EFFECTIVE REAL EXCHANGE RATES AND IRRELEVANT NOMINAL EXCHANGE-RATE REGIMES

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Abstract

We examine the relationship between the short-term volatility of the *effective* Real Exchange Rate (RER) and the degree of flexibility of the nominal exchange rate. Existing evidence demonstrates that the short-term variance of bilateral RERs is on average about 12 times higher under floating nominal exchange rate regimes than under fixed regimes. By comparison, based on pooled results across a set of countries with low and stable inflation and stable growth rates from 1978 to 1994, the effective RER is only twice as volatile under floating regimes compared with fixed regimes. Although this difference is statistically significant, results within countries show that for most countries there was no significant increase in effective RER volatility when moving to more flexible exchange-rate regimes. Surprisingly, there are even some countries for which volatility is lower under more flexible exchange-rate regimes. In part our findings reflect the fact that effective RERs are an average of bilateral RERs. Also, we suggest that there is a difference between a fixed exchange-rate regime during Bretton Woods and a fixed exchange-rate regime post-Bretton Woods.

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1.   Introduction

When the Bretton Woods system of fixed exchange rates was abandoned in the early 1970s, the subsequent high degree of short-term volatility in nominal exchange rates was largely unexpected. In addition, the short-term volatility of Real Exchange Rates (RERs) increased dramatically post-Bretton Woods. This positive relationship between the degree of flexibility of the nominal exchange-rate regime and the volatility of the RER is important for at least three reasons. First, the high degree of correlation between movements in the nominal exchange rate and the real exchange rate is consistent with the hypothesis that the prices of goods and services adjust sluggishly relative to asset prices, such as the nominal exchange rate.[1]

Second, lower volatility of the RER is viewed as an advantage of fixed nominal exchange-rate regimes over flexible regimes. In particular, lower volatility of the RER implies greater certainty about this important relative macroeconomic price.

Third, given that the RER is a key relative price in the determination of many real macroeconomic variables – including investment, consumption and trade flows – it seems odd that changes in the behaviour of the RER post-Bretton Woods were not associated with significant changes in the behaviour of these other macroeconomic variables (Baxter and Stockman 1989).

Following the seminal work of Mussa (1986), there has been extensive literature analysing the relationship between nominal exchange-rate regimes and the

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[1]   The broad class of models that incorporate the assumption of price sluggishness imply that RERs should move relatively slowly under fixed nominal exchange-rates regimes (except for changes in official parities or realignments), while under floating exchange-rate regimes, the RER and the nominal exchange rate should show a high degree of correlation.

behaviour of real macroeconomic variables.[2] Interest in this topic has been heightened by a number of recent events, including currency crises (especially in Asia) which have prompted some countries to move towards more flexible exchange-rate regimes. On the other hand, some countries have moved towards more rigid nominal exchange rate arrangements, including those countries joining the Euro bloc, while others have gone even further by establishing currency boards (Argentina for example).

There are many studies that conclude that RERs exhibit substantially higher short-term volatility under floating nominal exchange-rate regimes than under fixed exchange-rate regimes.[3] However, most of these studies are based on the analysis of *bilateral* RERs.[4] We suggest that from a macroeconomic point of view, an analysis of the behaviour of *effective* RERs may be of more interest,[5] and that *effective* RERs may in fact not alter their behaviour across different nominal exchange-rate regimes.[6] For example, the top panel of Figure 1 shows the monthly changes in the bilateral RER for Denmark against the United States. The volatility in the bilateral RER increases dramatically moving from the Bretton Woods system of fixed exchange rates to the more flexible post-Bretton Woods era in the early 1970s. However, such behaviour is not evident in the effective RER for Denmark shown in the lower panel of Figure 1.[7] In this paper we re-examine the effect of nominal exchange-rate regimes on the effective RER across a large sample of countries.

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[2] See Frankel and Rose (1995) for a summary of this literature.

[3] For example, Mussa (1986), Eichengreen (1988), Baxter and Stockman (1989), and Flood and Rose (1995). See Obstfeld (1998) for a recent exposition of this result.

[4] The IMF (1984) examined the volatility of the effective RER for seven major industrial countries.

[5] This was originally suggested by Black (1986) in his comments on Mussa (1986).

[6] A country's effective RER (also known as a multilateral RER) is the trade-weighted average of bilateral RERs with the country's trading partners (see Section 3).

[7] As we demonstrate later in the paper there is a very slight but *statistically insignificant* increase in the variance of changes in the effective RER for Denmark post-Bretton Woods. See Section 3 and the Appendix for a description of the data.

