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Trade intensity and purchasing power parity

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ABSTRACT

In this paper, we seek to contribute to the PPP literature by presenting evidence of a link between trade intensity and exchange rate dynamics. We first establish a negative effect of trade intensity on exchange rate volatility using panel regressions, with distance as an instrument to correct for endogeneity. We also estimate a nonlinear model of mean reversion to compute half-lives of deviations of bilateral exchange rates from the levels dictated by relative PPP, and find these half-lives to be significantly shorter for high trade intensity currency pairs. This result does not appear to be driven by Central Bank intervention. Finally, we show that conditioning on PPP may help improve the performance of popular currency trading strategies, such as the carry trade, especially for low trade intensity currency pairs.

1. Introduction

For international economists, exchange rate determination is a topic of perennial interest and a formidable challenge. While some models—such as Taylor et al. (2001), Molodtsova and Papell (2009), Mark (1995) and others—have outperformed Meese and Rogoff's (1983) famous random walk, the fraction of movement explained, let alone predicted, remains small.

According to Rogoff (2008), the most consistent empirical regularity is purchasing power parity (PPP). Despite their volatility, real exchange rates appear to revert back to long-run averages as predicted by relative PPP. In this paper, we investigate whether the degree of trade intensity (TI henceforth) between two countries affects mean reversion in their bilateral real exchange rate. Our hypothesis is straightforward. PPP is based on the Law of One Price, which in turn relies on goods arbitrage. As deviations from PPP widen, the number of goods for which price differences exceed transaction costs should increase. As agents exploit emerging opportunities for goods arbitrage, they increase demand for goods in cheap locations and supply in expensive ones. This reequilibration should be stronger between close trading partners, presumably due to lower transaction costs—which include transport and tariffs, but also fixed costs like translating, advertising, licensing, etc. Sooner or later, goods trade should translate into currency trades and affect nominal exchange rates, which typically drive most of the variability in real exchange rates. Although turnover in foreign exchange (forex) markets far exceeds export values, this stabilizing effect of exports on exchange rates need not be insignificant. In fact, forex market participants often claim that exports matter because, while speculative traders drive most volume, they open and close positions very frequently. By contrast, export driven transactions generate positions that are opened but never closed, exerting pressure on exchange rates in a much more consistent direction. Moreover, if investors take trade into account—for example by favoring countries with trade surpluses—when deciding which currencies to buy, speculative trades may actually complement the effect of exports.

We consider a sample of 91 currency pairs involving 14 countries over the period 1980–2005. To define and quantify TI, we largely follow Betts and Kehoe (2008). Our measures of TI between countries A and B are based on the magnitude of the bilateral trade between them, relative to A's (and/or B's) total trade. Not surprisingly, TI and exchange rate volatility are negatively correlated in our sample. This correlation is likely a product of causality in both directions. As mentioned above, TI may reduce volatility through goods arbitrage, which exerts pressure to reduce deviations from PPP. In the other direction, there is the argument—often brought up in defense of fixed exchange rates—that lower exchange rate volatility may increase trade between countries by reducing uncertainty and hedging costs. Since we are primarily interested in the first direction of causality, we begin the analysis by implementing panel regressions with exchange rate volatility as a

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dependent variable and TI as one of our independent variables, using the distance between two countries as an instrument. This approach is similar to that of Broda and Romalis (2009). Coefficient estimates from these regressions across various specifications show a negative effect of TI between two countries on their bilateral real exchange rate. We also find that, consistent with the literature on carry trades (see, for instance, Bhansali (2007)) exchange rate volatility increases with the absolute value of interest rate differentials. While most of the currencies in our sample are floating during all or most of the sample period, there are some exceptions. However, our results remain qualitatively unchanged when we drop or control for pegged currency pairs. Our results are moreover robust to the use of different measures of exchange rate volatility and TI, and to considering only major currency pairs, as opposed to minor/exotic pairs. Finally, the results are qualitatively preserved when we restrict attention to just the first, or second half, of the 1980–2005 period.

Motivated by Michael et al. (1997) and Taylor et al. (2001), who provide evidence of nonlinear mean reversion in a number of major real exchange rates, we quantify the size and persistence of PPP deviations using a nonlinear model. Specifically, we estimate an exponential smooth transition autoregressive (ESTAR) model, which allows the speed at which exchange rates converge to their long-run equilibrium values to depend on the size of the deviations. The model allows for the possibility that real exchange rates may behave like unit root processes when close to their long-run equilibrium levels, while becoming increasingly mean-reverting as they move away from equilibrium. For our comparison, we restrict attention to 35 highest and 35 lowest currency pairs, as ordered by TI. We make this choice to ensure that the difference in trade intensities between the two sets of currency pairs is so large and stable that variations of TI over time are negligible in comparison to the differences in trade intensities between the two sets of pairs. After estimating the ESTAR models, we investigate the dynamic adjustment in response to shocks to real exchange rates in the estimated ESTAR model by computing the generalized impulse response functions (GIs) using the Monte Carlo integration method introduced by Gallant et al. (1993). We find that, as hypothesized, the estimates of the half-lives of deviations from PPP for a given currency pair are higher the less intense the trade relationship between two countries. For currency pairs in the high TI group, the average half-life of deviations from PPP is given by 20.20 months, whereas for low TI pairs, it is 26.34 months. Moreover, this finding is statistically significant.

