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Fluctuations in the foreign exchange market: How important are monetary policy shocks?

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ABSTRACT

We study the effects of U.S. monetary policy shocks on the bilateral exchange rate between the U.S. and each of the G7 countries. We also estimate deviations from uncovered interest rate parity conditional on these shocks. The analysis is based on a structural vector autoregression in which monetary policy shocks are identified through the conditional heteroscedasticity of the structural disturbances. Unlike earlier work in this area, our empirical methodology avoids making arbitrary assumptions about the relevant policy indicator or transmission mechanism in order to achieve identification. At the same time, it allows us to assess the implications of imposing invalid identifying restrictions. Our results indicate that the nominal exchange rate exhibits delayed overshooting in response to a monetary expansion, depreciating for roughly ten months before starting to appreciate. The shock also leads to large and persistent departures from uncovered interest rate parity. Variance-decomposition results indicate that monetary policy shocks account for a non-trivial proportion of exchange rate fluctuations.

1. Introduction

The traditional framework used to study exchange rate determination rests on the premises of short-run price stickiness and uncovered interest rate parity (UIP). As first established by Dornbusch (1976), these assumptions together imply that the nominal exchange rate must immediately overshoot its long-run level in response to a monetary policy shock. Following the seminal work of Obstfeld and Rogoff (1995), recent theoretical studies on exchange rate determination have sought to incorporate these features into fully optimizing, rational-expectation models. Despite being more sophisticated, however, these models preserve the essence of the Dornbusch model, continuing to emphasize the interaction of nominal rigidities and monetary policy shocks as the main mechanism driving exchange-rate fluctuations.

The purpose of this paper is to evaluate the empirical relevance of this view. More specifically, we estimate the effects of U.S. monetary policy shocks on the bilateral exchange rate between the U.S. and each of the remaining G7 countries. We also estimate deviations from UIP conditional on these shocks. Finally, we measure the importance of monetary policy shocks in accounting for the volatility of both variables.

Existing empirical studies using structural vector autoregressions (SVARs) have not reached a consensus regarding the direction and the magnitude of the effects of monetary policy shocks on exchange rates. Some studies find that the nominal exchange rate does not immediately overshoot its long-run level in response to a monetary policy shock. Instead, it exhibits a hump-shaped profile, reaching its maximal response several months after the shock; a pattern often referred to as delayed overshooting (e.g., Eichenbaum and Evans, 1995; Grilli and Roubini, 1995, 1996). Others, in contrast, find that the exchange rate overshooting is nearly immediate (e.g., Kim and Roubini, 2000; Kalyvitisa and Michaelides, 2001). Similarly, there is little agreement on the importance of monetary policy shocks in accounting for exchange-rate movements: estimates of the fraction of exchange rate variability that is attributed to monetary policy shocks range from roughly 10% (e.g., Scholl and Uhlig, 2008) to over 50% (e.g., Kim and Roubini, 2000).

In the same vein, although it is now well established that there are significant departures from UIP, which imply the existence of predictable excess returns on the foreign exchange market, there is little and mixed evidence on the extent to which these departures are due to unexpected changes in monetary policy. Deviations from UIP conditional on monetary policy shocks and the importance of these

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shocks in accounting for the variability of excess returns are found to be large in some studies (e.g., Eichenbaum and Evans, 1995; Faust and Rogers, 2003) but fairly small in others (e.g., Cushman and Zha, 1997).

To some extent, the discrepancy in results across these earlier studies is attributed to the method used to identify monetary policy shocks within SVARs. Although most of the existing studies measure monetary policy shocks with innovations to the short term interest rate, they differ in the restrictions imposed on the interactions between the variables included in the SVAR, which in turn determine the mechanism through which shocks propagate. Four types of restrictions can be found in the literature: recursive zero restrictions (e.g., Eichenbaum and Evans, 1995; Grilli and Roubini, 1995, 1996), non-recursive zero restrictions (e.g., Kim and Roubini, 2000), sign and shape restrictions (e.g., Faust and Rogers, 2003; Scholl and Uhlig, 2008), and long-run restrictions (e.g., Clarida and Gali, 1994; Rogers, 1999).[2]

What these different types of restrictions have in common is that they are arbitrary in nature. Faust and Rogers (2003) further argue that some of the commonly used zero restrictions are highly stylized and, therefore, unlikely to provide a plausible description of the transmission channels of monetary policy shocks. Based on an empirical exercise in which they eliminate all dubious identifying assumptions, they conclude that the peak response of the nominal exchange rate to a monetary policy shock may be delayed or nearly immediate, and that monetary policy may or may not be important in accounting for exchange-rate fluctuations. While this study provides useful insights into the consequences of imposing dubious identifying assumptions, it does not resolve the uncertainty surrounding the effects of monetary policy shocks on foreign exchange variables. Scholl and Uhlig (2008) attribute this inconclusiveness to the fact that the restrictions imposed by Faust and Rogers (2003) are too weak to narrow down the range of plausible monetary policy shocks. Put differently, these restrictions lead to under-identified SVARs, so that monetary policy shocks are not uniquely determined. This in turn implies that the underlying restrictions are not testable.