Figure 1: Denmark – Monthly Bilateral and Effective RER Changes

Percentage change
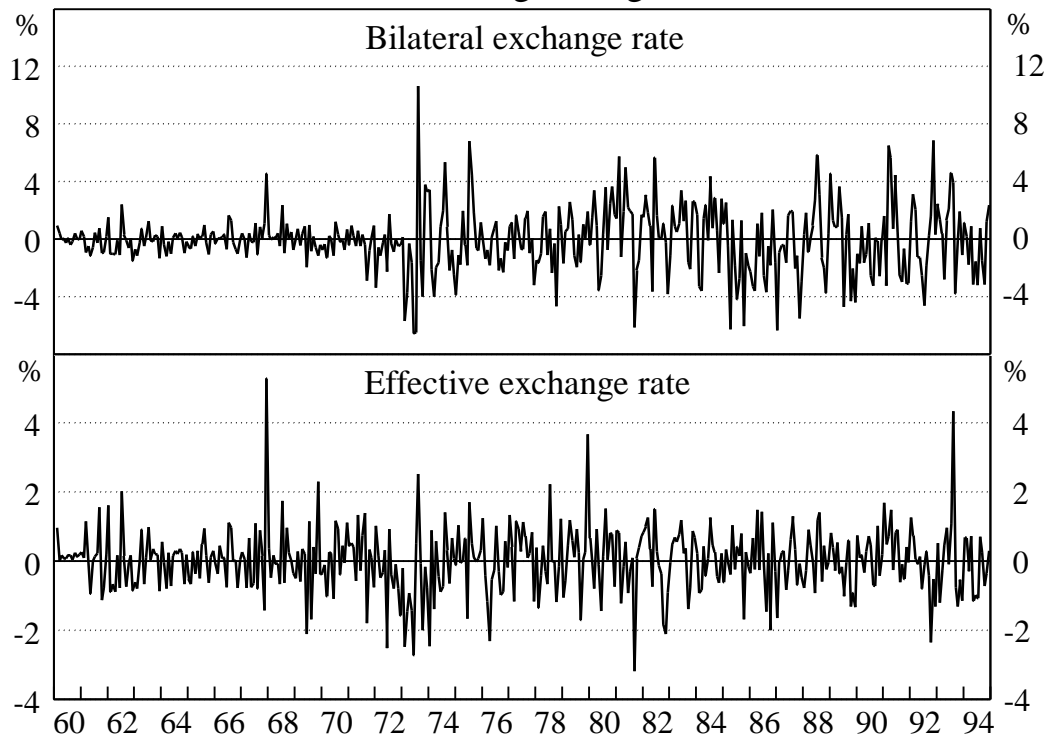
Note: The bilateral RER was based on the US dollar and the Wholesale Price Index.

It may be that the effect of averaging bilateral RERs reduces the variance of the effective RER to such a degree that the nominal exchange-rate regime has little impact on the volatility of *effective* RERs. In other words, the relationship between the flexibility of the nominal exchange-rate regime and RER volatility may be substantially weaker (or perhaps even insignificant) for effective RERs compared with bilateral RERs. Such a result would have a number of implications. First, this may help to explain why the existing studies have failed to find a significant change in the behaviour of a range of macroeconomic variables (other than the bilateral RER) across different nominal exchange-rate regimes. Second, the adoption of a more flexible nominal exchange-rate regime may not be associated with greater uncertainty with regard to the effective RER. Third, it may be that the prices of goods and services adjust sluggishly, but much less so relative to effective nominal exchange rates (compared with bilateral nominal exchange rates).

Implicit in the discussion above is the proposition that the effective RER is more relevant to the behaviour of macroeconomic variables than a country's bilateral RERs. This would appear to be reasonable, except in a world where different firms (and/or consumers) are sensitive to the volatility of specific bilateral exchange rates.

However, even in this case, it may be that the effects of a depreciation of one bilateral RER on one firm are offset by the effect of an appreciation of another bilateral RER on another firm; if the effective RER remains unchanged, the aggregate effect of bilateral RER changes across firms may be insignificant. If instead, firms are affected by more than one bilateral RER then the volatility of bilateral RERs may be less relevant to firms than the volatility of the effective RER.

A feature of many existing studies of the RER behaviour is their reliance on comparisons of the Bretton Woods system and post-Bretton Woods in order to delineate fixed and floating nominal exchange-rate regimes. This is problematic for two reasons. First, there is the problem of identification – it may be that some other event is related to a change in RER behaviour, and that this event is highly correlated with the end of the Bretton Woods system. For example, such an event might be the oil price shocks which led to higher volatility in energy prices and hence, the terms of trade of many countries.[8]

The other problem with studies that rely on the Bretton Woods era to define fixed exchange rates is that they may not tell us anything about fixed exchange-rate regimes in the post-Bretton Woods era. We suggest that the RER is likely to be less volatile during the Bretton Woods era because all countries were fixing their nominal exchange rates. In contrast, a country with a fixed exchange-rate regime post-Bretton Woods is fixing its exchange rate to currencies which are themselves under floating or managed exchange-rate regimes.

In this paper we present results using a large set of countries over the period 1978 to 1994. In contrast to data sets which are centred on the end of Bretton Woods, this data set exhibits variation in the timing of regime switches across different countries. In addition, results based on more recent experiences of countries with fixed exchange-rate regimes may be more relevant for policy-makers than the experience of fixed exchange rates during Bretton Woods.

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[8]   Alternatively, existing findings could be due to very different behaviour of the US RER during and after Bretton Woods, with no substantial change in the behaviour of other countries' RERs. O'Connell (1998) makes this point when talking about the time series properties of bilateral RERs versus effective RERs.

The paper proceeds as follows. In Section 2 we use Mussa's sample of 16 industrialised countries to examine the volatility of the RER under fixed and floating regimes which are identified by the Bretton Woods and post-Bretton Woods eras respectively. We show how the use of effective RERs in place of bilateral RERs has an important impact on the results.

