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Do sticky prices increase real exchange rate volatility at the sector level?

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ABSTRACT

We introduce the real exchange rate volatility curve as a useful device to understand the relationship between price stickiness and the fluctuations in Law of One Price deviations. In the presence of both nominal and real shocks, the theory predicts that the real exchange rate volatility curve is a U-shaped function of the degree of price stickiness. Using sector-level US–European real exchange rate data and frequency of price changes, we estimate the volatility curve and find the predominance of real effects over nominal effects. Good-by-good variance decompositions show that the relative contribution of nominal shocks is smaller at the sector level than what previous studies have found at the aggregate level, consistent with significant averaging out of good-specific real micro-economic shocks.

1. Introduction

Among international macroeconomists, it is widely believed that the variability of real exchange rates is increasing in the degree of price rigidity. A reasoning is found in a prominent textbook by Dornbusch et al. (2004):

> "Exchange rate overshooting results from the rapid response of exchange rates to monetary policy and the sluggish adjustment of prices. A monetary expansion will lead to an immediate depreciation but only a gradual increase in prices. Exchange rate overshooting implies that real exchange rates are highly volatile (p. 534)."

The basic idea is as follows. The nominal exchange rate is an asset price (since currencies are actively traded in the foreign exchange market) and thus it adjusts instantaneously in response to nominal shocks. However, if prices of many goods and services adjust sluggishly, the real exchange rate will be highly volatile because it comoves with the nominal exchange rate. The expectation, then, is a *positive* correlation between the volatility of real exchange rates and the degree of price stickiness if *nominal* shocks dominate the landscape, as they do in much theorizing on the topic. Quantitative investigations of this prediction have been undertaken, by Chari et al. (2002) who focus on the aggregate real exchange rates and by Kehoe and Midrigan (2007) who focus on Law of One Price (LOP) deviations.

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An early advocate for the role of real shocks in the equilibrium determination of real exchange rates is Stockman (1980). Stockman casts his model in a flexible price setting, so that nominal shocks make no contribution to real exchange rate volatility. Crucini et al. (2010), on the other hand, neutralize the effect of nominal shocks by focusing on intranational trade and investigate the role of real shocks on good-level real exchange rate volatility across cities in the presence of price rigidity. Unlike models emphasizing the role of the nominal shocks, their model predicts a *negative* correlation between price stickiness and real exchange rate variability because only *real* shocks affect real exchange rates across locations within a country.

The current paper puts these two views of real exchange rate determination on the same playing field by combining the model of Kehoe and Midrigan (2007) which emphasizes nominal shocks with the model of Crucini et al. (2010) which emphasizes real shocks. These models rely on the time dependent pricing assumption, but allow the frequencies of price changes to vary across goods, as measured in the micro-data. Under the synthesized framework, we theoretically explore the cross-sectional relationship between price stickiness and real exchange rate volatility at the level of individual goods. We refer to this relationship as the real exchange rate volatility curve: the functional relationship between the forecast error variance of the real exchange rate and the infrequency of price changes at the level of a good. When real shocks are absent, the volatility curve is upward-sloping: an increasing function of the price stickiness parameter and the good with the stickiest price should exhibit the greatest amount of real exchange rate variability. When nominal shocks are turned off, the volatility curve is downward-sloping: a decreasing function of the price stickiness parameter and the good with the stickiest price has the least amount of real exchange rate variability. When both real and nominal shocks are present, the real exchange rate volatility curve becomes U-shaped.

We estimate the volatility curve using sector-level real exchanges of Austria, Belgium, France, and Spain vis-à-vis the US, constructed by Kehoe and Midrigan (2007). We find that the estimated U-shaped curve is monotonically decreasing over the majority of the range of price stickiness. Our main findings regarding the shape of the curve are confirmed by both parametric and nonparametric estimation methods. The negative correlation together with the theoretical prediction of our model suggests the predominance of real shocks over nominal shocks in explaining the volatility of real exchange rates at the sector level.

At the aggregate level, the relative contribution of real and nominal shocks to real exchange rate variability has been typically evaluated in terms of forecast error variance decompositions (e.g., Clarida and Galí, 1994; Eichenbaum and Evans, 1995; Rogers, 1999).[1] Following this literature, we further conduct variance decompositions of real exchange rates at the sector level, and evaluate the relative contribution of nominal and real shocks. For the majority of goods, the contribution of nominal shocks is smaller than that of real shocks, and real shocks rise in dominance as the forecast horizon lengthens. To reconcile our microeconomic evidence with the macroeconomic evidence, it seems necessary to allow for large idiosyncratic real shocks at the sector level such that these microeconomic sources of variation average out in the move to the CPI-based real exchange rate (Broda and Weinstein, 2008; Bergin et al., in press; Crucini and Telmer, 2012).

2. The model

The theory combines the key features of Kehoe and Midrigan (2007) and Crucini et al. (2010). Both of these models assume heterogeneous price stickiness across goods, but the former relies on nominal exchange rate variations whereas the latter focuses on the labor productivity variations along with trade costs in explaining the volatility of good-level real exchange rates.

In what follows, we present a sketch of our model to discuss its main implications for good-level real exchange rate volatility.[2] The (log) real exchange rate for a bilateral pair of countries is defined as

$$q_{it} = s_t + p^*_{it} - p_{it}, \tag{1}$$

where p_{it} (p^*_{it}) denotes the (log) price index for good i in the home (foreign) country and s_t is the (log) nominal exchange rate, at period t.

To introduce the real exchange rate volatility curve, some simplifying assumptions are made on the sources of real exchange rate variation. The first assumptions concern nominal shocks and exchange rates and we take these assumptions from Kehoe and Midrigan (2007). Let M_t and P_t be the money demand and aggregate price level, respectively. The nominal shocks in the model are the home and foreign money growth rate, $\mu_t = \ln(M_t/M_{t-1})$ and $\mu^*_t = \ln(M^*_t/M^*_{t-1})$, which are independent and identically distributed (i.i.d.). We also assume that the period utility function is given by $\ln C_t - \chi L_t$, where C_t and L_t denote aggregate consumption and hours worked, respectively. The assumption on household preference, combined with a local-currency cash-in-advance constraint, $M_t = P_t C_t$, leads to the equality of the money growth differential and the nominal exchange rate growth (i.e., $\mu_t - \mu^*_t = \Delta s_t$). Conveniently, the i.i.d. process of the money growth rates gives rise to a nominal exchange rate s_t that follows a random walk, a characteristic similar to the data.[3]

[1] Some exceptions, such as Steinsson (2008), focus on the shape of impulse response function to evaluate the relative importance of nominal and real shocks.

[2] The full model is presented in Appendix A.

[3] With the cost of losing computational simplicity of the real exchange rate volatility curve, we can also replace i.i.d. money growth with serially correlated money growth.