The Impact of Foreign Interest Rate Shocks on the Economy: The Role of the Exchange Rate Regime*

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Abstract

It is often argued that small economies are affected by shocks originating from large countries. This paper explores the connection between interest rates in major industrial countries and annual real output growth in other countries. Our results show that increases in large countries' interest rates have a contractionary effect on annual real GDP growth in the domestic economy, but that this effect is centered on countries with fixed exchange rates. We then examine the potential channels through which large country interest rates affect small economies. The direct monetary policy channel is the most likely channel when compared to other possibilities, such as a general capital market effect or trade effect.

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1 Introduction

Discussions of globalization often assert that the fortunes of small countries are driven by larger countries' economies. This notion contends that small countries are highly susceptible to shocks originating in large countries and that their economies often experience volatility for reasons independent of domestic policies. One assumption underlying this idea is that foreign interest rates have a strong impact on conditions in smaller countries. At the same time, the open economy "trilemma" and empirical tests of it suggest that only countries with pegged exchange rate regimes give up their domestic monetary autonomy.[1] The monetary policy constraints suggested by the trilemma imply that the channel through which foreign interest rates affect smaller economies determines whether large country interest rates have the same effect on pegs and floats.[2] Pegs are expected to be more affected if the channel is monetary, but if the main channel is simply a general capital market effect, the exchange rate regime may be irrelevant.

This paper answers two questions. First, what is the effect of interest rates in base countries on other countries' annual real GDP growth? Second, how does this effect vary by institutional arrangement (primarily the exchange rate regime) and other country characteristics? Answering the second question may help to disentangle the channels through which large country interest rates affect other economies.

We find that annual real output growth in small countries is negatively associated with interest rate movements in base countries,[3] but that this effect holds only for countries with fixed exchange rates. This finding is robust across a wide set of specifications, and suggests that the primary impact of foreign interest rates is through the monetary policy channel, and

[1] The trilemma is the conjecture that at any one time a country can only pursue two of the three options: a fixed exchange rate, open capital markets, and monetary autonomy because a fixed exchange rate and open capital markets will imply by interest parity that a country has lost its monetary autonomy. See Obstfeld, Shambaugh and Taylor (2005) for discussion of the trilemma and empirical tests.

[2] A "peg" will henceforth refer to a country whose exchange rate stays within a prescribed range while "float" and "nonpeg" will be used interchangeably to refer to any country that is not pegged.

[3] The "base country" is the country to which a country pegs or the country to which it would peg if it were pegged. The discussion in section 4 regarding the definition of fixed exchange rates will elaborate.

not as strongly through a general capital market effect. Additional work exploring potential channels supports these implications. This result suggests that there are real costs to the loss of monetary autonomy that comes with pegging and is further support that monetary policy and changes in interest rates can have substantial effects on the real economy.

Specifically, we find that a 5 percentage point (500 basis points) increase in the base country interest rate leads to roughly a 1 percentage point decline in annual GDP growth in pegged countries as opposed to no change in floats. This result is robust to a variety of controls for year, country, income and capital controls, and holds when we run the regressions on samples divided by region or income level. In addition, the results are consistent with a wide variety of specifications that add in base country annual GDP growth and other covariates. We also find that countries pegged to currencies other than the U.S. dollar do not respond to dollar interest rates any more than floats do. This suggests that pegged economies are not simply more exposed to world markets, but in fact are more exposed to the interest rate of the country to which they peg. In addition, when considering a variety of country characteristics that could drive the relationship between domestic output movements and the base interest rate, we consistently find the exchange rate regime to be an important factor and few other factors have such a reliable effect.

Finally, when examining channels, we find that the base rate does not appear to have an effect on variables such as the exports to the base country, and its effect on the spread works counter to the direction that GDP moves (i.e., base rate increases reduce the gap between domestic and foreign rates and should thus help GDP growth). Furthermore, a variety of specifications of capital flows regressed on the base interest rate do not seem to show strong results for either pegs or floats. On the other hand, base interest rates do have an impact on domestic interest rates and the impact is much stronger for pegs. This finding, along with the differences seen across exchange rate regime, suggests that the direct monetary policy channel may be the primary channel through which interest rate shocks affect other countries.

These results are important both for understanding how and why monetary policy shocks are transmitted around the world, and how the exchange rate regime allows a country to insulate itself from shocks originating in large countries.

This paper sits at the nexus of two literatures: (i) the impact of monetary policy on the economy, and (ii) the impact of large countries on smaller countries' business cycles. There is an extensive literature on the impact of monetary policy on the economy.[4] In general, the literature finds that increasing interest rates has a negative effect on the real economy. Di Giovanni, McCrary, and von Wachter's (2005) contribution is the most relevant to this paper because they use the base country interest rate to instrument for domestic rates. Their results show that countries follow the base countries interest rate to some extent (i.e., their instrument has power) and that monetary policy has a causal impact on output growth.

The literature on how large countries affect developing countries' economies is also relevant. Dornbusch (1985) considers the role of large country business cycles in determining commodity prices and subsequently other outcomes for developing countries. Calvo, Leiderman and Reinhart (1996) focus on the interest rates of large countries and argue that due to capital market links, low interest rates in large countries tend to send investors looking for high-yield investments in other countries. This process generates capital inflows for developing countries, which could then reverse when large country interest rates increase.

There also have been several attempts to untangle the impact of large country interest rates on domestic annual GDP growth. Reinhart and Reinhart (2001) consider a variety of North-South links when examining G3 interest rate and exchange rate volatility. They find that capital tends to flow to emerging markets when the U.S. eases its monetary policy, but do not see a connection with these changes in the Fed Funds rate and growth in emerging market economies. However, they do find an effect of the U.S. real interest rate on growth in some regions. Frankel and Roubini (2001) also find a negative effect of G7 real interest rates on developing countries' output. Since these papers consider many aspects of North-South

[4]This literature is too broad to distill here, see Christiano, Eichenbaum and Evans (1999) for discussion.

relations, they do not have space to consider in detail how large country interest rates and the domestic economy are connected. In particular, they do not consider how these relationships vary across institutional details (e.g., exchange rate or capital controls regimes), do not test what the channels may be, nor do they conduct detailed robustness checks.

In addition to these two studies, there have been a number of papers that use vector autoregressions (VARs) to explore the transmission of international business cycles.[5] A notable contribution is Kim (2001), who finds that U.S. interest rates have an impact on output in the other six G7 countries. This paper is one of the few to examine the potential channels through which the interest rate has an effect. It finds virtually no trade impact and that the impact comes from a reduction in the world interest rate.[6]

A related literature focuses on the impact of interest rate spreads on the domestic country. Uribe and Yue (2005) examine the domestic interest rate, the U.S. rate and the spread and find that the U.S. rate can explain up to 20% of domestic aggregate activity.[7] The issue of spreads is more one of channels, and we thus return to it at the end of the paper.

What has been largely absent from the literature, though, is the fact that the exchange rate regime should play a major role in how interest rate shocks are transmitted.[8] The open economy trilemma suggests that countries with open capital markets and pegged exchange rates sacrifice monetary autonomy and must follow the base country. Work by Shambaugh (2004) and Obstfeld, Shambaugh and Taylor (2004, 2005) confirm these predictions empirically. Thus, countries should not react to changes in large country interest rates uniformly. Countries with fixed exchange rates should be the ones most directly affected. In addition, pegged countries should not react to simply any large country interest rate shock, but

[5]See for example, Canova (2005), Maćkowiak (2003), and Miniane and Rogers (2003).

[6]All countries studied float against the U.S., so there is implicitly no discussion of exchange rate regime in the analysis.

[7]The standard error bands on the output response to U.S. interest rate changes generally include zero and the sample size is restricted for data reasons, however. See also Neumeyer and Perri (2005). They examine the volatility of business cycles in five emerging economies, discern that real interest rate volatility contributes to the volatility of the cycle, and that both foreign rates and country risk contribute to the volatility of the real rate.

[8]Broda (2004) considers how exchange rate regimes affect terms of trade shocks.

particularly to the interest rate of the country to which they are pegged.[9]

In this paper we focus on these insights and try to uncover the impact of large country interest rates on other countries while paying particular attention to the way the exchange rate regime may affect the transmission. The paper makes a number of new contributions to the literature. First, it takes the institutional differences across countries seriously. We focus our study on the exchange rate regime and capital control regimes of countries in order to examine the heterogeneous responses to base country interest rate shocks. Second, we try to consider the channels through which base country interest rates affect domestic economies. Third, we examine a broad data set which includes almost all countries. Finally, we rely on differences across countries in the base interest rate to allow for an examination of year controls and to test whether countries respond to large country rates in general or only to the base country. This additional power increases confidence in the results.