We provide a brief description of our data in Section 3 and discuss the problematic task of classifying countries' exchange-rate regimes. In Section 4 we present results for the effective RER across a broad sample of countries over the period from 1978 to 1994. To make a valid determination of the effect of the nominal exchange-rate regime, it is necessary to compare the behaviour of the RER across countries which have similar characteristics. It would be inappropriate to compare experiences across extreme types of economies for which we would naturally expect different RER behaviour irrespective of the nominal exchange-rate regime. We chose a subset of countries based on their inflation experience and on the variability of their growth rates. Both of these factors are likely to influence the underlying behaviour of the RER. Countries with high and variable inflation or variable rates of growth also tend to exhibit high RER volatility across all nominal exchange-rate regimes. Therefore, we concentrated our efforts on countries with both low and stable inflation and stable growth rates. Section 5 concludes with some remarks concerning the interpretation of our results.

2. Re-examining Existing Evidence

In this section of the paper we show that the results of previous studies are driven partly by their reliance on bilateral RERs. We focus on Mussa's seminal paper by reproducing his results, using his sample of countries and his nominal exchange rate classification scheme, looking first at bilateral RERs and then at effective RERs.

We tested the hypothesis of no difference in the variance of monthly percentage changes in the RER across different nominal exchange-rate regimes using F-tests. To do this we used two different methods. First, we assumed that for a given exchange-rate regime, observations of monthly changes in the RER across all countries were the result of independent draws from the same distribution. This assumption allowed observations of RER changes from a given regime to be pooled across countries. In this way the relative variance of changes in the RER could be

compared across regimes. In addition to providing a convenient summary measure of the variance of the RER within each regime, this method was advantageous because it allowed us to include observations from countries that had experienced only one regime in the sample period. The disadvantage of this pooling method was that the assumption of a single distribution may be incorrect for countries which might have very different 'underlying' characteristics (and it may be impossible to control for these differences).

For the second method, observations of RER changes were assumed to be drawn from distributions which varied across countries. This justifies separate within-country comparisons of the variance of monthly changes in the RER across different regimes.

Mussa (1986) analysed the behaviour of bilateral RERs (versus the US dollar) of 15 industrialised countries. The Bretton Woods era was used to identify the fixed exchange-rate regime. He described the post-Bretton Woods period as being a floating exchange-rate regime for these industrialised countries. His main result was that the variance of the quarterly changes in the bilateral RERs was on average almost 14 times higher under the floating exchange-rate regime than under the fixed exchange-rate regimes. We replicated Mussa's results using the two methodologies described above for monthly *bilateral* RERs.[9] The left panel of Figure 2 illustrates the pooled variance of changes in the bilateral RER for each regime.[10] The variance

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[9] The bilateral RERs were based on Consumer Price Indices. Nominal exchange rates (versus the US dollar) were monthly averages throughout the paper (from the IMF, *International Financial Statistics*). We did not include Luxembourg in our sample. For the following countries we followed Mussa by representing the Bretton Woods regime as the period up to December 1970 and the post-Bretton Woods regime as the period from March 1973 onwards: Austria, Belgium, Denmark, France, Germany, Italy, Japan, the Netherlands, Norway, Sweden, Switzerland and the United Kingdom. Ireland was fixed against the pound sterling until December 1978, hence it was included in the Bretton Woods (fixed) regime up to that time and in the post-Bretton Woods (flexible) regime after that time. Following Mussa, Canada was included in the Bretton Woods regime from August 1962 until March 1970 and in the post-Bretton Woods regime from April 1970 onwards. The question of transitions between regimes was avoided here, as in Mussa, by excluding observations around the time of the breakdown of Bretton Woods. This issue is discussed in more detail in Section 4.

[10] Mussa's original sample period was from 1957 to 1984. Our effective RERs start in 1960, and we found it was straightforward to extend Mussa's regime classification scheme up to December 1990. Beyond that, Mussa's classification scheme becomes ambiguous for many

of bilateral RER changes was a lot higher post-Bretton Woods than during Bretton Woods; the ratio of the pooled variances was 12 to 1.[11] This difference was significant at the 5 per cent level.