We also verify that our result is not driven by Central Bank intervention. That is, a possible concern when interpreting our results is that, if Central Banks exhibit more *fear of floating* in response to exchange rate fluctuations against important trading partners, the observed differences in volatility may primarily be due to official reserve transactions, rather than trade. To address this concern, we consider various proxies for intervention—specifically the volatility of reserves and interest rates, following Calvo and Reinhart (2002). To judge by these measures, government intervention is unlikely to be the reason for faster convergence in high TI cases, since the degree of currency intervention is typically lower for high TI currency pairs.

Finally, we investigate whether our findings on TI and mean reversion can be used to improve the performance of forex trading strategies, such as the carry trade. To do this, we perform an exercise similar to Jordà and Taylor (2012). We simulate a PPP-augmented carry trade, which gives a buy signal only if there is a positive interest rate differential and the high interest currency is undervalued according to relative PPP. The criterion to decide whether a currency is over- or undervalued is simply whether the (lagged) real exchange rate is above or below its historical average by a percentage τ. (The higher τ, the greater of degree of undervaluation needed to satisfy the PPP condition.) We compare the performance of this PPP-augmented carry trade to a plain carry trade, which chases high interest rate differentials regardless of PPP valuations. We do this separately for a high TI and for a low TI portfolio. Across all our specifications of the carry trade, the PPP-augmented strategy outperforms the plain carry, in the sense that it has higher Sharpe ratios. These gains from conditioning on PPP tend to be greater in the low TI portfolio. Moreover, the optimal τ is also higher in the low TI case. While these results are obtained in sample, we find that the same patterns do hold out-of-sample, although the gains from conditioning on PPP become smaller, especially in the high TI group.

The rest of the paper is organized as follows. In Section 2, we describe our data and define variables. In Section 3, we provide evidence of a linkage between TI and exchange rate volatility using panel regressions. In Section 4, we present and discuss empirical results from ESTAR models. We also conduct and discuss stationary tests for estimated ESTAR models. Further, we investigate whether our half-life estimates are mainly driven by government intervention. In Section 5, we apply our findings to currency trading strategies. In Section 6, we conclude.

2. Data and variable definitions

2.1. Data sources

We collect monthly nominal exchange rates vis-à-vis the US Dollar (USD) from January 1980 through December 2008 for the following 13 currencies: Australian Dollar (AUD), Canadian Dollar (CAD), Euro/Deutsche Mark (EUR/DEM), Great Britain Pound (GBP), Japanese Yen (JPY), Korean Won (KRW), Mexican Peso (MXN), New Zealand Dollar (NZD), Norwegian Krone (NOK), Singapore Dollar (SGD), Swedish Krona (SEK), Swiss Franc (CHF), and Turkish Lira (TRY). To choose the currencies, we follow the BIS Triennial Central Bank Survey, and focus on the 20 most traded currencies in 2010. Six of the top twenty currencies, the Hong Kong Dollar (in 8th place), Indian Rupee, Russian Ruble, Chinese Renminbi, Polish Zloty (in places 15–18), and the South African Rand (in place number 20) were dropped due to data limitations, being fixed for most of the sample period, or both. Combining each of the 14 currencies with the rest, we obtain a total of 91 bilateral trade relationships and real exchange rates.

For all 14 currencies, we collect monthly money market interest rates, price indices, in particular the consumer price index (CPI), and foreign exchange reserves. We retrieve these data from the IMF's *International Financial Statistics* (*IFS*) database. Data for annual exports used to measure trade intensity (TI) are borrowed from Betts and Kehoe (2008).[2]

2.2. Measuring exchange rate volatility and trade intensity

The aim of this paper is to investigate the link between TI and exchange rate volatility. Our hypothesis is that the more intense the trade relationship between two countries, the less volatile their bilateral real exchange rate. To investigate the link between them, we start by defining our measures of exchange rate volatility and TI.

The real exchange rate Q_t is defined as

$$Q_t \equiv S_t \frac{P_t}{P_t^*}, \tag{1}$$

where S_t is the nominal exchange rate measured as the price of one unit of domestic currency in terms of foreign currency, and P_t and P_t^* denote domestic and foreign price levels, respectively. The log real exchange rate q_t is given by

$$q_t \equiv s_t + p_t - p_t^*, \tag{2}$$

[2] The data along with a data Appendix A for annual exports to measure TI are publicly available at Timothy Kehoe's webpage, http://www.econ.umn.edu/~tkehoe/research.html.