Section 2 discusses a conceptual framework briefly. Section 3 describes the empirical framework and any possible biases we expect to find. Section 4 presents the data and results. Section 5 concludes.

2 Conceptual Framework

When considering why the base interest rate should have any impact on other countries we begin from interest parity,[10]

$$R_t = R_t^b + \frac{\mathrm{E}_t e_{t+1} - e_t}{e_t}. \tag{1}$$

If the base interest rate rises, a floating country can simply allow e_t to rise (depreciate) creating a smaller expected future depreciation and no change in R_t. In doing so, local

[9] Our results are consistent with many other strands in the literature. The fact that only pegged economies respond to base country interest rate changes makes sense when one considers that exchange rates tend to be quite disconnected from macroeconomic fundamentals and that uncovered interest parity does not tend to hold (See for example Flood and Rose (1995, 1999) regarding the irrelevance of fundamentals for exchange rates and see Froot and Thaler (1990) for discussion of uncovered interest parity.). Given these long-standing results, we would be surprised if base country rates were generating large impacts through either the monetary or exchange rate channels for floating countries.

[10] While uncovered interest parity tends to fail empirically, as we will show later, it holds reasonably for fixed exchange rate countries making it relevant to the discussion.

borrowing costs have not changed and floating rates have served their insulating purpose.

As the trilemma suggests though, absent capital controls, a pegged country will be forced to increase the domestic interest rate to match the base interest rate or the peg will break. If the expected change in the exchange rate equals zero, and the base interest rate rises above the local rate, money will flee the home country until it forces the domestic rate to rise or the peg breaks. Thus, borrowing costs increase for the home country. In this setting, when the base interest rate increases the cost of borrowing has gone up for pegs and growth will likely slow down in the domestic economy, but there is no impact on floats. Furthermore, the foreign interest rate that matters is specifically the base interest rate, not simply any large country. In practice, we see pegs do in fact move their interest rate with the base rate and floats do not. On the other hand, while floats tend to depreciate over time, they do not do so in relation to moves in the base interest rate.

Alternatively, consider the supply of foreign capital. If a base interest rate declines, there may be more investors unable to achieve some desired threshold of return at home leading to more capital available to other countries. Such a process would again cause a negative relationship between the foreign interest rates and domestic output, but here the effect is identical across exchange rate regimes and it does not matter if the change in the interest rate is in the base country or any other large economy.

As this motivation focuses on interest parity relations and investors seeking high returns across borders, we see that it is the nominal foreign interest rate that requires our focus. At the same time, we focus on borrowing costs, suggesting that the local inflation rate may be a relevant consideration. We return to specific channels of the transmission later, but now turn to how we estimate the impact of the base interest rate on domestic growth.

3 Empirical Framework

Researchers face many challenges when trying to measure the causal impact of domestic interest rate changes on the real economy. In the present study, there are several potential biases in measuring the effect of domestic interest rates on short-term output growth when examining a large cross-section of countries.

One classic problem econometricians are concerned with in the macroeconomics literature is the forward-looking behavior of monetary policy. In particular, monetary authorities may act preemptively to offset future economic conditions. For example, a central bank may raise its interest rate in the current period because it is expecting growth to be above potential in the next period. If the policy is successful in pulling output growth down towards potential, one should expect to see a negative relationship between the interest rate and output growth. However, the econometrician normally only has a subset of information that the central bank to condition on; therefore, the measured coefficient for the interest rate in an OLS regression will be biased towards zero.

Another issue that is also important to consider, particularly in the case of smaller developing economies, is how to disentangle whether the interest rate drives output growth or vice versa. For example, poor fundamentals may drive up a country's borrowing costs, which in turn will lead to slower output growth, thus placing upward pressure on interest rates. This circular pattern may also be caused by the expectations of investors outside the economy, who place a high probability on worsening economic situations in the future, which in turn give them impetus to demand a higher return for borrowing today. Such behavior may result in a self-fulfilling slow-down of the economy.

The potential bias or simultaneity problems can be characterized by the following reduced-form equations. Let the nominal interest rate's dependence on current annual output growth, for a single country, be represented by:

$$R_t = \alpha_0 + \varphi y_t + \delta' \mathrm{W}_t + \eta_t, \tag{2}$$

where R_t is the domestic nominal interest rate, y_t is annual real output growth, and W_t is a matrix of other variables as well as lags of variables in the system. Equation (2) may represent a policy maker's reaction function or a particular channel through which current output growth affects the domestic interest rate, as discussed above.

Next, a common specification used when estimating the impact of the interest rate on output growth is:

$$y_t = \alpha_1 + \beta R_t + \phi' \mathrm{X}_t + \varepsilon_t, \tag{3}$$

where X_t is a matrix of other variables as well as lags of variables in the system. The estimated impact of the interest rate on output growth in an OLS regression ($\hat{\beta}_{OLS}$) will not be identified given equation (2).

The common approach in identifying the impact of the interest rate on output growth is the vector autoregression (VAR) framework, where the econometrician makes certain assumptions to identify the system (e.g., see Christiano et al. (1999) and references within). Recently, di Giovanni, McCrary and von Wachter (2005) suggest a simple instrumental variable approach (IV) to identify the impact of monetary policy on output growth given a potential forward-looking bias problem.[11]

The instrumental variable approach will not work in all cases, however. In particular, as several papers have pointed out (e.g., Calvo et al., 1996), the fortunes of smaller economies may depend on the movements of large countries' interest rates for other reasons. Therefore, the anchor (or base) country's interest rate may belong in the second stage of an IV regression, and therefore is not a suitable instrument. This issue motivates the first question we wish to answer about what is the effect of interest rates in base countries on domestic countries' growth rates. To begin, this question can be explored by the following output growth equation in a panel regression:

$$y_{it} = \alpha_2 + \theta R^b_{it} + \phi_1' \mathrm{X}_{it} + \nu_{it}, \tag{4}$$

where i represents a given country, R^b_{it} is the base country nominal interest rate, and X_{it} is a

[11] They use the German interest rate as an instrument for the domestic interest rate for European countries over the ERM/EMS period. The success of this strategy depends on the fact that many countries followed German monetary policy in order to maintain parity in the exchange rate systems, while other countries chose Germany as an anchor in order to import low-inflation credibility. Though the German rate is not a perfect instrument, it can be shown that the IV bias is less than the OLS bias (see di Giovanni et al. for details).

matrix of other covariates in the system. R^b_{it} varies across domestic countries since they have different base countries (see below for a further discussion). In this case, the OLS estimate of the impact of the base interest rate on domestic output growth ($\hat{\theta}_{OLS}$) is identified since domestic output growth will arguably not drive the base country's interest rate.

However, there is still a possibility of world shocks that influence domestic output growth and the base interest rate contemporaneously. We attempt to control for these shocks by including various controls in the X_{it} matrix, such as time fixed effects. Furthermore, the endogeneity of monetary policy in the *base country* may also bias the estimate of θ. In particular, the base interest rate may change in response to the base country policymaker's reaction to expected GDP growth, which might have a direct influence on domestic country GDP growth (i.e., on y_{it}). This effect actually works against finding a strong response of domestic GDP growth to the base country interest rate in that it will bias coefficients towards 0, so we also include base country controls in X_{it}.

The second question that this paper seeks to answer is whether the impact of the base interest rate on domestic output growth varies across exchange rate regimes. This hypothesis can be tested based on the following regression framework:

$$y_{it} = \alpha_3 + \theta_1 R^b_{it} + \theta_2 Peg_{it} + \gamma R^b_{it} \times Peg_{it} + \phi_2' X_{it} + \upsilon_{it}, \tag{5}$$

where Peg_{it} is a 0/1 dummy variable indicates whether country i is pegged or not to its base country. Testing the null hypothesis $\gamma = 0$ will answer whether there is a difference in the impact of the base country interest rate on domestic output growth across pegs and floats. In particular, we expect that $\gamma < 0$ if pegs are more affected by base country interest rates.

