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# Some empirical evidence on the effects of U.S. monetary policy shocks on cross exchange rates

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ABSTRACT

This paper examines the impact of U.S. monetary policy shocks on the cross exchange rates of sterling, yen and mark. The main finding of the paper is a 'delayed overshooting' pattern for all currency cross rates examined (sterling/yen, yen/mark and mark/sterling) following an unexpected U.S. monetary policy change, which in turn generates excess returns. We also provide evidence that the 'delayed overshooting' pattern in cross exchange rates is accompanied by asymmetric interventions by central banks in the foreign exchange markets under consideration triggered by a U.S. monetary policy shock.


## 1. Introduction

Following the classic Dornbusch (1976) 'overshooting' model on the impact of monetary policy on exchange rates and interest rates in the presence of price stickiness, a large empirical literature has focused on the assessment of these effects.[1] The standard theoretical framework predicts that a monetary tightening leads to an immediate exchange rate 'overshooting'. Several empirical papers have focused on the impact of U.S. monetary policy on interest rates and exchange rates vis-à-vis the U.S. dollar, and have established that the peak timing of this response occurs one to three years after rather than immediately ('delayed overshooting'). This accumulated evidence creates in turn a 'conditional forward premium puzzle' with opportunities for excess returns by borrowing abroad and investing in the U.S. Although the standard 'forward premium puzzle' is well documented in empirical studies of the foreign exchange market (Froot & Thaler, 1990; Hodrick, 1987), the puzzle now arises *conditional* on an exogenous change in U.S. monetary policy.

In particular, Eichenbaum and Evans (1995) have shown that, in response to a tighter U.S. monetary policy, the dollar exhibits a 'delayed overshooting' behaviour of two to three years vis-à-vis the major currencies, a pattern that is confirmed by Clarida and Gali (1994). 'Delayed overshooting' is also assessed by Evans (1994), who uses weekly data and finds that the dollar overshoots with a delay of two to three years vis-à-vis the mark and the yen, and Lewis (1995), who finds that the dollar appreciates against the mark and the yen for the first five months after the monetary policy shock. Eichenbaum and Evans (1995) also offer empirical evidence that after a contractionary U.S. monetary policy shock, domestic interest rates rise relative to foreign interest rates and the dollar appreciates. Kalyvitis and Michaelides (2001) adopt a specification with relative output and prices in order to capture the relative business cycle position of the U.S. and the domestic country; this approach solves the 'delayed overshooting' effect, but the authors report persistent deviations from the uncovered interest rate parity hypothesis.

The 'delayed overshooting' and the 'conditional forward premium puzzle' are specific examples of how economies might be influenced by monetary policy abroad. However, the size of these impacts is likely to vary between countries due, for instance, to discrepancies in the structural characteristics of the economy, differences in nominal rigidities and/or asymmetries in the monetary policy functions of foreign countries driven by differential responses to deviations of inflation or output from the respective targets. A challenging empirical issue is therefore the potential *asymmetry* of 'delayed overshooting' between cross exchange rates, i.e. whether the magnitude of, say, the dollar appreciation against

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[1] See Christiano, Eichenbaum, and Evans (1999) for an extensive survey of the relevant studies.

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major currencies following a U.S. monetary policy tightening differs. This question was originally posed by Frankel (1986), but has only recently received some attention in the study by Lobo, Darrat, and Ramchander (2006) who examine the impact of changes in the Federal Funds Rate (*FFR*) target on daily dollar exchange rates and find that surprises associated with monetary contraction have a larger effect compared to monetary easing for the sterling, mark and Canadian dollar rates, whereas the opposite holds for the yen.

Taking 'delayed overshooting' as a stylized fact, in this paper we first attempt to investigate how and to what extent cross exchange rates of major currencies (sterling, Japanese yen and German mark) respond to U.S. monetary policy shocks. In this vein, we define 'delayed overshooting' as a change in the three cross exchange rates examined, which is triggered by a contractionary U.S. monetary policy shock, and gradually continues for some months or quarters after the shock. We also assess the response of interest rate differentials between the three countries (UK, Japan and Germany) and the existence of excess returns in these economies. To this end, we use the Structural Vector Autoregression (SVAR) approach that has been routinely used in the recent literature, in which we proxy U.S. monetary policy changes by the Romer and Romer (2004) narrative index (*RR*). This measure of U.S. monetary policy is better equipped to overcome the endogeneity and anticipatory biases that are inherent in other standard indices, such as the *FFR* or the non-borrowed reserves ratio.

We find a 'delayed overshooting' pattern for all the currency cross rates examined (sterling/yen, yen/mark and mark/sterling) when the Federal Reserve tightens U.S. monetary policy. Specifically, the mark appreciates with a delay relative to the yen with a peak at around ten months following the U.S. monetary policy shock, whereas the mark appreciates against the sterling, and the sterling against the yen with a peak at around six months after the shock. We find that the responses of exchange rates and interest rates following the U.S. monetary policy tightening leave room for excess returns in the three foreign exchange markets under consideration.

