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Comment on "Taylor Rule Exchange Rate Forecasting During the Financial Crisis" *

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Abstract

In this note we discuss the paper on exchange rate forecasting by Molodtsova and Papell (2012). In particular we discuss issues related to forecast origins and forecast horizons when higher frequency exchange rate movements are predicted using lower frequency quarterly macroaggregates.

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1 Introduction

This paper makes me think of academic seminars. Not in the content per se or even it's presentation but rather in how I personally know when I think a seminar is "good" or "bad." Since there exists no such thing as a perfect paper my definition of a good or bad seminar does not reflect whether the paper is perfect. For me, a good seminar is one where I like the paper enough to be willing to engage in an active discussion even if that means pointing out aspects of the paper I disagree with. In contrast a bad seminar is one associated with a paper that is so bad that I don't want to ask questions because that only prevents me from getting out of the seminar as soon as possible.

This is a good paper. It has a question that I find intriguing and addresses the question in a reasonable fashion. And yet it is not perfect and there are many issues that can be criticized. These include focusing only on one quarter ahead forecasts, using rolling windows to estimate parameters despite very small sample sizes, the potential for data snooping over the many models and periods considered, using somewhat quirky and oddly timed OECD data, etc.

Rather than spend time working my way through a list of referee-style suggestions that might improve the paper, in the remainder I'll focus on what I think is a deeper issue in this paper and more generally the literature on very standard empirical macroeconomic models of exchange rates. In particular I discuss some very pragmatic forecasting issues involving forecast origins and the relevant forecast horizons.

2 Forecast origins and horizons

As someone who works at a central bank I tend to think of forecasting in the context of (a) FOMC dates and (b) macroeconomic aggregates. The former implies a very specific set of forecast origins – dates on which a forecast must be produced. The latter implies a very specific set of forecast horizons – the difference between the FOMC date and the dates on which the macroeconomic variables is published by the BEA (e.g. GDP), the BLS (e.g. the unemployment rate), or even the Federal Reserve System (e.g. industrial production). Both are very convenient because they define the collection of data available at any given FOMC meeting (anything observed before that date) and it defines how far into the future we have to forecast (the day in which the data is released). In the notation of a forecasting model this tells me when my forecast origin t is and how far ahead into the future h my forecast horizon is. In contrast, in this paper these quantities are not very clearly motivated and hence the remainder of my discussion will focus on how that affects how we should view their results on the predictive content of macroeconomic models of exchange rate predictability.

In this paper the authors consider a very standard forecasting exercise in which they investigate the predictability of bilateral U.S.$–Euro exchange rate movements. To do so they consider a very standard collection of empirical models including the Monetary, Purchasing Power Parity, and Interest rate differentials models as well as variants of a Taylor-rule based model developed in earlier work by Moltsdovoya and Papell (2009). Each of these models implies a set of predictors x that are observed at a quarterly frequency. In addition, following the literature the y variable being predicted is measured as the log-difference of the exchange rate observed on the last business day of each quarter. For example this implies that $y_{2012:Q1}$ equals the natural log of the exchange rate measured on March 31, 2012 minus the same measured on December 31, 2011. In each case the predictive model is an OLS estimated linear regression of the form

$$y_{t+1} = x_t'\beta + u_{t+1}$$

in which measurements of macroeconomic aggregates obtained prior to the current quarter are used to predict the current quarter log-difference in the exchange rate.

While standard, this modeling procedure is not obvious for someone who works in a very structured forecasting environment such as a central bank. For example, suppose that I observe my quarterly frequency x_t value on December 31, 2011. Why is it that we forecast exchange rate movements at the one quarter horizon and not, say, at the one month horizon? In this framework we would define y_{t+1} as the log-difference in the exchange rate over the first month of quarter $t+1$ and hence $y_{2012:Q1}$ equals the natural log of the exchange rate measured on January 31, 2012 minus the same measured on December 31, 2011? The $-Euro exchange rate varies not only across the quarter but also does so monthly, weekly, daily, and even intra-daily. That's not to say that the one quarter horizon isn't potentially interesting but rather there is nothing about the exchange rate market that implies that a one quarter ahead horizon is a natural forecast horizon given an information set of data available through the end of the previous quarter. It is perfectly possible that a quarterly frequency predictor x_t would be useful for forecasting soon after it's release date (a day, a week, or even a month) and yet at a one quarter ahead horizon a naive random walk forecast dominates. My fear is that the one quarter ahead horizon is chosen by default simply because the $x-$variable is observed at a quarterly frequency.