This paper is in the spirit of the work of Faust and Rogers, but differs from it in several important respects. It estimates a flexible SVAR where monetary policy shocks are identified by exploiting the conditional heteroscedasticity of the structural innovations, a procedure that has recently been proposed by Normandin and Phaneuf (2004). Unlike the identification procedures used in earlier studies, which impose conditional homoscedasticity of the innovations, this data-based approach does not rely on any arbitrary assumption about the relevant indicator or transmission mechanism of monetary policy. It is therefore a judgement-free approach which, in addition, allows one to formally test the commonly used restrictions. Intuitively, identification through heteroscedasticity exploits changes in the volatility of the structural shocks to extract additional information that allows to identify more parameters (relative to the homoscedastic case) of the matrix of contemporaneous interaction between variables.

Our results indicate that following an unanticipated monetary expansion, the nominal exchange rate exhibits delayed but rapid overshooting, reaching its maximal depreciation between 8 and 11 months after the shock. The monetary policy shock also triggers significant and persistent departures from UIP. Interestingly, our approach generates empirically plausible results for all the variables included in the SVAR without having to impose arbitrary restrictions on their dynamic responses. Variance-decomposition results reveal that monetary policy shocks are relatively important in explaining the variability of the nominal exchange rate, with a contribution that exceeds 30% at the 36-month horizon in some cases. In contrast, there is no clear evidence that the empirical failure of UIP is mainly driven by monetary disturbances, at least at short horizons. Compared with the results reported by Faust and Rogers, our findings provide more conclusive evidence on the effects of monetary policy shocks. This is mainly because our identification procedure tightly identifies these shocks.

We also find that imposing the commonly used identifying restrictions may yield misleading impulse–response and variance-decomposition results. In particular, when monetary policy shocks are identified with orthogonalized innovations to the federal funds rate, as is frequently assumed, the dynamic response of the nominal exchange rate to a monetary policy shock is counterfactually small and lacks the delayed overshooting pattern. The restrictions associated with the federal funds rate also result in a severe understatement of the importance of monetary policy shocks in accounting for the variability of the nominal exchange rate. Likewise, the sign-restriction approach advocated by Scholl and Uhlig (2008) underestimates the magnitude of the exchange rate response and overestimates the contribution of monetary policy shocks to the variability of excess return.

The rest of the paper is organized as follows. Section 2 describes the empirical methodology. Section 3 performs a preliminary analysis of the data. Section 4 discusses the estimated effects of monetary policy shocks on the nominal exchange rate and on deviations from UIP. Section 5 performs a robustness analysis. Section 6 concludes.

2. Empirical methodology

2.1. Specification

The SVAR system (in innovation form) is:

$$A\nu_t = \epsilon_t, \tag{1}$$

where ν_t are the statistical innovations, ϵ_t are the structural innovations, and A captures the interactions between current statistical innovations. The SVAR includes variables that belong to the goods market, reserve market, and foreign exchange market. The goods variables are U.S. total output, y_t, the U.S. price index, p_t, and the world commodity-price index, cp_t. The reserve variables are the U.S. non-borrowed reserves, nbr_t, total reserves, tr_t, and the federal funds rate, ff_t. The foreign exchange variables are the differential between the foreign and U.S. nominal short-term interest rates, dr_t, and the nominal exchange rate measuring the number of U.S. dollars needed to buy 1 unit of foreign currency, e_t.[3]

Following Bernanke and Mihov (1998), the market for U.S. bank reserves is further developed via the simple formulation:

$$\nu_{nbr,t} = \phi_d\sigma_d\epsilon_{d,t} - \phi_b\sigma_b\epsilon_{b,t} + \sigma_s\epsilon_{s,t}, \tag{2}$$

$$\nu_{tr,t} = -\alpha\nu_{ff,t} + \sigma_d\epsilon_{d,t}, \tag{3}$$

$$\nu_{tr,t} - \nu_{nbr,t} = \beta\nu_{ff,t} - \sigma_b\epsilon_{b,t}, \tag{4}$$

where $\epsilon_{s,t}$ is a shock representing an exogenous policy action taken by the Fed, or monetary policy shock, while $\epsilon_{d,t}$ and $\epsilon_{b,t}$ denote respectively the shocks of demand for total reserves and for borrowed reserves by commercial banks. The parameters σ_s, σ_d, and σ_b are the standard deviations scaling the structural innovations of interest, while ϕ_d and ϕ_b are unrestricted parameters, and α and β are positive parameters. Eq. (2) describes the procedures that may be used by the Fed to select its monetary policy instruments. Eq. (3) represents the banks' demand for total reserves in innovation form. Eq. (4) is the banks' demand for borrowed reserves in innovation form, under the assumption of a zero discount-rate innovation.

[2] Studies based on long-run restrictions have mostly focused on the real rather than the nominal exchange rate.

[3] The choice of these variables is further discussed in Section 2.3.