A matrix of controls, X_{it}, is also included. Again, one concern is the potential bias due to the endogeneity of base country monetary policy. It is worthwhile noting that this bias is expected to be larger for pegged countries because these countries' economies are likely to be more dependent on that of the base country, thus increasing the potential impact of the forward-looking bias of the base country in regression (5).[12]

[12]See di Giovanni et al. (2005) for an analysis of different economic variables that the bias may be related

3.1 Random Coefficients Model

Estimation of equation (5) poses certain limitations and assumptions, which may not be optimal. First, it assumes that the impact of the base rate (and other covariates) on domestic GDP growth is homogeneous across countries at time t, which need not be the case.[13] Second, we would like to interact the base interest rate with other potential covariates, but doing so with too many variables makes the estimation and interpretation of estimated coefficients from equation (5) unwieldy. Therefore, given that the focus of the paper is to examine what cross-country characteristics matter for the impact of the base rate on domestic GDP growth, we estimate the following system of equations:

$$y_{it} = \mathrm{X}_1\beta_1 + \mathrm{X}_2\beta_{2i} + \omega_{it} \tag{6}$$

$$\beta_{2i} = \mathrm{Z}_i\widetilde{\gamma} + \xi_i, \tag{7}$$

where X_1 is a matrix of country-specific dummies, time dummies, and other covariates such as base GDP growth, oil prices, and other variables. The X_2 matrix contains the base country interest rate. A key assumption underlying equation (6) is that we allow all the coefficients in β_1 to vary by country, except for the time dummies, which capture common shocks across countries. The coefficients for β_{2i} are treated as random, and are modeled as a function of country-specific covariates (Z_i) in equation (7). These covariates are country characteristics averaged over the sample period. For example, one such variables is the average of Peg_{it} over time, where a 0 would indicate never pegged vs. a value of 1, which would indicate continuously pegged.

Equations (6) and (7) can be combined to produce a Random Coefficients Model (RCM) representation of the system:

$$y_{it} = \mathrm{X}_{\mathbf{1}}\beta_1 + \mathrm{X}_2\mathrm{Z}_i\widetilde{\gamma} + \epsilon_{it}, \tag{8}$$

to.

[13] E.g., see Hsiao and Pesaran (2004) and Smith and Fuertes (2004).

where $\epsilon_{it} = \mathrm{X}_2\xi_i + \omega_{it}$. Thus, the coefficients in the vector $\widetilde{\gamma}$ capture how the impact of the base rate on domestic GDP growth varies by country characteristics.[14]

3.2 Channels

To understand the channels through which the base interest rate operates, we first consider the implications of our results on which characteristics are consistent with a strong reaction to the base interest rate. We replicate regressions (4) and (5) for different channel variables, z_{it}. In particular, the following regressions are estimated:

$$z_{it} = \alpha_4 + \pi R^b_{it} + \phi'_3 \mathrm{X}_{it} + \zeta_{it} \tag{9}$$

$$z_{it} = \alpha_5 + \pi_1 R^b_{it} + \pi_2 Peg_{it} + \lambda R^b_{it} \times Peg_{it} + \phi'_4 \mathrm{X}_{it} + \vartheta_{it}, \tag{10}$$

where the primary hypotheses that we are interested in testing are $\pi = 0$ and $\lambda = 0$. This process does not definitively establish the existence of a channel, but allows us to see which variables move with the base rate, move in the direction consistent with the impact on GDP, and move differentially for pegs and floats.

4 Data and Results

4.1 Data

Data sources are described in detail in Appendix A. Most financial and exchange rate data comes from the IMF's International Financial Statistics while most real economy data (GDP, trade levels, etc.) come from the World Bank's World Development Indicators. The exchange rate regime classification is from Shambaugh (2004) and is a de facto classification, which is described in detail in the appendix. The sample runs from 1973–2002 for 160 countries, yielding roughly 4000 country/year observations for most specifications.[15]

[14] Following Amemiya (1978) and Hsiao (2003), equation (8) is estimated using Feasible Generalized Least Squares (FGLS). See Appendix B for details on estimation as well as assumptions and tests of the model. Note that the sample is restricted so that countries must have a minimum of twenty observations to be included in the sample for this analysis.

[15] The sample is limited in a few ways. First hyperinflations are eliminated as they are generally outliers for many of the dimensions of interest (for example domestic interest rates). Second, we eliminate countries

Table A1 lists our country sample and Table A2 shows simple summary statistics. Our sample is dived roughly equally between pegs and nonpegs and the average growth rates of the two are nearly identical. The growth rate of pegs does exhibit a slightly higher volatility; an unconditional finding, but one consistent with our subsequent work showing that annual growth rates in pegs are affected by base interest rates.

4.2 Panel Estimation

4.2.1 Core Results

The most basic result is obtained from testing equation (4) for the full sample. In this specification, we look to see if on average, countries' annual real GDP growth varies with the base country interest rate. Column 1 of Table 1 shows this basic result where there is a negative point estimate, but it is close to zero and not remotely statistically significant.[16] Thus, on average, countries do not seem to be affected by the base interest rate, or at least the biases towards zero discussed above dominate any relationship. The second and third columns, though, show that there is a significant relationship for pegged countries but none for nonpegs. The fourth column pools the data and uses the interaction term to highlight the exchange rate regime effect (equation (5)). Again, there is no general effect on countries (the coefficient on base R is effectively zero) and yet there is a statistically significant negative coefficient on the interaction term. Pegs' economic activity appears to slow down when the

with GDP growth either above 20% or below -20%. We view these growth rates as either mistakes in the data or highly unusual circumstances that may cloud the results. As it turns out, moving the cutoffs or allowing these outliers in the data set does not change the results except in a few circumstances where they appear to strengthen our results. Finally, we drop countries with a population less than 250,000 as we view them as too small to be representative.

[16]The standard errors are clustered at the country level. This is the most conservative clustering setup in that it increases standard errors over other choices such as simply using robust standard errors or clustering at the base country level. The latter may be a preferable choice in that the base interest rate obviously repeats for all countries pegged to the same base. We choose to use local country clustering in part to be more conservative. Clustering allows an unspecified autocorrelation matrix removing concerns of serial correlation in the error term (see Bertrand, Duflo and Mullainathan (2004)). GDP growth is persistent, but not strongly so. The autocorrelation is only 0.29. Base interest rates are more persistent, but the overall regression shows only a 0.28 serial correlation in the error. When time and country controls are included this serial correlation is even lower. Thus, the serial correlation appears low enough that clustering is a sufficient means to compensate.

base country interest rate rises.[17]

These results are economically significant as well. They imply that a 1 percentage point increase in the base rate cuts 0.1-0.2 percentage points off of annual GDP growth for pegged countries. Thus, if the base is in a tight monetary policy period vs. a loose period (often up to a 500 basis point swing in interest rates), this could have a full percentage point impact on pegged countries annual GDP growth while having no impact on floats. Again, these results are likely biased towards zero, and the gap should be biased down as well.

The positive coefficient on the peg variable should be interpreted carefully because the coefficient on the interaction of peg and base interest rate is negative and the base interest rate is a positive variable. The mean of base interest rate is 0.07, and when multiplied by the -0.18 coefficient on the interaction, we see the mean impact of a peg is zero ($0.139 + -0.18 \times 0.07$). The lack of an impact on annual growth rates for a pooled sample is consistent with Husain, Mody and Rogoff (2005).

4.2.2 Fixed Effects and Other Controls

As discussed, we are concerned about omitted variables. In particular, one concern includes world shocks that raise interest rates and slow down growth around the world. Alternatively, the direct effects from the base country's annual GDP growth to the domestic country's and the fact that base GDP and base interest rates are related are also problematic. Table 2 explores some of these issues by including a variety of fixed effects and base country GDP growth. First, we include year effects to control for worldwide shocks.[18] Column 1 shows that year effects do alter the regression by shifting the coefficient on the base rate to positive, but the gap between pegs and floats remains the same and remains significant.

[17]We also note that the fact that nonpegs includes many countries that are truly between pegging and floating, but are not pure pegs or countries that only peg for part of the year. This methodology should blur the distinction between the two regimes and makes our finding of a significant difference all the more surprising.

[18]Most data sets are unable to explore such an effect because they only use one world interest rate as opposed to a base interest rate that can vary across countries depending on the base. The base interest rates are certainly correlated, so including such year controls takes some power away from the regressions.

Alternatively, growth rates may differ across countries. We thus include country fixed effects. The results are still quite similar with these effects included. The positive coefficient on the base rate disappears but the negative and significant coefficient on the interaction term remains. Finally, we include base GDP growth in the regression. While the coefficient is positive (as expected), it has little impact on the regression results and is only significant when year effects are excluded.

Since we motivated the empirical work by considering the interest parity relationship and the costs of borrowing, there are two other variables that may be relevant. First, we may be concerned with the real cost of borrowing in the domestic country. In this case, the local inflation rate will be relevant. Likewise, the interest parity relationship suggests the expected change in the exchange rate should be included, so we include the change in the exchange rate. Column 4 shows that high inflation countries grow more slowly and the change in the exchange rate has no impact. The inflation rate is highly correlated with the GDP deflator's growth rate, and thus it may be problematic to include contemporaneous inflation. No impact is found when including lagged inflation to proxy for expected inflation, though now the change in the exchange rate is significant and negative (inflation and the change in the exchange rate are highly correlated).[19] Finally, particular world shocks, such as oil shocks, may affect growth. The final column includes real oil prices and shows that in aggregate they have no effect.[20] We also note that the results change little or not at all if we drop crisis years, drop regime transition years, or drop observations that Reinhart and Rogoff (2004) describe as "freely falling" (see Table A4).