In the above example I assumed that my quarterly frequency predictor x_t was observed on the last day of the previous quarter, say December 31, 2011. If I am using it as a predictor of current quarter exchange rate movements, the earliest possible forecast origin is clearly December 31, 2011. But what if I am asked to provide a forecast of *future* current quarter exchange rate movements at an FOMC meeting dated January 31, 2012? I could still use it as a predictor but I would want to redefine my y-variable. For example, suppose I define $y_{t+1} = y_{2012:Q1}$ as the natural log of the exchange rate measured on March 31, 2012 minus the same measured on January 31, 2012. There is nothing stopping me from using the same regression framework from above to construct a forecast. In this hypothetical world since x_t is defined on the last day of the previous quarter I could conduct this type of exercise for y-variables defined over any subperiod of quarter t.

In Figure 1 we consider such an exercise for four distinct definitions of y_{t+1} when the Taylor rule fundamentals model uses the output gap for prediction.[1] When defined relative to $t+1$ =2012Q1, these take the values of the difference in the log-exchange rate between (a) March 31, 2012 and December 31, 2011 (the definition of y_{t+1} considered in the paper and elsewhere in the literature), (b) January 31, 2012 and December 31, 2011, (c) February 28, 2012 and January 31, 2012, and (d) March 31, 2012 and February 28, 2012. The figure consists of 4 lines. When $y_{t+1} = e_{t+1} - e_t$, the line corresponds to the MSPE ratio path from Table 1 panel A of the paper (case (a) above). The other lines are the MSPE ratio paths when the forecast origin and horizon are defined relative to cases (b), (c), and (d) above.

We immediately find there is considerable heterogeneity in the predictive content of this model across the quarter. Over the first month of the quarter (so that $y_{t+1} \equiv e_{t+1/3} - e_t$) the model predicts quite poorly relative to the random walk benchmark with MSPE ratios near 1.2. Over the second month of the quarter ($y_{t+1} \equiv e_{t+2/3} - e_{t+1/3}$) the model does a bit better with ratios near 1.1 but is still worse than the random walk model. Somewhat surprisingly the model consistently outperforms the random walk model during the last month of the quarter ($y_{t+1} \equiv e_{t+13} - e_{t+2/3}$) with MSPE ratios generally below one with values ranging from 0.95 to 0.9. Integrating across these three lines we obtain the line that

[1] The data was kindly provided by the authors.

matches the numbers from Table 1 panel A ($y_{t+1} \equiv e_{t+1} - e_t$).

The MSPE ratio paths lead to a somewhat odd conclusion: the model performs better, relative to the random walk model, the closer we get to the end of the quarter. This is despite the fact that the information content in the predictors is increasingly stale as we move from a forecast origin of the last day of the previous quarter to a forecast origin of the last day of the second month of the current quarter. If we take a deeper look at the raw MSPEs from the random walk and Taylor rule models (not shown) we find that both models contribute to this result: the random walk MSPE path associated with the first month of the quarter tends to be a bit lower than that from the third month of the quarter while the Taylor rule model MSPE path associated with the first month of the quarter tends to be a bit higher than that from the third month of the quarter. Whether or not these paths are statistically distinct from one another is beyond the scope of the discussion but the differences are interesting nevertheless.

One potential explanation might arise from the derivation of the Taylor rule based models and in particular the timing of information flows within these models. As described in section 2.1, equation (1) of the text, the basic building block of this model is an equation of the form[2]

$$i_t = \pi_t + \phi(\pi_t - \bar{\pi}) + \gamma g_t + R \tag{1}$$

where i_t is the target for the short-term nominal interest rate, π_t is the inflation rate, $\bar{\pi}$ is the target level of inflation, g_t is a measure of the output gap (or more generally some measure of economic slack in the economy), and R is the equilibrium level of the real interest rate. The equilibrium concepts $\bar{\pi}$ and R are known constants chosen by the relevant monetary authority. Moreover, the preference parameters ϕ and γ are also known to the monetary authority. The basic premise of this rule is that it provides a description of what the monetary authority should do when selecting the target for the short-term nominal interest rate i at time t based on the levels of π and g observed at time t.

