the relative price variability tends to be quite limited compared with that of the (highly volatile) nominal exchange rate during the current float.[2] Therefore, it may not be surprising that highly variable nominal exchange rates play a more important role during the current float era as Cheung et al. (2004) report.

By the same token for the long-horizon data, since nominal exchange rates before 1973 exhibit limited movements, it is possible the present analysis is similarly affected by that. However, observations in the present paper include both the fixed and the float eras, so it may help evaluate overall effects. Furthermore, my analysis confirms Cheung et al.'s (2004) findings when there is a nominal exchange rate shock, finding a dominant role of the nominal exchange rate when there's a nominal exchange rate shock. My additional contribution is that I find fairly important role of the relative price when there a relative price shock, which was not reported by Cheung et al. (2004).[3] We also find that relative prices often converge at a slower rate than nominal exchange rates when relative price shocks occur.[4]

Third, we observed protracted responses of the real exchange rate more often when relative price shocks occur. Such hump-shaped responses are observed a lot less frequently when there is a nominal exchange rate shock. These findings are consistent with Steinsson's (2008) results from his underlying microfounded sticky price model. We also implement a variance decomposition analysis. For the majority countries, we find that nominal exchange rates hardly explain variations of relative prices, while relative prices explain a great deal of variations of nominal exchange rates in the long-run. This implies that the relative price serves as an attractor for the nominal exchange rate.

The present paper is organized as follows. In Section 2, we outline our baseline VECM and demonstrate that VECMs may be of limited usefulness under a certain circumstances. We also provide some pretest results. Section 3 reports estimates for relative contributions of the nominal exchange rate and the relative price in PPP reversion. In Section 4, we report the estimates for an array of metrics, proposed by Steinsson (2008), including the half-life, up-life, and quarter-life along with some test statistics for the hump-shaped dynamics. The variance decomposition estimates are also reported. Section 5 concludes.

2. The econometric model and pretest results

2.1. The model

Let e_t be the log nominal exchange rate as the unit price of the foreign currency in terms of the domestic currency. $\tilde{p}_t$ is the log relative price, $p_t - p_t^*$, where p_t and p_t^* are the log domestic price and the log foreign price, respectively. The log real exchange rate (s_t) is $e_t - \tilde{p}_t$.

When e_t and $\tilde{p}_t$ are individually $I(1)$, but cointegrated with the cointegrating vector $[1\ -1]$, the Granger Representation Theorem (Engle and Granger, 1987) implies the following VECM of e_t and $\tilde{p}_t$.

$$\begin{bmatrix}\Delta e_t\\ \Delta\tilde{p}_t\end{bmatrix} = \mathbf{a} + \begin{bmatrix}\rho_1\\ \rho_2\end{bmatrix} s_{t-1} + \sum_{j=1}^{k}\begin{bmatrix}\beta_{11,j} & \beta_{12,j}\\ \beta_{21,j} & \beta_{22,j}\end{bmatrix}\begin{bmatrix}\Delta e_{t-j}\\ \Delta\tilde{p}_{t-j}\end{bmatrix} + \mathbf{C}\begin{bmatrix}u_t^e\\ u_t^{\tilde{p}}\end{bmatrix}, \tag{1}$$

where $\mathbf{a}$ is a 2×1 vector of constants, s_{t-1} denotes the error correction term, and ρ's are the convergence rates of e_t and $\tilde{p}_t$. $\mathbf{C}$ is a 2×2 matrix that describes contemporaneous relations between structural shocks u_t^e and $u_t^{\tilde{p}}$. Equivalently,

$$\Delta\mathbf{y}_t = \mathbf{a} + \rho\beta'\mathbf{y}_{t-1} + \sum_{j=1}^{k}\mathbf{B}_j\Delta\mathbf{y}_{t-j} + \mathbf{C}\mathbf{u}_t, \tag{2}$$

[1] Complete description of his underlying model is available at http://www.columbia.edu/~js3204.

[2] This probably is because prices/inflation rates became quite stable since 1980s (e.g., post-Volcker era in the US).

[3] It should be also noted that the current float data often provides very weak or virtually no support for PPP, which is essential for our analysis.

[4] Cheung et al. (2004) report convergence rates only when there is a nominal exchange rate shock (p. 145), where they find faster convergence rate for the relative price than the nominal exchange rate. Our findings also confirm such results. However, we obtain very different results when there is a relative price shock.