4.2.3 Sub-Samples

Table 3 shows the results across different sub-samples of the data. First, the results hold in the very broad groupings of developing (LDC) and industrial countries (DC). In both

[19]Even when using lagged inflation, the change in the exchange rate is not significant if we exclude high depreciation countries (those depreciating more than 20 percent in a year).

[20]The lack of an impact is likely because high oil prices help some countries and hurt others. In a later section, we allow the impact to vary across countries.

cases, there is a significant negative relationship for the interaction term of base interest rate and pegging. There is a small and weakly significant negative coefficient on the base rate for industrial countries in general, implying that all countries are affected regardless of exchange rate regime.[21] Dividing further by income groupings, there are strong significant reactions in high income and lower middle income countries. The response for low income countries has the expected point estimate, but is not significant. The only grouping not to show expected results is the upper middle income. According to geographical groups, the results are strongest in the Middle-East and Europe. No region has a significant coefficient on the non-interacted base rate, so no region shows evidence of nonpegs being affected by the base rate, and all but South Asia show coefficients on the interaction term in the expected range. The results are not always significant as sample size shrinks, but it does not appear that our results are driven by any one type of country or region, and they seem to be representative across a broad cross-section of countries.[22]

4.2.4 Alternate Base Interest Rates

While the results appear robust to a variety of fixed effects, we can further explore the results by taking advantage of the fact that countries do not all peg to the same currency. Thus, we can check non-dollar based countries against the U.S. interest rate. If the only issue is a capital market effect, the dollar rate should be important, but if the effect is driven by the monetary channel suggested by the trilemma, only the actual base interest rate should matter. That is, if we see a gap between pegs and floats, does this gap exist for all large country interest rates, or only for the rate of the country to which they have pegged? Table 4 shows that in the core regression, dollar based countries and non-dollar based countries

[21]We are unable to include year effects in these specifications because in some sub-samples there is insufficient variation in which country is the base.

[22]Much of the previous work on this topic has focused on Latin America. We note that this is the one region that comes close to having a significant reaction on the base interest rate regardless of exchange rate regime. In addition, if one does not exclude the very high inflation outliers in this region, the coefficient on base interest rate becomes significant. Keeping high inflation countries in the full sample does not have this effect.

look similar, though the results are stronger for countries pegged to the dollar. We cannot use year effects on the dollar sample in column 1 because there is only one base interest rate used. Column 2 is the analogous regression for nondollar countries. Column 3 includes year effects as well. When we substitute the U.S. interest rate for the base interest rate for the non-U.S. based countries, there are no significant relationships. Neither pegs nor non-pegs respond to U.S. rates and the gap is insignificant. The relationship is completely insignificant even with no fixed effects.

These regressions show that pegs are not simply more affected by large country interest rates, but are affected by the interest rates of their base in particular. Second, the fact that U.S. rates are moot for non-U.S. based countries suggests that the capital market effect is not the primary channel. For almost any country, the U.S. interest rate is important in financial markets, but, pegs only respond to their base, not to the dollar interest rate.

4.2.5 Other Controls and Robustness Checks

We have motivated some of our discussion with the trilemma. This suggests, though, that capital controls should also be an important consideration. If a country has capital controls, it may be less sensitive to a capital markets channel, and its monetary policy should also be less constrained by the base interest rate if it is pegged. As we add more controls and characteristics, though, the number of interaction and cross interaction terms required makes the results less straightforward to interpret. For capital controls, trade levels, and any other characteristic, we instead turn to the random coefficients structure described above where we can try to explain the reaction of a countries' growth rate to the base interest rate using a number of different institutional and country characteristics ranging from the exchange rate regime to capital controls to trade levels.[23]

Before turning to these results, we briefly summarize other controls and estimation issues

[23] When we include capital controls and the variety of necessary interactions, our core results do not change. The results for the capital control variables have the expected sign although they are only significant in certain specifications.

we have considered. First, we have run regressions using a dynamic specification of equation (5). In particular, we include lagged domestic GDP growth. We see very little difference in the results, most likely because output growth is not necessarily a very persistent variable (unlike the level of GDP, for example). We have used real interest rates instead of nominal interest rates. While the rate that is relevant in interest parity or other international conditions is the nominal rate, we also examine base real interest rates. Results vary depending on how the base real interest rate is defined (subtracting current or lagged inflation from the nominal rate). Alternatively, if we simply include the base interest rate and base inflation separately, we continue to find our standard results. In addition, we have examined our results across subsets of countries divided by debt levels. Least indebted countries appear to be the least exposed to foreign interest rate shocks, yet our core result of pegs reacting more than floats appears to hold across quartiles by debt level, though the significance varies.[24]

In addition, since we discuss borrowing costs as a potential channel, we check that our results hold for real investment growth in addition to real GDP growth. We find (see Table A3) results that are even stronger than our main results in both size and significance. Again, there is a strong difference between pegs and nonpegs. Pegs exhibit a strong negative response in real investment growth rates after a base interest rate increase. And, again, nonpegs do not respond to dollar interest rates despite responding quite strongly to their own base country interest rates.

Finally, we also examine other exchange rate regime classifications. If we simply replicate Table 1 using de jure codes (countries' declared regime status), we see directionally similar but much weaker results without fixed effects and reach an opposite conclusion with effects (see Table A5). This is not surprising given the fact that some of the observations are miscoded in the de jure codes mixing pegs and floats together. When using Reinhart and Rogoff's classification codes (condensed to a binary coding) we see similar, though slightly weaker, results without fixed effects, and, again, opposite reactions with full effects. If we

[24] All these results are available from the authors upon request.

restrict ourselves to the 80 percent of the observations where the Reinhart and Rogoff and Shambaugh classifications agree, the results are similar without effects and unclear with the effects. As columns 1 and 2 show, we lose a significant number of observations when using Reinhart and Rogoff codes. Furthermore, their codes show fewer switches making finding significant results with country fixed effects less likely. Finally, we use the disaggregated Reinhart and Rogoff codes as well (see Table A6). Here we see that with no fixed effects only pegs have a significant relationship with the base interest rate and only pegs and crawling pegs have strongly significant reactions with fixed effects. Thus, the reactions are not identical across classifications, but they are similar in a number of specifications. [25]

4.3 Random Coefficients Estimation

We next turn to results from estimating equation (8). As discussed above, using a random coefficients framework provides a method that not only allows for greater flexibility in estimating the impact of the base interest rate on domestic annual GDP growth using the time series data while controlling for global shocks, but also allows us to take into account many cross-country controls when trying to explain this impact of the base interest rate.

This estimation methodology confirms the importance of the exchange rate regime. In particular, Tables 5 and 6 present the estimated coefficients for the whole sample and the less developed country sub-sample, respectively.[26] The country-specific variables used in the regressions (i.e., the X_1 variables) include a constant, base GDP growth, and the oil price. Furthermore, a time effect is included for all countries. We also experimented with including inflation and exchange rate changes, but, like in the panel estimation, including these variables do very little to our estimates and reduce sample size.

Before turning to the precise quantitative results, our main result can be summarized in

[25] We see an advantage in using the Shambaugh classification based on data coverage, availability, and the annual nature of the coding used which matches the frequency of our other analysis and data. Thus, we use it for the bulk of our analysis. See Shambaugh (2004) for an extensive discussion of the different classifications.

[26] Results were broadly consistent for the developed country sub-sample, but statistical significance is lower given a smaller cross-sectional component. Results are available from the authors upon request.

Figure 1. The vertical axis represents estimated coefficients of the impact of the base rate on annual GDP growth, and are calculated from a first-step estimation of a FGLS procedure (see Appendix B for details). The horizontal axis represents how pegged a country was over the sample; i.e., it is an average of the exchange rate regime binary indicator over the period. A value of zero implies that the country was always a nonpeg, while a one indicates that country always fixed to its base. The figure depicts a negative relationship, implying that the average impact of a foreign interest rate movement on domestic real annual GDP growth will be larger the more fixed a country is on average.

Table 5 shows that this result is robust across all specifications, and is both economically and statistically significant. The average of the results across specifications indicates that a 1 percentage point foreign interest rate shock will result in a 0.25 percentage point greater impact on annual real GDP growth for countries that were pegged throughout the sample compared to those that were floating. Interestingly, the other control variables are not significant. However, it is worth noting that the sign of the coefficients in general line up with what one would expect.

