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Taylor rules with real-time data: A tale of two countries and one exchange rate ☆

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ABSTRACT

Using real-time data that reflects information available to monetary authorities at the time they are formulating policy, we find that estimated Taylor rules based on revised and real-time data differ more for Germany than for the U.S., Taylor rules using real-time data suggest differences between U.S. and German monetary policies, and Taylor rules for the U.S. using inflation forecasts are nearly identical to those using lagged inflation rates. Evidence of out-of-sample predictability for the dollar/mark nominal exchange rate with forecasts based on Taylor rule fundamentals is only found with real-time data and does not increase if inflation forecasts are used.

1. Introduction

Taylor's (1993) paper, "Discretion versus Policy Rules in Practice," has inspired voluminous empirical research on interest rate reaction functions using a variety of specifications. The simplest monetary policy rule states that the central bank adjusts its short-term nominal interest rate in response to changes in inflation and the output gap.[1] Subsequently, policy rules that incorporate inertia and relate the interest rate to expectations of inflation, the output gap, and output gap growth have been found to be more successful than Taylor's original specification.[2] Although these rules are modifications of the original specification, referring to them as Taylor rules has become standard in the literature.

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[1] This form of the Taylor rule naturally arises under the assumption that the Federal Reserve minimized the intertemporal loss function consisting of the loss due to deviation of (expected) inflation from its target and the output gap (see, for example, Woodford, 2001).

[2] Orphanides (2008) provides a recent survey of various types of Taylor rules.

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The first papers to estimate Taylor rules, such as Clarida et al. (1998), (CGG), fit specifications to the longest available span of historical data. However, as argued by Orphanides (2001), revised data does not reflect the information available to monetary authorities and is therefore a poor guide to understanding their behavior. He finds that U.S. monetary policy is less accommodative to inflation when Taylor rules are estimated using real-time data rather than revised data. The logic that monetary policy evaluation should be conducted by using only information available to policymakers at the time they are formulating policy seems compelling and recent papers, such as Rudebusch (2006), tend to use real-time data. Interest rate reaction functions using real-time data have also been estimated by Nelson (2003) for the UK and Clausen and Meier (2005) and Gerberding et al. (2005) (GWS) for Germany.

While data revisions for inflation and the output gap both create differences between the data available to researchers and the data available to policymakers, the differences are more substantial for the latter. For inflation, the differences are only caused by definitional changes and the data revisions themselves. For the output gap, the differences are also caused by changes to potential output. While the extent to which revisions in output and inflation are forecastable and might be used by policymakers is arguable, revisions in potential output can change perceptions of historical output gaps many years after the fact. Another distinction involves real-time data that, while not available to the public, is available to policymakers. This data, including Greenbook forecasts of inflation and internal Federal Reserve estimates of the output gap and forecasts of output gap growth, has been extensively used by Orphanides (2001, 2003, 2004) to estimate Taylor rules that incorporate the information available to the FOMC at the time of monetary policy decisions.

Taylor rules also provide a framework for modeling exchange rate determination. By specifying Taylor rules for two countries and subtracting one from the other, an equation is derived with the interest rate differential on the left-hand side and the inflation and output gap differentials on the right-hand side. By using uncovered interest rate parity (UIRP), where the interest rate differential equals the expected rate of depreciation, and solving expectations forward, an exchange rate equation is derived. Engel and West (2006) and Mark (2007) have examined the empirical performance of Taylor rule-based exchange rate models.

The Taylor rule-based exchange rate model can also be evaluated out-of-sample. If the UIRP assumption is maintained, an exchange rate forecasting equation can be derived because an increase in either the inflation or the output gap differential would lead to an expected depreciation of the currency. An extensive literature, however, has shown that regressing exchange rate changes on interest rate differentials not only does not produce coefficients equal to one, it often produces negative coefficients. This is consistent with the recent "carry trade" literature, where countries with high interest rates appear to have appreciating currencies. In addition, as argued by Clarida and Waldman (2008), if an unexpected increase of the inflation rate above its target creates the expectation that the central bank will respond by raising the interest rate, the exchange rate will appreciate, rather than depreciate, in response to the news. We therefore use Taylor rule fundamentals to forecast exchange rate changes, but remain agnostic regarding the direction of the forecasts.

Since the seminal work of Meese and Rogoff (1983), it has proven very difficult for models to forecast exchange rates better than a naïve no-change (random walk) model. Cheung et al. (2005), for example, conclude that no model does statistically better than the random walk. Virtually all existent literature on exchange rate predictability has used fully revised data to assess the out-of-sample performance of empirical exchange rate models. Although the argument for using real-time data seems at least as compelling for exchange rate forecasting as for Taylor rule modeling, the only paper, to our knowledge, that uses real-time data to evaluate nominal exchange rate predictability is Faust et al. (2003). They examine the predictive ability of Mark's (1995) monetary model using real-time data for Japan, Germany, Switzerland and Canada vis-à-vis the U.S. dollar and conclude that, while the models consistently perform better using real-time data than fully revised data, they do not perform better than the random walk model.

One potential reason for the failure of empirical exchange rate models to forecast better than a random walk out-of-sample is that the tests commonly used to compare predictive ability, those of Diebold and Mariano (1995) and West (1996) are, as demonstrated by Clark and McCracken (2001), severely undersized when used with nested models. Molodtsova and Papell (2008), exploiting recent econometric work by Clark and West (2006), test the out-of-sample predictability of nominal exchange rate changes using Taylor rule fundamentals model for 12 countries from 1973 to 2006. While real-time data is not available during the post-Bretton Woods period for most of the countries, they construct output gaps as deviations from "quasi-revised" trends in potential output, where the trends, while incorporating data revisions, are updated each period so as not to incorporate ex post data. Although they find strong evidence of short-run predictability with quasi-revised data for most of the considered currencies using Taylor rule fundamentals, they do not produce forecasts with real-time data.[3]

The objective of this paper is to estimate Taylor rule interest rate reaction functions with real-time data for the United States and Germany from 1979, the beginning of the European Monetary System, through 1998, the advent of the Euro, and to use these specifications as fundamentals for evaluating out-of-sample predictability of the United States dollar/deutsche mark (USD/DM) nominal exchange rate. This paper is, to our knowledge, the first to combine out-of-sample exchange rate predictability, Taylor rule fundamentals, and real-time data. The reasons for the choice of countries and exchange rate are

[3] Engel et al. (2007) use a more constrained version of the Molodtsova and Papell (2008) specification with fully revised data. They find less evidence of short-horizon predictability, but more evidence of long-horizon predictability, than Molodtsova and Papell.