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THE FRAGILITY OF OVERSHOOTING

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Using VAR, a large literature claims to find evidence of some form of Dornbusch overshooting. But the evidence is fragile in the sense of Leamer. The literature uses the wrong test for overshooting, unusually narrow confidence intervals and questionable shocks. In addition, it is difficult to reconcile overshooting with the fact that daily and weekly exchange rates are approximately martingales.

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A large and growing literature uses responses derived from vector autoregression (VAR) to investigate how exchange rates respond to monetary shocks. All but one article claims to find evidence of overshooting. Some claim to find evidence of Dornbusch overshooting, but most claim to find evidence of a delayed version of Dornbusch overshooting.

But, as shown below, the evidence for some form of Dornbusch overshooting is fragile in the sense of Leamer (1983).[1]

> ….an inference is not believable if it is fragile, if it can be reversed by minor changes in assumptions. As consumers of research, we correctly reserve judgment on an inference until it stands up to a study of fragility, usually by other researchers advocating opposite opinions.

While the evidence for some form of Dornbusch overshooting is fragile, there is very robust evidence that is difficult to reconcile with overshooting. As is well known, with flexible rates, daily exchange rates are approximately martingales. Those martingales imply that daily changes in exchange rates are approximately white noise. White noise implies that the long-run, intermediate run and short-run fluctuations in daily exchange rates all contribute the same amount to the volatility of exchange rates. Such white noise appears inconsistent with the claim that overshooting explains both a statistically and economically significant part of the volatility of exchange rates.

Section 1 briefly reviews the literature on martingales. Section 2 distinguishes between generic overshooting and some form of Dornbusch overshooting. Section 3 discusses the difference between impulse and step responses. Section 4 uses Sections 2 and 3 as the basis for a critical review of the overshooting literature. Section 5 presents my summary and conclusions.

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[1] Faust and Rogers (2003) examines the robustness of estimates of the maximum overshoot, but it concentrates on the timing of the overshoot. Faust and Rogers does not directly challenge overshooting.

1.0 Martingales

The long-run model in Dornbusch (1976) where income can change does not imply overshooting. Whether or not there is overshooting in that model depends on certain parameter values. It is the short-run model where income is constant that implies overshooting. Such a short-run model suggests that daily or weekly data would be more appropriate for evaluating overshooting than the monthly or quarterly data used in the overshooting literature.

The reason for using monthly or quarterly data is a practical one. The data used to test for the conditional effect of monetary shocks is not always available on a daily or even weekly basis. But using monthly or quarterly data means that the research could completely miss overshooting if its effects disappeared within a month. On the other hand, if overshooting has both a significant statistical and a significant economic effect on exchange rates in the short run, then we should see some evidence of that effect in daily exchange rates.

Table 1
The Behavior of Spot Exchange Rates*

Citation	Currencies*	Interval	
Hsieh (1988)	C$ DM JY SF £	1974:01-1983:12	Daily
Hsieh (1989)	C$ DM JY SF £	1974:01-1983:12	Daily
Fong & Ouliares (1995)	C$ DM FF JY £	1974:08-1989:03	Wednesdays
Kuan & Liu (1995)	C$ DM JY SF £	1980:03-1985:01	Daily
Hong (1999)	DM	1976:01-1995:11	Wednesdays
Hong & Lee (2003)	C$ DM FF JY £	1975:01-1998:12	Wednesdays
Chung & Hong (2007)	A$ C$ DM JY SF £	1987:01-2003:04	Daily
Pippenger (2008)	CD DM JY SF £	Mixed**	Daily

* A$ Australian $, C$ Canadian $, DM German mark, FF French franc, IL Italian lira, JY Japanese yen, SF Swiss franc, £ pound sterling. ** Intervals vary because they depend on when foreign central banks did not intervene in the market for U.S. dollars.

Table 1 lists some of the relevant research that uses daily and weekly exchange rates. Put briefly, that research says that, while exchange rates are not strictly martingales, changes in exchange rates are approximately white noise. While there may be information in exchange rates that can be used to predict the sign of changes, neither Chung and Hong (2007) nor any of the other articles in Table 1 suggest that overshooting is the source of that predictability. Although an efficient market does not imply that exchange rates are martingales, assuming that exchange rates are martingales provides a convenient alternative working hypothesis to overshooting.