First, the capital controls variable is positive, indicating that restricting the capital account will dampen the impact of foreign interest rate shocks. Meanwhile the trade/GDP coefficient is generally negative indicating that foreign interest rates have a larger impact for economies that are open to trade. There is no *a priori* reason to expect this result, but trade and financial openness are strongly correlated, and more financially open countries may be impacted more by foreign interest rate movements. Third, the more a country exports to its base country (as a ratio of GDP) the impact of the base rate on domestic output growth is weaker, which makes sense given the identification problem resulting from the forward-looking bias of the foreign monetary policymaker and common shocks.[27] It is also interesting to see the coefficient on the peg increase (in absolute terms) when including the exports to

[27]Note that we also control for this effect in the time series part of the estimation by including base GDP growth in X_1.

base variable. Finally, income variables are not significant, though their inclusion increases the point estimate of the Peg coefficient.

The results for the less developed country sub-sample in Table 6 are very similar to those for the whole sample in Table 5, but the effect of the exchange rate regime is even stronger now. The average of the results across specifications indicates that a 1 percentage point foreign interest rate shock will result in a 0.30 percentage point greater impact on annual real GDP growth for countries that were pegged throughout the sample compared to those that were floating. It is also interesting to note that the trade/GDP measure is now also significant.

Financial markets, both domestic and international, may also affect how strongly the domestic economy reacts to movements in the base rate. We therefore examine the impact of the average level of financial development, external capital flows, and financial openness in Appendix Table A7.[28] The only new variable that is significant is the ratio of credit to GDP in column 2, which has a positive coefficient, indicating that a move in the base rate has a smaller impact in more financially developed economy (viz. credit).[29] The Peg coefficient only loses its significance in this specification. However, the absolute coefficient size does not drop dramatically, and the decrease in sample size of including this variable has a negative impact on the power of any tests.[30]

4.4 Channels

A foreign interest rate shock should not have a direct effect on the domestic economy. However, it may operate through some channel and have an indirect impact either by affecting

[28] Results look similar for sub-samples.

[29] This result points to a potential dampening effect of financial depth on the impact of the base interest rate on annual output growth. Furthermore, interacting the peg with the credit variable produces a positive, but not significant coefficient, and returns the Peg coefficient to being significant and with a size comparable to the other specifications in the table. This dampening effect of financial depth has been highlighted in recent work by Aghion, Bacchetta, Rancière and Rogoff (2005).

[30] There is also a sampling issue. In particular, running the regression on the same sample while excluding the credit ratio variable also yields insignificant coefficients for the Peg variable, which stands in contrast to the results found in column 5 of Table 5.

domestic interest rates, investment flows, or other variables that contribute to annual GDP growth. In many ways, we have already tested the channels by examining characteristics and base rates. Our results that pegs are more affected than floats is consistent with a monetary channel. The lack of an effect of the U.S. interest rate on both pegs and floats that are based to countries other than the U.S. is inconsistent with the capital market channel. Similarly, the fact that the exchange rate regime is the most dominant characteristic driving the relationship between base rates and GDP growth in the RCM framework is again consistent with the monetary channel.

To further determine through which channel(s) the foreign interest rate operates, we test a series of variables against the base interest rate and see if they move in a direction consistent with the direction that GDP growth moves. If there is no relationship between a particular variable and the base interest rate, this suggests that the channel is not operational. Finding significant relationships does not establish that a channel is the primary one affecting domestic growth definitively, however, but establishes the existence of a potential channel.

This methodology is analogous to that of Kim (2001), who applies the same identification strategies he uses to identify the impact of monetary policy on output to other channel variables (e.g., trade). He then asks what models the resulting impulses of these variables are consistent with. We do not follow a VAR strategy to identify monetary shocks, but we expect that the impact of base interest rates on economic variables to differ given potential channels, as well as across different exchange rate regimes.

4.4.1 Interest Rate Channel

We consider a wide variety of potential channels. As noted often in the paper, one focus is on the direct effect of base interest rates on domestic interest rates. The presumption is that domestic interest rates have some impact on the economy, and if movements in base interest rates force movements in the local rate, this will have an impact on the economy. Thus, we test the impact of changes in base interest rates on domestic rates.

This channel has been tested in Shambaugh (2004) and Obstfeld, Shambaugh and Taylor (2004, 2005) with a series of controls and robustness checks. We do not repeat all tests here but simply check the basic specifications with our data.[31] We see in Table 7 that domestic rates do seem to move with base interest rates, but this is driven by pegs. In the pooled sample, there is no effect on floats, but the pegged sample shows a statistically significant and economically meaningful coefficient of roughly 0.4 depending on the specification, implying 40% of base rate changes are passed through to domestic rates in fixed exchange rate countries.[32] Thus, the direct monetary channel appears to be a possible explanation for the growth impact. When base interest rates rise, domestic rates in pegged countries rise. The direction and difference between pegs and nonpegs are consistent with our growth results.

4.4.2 Interest Rate Gap Channel

Alternatively, the foreign interest rate may not only move the domestic rate directly, but also have an impact on the spread. Consider the equation:

$$R_{it} = R_{it}^{b} + \Delta e_{it} + \delta_{it}, \tag{11}$$

where R_{it} is the local rate, Δe_{it} is the expected change in the exchange rate, and δ_{it} is a relative risk premium on domestic vs. foreign assets. The change in the base rate may not simply affect the domestic rate directly, but it may also change expectations on the exchange rate and the risk premium causing a change in the spread between the domestic and foreign rates. Uribe and Yue (2005) note that an increase in the base rate might not only increase

[31] Shambaugh (2004) discusses the fact that we should be worried about persistence in nominal interest rates and should consider a specification in differences. We follow that here. Domestic rates are far more persistent than the other variables we consider for channels, that is why we turn to differences only for the interest rate and spreads regressions.

[32] These results are also consistent with findings in Miniane and Rogers (2003) who find that local interest rates respond to base interest rates more for pegs. Borensztein, Zettelmeyer and Philippon (2001) also find pegs respond more to monetary shocks when looking at a small group of countries. Frankel, Schmukler and Servén (2004) agree that short run reactions are slower in nonpegs than in pegs, though they argue that long run reactions are more similar (cf Shambaugh). Finally, Hausmann, Gavin, Pages-Serra and Stein (1999) do not find this relationship when using a small panel of Latin American countries and using real interest rates.

the domestic rate directly, but may also increase the spread generating the possibility of a more than one for one increase in domestic rates. We thus test the impact of the base rate on the spread between domestic and base rates.[33]

When we examine the interest rate gap (defined as the domestic minus the base interest rate) and the base interest rate, we see statistically significant results, but the direction of the reactions would not explain a decrease in GDP growth after an increase in base rates. Table 8 shows the results. There is a strongly negative reaction implying that the spread declines after an increase in base interest rates, and this reaction is stronger for nonpegs. This result is not surprising. If the domestic rate does not respond to the base rate in floating countries, as Table 7 shows, then the spread automatically moves opposite the base interest rate. The spread shifts less for pegs because domestic interest rates do go up with the base interest rate to some extent in these countries. A declining spread should be positively correlated with GDP growth, but we do not see improvement in GDP after a base rate increase. Thus, these results seem to imply there is not a strong spreads channel largely because for most countries, there is no affect of base interest rates on domestic rates, and the spread is not acting like a multiplier of base rate changes, but is simply the residual arising from domestic rates not moving with the base rate fully.[34]

4.4.3 Exports to Base Channel

Changes in the base country interest rate may also have real effects in the base country. To the extent that some countries are economically dependent on the base country, a primary channel through which this may have a direct effect on the domestic GDP growth is changes in exports to the base country. There are two reasons to be somewhat skeptical that this channel will have strong effects, however. First, to the extent that interest rates in the

[33]Note that Uribe and Yue (2005) look at foreign currency denominated bonds, so their spread is strictly δ_{it} , whereas our interest rates are domestic, so our spread is $\delta_{it} + \Delta e_{it}$.

[34]These results are almost identical if one looks at the the spread rather than the change in the spread itself. The only difference being that the difference between pegs and nonpegs becomes less significant. We use differences because spreads, like domestic interest rates, are quite persistent.

base countries are counter-cyclical, we would expect the classic monetary policy result that the increased interest rates are simply offsetting higher expected growth, and not actually slowing the economy down to recession levels. Thus, it would be surprising to see an impact through the growth rates of the base economy. In addition, base country GDP growth has been included in the output growth regressions, and it does not weaken the base interest rate effect. Still, we test here the impact of base rates on exports to the base country to see if there is a possibility of such a channel.

