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Are supply shocks important for real exchange rates? A fresh view from the frequency-domain ☆

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ABSTRACT

This paper re-examines the role of supply shocks for real exchange rate fluctuations and contributes by exploiting insights from the frequency-domain perspective. In contrast to the existing literature, our empirical findings point towards an important role played by supply (productivity) shocks in driving US real effective exchange rate fluctuations at low frequencies, while real demand shocks matter mostly at high and medium frequencies. In addition, we propose an approach to structurally decompose the persistence of the real exchange rate and find that supply shocks explain up to half of its persistence.

1. Introduction

Real exchange rates (RER) of major industrialized economies have been volatile and persistent ever since the Bretton Woods system of fixed exchange rates was abandoned in the 1970s (Rogoff, 1996). Economic theory suggests that supply shocks explain a large fraction of the fluctuations of RERs: Balassa (1964) and Samuelson (1964) highlight relative productivity as the driving force for long-run RERs. More recently, Steinsson (2008) shows that real shocks, including productivity and labor supply shocks, are important for generating hump-shaped impulse responses of real exchange rates in sticky price models. As a result, they can reconcile the puzzling finding of joint persistence and volatility of RERs.

Despite the ample theoretical arguments in favor of a significant role of supply shocks for RER dynamics, evidence from structural vector autoregressions (SVARs) remains mixed. Clarida and Galí (1994) find that the role of supply shocks for RER fluctuations is negligible both in the short-run and the long-run. Farrant and Peersman (2006) and Juvenal (2011) conclude that supply shocks account for only 10% of real exchange rate dynamics. According to these studies, the main drivers for

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RERs are demand or nominal disturbances.[1] The only exception is Alexius (2005) who argues that, when allowing for a stochastic long-run relationship between the level of the real exchange rate and its fundamentals, supply shocks account for most of the forecast error variance of real exchange rates measured at long forecast horizons. These results suggest that the conclusions about the importance of a structural shock for the RER depend on which horizon one looks at.

In contrast to the existing literature, this paper finds in a SVAR that supply shocks are in fact one of the most important drivers of the low frequency dynamics of the US real exchange rate. We come to this novel conclusion by studying the sources of RER dynamics using a frequency-based variance decomposition, as proposed by Stiassny (1996) and Altig et al. (2011). Generally, macroeconomic dynamics are driven by shocks with potentially heterogeneous frequency responses. The spectral variance decomposition (SVD) provides a compact and clear characterization of how structural shocks affect economic dynamics at different frequencies and allows a sharp test for competing theoretical models. Instead of looking at the overall error variation in one variable due to a structural shock as the classical forecast error variance decomposition (FEVD) does, we examine the share of variation in that variable due to a specific structural shock at specific frequencies of interest.

The SVD is particularly useful for analyzing the role of supply factors given that supply shocks have potentially long-lasting effects on the RER. Compared to the commonly used FEVD, the SVD reveals that productivity differences between countries indeed matter for the low frequency properties of the RER. The opposite holds for relative demand shocks, which matter mainly for high-frequency fluctuations. We argue that earlier studies tend to overlook this pattern as they focused on variance decompositions in the time-domain only. Furthermore, we propose a new measure for decomposing the structural sources of RER persistence based on a structural decomposition of the spectral density at frequency zero. This measure focuses solely on the variance at the lowest frequency. By contrast, earlier studies measure the structural sources of long-run dynamics with the FEVD at long forecast horizons (e.g., Alexius, 2005). Intuitively, the FEVD at long forecast horizons mixes variance from low frequencies and high frequencies.[2]

To distill the intuition of our empirical results, we begin by illustrating the difference between the SVD and the FEVD in a controlled environment, where the data generating process is known. In particular, we use both of these methods to analyze the RER dynamics in a standard two-country open economy DSGE model. The model features persistent and transitory shocks. First, we decompose the theoretical variance of the RER in the DSGE model on the time-domain and the frequency-domain. When interpreting the FEVD alone, one would substantially underestimate the role of supply, and in turn overestimate the role of demand. By contrast, the SVD precisely uncovers the true structural driving forces of the RER across all frequencies. Second, we confirm this finding with simulated data from the model, i.e., with short sample size and imperfect identification in an SVAR as carried out on real world data.

Next, we apply this idea to real data. We estimate a 4-variable SVAR model similar to that of Farrant and Peersman (2006). Our analysis looks at the US vis-à-vis an aggregate of industrialized countries with data from 1978Q1 to 2013Q4. Using sign restrictions, we identify a set of structural shocks typically used in the literature. Based on the FEVD, we find that productivity shocks account for 2 up to 20% of US real exchange rate volatility at different forecast horizons. Real demand shocks explain up to half of the RER variation in the short-run and around 20% in the long-run. Monetary policy shocks are relatively unimportant with roughly 10% across all forecast horizons. These results are largely in line with the findings from previous SVAR studies (e.g., Clarida and Galí, 1994; Farrant and Peersman, 2006; Juvenal, 2011). The SVD, on the other hand, suggests a larger role for the productivity shock and a weaker role for the real demand shock at low frequencies. The strong role of real demand is salient at business cycle frequencies. The SVD at frequency zero attributes up to half of RER persistence to the productivity shock, while only about 10% to the real demand shock.

Despite these successes, this baseline SVAR also predicts a very substantial role of the risk premium shock for the RER, even in the long-run and at low frequencies. We suspect that this rather counter-intuitive result may be due to an imperfect identification of structural shocks. As a result, we propose larger 5-variable SVAR models. In these models, we identify a second source of supply shock originating from the labor market. These settings are motivated among others by the theoretical arguments of Steinsson (2008) for a role of labor supply shocks for RER fluctuations. We propose two different identification strategies for labor supply shocks based on data on country differentials of hours worked and real wages. In these larger SVARs that control for the effects of labor supply, the SVD reveals an even stronger role for productivity and a reduced role of the risk premium shock at low frequencies. At frequency zero, productivity shocks can explain more than half of RER persistence, while demand and monetary policy shocks account for less than 10%. The risk premium shock accounts for at maximum 20%. An analysis of the variance of the forecast errors at a long forecast horizon clearly underestimates the importance of productivity shocks for the persistence of the RER. We interpret these findings as evidence in favor of an important role of productivity differences for shaping RERs, in particular at low frequencies.

The literature using frequency-domain tools is fast growing in economics and finance. First, our methodology echoes those studying economic dynamics on the frequency-domain. Rabanal and Rubio-Ramirez (2015) show that international

[1] This view has been shared by SVAR studies based on different identification schemes. See, e.g., Rogers (1999) and Artis and Ehrmann (2006) for an identification with short-run zero restrictions. These earlier SVAR analyses focus on the role of monetary policy as also discussed by Eichenbaum and Evans (1995) and Chadha and Prasad (1997).

[2] The FEVD at the infinite forecast horizon decomposes the unconditional variance of the series, i.e., the sum of the variances over all frequencies rather than the low frequencies only.