The variability of exchange rates is usually measured by the variance of the change of the log of the exchange rate. Martingales imply that those changes are white noise. The spectrum for a series describes how the variance in that series is distributed by frequency. White noise means that the spectrum is flat. The fact that changes in the log of daily exchange rates are approximately white noise means that decade to decade, year to year, month to month, week to week and day to day fluctuations all contribute about equally to the variance. Such spectra reject overshooting because overshooting implies that exchange rates should be more volatile in the short-run than in the long run. That is more volatile at high frequencies than at low frequencies.

2.0 Overshooting

Overshooting is widely used outside economics. The following definition of 'overshoot' is from an engineering textbook by Distefano, Stubberd and Williams (1990, 234).

> The overshoot is the maximum difference between the transient and steady state solutions for a unit step input.

Assuming an expansionary monetary shock, that definition for overshoot implies that, for overshooting to be statistically significant, the estimate of some transient response to a unit step input must be significantly larger than the estimate for the steady state response.

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'Dornbusch' overshooting and 'delayed' overshooting are special cases of the generic form of overshooting described by Distefano, Stubberd and Williams. What 'overshooting' means in Dornbusch (1976) is clear. Consider for example Faust and Rogers (2003, 1407).

> The Dornbusch overshooting hypothesis predicts that *ceteris paribus* a one-time permanent increase in the domestic money stock will cause the home currency to depreciate on impact beyond its long-run value and then appreciate toward the terminal value. Overshooting is a robust prediction of models exhibiting three standard building blocks: a liquidity effect of monetary policy shocks, UIP, and long-run PPP. By long-run PPP, the home currency must ultimately settle at a depreciated value after the money expansion.

The reference to a "unit step input" in Distefano, Stubberd and Williams (1990) corresponds to the "one-time permanent increase in the domestic money stock" in Faust and Rogers (2003).

Dornbusch overshooting is a special case of the generic overshooting described by Distefano, Stubberd and Williams. For overshooting to be some form of *Dornbusch* overshooting, the steady state response of the exchange rate should be positive. That is, "the home currency must ultimately settle at a depreciated value after the monetary expansion".

Note that the key role for purchasing power parity in Dornbusch overshooting also implies that a valid monetary expansion should cause the domestic price level to rise in the long run. This aspect of a valid expansionary monetary shock has been largely ignored in the overshooting literature. Later I will use steady state responses for exchange rates and price levels to some unit step input as criteria for whether or not that unit step qualifies as an expansionary monetary shock consistent with Dornbusch (1976). These criteria do not depend on a rigorous interpretation of purchasing power parity. They depend only on the widely accepted idea that, *ceteris paribus*, monetary expansions should eventually raise commodity prices and the domestic price of foreign exchange.

While Faust and Rogers (2003) provides a clear description of Dornbusch overshooting, I have never seen anything similar for 'delayed' overshooting. A clear description of delayed overshooting is necessary for my critical review of the overshooting literature in Section 4.

The literature suggests that the only difference between Dornbusch overshooting and delayed overshooting is the lag at which the depreciation peaks. From this point on, 'delayed' overshooting will mean that the maximum transient response of the exchange rate to a permanent expansionary monetary shock is after the impact response.

When testing for overshooting, both Dornbusch overshooting and delayed overshooting should meet three criteria: (1) Some transient response for the exchange rate to a permanent expansionary monetary shock should be significantly larger than the steady state response. (2) The steady state response for the exchange rate should display significant depreciation. (3) The steady state response for the price level should be significantly greater than zero. Purchasing power parity need not hold. The percentage change in the price level need not equal the percentage change in the exchange rate. In the long run, the two changes just need to be positive and significant.