Table 9 shows that exports to the base do not move in a direction consistent with our results. Without any fixed effects we see that nonpegs experience a drop in exports to the base while pegs experience a slight rise. This result is inconsistent with the annual growth impacts that we find. Furthermore, when more controls are added, the impact on nonpegs disappear and we are left with a slight increase in exports to the base by pegs. This result fits our assumption that base countries may be acting counter-cyclically and this counter-cyclicality may in fact be mitigating our main results. It appears that pegs are helped by an increase in exports to the base when the base rate is high, but that this relationship is overwhelmed by the monetary channel.[35]

4.4.4 Capital Flows Channel

Calvo et al. (1996) consider the impact of large country interest rates on financial flows. Their concern is that interest rate movements in developed countries may affect the volume of capital flows to developing countries. The hypothesis is that an increase (decrease) in base interest rates would shrink (expand) the pool of capital available outside the base country because more base country funds would stay (leave) home. Thus, we test the impact of base interest rates on domestic country financial flows. There is no *a priori* reason for this effect

[35] The exports to base/GDP series is quite persistent as well, suggesting the possibility of using changes for this channel as well. When changes in exports to base (divided by GDP) are regressed on changes in the base interest rate, there is no significant coefficient on the interaction, but the non-interacted base interest rate coefficient is now small and significantly positive implying that the boost in exports that comes with growing base countries may hit pegs and nonpegs alike. Regardless, this does not seem to be a channel that explains a slowdown in growth after base interest rates rise.

to differ across exchange rate regime.

Table 10 shows the effect of the base rate on capital flows. We consider two indicators of the impact. First, we look at the percentage change in total external liabilities against the base rate. Second, we look at the change in total liabilities to GDP. In general, the results do not support a capital flows channel. When no controls for year or country are included, the change in liabilities/GDP is negatively related to the base rate for pegs, but this effect disappears with controls included.[36] The change in external liabilities does not show a relationship in either specification. Thus, it does not appear that the base interest rate significantly affects capital flows into these countries.

4.4.5 Expenditure Switching Channel

Changes in the base rate will potentially move the domestic exchange rate and hence affect the economy through an expenditure switching channel. An increase in the base rate may cause the base currency to appreciate against all other currencies (that float) meaning that any floating country will depreciate against the base. Thus, we test the nominal exchange rate relative to the base country against the base interest rate. Table 11 shows the results. The pooled samples in columns 3-6 show that there are no significant reactions to the base interest rate. The only significant reactions are to the peg and the constant. When added, we see that pegs' exchange rates change very little, while nonpegs tend to depreciate roughly 10 percent a year on average. Given the insignificant reaction to the base interest rate, though, this does not appear to be a primary channel.

Thus, while these explorations of the channels are not intended to be definitive on any one relationship measured, the one effect that seems to both run in the direction that would slow annual growth and differ significantly by exchange rate regime is the impact of base rates on domestic interest rates. This finding does not establish it as the only channel, but it seems to be an important one.

[36] We have also experimented with examining changes in the base rates and results are similar.

5 Conclusion

This paper shows that while interest rates in large countries may have an effect on other countries' real economy, this impact only exists for pegged countries. Countries without a fixed exchange rate show no relationship between annual real GDP growth and the base interest rate, but countries with a fixed exchange rate grow 0.1 to 0.2 percentage points slower when base interest rates are 1 percentage point higher. The results appear robust to a wide variety of controls and specifications. Controlling for time, region, income, base country GDP growth, and other controls all present the same picture. In addition, pegged countries do not respond to any world interest rate, but only the rate of the country to which they peg — further suggesting the importance of the peg in this relationship.

Our work on channels suggests that the effect of base rates on domestic interest rates in pegged countries is the primary channel through which this impact on GDP takes place. Pegged countries move their interest rates with the base country interest rates while floats do not. On the other hand, there does not seem to be a robust relationship consistent with the direction that growth moves between the base country interest rate and numerous other potential channels such as the exchange rate, capital flows, and the interest rate spread over the base country.

While the fact that the fixed exchange rate countries' growth rates move with the base interest rate matches our theoretical predictions, the results are surprising on two levels. First, the lack of a reaction in the floating countries runs counter to conventional wisdom regarding the extent to which large country interest rate shocks affect the rest of the world. Second, with the findings that the primary channel is the direct monetary policy channel, we add to our understanding of how and why large country interest rates matter for pegs and demonstrate that exogenous monetary policy can have a palpable effect on the economy.

For many years, economists have struggled with the difficulty of finding robust macroeconomic relationships that vary across exchange rate regime. Recently, there has been additional work suggesting that monetary policy autonomy, growth, inflation, and trade may all vary with the exchange rate regime at least to some extent. Stretching back further, Flood and Rose (1995) found a negative relationship between exchange rate and output variability. The results here suggest that being forced to follow the base countries' monetary policy even when it is not optimal for the domestic economy may cause the increased volatility in GDP for fixed exchange rate countries.

These results do not suggest that pegging is either a good or bad idea, but add to the calculus of costs and benefits (in this case costs) an economy will face when it fixes its exchange rate. Furthermore, our results suggest that losing monetary autonomy when pegging has real impacts on the economy. Obviously, by floating, a country may expose itself to volatility due to changes in the nominal exchange rate, but pegging does not eliminate volatility. Pegging forces a country's interest rates to follow the base country rates which may generate more volatility in GDP by eliminating counter-cyclical monetary policy as an option.

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Appendix A Data Appendix

The exchange rate regime classification comes from Shambaugh (2004) and is described there in detail. In short, a country is classified as pegged if its official nominal exchange rate stays within ±2% bands over the course of the year against the base country. The base country is chosen based on the declared base, the history of a countries' exchange rate, by comparing its exchange rate to a variety of potential bases, and by looking at regional dominant currencies. In addition, single year pegs are eliminated as they more likely represent a random lack of variation rather than a true peg. Finally, realignments, where a country moves from one peg level to another with an otherwise constant exchange rate are also considered pegs. Nonpegs are also assigned a base determined by the country they peg to when they are pegging at other times in the sample. While we typically use the term "nonpeg" and the more colloquial "float" interchangeably, any country/year observation not coded as a peg is considered a nonpeg, so they are not all pure floats, but include all sorts of nonpegged regimes. Shambaugh (2004) makes extensive comparisons of this methodology and other classifications.

The capital control data come from the IMF Annual Report on Exchange Rate Arrangements line E2, which signifies "restrictions on payments for capital transactions." For 1973–95, we begin with data provided by Gian Maria Milesi-Ferretti and augment it with data from Shambaugh (2004). After 1995, the IMF stopped reporting this series and reported disaggregated information. The series is extended for 1996–2002 using changes in the disaggregated coding and descriptions in the yearbook to determine changes in the binary codes. Shambaugh (2004) discusses the coding in more detail including the fact that this series is highly correlated with other more detailed or disaggregated measures.

Our financial flows and debt variables are updated data from Lane and Milesi-Ferretti (2001). The Credit/GDP variable is defined as private credit by banks and other Financial institutions to GDP, and comes from the updated financial Development and Structure database of Beck, Demirgüç-Kunt and Levine (1999), which can be found at `http://econ.worldbank.org`.

The rest of the macroeconomic data come from standard sources. Real GDP, oil prices, M2/GDP, Trade/GDP, income levels, and regional and income dummies come from the World Development Indicators database of the World Bank. Exchange Rates and inflation come from the International Monetary Fund's International Financial Statistics database. Interest rates are from the IFS as well as Datastream and Global Financial Database. Exports to the base country are derived from the IMF Direction of Trade Statistics.

Appendix B Estimation of RCM Model

The the RCM regression presented in Section 3.1, equation (8), can be re-written in the following matrix notation:

$$\mathrm{y} = \mathrm{X}_1\beta_1 + \mathrm{X}_2\mathrm{Z}\widetilde{\gamma} + \epsilon, \tag{B.1}$$

where the matrices are as follows for N countries over T time periods:

$$\mathrm{y} = \underbrace{\begin{pmatrix} \mathrm{y}_1 \\ \vdots \\ \mathrm{y}_N \end{pmatrix}}_{NT\times 1}, \quad \mathrm{X}_1 = \underbrace{\begin{pmatrix} \mathrm{YEAR} & \mathrm{X}_{11} & 0 & 0 \\ \vdots & 0 & \ddots & 0 \\ \mathrm{YEAR} & 0 & 0 & \mathrm{X}_{1N} \end{pmatrix}}_{NT\times(T+N\times K1)},$$

$$\mathrm{X}_2 = \underbrace{\begin{pmatrix} \mathrm{X}_{21} & 0 & 0 \\ 0 & \ddots & 0 \\ 0 & 0 & \mathrm{X}_{2N} \end{pmatrix}}_{NT\times N}, \quad \mathrm{Z} = \underbrace{\begin{pmatrix} \mathrm{Z}_1 & 0 & 0 \\ 0 & \ddots & 0 \\ 0 & 0 & \mathrm{Z}_N \end{pmatrix}}_{NT\times N}, \quad \epsilon = \underbrace{\begin{pmatrix} \epsilon_1 \\ \vdots \\ \epsilon_N \end{pmatrix}}_{NT\times 1},$$

$$\beta_1 = \underbrace{\begin{pmatrix} \beta_{\mathrm{YEAR}} \\ \beta_{11} \\ \vdots \\ \beta_{1N} \end{pmatrix}}_{(T+N\times K1)\times 1}, \quad \widetilde{\gamma} = \underbrace{\begin{pmatrix} \widetilde{\gamma}_1 \\ \vdots \\ \widetilde{\gamma}_M \end{pmatrix}}_{M\times 1},$$

and note that $\beta_2 = \mathrm{Z}\widetilde{\gamma} + \xi$ and that $\epsilon = \mathrm{X}_2\xi + \omega$.