Figure 2: Variance of Monthly RER Changes

Mussa's sample of industrialised countries
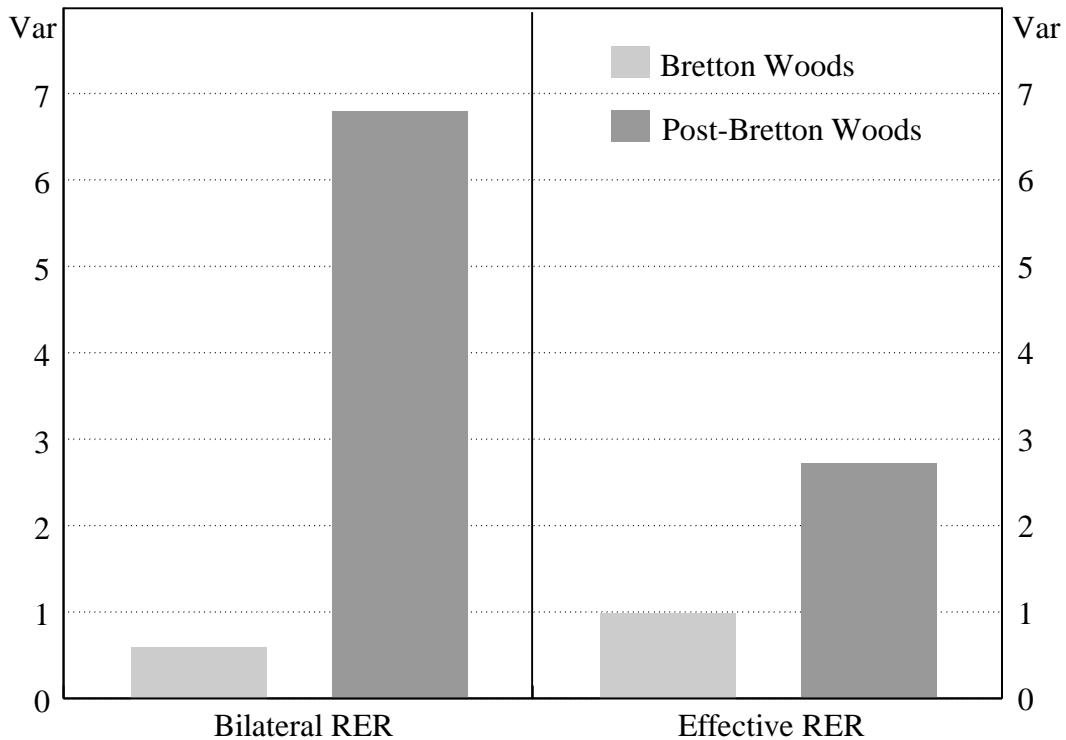
Notes: The bilateral RER was based on the US dollar and the CPI. The effective RER variance estimates included the United States and placed Austria in the Bretton Woods (that is, fixed exchange rate) regime for the full sample; likewise for Ireland until December 1978.

We also conducted F-tests on the ratio of the variances of bilateral RER changes across nominal exchange-rate regimes within each country. All of these tests (not reported here) conclusively indicated a higher variance under floating exchange rates than fixed exchange rates for every country in the sample. Therefore, the within country results support the results of the pooled analysis, namely, that

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European countries which dabbled with fixed exchange rates for a time (especially Sweden, the United Kingdom and Italy).

[11] The ratio of the average variance is lower than Mussa's result due to slightly different sample periods, the use of monthly instead of quarterly data, and slightly different regime classifications for Ireland and Canada.

bilateral RERs displayed systematically higher short-term volatility post-Bretton Woods compared with during Bretton Woods.

The pooled and within-country tests were repeated on this set of countries using effective RERs. The issue of the classification of the nominal exchange-rate regimes was more difficult in the case of effective RERs than in the case of bilateral RERs. For instance, the Austrian schilling was fixed against the US dollar under Bretton Woods and then floating against the US dollar post-Bretton Woods. This is a natural way of classifying the nominal exchange-rate regime for the purpose of examining the behaviour of the Austrian bilateral RER (relative to the US). However, when analysing the Austrian effective RER, it is natural to classify the nominal exchange-rate regime as fixed both during and after Bretton Woods – that is, fixed first against the US dollar and later fixed against the Deutsche Mark.

Mussa accounted for these problems by considering more than one bilateral RER for a given country. In contrast, we classified countries' exchange-rate regimes according to whether the country was fixing its exchange rate against any major currency and not just against the US dollar. Also, we added the US to the sample of countries. The results from pooling countries together are shown in the right panel of Figure 2 (a description of the data is provided in Section 3). The variance of changes in the effective RER post-Bretton Woods was less than three times the variance during Bretton Woods.[12] This difference was significant at the 5 per cent level, although it was clearly smaller for effective RERs than for bilateral RERs.

Results of within country F-tests are shown in Table 1. In contrast to the pooled results, three countries, Denmark, France and the Netherlands, showed no evidence of a significant difference in the variance of the monthly changes in the effective RER across nominal exchange-rate regimes. (Notice that the high variance of changes in the RER for Japan post-Bretton Woods pushed up the level of the pooled variance – excluding Japan from the sample reduced the pooled variance post-Bretton Woods from 2.7 to 2.5, but did not alter the result of the pooled F-test.)

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[12] This was robust to using exactly the same set of countries and the same nominal regime classifications used by Mussa (that is, as in the left panel of Figure 1).

Table 1: F-Tests for Differences in Variances of Effective RERs Across Nominal Exchange-rate Regimes[a]

	Country	Bretton Woods Variance	Post-Bretton Woods Variance	F-Test[b]	Direction[c]
1	Austria	1.51[d]			
2	Belgium	0.39	0.68	1.77*	+
3	Canada	0.07	1.11	14.83*	+
4	Denmark	0.71	0.89	1.25	0
5	France	1.45	1.58	1.09	0
6	Germany	0.85	1.45	1.70*	+
7	Ireland	1.11	2.16	1.95*	+
8	Italy	0.38	1.54	4.03*	+
9	Japan	1.08	5.38	5.00*	+
10	Netherlands	0.61	0.78	1.27	0
11	Norway	0.72	1.15	1.61*	+
12	Sweden	1.34	2.02	1.50*	+
13	Switzerland	0.35	2.21	6.32*	+
14	United Kingdom	2.46	3.95	1.61*	+
15	United States	0.17	2.39	14.29*	+

Notes: (a) Variances are based on monthly percentage changes in the effective RER.