If (1) does not hold, there is no evidence of overshooting of any kind. If (1) holds, but (2) does not hold, there is evidence of overshooting, but the overshooting is neither Dornbusch nor delayed. For the unit step to qualify as an expansionary monetary shock that is consistent with Dornbusch (1976), (2) and (3) should both hold.

3.0 Impulse versus Step Response

The overshooting literature routinely refers to 'impulse' responses. But when authors interpret those responses they interpret them as though they were step responses. See for

example Panel C of Figure 3 in Bacchetta and van Wincoop (2010) and various figures in Jang and Ogaki (2004).

I want to clarify how I will use the terms 'impulse' and 'step' response. To keep things as simple as possible, in my example I use just two variables: the log of the domestic price of foreign exchange denoted *s(t)* and the log of the domestic stock of money denoted *m(t)*. In eq. (1) *h(j)* is the impulse response function from *m(t)* to *s(t)*.

$$s(t) = h(0)m(t) + h(1)m(t-1) + h(2)m(t-2) + \ldots h(\infty)m(t-\infty) = \sum_{j=0}^{\infty} h(j)m(t-j) \qquad (1)$$

For the system described by eq. (1) to be stable, h(j) must converge to zero as j goes to infinity. If it does not, then bounded inputs like a unit step produce unbounded outputs.

Estimates of *h(j)*, denoted $\hat{h}(j)$, describe how *s(t)* responds to a unit pulse in *m(t)* where the unit pulse is a one-time increase in *m(t)*. The corresponding step response, which is typically denoted *g(j)*, is the appropriate sum of the *h(j)*. That is *g(j)* equals $\sum_{\tau=0}^{j} h(\tau)$ and *h(j)* equals *g(j)* minus *g(j−1)*. Estimates of *g(j)* describe how *s(t)* responds to a unit step in *m(t)* where the unit step is a permanent increase in *m(t)*.

It is straightforward to derive the step response from the impulse response, but computing the corresponding confidence intervals is not straightforward. The overshooting literature avoids the problem of computing confidence intervals with a clever 'trick'. It interprets estimates of the *impulse* response from *Δm(t)* to *s(t)* as though they were estimates of the step response from *m(t)* to *s(t)*.[2]

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[2] There is no free lunch. This 'trick' has its own problems. For the system described by eq. (2) below to be stable, *[h(j)/Δ]* must converge to zero as *j* goes to infinity. As a result, a stable system is inconsistent with both Dornbusch and delayed overshooting which require *g(j)* to be positive as *j* goes to infinity.

$$s(t) = (1/\Delta)[h(0)\Delta m(t) + h(1)\Delta m(t-1) +.. + h(N)\Delta m(t-N)] = \sum_{j=0}^{N} [h(j)/\Delta]\Delta m(t-j) \qquad (2)$$

Since the *h(j)/Δ* in eq. (2) could be interpreted as the *g(j)* implied by the *h(j)* in eq. (1), an estimate of the impulse response in eq. (2) might be interpreted as an estimate of the step response from *m(t)* to *s(t)*.[3] To avoid any confusion, from this point on when I interpret an estimate of an impulse response like *h(j)/Δ* in eq. (2) as an estimate of the step response from *m(t)* to some output like *s(t)*, I will refer to that estimate as $\hat{\gamma}(j)$. In addition, from this point on, *N* denotes the longest estimated lag in an article and an *n* denotes a transient response. As the $\hat{\gamma}(j)$ with the largest *j* in each article, $\hat{\gamma}(N)$ is the best available estimate of the steady state response to a unit step. For there to be significant evidence of some kind of positive overshooting, some $\hat{\gamma}(n)$ for the exchange rate should be significantly larger than $\hat{\gamma}(N)$. For there to be significant evidence of some form of Dornbusch overshooting two additional conditions should hold: (1) The $\hat{\gamma}(N)$ for the exchange rate should be significantly larger than zero. (2) The $\hat{\gamma}(N)$ for the price level should also be significantly larger than zero.