The vector y contains output growth, X_1 is a matrix of year dummies (YEAR) and country-specific variables that vary over time (e.g., base country output growth, inflation, oil price, etc.) and a country-specific intercept, X_2 is a matrix of base-country interest rates, and Z is matrix of country variables that are averaged over the sample period (e.g., the average time a country is pegged, or has capital controls). By making parts of X_1 and X_2 block-diagonal, we allow country dynamics to be heterogenous.[37] Finally, the coefficient matrix of interest, $\widetilde{\gamma}$, relates country "fundamentals" (Z) to the average dynamic impact of the base country interest rate (X_2) on output growth (y). The null hypothesis is that this impact will be negative for countries that are pegged more on average: $\widetilde{\gamma}_1 < 0$.

We assume that ω and ξ are both independent, normally distributed errors with mean zero, and are independent of each other. The main reason for making these assumptions is tractability in the estimation procedure. Imposing a common coefficient on year effects helps alleviate any cross-country correlation arising from global shocks in the ω vector.[38] Furthermore, including these dummies and the impact of oil prices also helps alleviate auto-correlation in the errors of ω.[39] By forcing ξ to be distributed independently across sections and homoscedastic, we are assuming that the $\beta_{2,i}$'s are uncorrelated across countries, and have a constant variance. Inspection and tests of the covariance matrix of equation (7) indicate that these are reasonable assumptions to make. Finally, assuming that ω and ξ are independent implicitly assumes that the dynamic and cross-sectional error structures are uncorrelated, which is standard in panel analysis. Many of these assumptions can be relaxed by using GMM estimation techniques, but would result in a loss of efficiency.

Given the assumptions made on the error structure, one can easily apply a two-step FGLS estimation technique based on Amemiya (1978), and found in Hsiao (2003). In particular, first regress y on X_1 and X_2 and calculate a variance-covariance matrix, Σ_1. Next, take

[37] Tests of coefficient homogeneity rejected the null hypothesis of equality.

[38] See Hsiao and Pesaran (2004), Section 9, on the difficulties of modeling cross-section correlation when N is large (> 10) and for a discussion on other possible ways to model cross-section correlation in a RCM set-up. Note that a SURE framework would not work since $N > T$ in our sample.

[39] See the discussion on the panel results in footnote 16.

the estimated country-specific base rate coefficients, $\hat{\beta}_{2i}$, and regress these on Z to produce OLS estimates of $\widetilde{\gamma}$, $\widehat{\widetilde{\gamma}}_{OLS}$.[40] The variance-covariance matrix, Σ_2, of these estimates is then calculated taking into account the uncertainty of the estimated base rate coefficients from the first regression. The final output of this first-step procedure is a total variance-covariance matrix, which is the sum of the two variance-covariance matrices $(\Sigma_1 + \Sigma_2)$ and is block diagonal. This matrix captures the uncertainty of the estimated β and $\widetilde{\gamma}$ coefficients. The second-step of the procedure is to estimate equation (B.1) by weighting with this total variance-covariance matrix. This estimation produces the most efficient estimates of $\widetilde{\gamma}$, $\widehat{\widetilde{\gamma}}_{GLS}$, and $\hat{\beta}_1$, $\hat{\beta}_{1GLS}$.

[40] It is these estimated $\widetilde{\gamma}$ that are plotted against the average peg variables (Z_1) in Figure 1.

Table 1. The Effects of the Base Interest Rate on Real Output Growth: Baseline Least Square Estimates

	(1) Full Sample	(2) Nonpegs	(3) Pegs	(4) Full Sample
Base R	-0.046	0.046	-0.137**	0.046
	(0.032)	(0.039)	(0.044)	(0.039)
Base R × Peg				-0.183**
				(0.055)
Peg				0.014**
				(0.004)
Constant	0.036**	0.030**	0.043**	0.030**
	(0.002)	(0.003)	(0.003)	(0.003)
Observations	3831	2078	1753	3831
R^2	0.001	0.001	0.009	0.005

Notes: The table gives OLS estimates of the effect of the base country nominal interest rate on annual real economic growth. The sample period is 1973–2002. Estimates in columns (1)-(4) do not include any additional controls. Robust standard errors are clustered at the country level. + significant at 10%; * significant at 5%; ** significant at 1%.

Table 2. The Effects of the Base Interest Rate on Real Output Growth: Additional Controls

	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Base R	0.132*	-0.046	-0.037	-0.015	-0.019	0.019
	(0.062)	(0.045)	(0.045)	(0.046)	(0.047)	(0.036)
Base R × Peg	-0.189**	-0.137**	-0.138**	-0.171**	-0.168**	-0.166**
	(0.057)	(0.053)	(0.053)	(0.050)	(0.049)	(0.046)
Peg	0.013**	0.010*	0.010*	0.011*	0.010*	0.013**
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Base GDP Growth			0.085	0.112	0.117	0.255**
			(0.075)	(0.076)	(0.080)	(0.049)
ΔExchange Rate				-0.008	-0.024**	-0.027**
				(0.009)	(0.007)	(0.007)
Lagged Inflation					0.000	0.000
					(0.000)	(0.000)
Inflation				-0.024*		
				(0.011)		
Real Oil Price						0.000
						(0.000)
Constant	0.034**	0.052**	0.051**	0.052**	0.047**	0.025**
	(0.007)	(0.007)	(0.007)	(0.007)	(0.008)	(0.003)
Country FE	no	yes	yes	yes	yes	yes
Year FE	yes	yes	yes	yes	yes	no
Observations	3831	3831	3831	3415	3385	3385
$\mathbf{R^2}$	0.04	0.177	0.177	0.203	0.197	0.171

Notes: The table gives OLS estimates of the effect of the base country nominal interest rate on annual real economic growth. The sample period is 1973–2002. Robust standard errors are clustered at the country level. + significant at 10%; * significant at 5%; ** significant at 1%.

Table 3. The Effects of the Base Interest Rate on Real Output Growth: Sub-Samples of the Data

	(1) Full Sample	**(2) LDC**	**(3) DC**	**(4) HI**	**(5) UMI**	**(6) LMI**	**(7) LI**
Base R	-0.014	0.003	-0.076+	-0.055	-0.085	0.049	-0.002
	(0.030)	(0.036)	(0.042)	(0.039)	(0.069)	(0.046)	(0.075)
Base R × Peg	-0.145**	-0.162**	-0.157*	-0.182*	0.093	-0.378**	-0.117
	(0.050)	(0.056)	(0.064)	(0.088)	(0.136)	(0.097)	(0.093)
Peg	0.014**	0.016**	0.009+	0.008	0.005	0.036**	0.009
	(0.004)	(0.005)	(0.005)	(0.006)	(0.013)	(0.007)	(0.009)
Constant	0.032**	0.032**	0.033**	0.038**	0.035**	0.029**	0.031**
	(0.003)	(0.003)	(0.003)	(0.003)	(0.006)	(0.004)	(0.006)
Observations	3831	3145	686	938	547	1021	1325
$\mathbf{R^2}$	0.142	0.138	0.175	0.199	0.157	0.192	0.091
	(8) EAP	**(9) ECA**	**(10) LACA**	**(11) MIDNA**	**(12) SA**	**(13) SSA**	
Base R	0.013	-0.069	-0.094	0.079	-0.026	-0.005	
	(0.063)	(0.048)	(0.071)	(0.073)	(0.092)	(0.071)	
Base R × Peg	-0.135	-0.188*	-0.095	-0.388+	0.077	-0.123	
	(0.194)	(0.095)	(0.108)	(0.217)	(0.117)	(0.082)	
Peg	0.022	0.015*	0.019*	0.018	0.002	0.002	
	(0.018)	(0.008)	(0.009)	(0.012)	(0.010)	(0.009)	
Constant	0.043**	0.033**	0.027**	0.034**	0.046**	0.035**	
	(0.006)	(0.003)	(0.006)	(0.009)	(0.007)	(0.007)	
Observations	494	862	709	423	174	1139	
$\mathbf{R^2}$	0.199	0.196	0.100	0.110	0.120	0.100	

Notes: The table gives OLS estimates of the effect of the base country nominal interest rate on annual real economic growth. The sample period is 1973–2002. The estimates are based on specification (4) of Table 1, and include country fixed effects. The following country classifications are used LDC (less developed), DC (developed/industrial), HI (high income), UMI (upper middle income), LMI (lower middle income), LI (lower income), EAP (East Asia and Pacific), ECA (Europe and Central Asia), LACA (Latin America and the Carribean), MIDNA (Middle East and North Africa), SA (South Asia), and SSA (Sub Sahara Africa). Classifications based on World Development Indicators. Robust standard errors are clustered at the country level. + significant at 10%; * significant at 5%; ** significant at 1%.