(b) * indicates significance at the 5 per cent level.

(c) A positive (negative) sign indicates that the variance is significantly higher (lower) for the Bretton Woods regime. A zero indicates no significant difference in the variance across regimes.

(d) Austria had a fixed exchange rate over the full sample period. Therefore, only one variance over the whole sample period is reported.

In summary, the ratio of the short-term volatility of the RER under floating versus fixed regimes was about 12 to 1 for bilateral RERs, but the ratio was less than 3 to 1 for effective RERs. Furthermore, within country tests showed that for three of the 14 countries in the sample, there was no significant difference in the short-term volatility of the effective RER during and after Bretton Woods.[13] In other words, increased RER volatility post-Bretton Woods is no longer as conspicuous when we consider effective RERs.

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[13] The IMF (1984) show that the average of month-to-month changes in the effective RER more than doubled for France post-Bretton Woods, however, this study makes no comparison of the variance of these short-term changes in the effective RER.

As we mentioned above, a major problem with this sample of industrialised countries is that most of the changes in the exchange-rate regimes occurred at the same time (around the collapse of the Bretton Woods system). This is troubling because it is not clear that a finding of different behaviour of the RER is due to a change in nominal exchange-rate regimes or other contemporaneous changes in the world economy.

In Section 4 we examine the behaviour of the effective RER across a larger set of countries using data well after the collapse of the Bretton Woods system. For this data set, changes in nominal exchange-rate regimes were not strongly correlated over time.

3.   Data

Our data set consisted of 90 countries with monthly data on the effective RER, nominal exchange-rate regimes and inflation rates over the period 1978 to 1994.[14] Also, we used annual data on real GDP to calculate the variance of real GDP growth rates.

We used data from Goldfajn and Valdes (1996) on monthly effective RERs, available from January 1960 to December 1994. The effective RER is a trade-weighted average of bilateral RERs with those trading partners encompassing 4 per cent or more of trade in either imports or exports. In the construction of these bilateral RERs, the Wholesale Price Index was used if available; otherwise the Consumer Price Index was used.

We built our data set on nominal exchange-rate regimes from the monthly issues (October 1978 to November 1996) of the International Monetary Fund's *International Financial Statistics* (IFS) and from the *Annual Report on Exchange Arrangements and Exchange Restrictions* also of the IMF (1978 to 1983). The raw data on regimes describes over 25 possible exchange rate arrangements. We simplified this classification scheme by aggregating categories into three broad groupings (see Appendix for details). The fixed exchange-rate regime included pegs

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[14] Quarterly data was available for two additional countries, New Zealand and Papua New Guinea.

to single currencies and pegs to the SDR or other baskets. The second regime allowed for some flexibility in the nominal rate and included countries in the European Monetary System (EMS), pegs which are adjusted frequently and managed floating rates. The third regime consisted of freely floating exchange rates. In practice, these three groups represent relative degrees of flexibility rather than precise distinctions. For expositional purposes, we refer to these regimes as fixed, managed and floating exchange-rate regimes.

Our broad classification scheme is similar to that adopted by the IMF. It differs from Mussa by differentiating between managed and floating exchange-rate regimes which he had combined into a single group. The other difference is due to our focus on effective RERs. For example, as already mentioned in our classification scheme, Austria was fixed to a major currency until 1990 and so it was included in the fixed exchange-rate regime throughout this period.

The accuracy of our classification scheme depends partly on the accuracy of the information that member countries submit to the IMF. The IMF attempts to assess the accuracy of this information and on occasion shifts countries into nominal exchange-rate regime categories accordingly.

Ideally, the classification of the nominal exchange-rate regime should be based on a country having in place a broad set of policies which are consistent with a given regime. However, on occasion, a country will claim to be in a given regime but run policies which are inconsistent with this regime. For example, a country with very high inflation that attempts to be in a fixed regime, but does nothing other than switch to a fixed regime in order to control inflation, is unlikely to be able to hold a fixed peg for an extended period. Therefore, such a country will display a highly variable RER (and nominal exchange rate) simply because the peg has to be devalued in large discrete steps in order to prevent sustained appreciations of the RER. In practical terms, such a country is not genuinely in a fixed exchange-rate regime. We addressed this problem by examining a subset of countries with low and

stable inflation and stable growth rates that were most likely to be accurately classified in terms of their exchange-rate regimes.[15]

4. New Evidence

We examined the variance of monthly percentage changes in the effective RER across three possible nominal exchange-rate regimes for the period November 1978 to December 1994. We arrived at our preferred set of results in a number of stages. In the first stage we derived the pooled results for the full sample of countries. In the second stage we dealt with the problem associated with observations close to regime transitions. We elected to remove three monthly observations on either side of regime switches and maintained this refinement thereafter. In further stages we eliminated countries from the sample until we were left with a preferred sub-sample of countries with low and stable inflation and stable growth experiences; at this final stage we derived both pooled and within-country results.

Stage 1: Full Sample

The results for the full sample of countries using the pooled analysis are shown in row (1) of Table 2. The pooled variance of effective RER changes was substantially higher under the floating exchange-rate regime than the fixed and managed exchange-rate regimes (389 versus 113 and 86 respectively). However, the variance under all regimes appears to be high, in part because of large and infrequent changes in nominal exchange rates which were associated with switches in nominal exchange-rate regimes.