With this in mind consider the logic followed in developing the Taylor rule-based predictive model for exchange rates. First we take the time t difference between the Taylor rule associated with the FOMC and that for the Governing Council of the ECB (GC hereafter) as the authors do for equation (4) of the text

$$i_t - i_t^* = \alpha + \lambda(\pi_t - \pi_t^*) + \gamma(g_t - g_t^*) \tag{4}$$

[2] In the following I use g to denote an output gap rather than y as is done in the text. I do so to distinguish it from the generic use of y as a dependent variable.

where asterisks denote observables for the Euro Area and the lack thereof denotes an observable for the U.S. In addition we maintain that the policy parameters ϕ and γ are common across the FOMC and GC and hence $\lambda = 1 + \phi$ while we aggregate R, R^*, $\bar{\pi}$, $\bar{\pi}^*$, and ϕ into the constant term α. From here, with a bit of handwaving that links interest rate differentials to exchange rate movements the authors obtain the predictive equation

$$\Delta e_{t+1} = \omega - \omega_\pi(\pi_t - \pi_t^*) - \omega_y(g_t - g_t^*) + \eta_{t+1}. \tag{5}$$

In the paper, t is linked one-to-one with quarters as defined by a calendar year where, as an example, January, February, and March together define the first quarter of a year. This is not entirely unreasonable and is the procedure followed throughout much of the literature including Mark (1995), Cheung, Chinn, and Pascual (2002), and Engel, Mark, and West (2008) in the context of other, non-Taylor rule-based, quarterly frequency macroeconomic models of exchange rate determination. Moreover, with t defined relative to a sequence of quarters within a calendar year, setting h equal to 1 is not an unreasonable choice.

And yet given the description of the Taylor rule from above, it's not clear that is the correct way to view t. Recall that i is *defined as the target* for the short-term nominal interest rate. This rate typically only changes when the FOMC or the GC has it's regularly scheduled meetings: 8 times a year for the FOMC (twice per quarter; approximately the 3rd and 9th week of each quarter) and 12 times a year for the GC (once per month and typically in the first two weeks of the month)[3]. This implies that irrelevant of the terms on the right hand-side of (4), the left hand-side will literally only change if either the FOMC or the GC changes it's respective policy rate. Put differently, equation (4) implies that t is not so much indexed to calendar time as indexed to scheduled meetings of the FOMC or the GC.

That is not to say that the right hand-side terms in (4) are irrelevant for exchange rate movements. Quite the contrary, these are very much the types of data the FOMC and GC looks at when making decisions about the short term policy rate. The problem is that by transitioning from equation (4) to equation (5) you're changing a time index that is primarily associated with the timing of FMOC and GC meetings to one that is interpreted as being associated with (end of quarter) quarterly calendar dates.

To see how this might affect the intra-quarter predictability of the Taylor rule based

[3] The ECB Governing Council meets more like twice per month for a total of 24 times per year. However, the first meeting of the month is the one associated with decisions on the policy stance of the ECB.

model consider the following approximate time line of FOMC and GC meetings for the first quarter of 2012: Jan. 12*, Jan. 25, Feb. 9*, March 8*, and March 13 where I've let an asterisk denote a GC meeting and the absence of an asterisk denotes an FOMC meeting. If the Taylor rule-based predictive model is taken literally, exchange rate movements in 2012Q1 due to changes in policy rates $i_t - i_t^*$ can only occur on or after these dates. These policy rates in turn will have changed only if the inflation rate or the output gap changed since the previous meeting. Since US RGDP for 2011Q4 was released on January 28th, 2012, Euro Area RGDP for 2011Q4 was released on February 15th, 2012, and the next GC and FOMC meetings don't occur until March, the only month within 2012Q1 that the output gap component of the Taylor rule will be able to affect exchange rate movements is March - the third month of the quarter, in accordance with the MSPE ratio paths from Figure 1.

3 Conclusion

As I said in the introduction, I like this paper and alot can be learned from it. Perhaps my favorite part is simply that the authors took the time to gather vintage data in order to conduct their forecasting exercises in something akin to a real time environment - the kind of environment policy makers would have faced throughout the past decade and particularly during the Great Recession. Even so, there are many unanswered questions associated with the paper. And as I made clear in my discussion, the aspect of the paper that confuses me the most is the simple definition of the forecast origins and horizons implied by these quarterly frequency macroeconomic models of exchange rate predictability. And again, to be fair, this concern is not uniquely tied to this paper but it is exacerbated by the focus this paper puts on Taylor rule-based models of exchange rate predictability – models which center around changes in the short term policy rates *set* by both the FOMC and Governing Council of the ECB .

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Figure 1: MSPE Ratios
Taylor Rule Fundamentals Model with Output Gap