4.0 A Critical Review of the Literature

The overshooting literature is fragile for at least three reasons: (1) Articles do not use an appropriate test for overshooting. The definition of 'overshoot' implies that the appropriate test is whether or not some transient response is significantly larger than the steady state response, but that is not how the literature appears to test for overshooting. (2) Most overshooting articles use unusually narrow confidence intervals. Confidence intervals are usually about 68% rather than the more conventional 90 or 95 percent. (3) The literature largely ignores whether or not the unit step inputs correspond to the monetary shocks in Dornbusch (1976). Unlike Dornbusch

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[3] Since *h(j) = Δg(j)* it follows that *[h(j)/Δ] = g(j)*.

(1976), in most cases permanent increases in proposed monetary shocks do not produce permanent increases in either exchange rates or price levels. As a result, it is not clear what those shocks represent.

TABLE 2
Testing for Overshooting: The Effect of Different Tests

Citation/ Interval	Currencies	Confidence Interval	$\hat{\gamma}(n){>}0$	$\hat{\gamma}(n){>}\hat{\gamma}(N)$
Eichenbaum & Evans (1995) 1974:01-1990:05	6	±1 SD	15Y 5N	0Y 20N
Grilli & Roubini (1996) 1974:12-1991:12	6	±1 SD	12Y 6N	10Y 8N
Cushman & Zha (1997) 1974-1993	1	±1 SD	3Y 0N	2Y 1N
Kim & Roubini (2000) 1974:07-1992:05	6	±1 SD	5Y 1N	5Y 1N
Kalyvitis & Michaelides (2001) 1975:01-1996:12	5	95%	4Y 1N	0Y 5N
Faust & Rogers (2003) 1974:01-1997:12	2	68%	7Y 1N	5Y 3N
Kim (2003) 1974:01-1996:12	1(TW)	90%	7Y 0N	0Y 7N
Jang & Ogaki (2004) 1974:01-1990:05	1	±1 SD	3Y 0N	2Y 1N
Kim (2005) 1975:01-2002:02	1	90%	1Y 0N	0Y 1N
Scholl & Uhlig (2008) 1975:07-2002:07	4	±1 SD	9Y 1N	1Y 9N
Bjørnland (2009) 1981:I-2004:IV	4	±1 SD	4Y 0N	3Y 1N
Landry (2009) 1974:I-2005:IV	PW	90%	1Y 0N	0Y 1N
Bouakez & Normandin (2010) 1982:11-2004:10	6	68%	11Y 1N	9Y 3N
Total			82Y 16N	37Y 61N

TW: Trade weighted exchange rate; PW: Population weighted exchange rate.

4.1 The Right Test

Assuming for simplicity that all monetary shocks are expansionary, the literature appears to test for overshooting essentially by asking the following question: Is some $\hat{\gamma}(n)$ greater than

$\hat{\gamma}(N)$ and also significantly greater than zero? If the answer is yes, the article interprets the evidence as supporting overshooting.

The definition of 'overshoot' in Distefano, Stubberd and Williams (1990) implies a different test for overshooting: Is some $\hat{\gamma}(n)$ significantly larger than $\hat{\gamma}(N)$? As Table 2 shows, these two questions produce different results.

Table 2 includes all the published articles I know of that report step responses using VAR with confidence intervals and orthogonal inputs.[4] It does not include working papers. When I discuss the articles in Table 2 I assume that all inputs are expansionary. If an article reports the results of a contractionary shock, I reinterpret those results as though the shock had been expansionary. This eliminates any confusion that might be caused by some articles using expansionary shocks and others contractionary. Table 2 uses the confidence interval used in each article. The effects of using more conventional confidence intervals are taken up in the following subsection.

Column 1 on the left in Table 2 provides the citation and data interval for each article. Column 2 shows the number of exchange rates. Column 3 reports the confidence interval used in the article. That confidence interval is the interval used in columns 4 and 5. In column 4 each *Y* indicates significant support for overshooting using the test from the literature. For example, the seven *Y*s and one *N* for Faust and Rogers in column 4 indicates that for seven of the tests reported in Faust and Rogers (2003) some $\hat{\gamma}(n)$ for exchange rates is larger than $\hat{\gamma}(N)$ and also significantly greater than zero. The one *N* indicates that for one test either no $\hat{\gamma}(n)$ is larger than $\hat{\gamma}(N)$ or, if one is larger than $\hat{\gamma}(N),$ it is not significantly larger than zero.