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[15] Also, for reasons that we do not fully understand, many developing countries (which also have high inflation) report their regimes as floating when they clearly are not.

Table 2: Variances of Effective RERs Across
Nominal Exchange-rate Regimes

Stage		Fixed Regime	Managed Regime	Floating Regime
		Variance	Variance	Variance
1	Full sample of 90 countries	113	86	389
	– no correction for regime switching	(7 874)	(6 121)	(2 477)
2	Full sample of 90 countries	46	76	32
	– with correction for regime switching	(7 634)	(5 838)	(2 272)
3a	Sample of 45 high inflation countries	77	159	50
	– inflation more than 10 per cent per annum – with correction for regime switching	(3 521)	(2 752)	(1 426)
3b	Sample of 45 low inflation countries	20	2.4	3.4
	– inflation less than 10 per cent per annum – with correction for regime switching	(4 106)	(3 083)	(828)
4	Sample of 27 low and stable inflation and stable growth rate countries	1.7	2.2	3.3
		(1 207)	(2 840)	(815)
	– inflation less than 10 per cent per annum – standard deviation of annual growth less than 4.5 per cent – standard deviation of monthly inflation less than 1.5 per cent – with correction for regime switching			

Notes: Figures in parentheses are the number of observations that pertain to each pooled variance.

Stage 2: Regime Switching

Regime switches often involve large movements in both the nominal exchange rate and the RER. These transitions were problematic because it was not clear whether these movements were associated with the new or the old regime (or simply because the regime was in transition). Indeed, a large depreciation may take place at the onset of a flexible regime but may in fact be a correction of a significant overvaluation that occurred during the fixed exchange-rate regime. We controlled for this problem by deleting the last three months at the end of an old regime and the first three months at the beginning of a new regime. Row (2) of Table 2 shows the pooled results with this correction. Compared with the results in the first row, the short-term volatility of the effective RER was substantially lower for all regimes, especially for the floating exchange-rate regime (which is consistent with the

example of regime switching mentioned above). All of the results that follow in the paper are based on this correction for regime switching.[16]

Stage 3: High and Low Inflation Countries

We divided the sample of countries between those with high inflation and those with low inflation; we used a cut-off rate of 10 per cent per annum averaged over the sample.[17] This helped to account for systematic differences across country types that might be relevant to the behaviour of the RER but not necessarily related to the nominal exchange-rate regime.[18] The results shown in rows (3a) and (3b) of Table 2 confirm our suspicion that high inflation countries had much greater RER volatility than low inflation countries. We concentrated the rest of our analysis on the set of low inflation countries.

For the set of low inflation countries, the managed and floating exchange-rate regimes displayed significantly lower RER volatility than the fixed exchange-rate regime (2.4 and 3.4 compared with 20). This apparently perverse result may reflect the fact that many countries that experienced the fixed exchange-rate regime had low average inflation but highly variable inflation and highly variable growth rates, which should have increased the volatility of the RER for these countries.[19]

Stage 4: Countries with Low and Stable Inflation and Stable Growth Rates

Figure 3 shows the standard deviation of inflation and growth rates for the set of low inflation countries. We chose to exclude from our sample of low inflation countries those countries with either a standard deviation of growth greater than

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[16] Although we do not consider it in this paper, the behaviour of the RER at the time of regime switches is often dramatic and is one way in which the nominal exchange-rate regime may in fact have important implications for the RER and the economy in general.

[17] Inflation rates were calculated as monthly changes in the CPI (or the WPI when the CPI was unavailable) from the IFS.

[18] This is also a useful distinction because the regime classification scheme is likely to be more accurate for low inflation and more developed economies (as mentioned in Section 3).

[19] This volatility must reflect greater instability both in terms of external shocks, such as the terms of trade, and internal shocks such as changes in domestic policy settings. Most of these countries are members of the CFA African Franc Zone, which experienced a very substantial real and nominal devaluation in January 1994 (Savvides 1996).

4.5 per cent or a standard deviation of inflation greater than 1.5 per cent (that is, those countries shown in the upper and right quadrants of Figure 3).