Next, we take our analysis one step further by attempting to explore whether the driving force of 'delayed overshooting' in the cross exchange rates has been *asymmetric* foreign exchange interventions by central banks (that is, interventions following a specific foreign monetary policy shock, which differ in size and/or direction). Our investigation is motivated by several studies that have investigated the repercussions of foreign exchange intervention on the exchange rate following a monetary policy shock. Lewis (1995) has reported that central banks intervene to support a monetary policy that is consistent with their exchange rate targets, as monetary policy changes driven by domestic targets may trigger counter-movements in the exchange rate. Bonser-Neal, Roley, and Sellon (1998) have claimed that interventions may at times react to past monetary policy actions, e.g. if U.S. monetary authorities wished to keep the exchange rate path within a particular zone. They find that not only various policies were evident at different periods, but also that the exchange rate responses to *FFR* changes are unaffected when one controls for central bank foreign exchange intervention. Kim (2003, 2005) has examined the joint effects of monetary policy and foreign exchange intervention on the U.S.–Canada exchange rate and has found evidence that 'delayed overshooting' can be explained by interventions in the foreign exchange market intended to weaken the exchange rate appreciation following a monetary policy tightening.

Given these points, we use recently published foreign exchange intervention data to assess the potential impact of central bank intervention in the foreign exchange markets under consideration following a U.S. monetary policy shock. Our evidence shows that the 'delayed overshooting' pattern in cross exchange rates is accompanied by asymmetric foreign exchange interventions. The evidence points towards a 'leaning-with-the-wind' intervention policy by the Japanese monetary authorities, a finding that is in accordance with an effort to drive the yen to its new equilibrium against the dollar following a U.S. monetary policy tightening. In contrast, we find evidence of a 'leaning-against-the-wind' intervention by the German monetary authorities, which is consistent with a strengthening of the mark against the dollar following a U.S. monetary policy shock.

The paper makes two contributions in the relevant literature. First, the 'delayed overshooting' pattern of cross exchange rates has, to our knowledge, been unnoticed in existing empirical studies on the monetary policy transmission mechanism. Given the robustness of our empirical results, this pattern is likely to have comprised a substantial factor of exchange rate variability in the floating rate era. Second, the paper points out a source of exchange rate variability triggered by asymmetric central bank interventions, which offers a route for further explorations of the role of central banks in excess exchange rate movements, a role that is now conditional on an external monetary policy shock.

The rest of the paper is structured as follows. Section 2 outlines the empirical methodology and the data utilized. Section 3 assesses the impact of the monetary policy shocks using a SVAR model, while Section 4 develops robustness analysis. Section 5 explores the role of foreign exchange interventions. Finally, Section 6 concludes the paper.

## 2. Methodology and data

### 2.1. Empirical specification

The empirical studies on 'delayed overshooting' are largely based on VAR models with U.S. monetary policy typically being identified by exogenous shocks in the *FFR*, the ratio of non-borrowed to total reserves or the target *FFR*. In their extensive study on the empirical effects of U.S. monetary policy on dollar exchange rates, Eichenbaum and Evans (1995) estimated VAR models for the U.S. and the other G7 economies, including U.S. and foreign output, prices, interest rates, U.S. non-borrowed reserves, the *FFR* and the nominal U.S. dollar exchange rate vis-à-vis the foreign currencies, and assuming a recursive VAR structure in which the monetary policy shock is identified as an orthogonal innovation to the *FFR* or non-borrowed reserves.[2]

Subsequent empirical studies on the impact of monetary policy on asset prices have mostly involved VARs with identification imposed as restrictions mapping the reduced-form shocks to structural shocks. Cushman and Zha (1997) constructed a two-country SVAR model assuming block exogeneity for the domestic variables of a small open economy (Canada) relative to the external (U.S.) variables. Their specification resolves some standard empirical puzzles, like the domestic currency depreciation following a domestic monetary policy contraction and the 'price puzzle',

[2] Bonser-Neal, Roley, and Sellon (1998) use the *FFR* target as a monetary policy indicator and find that the dollar overshoots immediately after the shock, thus exhibiting the classic Dornbusch (1976) 'overshooting' pattern. These authors claim that due to large deviations of the actual *FFR* (used in previous studies) from the *FFR* target, the latter should be considered as a better proxy for the true monetary policy measure. Bonser-Neal et al. (1998) also criticize the use of VARs for inaccurately measuring monetary policy effects due to problems related to the limitation of the information set. They claim that monetary policy may be inadequately represented when measured by shocks in the *FFR* within a VAR context; see also Rudebusch (1998). Another main category of U.S. monetary policy measures is known as the 'narrative approach' (Romer & Romer, 1989). Eichenbaum and Evans (1995) find that the 'delayed overshooting' pattern also arises when the dates identified by Romer and Romer (1989) are used to identify U.S. monetary policy contractions.