Column 5 tests for overshooting using the alternative test suggested by the definition of overshoot. Each Y indicates that some $\hat{\gamma}(n)$ for the exchange rate is significantly larger than $\hat{\gamma}(N)$.[5] For example, the five *Y*s and three *N*s for Faust and Rogers in column 5 indicate that for five tests of overshooting $\hat{\gamma}(n)$ lies above the confidence interval for $\hat{\gamma}(N)$. The three *N*s indicate that for three tests no $\hat{\gamma}(n)$ lies above the confidence interval for $\hat{\gamma}(N)$.

The entries for Eichenbaum and Evans (1995) in Table 2 require some explanation. The results in column 4 use the test usually used in the literature. Most of the literature interprets the responses in Eichenbaum and Evans (1995) as evidence of overshooting.[6] The 15 *Y*s and 5 *N*s in column 4 for Eichenbaum and Evans correspond to the usual interpretation of their results in the literature.

But Eichenbaum and Evans do not interpret their responses as evidence of overshooting. They interpret them as indicating a persistent response to a permanent monetary shock.[7] While Eichenbaum and Evans raise the possibility of delayed overshooting, they never claim to find evidence for such overshooting.[8] The 20 *N*s in column 5 reflect how Eichenbaum and Evans interpret the $\hat{\gamma}(j)$ for exchange rates in their article.

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[5] If $\hat{g}(N)$ is negative, I use the confidence interval where $\hat{g}(n)$ crosses zero.

[6] For example, Kalyvitis and Michaelides (2001, 255) says the following: "In a seminal paper Eichenbaum and Evans (1995) have shown that in response to a tighter US monetary policy, the US Dollar exhibits a 'delayed overshooting' pattern of 2 to 3 years vis-à-vis the major currencies……" While Landry (2009) says the following: "..the dynamic response of the nominal exchange rate mimics the delayed overshooting result of Eichenbaum and Evans (1995)…"

[7] Eichenbaum and Evans (1995, 976) summarizes the results as follows: "Second, we find that the same shocks lead to sharp, persistent appreciations in the U.S. nominal and real exchange rates." There is nothing in this summary about overshooting.

[8] Here is what Eichenbaum and Evans (1995, 982-4) says about delayed overshooting: "Third, a contractionary shock to U.S. monetary policy leads to persistent appreciations in nominal and real U.S. exchange rates. …..This response pattern is inconsistent with simple overshooting models of the sort considered by Dornbusch (1976), ……. However our results could be viewed as supporting a broader view of overshooting in which exchange rates eventually depreciate after appreciating for a period of time." At no point does Eichenbaum and Evans (1995) claim to find evidence of delayed overshooting.

Table 2 shows that how one tests for overshooting makes a difference. Using the Total at the bottom of column 4, about 84% of the tests support overshooting. Using the Total for the alternative test based on the definition of overshoot, only 38% support overshooting.

Even excluding Eichenbaum and Evans (1995), the difference remains substantial. Excluding Eichenbaum and Evans, the results are *67Y* and *11N* versus *37Y* and *41N*. That is about 86% versus 47%.

The difference between the two tests is even larger for the articles that use more conventional confidence intervals. For the four articles using 90 or 95% confidence intervals the results in column 4 are *13Y* and *1N* while in column 5 they are *0Y* and *14N*. That is about 93% supporting overshooting versus no support.

The next subsection takes up the issue of confidence intervals in more detail.

4.2 Confidence Intervals

Most of the articles in Table 2 use confidence intervals of only plus or minus one standard deviation, which is an interval of about 68%. With only confidence intervals reported in figures to work with, it is impossible to calculate accurately more conventional intervals. However it is possible to 'eyeball' intervals of plus or minus two standard deviations or about 95%.