Figure 3: Variability of Inflation and Growth for Low Inflation Countries
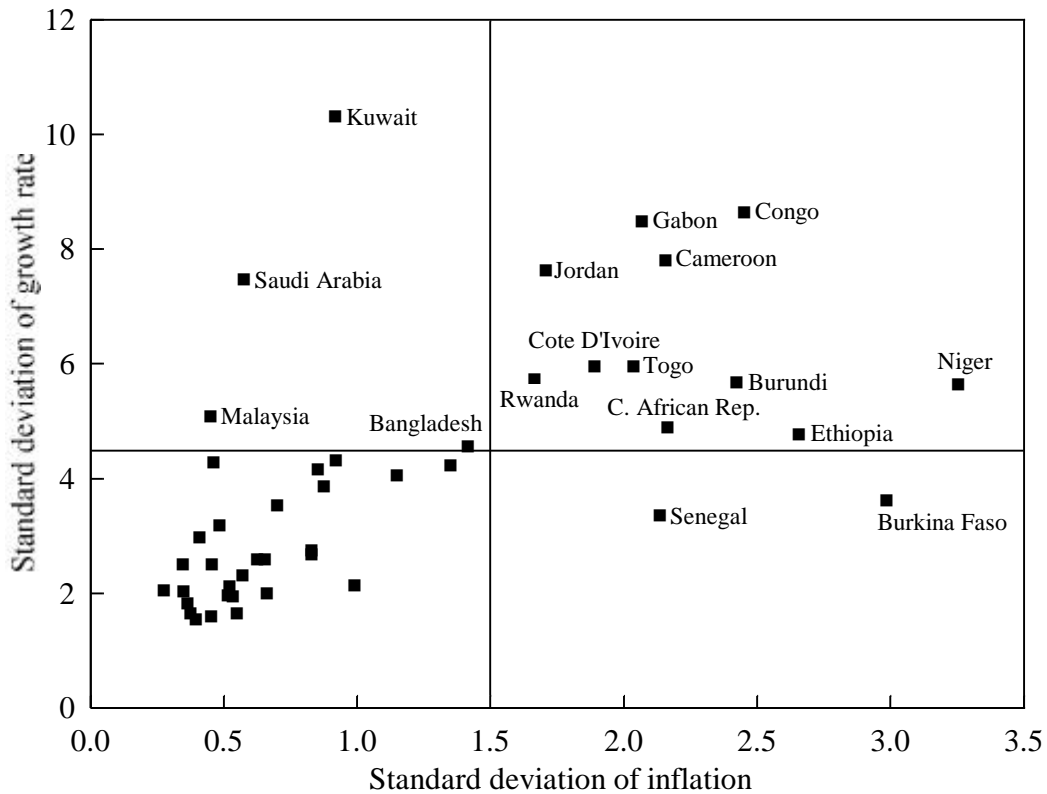
Notes: These calculations were based on monthly inflation and annual growth of real GDP. Real GDP data was from the Summers and Heston database in the Mark 5.6 version of the Penn World Tables.

The results of the effective RER volatility for 27 low and stable inflation and stable growth countries are shown in row (4) of Table 2. The ratio of the pooled variance of percentage changes in the effective RER during the floating exchange-rate regime compared with the fixed exchange-rate regime was 1.9 to 1. This difference was significant at the 5 per cent level. The short-term volatility of the effective RER during the managed float regime lay in between the other regimes (and was significantly different from both of these regimes).

The pooled results suggest that the effective RER displays greater volatility under more flexible nominal exchange-rate regimes, consistent with earlier findings based on bilateral RERs. However, the within country results in Table 3 show that there was no systematic difference in the short-term volatility of the effective RER across nominal exchange-rate regimes. Within the sample of 27 countries with low and

stable inflation and stable growth rates, there were 17 countries which experienced more than one regime over the sample period. Of these countries, only five had significantly more volatile effective RERs under more flexible exchange-rate regimes. Two countries displayed significantly lower RER volatility under more flexible regimes. Ten countries displayed no significant difference in the short-term volatility of the effective RER.

Table 3: F-Tests for Differences in Variances of Effective RERs Across Nominal Exchange-rate Regimes[a]

	Country	Fixed regime	Managed regime	Floating regime	F-Test[b]	Direction[c]
		Variance	Variance	Variance		
1	Australia		1.60	6.48	4.04*	+
2	Canada		1.14	0.95	1.19	0
3	Finland	1.26		3.42	2.72*	+
4	India		4.94	1.08	4.58*	−
5	Italy		0.66	2.72	4.15*	+
6	Japan		6.74	4.95	1.36	0
7	Korea	1.15	1.61		1.40	0
8	Morocco	1.54	2.38		1.55*	+
9	New Zealand[d]		1.46	1.10	1.10	0
10	Norway	0.92		0.51	1.80*	−
11	Pakistan	2.94	2.91		1.01	0
12	Singapore	0.66	0.68		1.03	0
13	Spain		1.71	1.01	1.69	0
14	Sweden	1.89		3.65	1.94*	+
15	Thailand	1.85	2.42		1.31	0
16	United Kingdom		3.68	3.68	1.00	0
17	United States		2.37	1.79	1.33	0

Notes:　(a) Variances were based on monthly percentage changes in the effective RER.

(b) * indicates significance at the 5 per cent level.

(c) A positive (negative) sign indicates that the variance is significantly higher (lower) for the Bretton Woods regime. A zero indicates no significant difference in the variance across regimes.

(d) For comparative purposes, the quarterly percentage changes for NZ were converted to the equivalent monthly changes.

5.   Concluding Remarks

In this paper we have re-examined the relationship between nominal exchange-rate regimes and the short-term volatility of the real exchange rate (RER). Our paper has incorporated two innovations. First, we focused our attention on the effective RER (as opposed to the bilateral RER used in previous studies of this type). We presented results for a set of industrialised countries, using the Bretton Woods and post-Bretton Woods eras to distinguish between fixed and floating exchange-rate regimes respectively. Like earlier studies, the variance of monthly percentage changes in the effective RER was significantly higher under the more flexible exchange-rate regime of the post-Bretton Woods period. However, whereas the short-term volatility of bilateral RERs increased about 12 fold post-Bretton Woods, for effective RERs the increase was just less than three fold (based on results pooled across all countries). Using within country analysis, for bilateral RERs this increase was of the same order of magnitude and statistically significant for all countries, however, in the case of effective RERs, there was no significant increase in volatility for three of the 14 countries in the sample.