I evaluate the effects of different confidence intervals by comparing more conventional intervals to the intervals used in the literature. First I use the confidence interval used in each article and again ask whether or not some $\hat{\gamma}(n)$ lies above the confidence interval for $\hat{\gamma}(N)$. Those results appear in column 4 of Table 3 and are the same as for column 5 in Table 2. Then I ask whether or not some $\hat{\gamma}(n)$ lies above a 95% confidence interval for $\hat{\gamma}(N)$. Those results appear in column 5.

The first and second tests treat $\hat{\gamma}(n)$ as though it were deterministic rather than stochastic.

The last test recognizes that both $\hat{\gamma}(n)$ and $\hat{\gamma}(N)$ are stochastic. For the last test I ask whether or not some $\hat{\gamma}(n)$ for the exchange rate lies above $\hat{\gamma}(N)$ and the 95% intervals for $\hat{\gamma}(n)$ and $\hat{\gamma}(N)$ do not overlap. Those results appear in column 6 of Table 3.

TABLE 3
Testing for Overshooting: The Effect of Confidence Intervals

Citation/ Interval	Currencies	Confidence Interval	$\hat{\gamma}(n) > \hat{\gamma}(N)$	$\hat{\gamma}(n) > \hat{\gamma}(N)$ 95% NO	$\hat{\gamma}(n) > \hat{\gamma}(N)$ 95% O
Eichenbaum & Evans (1995) 1974:01-1990:05	6	±1 SD	0Y 20N	0Y 20N	0Y 20N
Grilli & Roubini (1996) 1974:12-1991:12	6	±1 SD	10Y 8N	6Y 12N	2Y 16N
Cushman & Zha (1997) 1974-1993	1	±1 SD	1Y 2N	0Y 3N	0Y 3N
Kim & Roubini (2000) 1974:07-1992:05	6	±1 SD	5Y 1N	3Y 3N	3Y 3N
Kalyvitis & Michaelides (2001) 1975:01-1996:12	5	95%	0Y 5N	0Y 5N	0Y 5N
Faust & Rogers (2003) 1974:01-1997:12	2	68%	5Y 3N	2Y 6N	2Y 6N
Kim (2003) 1974:01-1996:12	1(TW)	90%	0Y 7N	0Y 7N	0Y 7N
Jang & Ogaki (2004) 1974:01-1990:05	1	±1 SD	1Y 2N	1Y 2N	0Y 3N
Kim (2005) 1975:01-2002:02	1	90%	0Y 1N	0Y 1N	0Y 1N
Scholl & Uhlig (2008) 1975:07-2002:07	4	±1 SD	1Y 9N	0Y 10N	0Y 10N
Bjørnland (2009) 1981:I-2004:IV	4	±1 SD	3Y 1N	0Y 4N	0Y 4N
Landry (2009) 1974:I-2005:IV	PW	90%	0Y 1N	0Y 1N	0Y 1N
Bouakez & Normandin (2010) 1982:11-2004:10	6	68%	9Y 3N	7Y 5N	1Y 11N
Totals			37Y 61N	19Y 79N	8Y 90N

TW: Trade weighted exchange rate; PW: Population weighted exchange rate.

Although I try to be as impartial as possible when constructing 95% intervals, using an 'eyeball' approach opens up the possibility of subjective bias. I urge every interested reader to check my intervals by constructing their own 95% intervals.

The Total for column 4 again shows that, using the confidence intervals from each article, 38% of the tests support overshooting. For column 5 that drops to just 19%. Requiring that the confidence intervals not overlap reduces the percentage to only 8%.

The decline in support for overshooting in Tables 2 and 3 illustrates the fragility of the evidence supporting overshooting. But both tables assume that all unit step inputs correspond to a permanent expansionary shock that is consistent with permanent monetary shocks in Dornbusch (1976).

4.3 Monetary Shocks?

Dornbusch (1976) describes how *markets* might produce overshooting. If a central bank produced overshooting by responding to an exogenous expansionary monetary shock with a contractionary monetary policy because it wanted to stabilize prices, such overshooting would not be Dornbusch overshooting. In Dornbusch (1976) overshooting created by the market's response to a permanent expansionary shock has two important and closely related effects: (1) A permanent increase in the domestic price of foreign exchange. (2) A permanent increase in the domestic price level. When identifying shocks as monetary, the overshooting literature seldom asks whether or not the supposedly monetary shocks produce these effects. As Table 4 shows, they usually do not.

Columns 2 to 4 in Table 4 all use an 'eyeball' 95% confidence interval. Column 2 asks whether or not $\hat{\gamma}(N)$ for prices are significantly greater than zero. Column 3 asks whether or not there is overshooting as in column 5 of Table 3 *and* the $\hat{\gamma}(N)$ for the exchange rate is significantly

greater than zero. Column 4 asks whether or not there is overshooting as in Column 6 of Table 3

and the $\hat{\gamma}(N)$ for the exchange rate is significantly greater than zero.

TABLE 4
Response for Prices and Exchange Rates

Citation/ Interval	Prices 95%	Ex. Rates 95% NO	Ex. Rates 95% O
Eichenbaum & Evans (1995) 1974:01-1990:05	NA	0Y 20N	0Y 20N
Grilli & Roubini (1996) 1974:12-1991:12	0Y 6N	1Y 17N	0Y 18N
Cushman & Zha (1997) 1974-1993	0Y 1N	0Y 3N	0Y 3N
Kim & Roubini (2000) 1974:07-1992:05	0Y 6N	0Y 6N	0Y 6N
Kalyvitis & Michaelides (2001) 1975:01-1996:12	NA	0Y 5N	0Y 5N
Faust & Rogers (2003) 1974:01-1997:12	0Y 8N	0Y 8N	0Y 8N
Kim (2003) 1974:01-1996:12	0Y 3N	0Y 7N	0Y 7N
Jang & Ogaki (2004) 1974:01-1990:05	1Y 2N	0Y 3N	0Y 3N
Kim (2005) 1975:01-2002:02	0Y 1N	0Y 1N	0Y 1N
Scholl & Uhlig (2008) 1975:07-2002:07	0Y 6N	0Y 10N	0Y 10N
Bjørnland (2009) 1981:I-2004:IV	NA	0Y 4N	0Y 4N
Landry (2009) 1974:I-2005:IV	0Y 1N	0Y 1N	0Y 1N
Bouakez & Normandin (2010) 1982:11-2004:10	0Y 6N	0Y 12N	0Y 12N
Total	1Y 40Y	1Y 97	0Y 98N

TW: Trade weighted exchange rate; PW: Population weighted exchange rate.

In column 2 only about 3% of the permanent shocks that are identified as monetary shocks

in the literature produce permanent increases in the price level. In column 3 of Table 4 only1%

of the unit steps produce significant overshooting *and* a significant permanent increase in the

domestic price of foreign exchange. Column 4 uses a stronger test for overshooting than column

3. In column 4 none of the permanent shocks that are identified as monetary shocks in the

literature produce significant overshooting *and* a significant permanent increase in the domestic price of foreign exchange.

The results in Table 4 suggest that the unit step inputs that are used to test for overshooting do not correspond to permanent monetary shocks that are consistent with such shocks in Dornbusch (1976).

5.0 Summary and Conclusions

Daily and weekly exchange rates are approximately martingales. Martingales imply that the changes in those series are approximately white noise. It is very difficult to reconcile that white noise with overshooting that is both statistically and economically significant.

While the evidence supporting martingales is very robust, the evidence supporting overshooting for exchange rates is very fragile. The overshooting literature does not use an appropriate test for overshooting. It uses unusually narrow confidence intervals. In addition the 'monetary' shocks used in the literature apparently do not correspond to such shocks in Dornbusch (1976). They seldom produce permanent increases in either exchange rates or commodity prices.

Any future research claiming that overshooting is both statistically and economically significant must correct these deficiencies. (1) It must use an appropriate test for exchange-rate overshooting. (2) It must use conventional confidence intervals. (3) It must show that the monetary shocks are truly monetary in the sense of Dornbusch (1976). (4) Most important of all, future research must explain how such overshooting can be consistent with daily and weekly exchange rates being approximately martingales.

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