The second innovation of our paper was to examine results based on a larger sample of countries using more recent monthly data on nominal exchange-rate regimes compiled from IMF records. Three broad regime classifications were identified – fixed, managed and floating. This data set had the advantage of significant variation in the timing of regime switches across different countries.

We focused our efforts on a group of 27 countries which experienced low and stable inflation and stable growth over the sample period (1978 to 1994). The results of pooling observations across countries, within regimes, implied that the short-term volatility of the effective RER under floating exchange-rate regimes was almost double the volatility under fixed exchange-rate regimes. This difference was statistically significant. However, the results from the within country analysis suggest that the relationship, if any, between the volatility of the effective RER and the nominal exchange-rate regime is quite weak. The within-country results are more appropriate than the pooled analysis if the behaviour of the RER is influenced by characteristics which vary across countries (although we attempted to control for some of these differences by restricting our sample to countries with common inflation and growth experiences).

There were 17 countries with low and stable inflation and stable growth rates, which had experienced more than one regime since 1978. Of these, only five displayed significantly greater short-term volatility of the effective RER under more flexible exchange-rate regimes. Twelve countries displayed no significant increase in the short-term volatility of the effective RER under more flexible regimes. Two of these countries actually displayed significantly lower volatility under more flexible regimes.

Our finding is not inconsistent with earlier findings which show that bilateral RERs are more volatile under floating exchange-rate regimes. First, a country's effective RER typically has lower variance than most of its component bilateral RERs. Second, it seems plausible that the nature of the fixed exchange-rate regime of the Bretton Woods system may differ from that of a fixed exchange-rate regime post-Bretton Woods. The variance of the effective RER under fixed exchange rate arrangements may depend on the extent to which major trading partners are also in a fixed exchange-rate regime. In other words, the fixed exchange-rate regime during Bretton Woods is quite likely to result in lower variance of the effective RER than the fixed exchange-rate regime post-Bretton Woods.[20] However, as our data set stands, there are almost no countries which are in the fixed exchange-rate regime both during and after Bretton Woods and are fixed to a single currency. The few that we can clearly identify as remaining fixed post-Bretton Woods also simultaneously went from fixed to the US dollar to fixed to a basket of currencies – and experienced a fall in their effective RER volatility post-Bretton Woods.[21]

One potential bias in our estimates of RER volatility comes about because we have excluded observations near to regime transitions. If anything, we feel that we have underestimated the volatility of the RER under the fixed exchange-rate regime because most of the changes in RERs at the time of regime transitions are probably due to fixed exchange rates (we leave this to further research).

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[20] Our results are consistent with this idea, although the comparison must necessarily be across a different set of countries over the two periods. The variance of monthly changes in the effective RER was 0.98 for the pooled sample of 16 industrialised countries during Bretton Woods. The pooled result for fixed exchange-rate regimes after 1978, based on a set of countries with low and stable inflation and stable growth rates, was 1.71.

[21] To investigate this issue more carefully would require an extension of our regime classification back to at least 1973.

Higher volatility of bilateral RERs under more flexible exchange-rate regimes has been explained in the past as being due to higher volatility of nominal exchange rates, combined with sluggish adjustment of prices. Our result does not discount this explanation – it may be that volatility across a range of bilateral nominal exchange rates is averaged out considerably when constructing effective real exchange rates. However, there is an alternative interpretation of our findings. It may be that countries choose nominal exchange-rate regimes in order to minimise RER volatility; that is, the choice of nominal exchange-rate regimes may be endogenous.[22] If this is the case, it may be difficult to find evidence of a systematic relationship between the nominal exchange-rate regime and effective RER volatility across all countries, even though the nominal exchange-rate regime may influence the volatility of the effective RER.

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[22] For a discussion of this topic see Edwards (1996).

Appendix: Nominal Exchange-rate Regimes

Table A1 indicates how the many different nominal exchange-rate regimes described by the IMF are aggregated into our three broad groupings. Our data on nominal regimes starts in November 1978 and ends in December 1994.

Table A1: Nominal Exchange Regimes – IMF Descriptions

	Description	Regime
1	pegged to US dollar	Fixed
2	pegged to Pound Sterling	Fixed
3	pegged to French Franc	Fixed
4	pegged to Spanish Peseta	Fixed
5	pegged to South African Rand	Fixed
6	pegged to Australian Dollar	Fixed
7	pegged to Indian Rupee	Fixed
8	pegged to Deutsche Mark	Fixed
9	pegged to Russian Rouble	Fixed
10	pegged to Italian Lira	Fixed
11	pegged to Ethiopian Birr	Fixed
12	pegged to Singapore Dollar	Fixed
13	pegged to SDR	Fixed
14	pegged to other (currency) composite	Fixed
15	exchange rate adjusted according to set of indicators	Managed
16	cooperative exchange rate arrangements	Managed
17	other, split into 3 categories as of 31 July 1982	*
18	flexibility limited in terms of a single currency	Managed
19	more flexible: other managed floating	Managed
20	more flexible: independently floating	Floating

Notes: * Category 17 is simply denoted 'other' in the *IFS* prior to 31 July 1982. For dates prior to this we used information from the IMF *Annual Report on Exchange Arrangements and Exchange Restrictions,* to dissagregate category 17 into categories 18, 19 and 20 shown above. More detailed information is available on request.

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