Table 4. Considering Non-Base Interest Rates

	(1) Dollar Base	(2) Non-Dollar Base	(3) Non-Dollar Base	(4) Non-Dollar Base	(5) Non-Dollar Base
Base R	-0.004	-0.058	0.002		
	(0.043)	(0.038)	(0.060)		
Base R × Peg	-0.160*	-0.107+	-0.117+		
	(0.076)	(0.064)	(0.070)		
Peg	0.016**	0.007	0.007	0.005	0.001
	(0.006)	(0.005)	(0.006)	(0.007)	(0.007)
U.S. R				0.058	0.037
				(0.038)	(0.042)
U.S. R × Peg				-0.034	-0.032
				(0.080)	(0.084)
Constant	0.031**	0.039**	0.052**	0.028**	0.032**
	(0.003)	(0.003)	(0.008)	(0.004)	(0.004)
Country FE	yes	yes	yes	yes	no
Year FE	no	no	yes	no	no
Observations	2338	1493	1493	1550	1550
R^2	0.145	0.153	0.205	0.145	0.001

Notes: The table gives OLS estimates of the effect of the base country nominal interest rate on annual real economic growth. The sample period is 1973–2002. Estimates in columns (1)-(5) do not include any additional controls. Robust standard errors are clustered at the country level. + significant at 10%; * significant at 5%; ** significant at 1%.

Table 5. Explanation of Base Interest Rate Impact on Real Output Growth: Random Coefficients Model for the Whole Sample

	(1)	(2)	(3)	(4)	(5)	(6)
Peg	-0.187+	-0.191+	-0.204+	-0.275**	-0.315**	-0.275**
	(0.099)	(0.103)	(0.108)	(0.106)	(0.115)	(0.109)
Capital Control		0.033	0.031	0.082	0.051	0.083
		(0.112)	(0.116)	(0.119)	(0.148)	(0.148)
Trade/GDP			0.097	-0.123	-0.119	-0.123
			(0.092)	(0.116)	(0.120)	(0.117)
Exports to Base/GDP				0.832	1.006	0.837
				(0.794)	(0.863)	(0.803)
High Income					-0.033	
					(0.146)	
Lower Mid Income					-0.079	
					(0.142)	
Low Income					0.049	
					(0.149)	
Real GDP (US$)						0.000
						(0.000)
Constant	-0.0631	-0.102	-0.182	-0.084	-0.048	-0.084
	(0.075)	(0.116)	(0.138)	(0.148)	(0.195)	(0.191)
Observations	3374	3300	3164	2993	2993	2993
Countries	118	116	112	106	106	106
$\mathbf{R^2_{whole}}$	0.283	0.281	0.282	0.279	0.279	0.279
$\mathbf{R^2}_{\beta_2}$	0.046	0.042	0.036	0.105	0.122	0.105

Notes: The table give the RCM estimates of the coefficients $\hat{\gamma}$ from the model $y_{it} = \mathrm{X}_{\mathbf{1}}\beta_1 + \mathrm{X}_2\mathrm{Z}_i\widetilde{\gamma} + \epsilon_{it}$, where X_1 is a matrix containing country specific intercepts, base country GDP growth, real oil prices, and a matrix of time dummies, X_2 is a matrix of base country interest rates, and Z_i is a matrix of the variables in the table, which have been averaged over the sample period per country. $\mathbf{R^2_{whole}}$ refers to the R^2 from estimation of equation (8). $\mathbf{R^2}_{\beta_2}$ refers to the R^2 from estimation of equation (7) — this is done using estimates from a first-step of a FGLS procedure. The sample period covers 1973–2002. Estimates are calculated using a FGLS estimator, as described in Appendix B. + significant at 10%; * significant at 5%; ** significant at 1%.

Table 6. Explanation of Base Interest Rate Impact on Real Output Growth: Random Coefficients Model for Less Developed Countries Sample

	(1)	(2)	(3)	(4)	(5)
Peg	-0.248*	-0.251+	-0.254+	-0.331**	-0.330**
	(0.123)	(0.130)	(0.134)	(0.131)	(0.132)
Capital Control		0.031	0.006	-0.001	0.026
		(0.181)	(0.185)	0.1866	0.2012
Trade/GDP			0.104	-0.253+	-0.253+
			(0.114)	(0.171)	(0.172)
Exports to Base/GDP				0.759	0.719
				(0.931)	(0.948)
Real GDP (US$)					0.000
					(0.000)
Constant	0.002	-0.049	-0.118	0.141	0.102
	(0.104)	(0.198)	(0.214)	(0.238)	(0.259)
Observations	2445	2371	2302	2187	2187
Countries	86	84	82	78	78
$\mathbf{R^2_{\text{whole}}}$	0.253	0.249	0.257	0.254	0.254
$\mathbf{R^2}_{\beta_2}$	0.065	0.059	0.050	0.132	0.132

Notes: The table give the RCM estimates of the coefficients $\hat{\gamma}$ from the model $y_{it} = \mathrm{X}_{\mathbf{1}}\beta_1 + \mathrm{X}_2\mathrm{Z}_i\widetilde{\gamma} + \epsilon_{it}$, where X_1 is a matrix containing country specific intercepts, base country GDP growth, real oil prices, and a matrix of time dummies, X_2 is a matrix of base country interest rates, and Z_i is a matrix of the variables in the table, which have been averaged over the sample period per country. $\mathbf{R^2_{\text{whole}}}$ refers to the R^2 from estimation of equation (8). $\mathbf{R^2}_{\beta_2}$ refers to the R^2 from estimation of equation (7) — this is done using estimates from a first-step of a FGLS procedure. The sample period covers 1973–2002. Estimates are calculated using a FGLS estimator, as described in Appendix B. + significant at 10%; * significant at 5%; ** significant at 1%.

Table 7. The Impact of Change in Base Interest Rates on Change in Domestic Interest Rates

	(1) Full Sample	**(2) Nonpegs**	**(3) Pegs**	**(4) Full Sample**	**(5) Full Sample**	**(6) Full Sample**
ΔBase R	0.327**	0.169	0.580**	0.169	0.136	0.102
	(0.091)	(0.140)	(0.071)	(0.140)	(0.158)	(0.188)
ΔBase R × Peg				0.411**	0.455**	0.381*
				(0.147)	(0.162)	(0.162)
Peg				-0.002	-0.013	-0.012
				(0.004)	(0.010)	(0.010)
Constant	-0.002	-0.001	-0.003*	-0.001	0.003	0.021**
	(0.002)	(0.003)	(0.001)	(0.003)	(0.004)	(0.008)
Observations	no	no	no	no	yes	yes
Countries	no	no	no	no	no	yes
$\mathbf{R^2_{whole}}$	2053	1290	763	2053	2053	2053
$\mathbf{R^2}_{\beta_2}$	0.005	0.001	0.078	0.007	0.112	0.137

Notes: The table gives OLS estimates of the effect of the base country nominal interest rate on domestic nominal interest rates. The sample period is 1973–2002. Estimates in columns (1)-(4) do not include any additional controls. Robust standard errors are clustered at the country level. + significant at 10%; * significant at 5%; ** significant at 1%.

Table 8. The Impact of Change in Base Interest Rates on Change in Interest Rate Gaps

	(1) Full Sample	**(2) Nonpegs**	**(3) Pegs**	**(4) Full Sample**	**(5) Full Sample**	**(6) Full Sample**
Base R	-0.663**	-0.810**	-0.434**	-0.810**	-0.791**	-0.849**
	(0.102)	(0.151)	(0.081)	(0.151)	(0.170)	(0.192)
Base R × Peg				0.376*	0.382*	0.318*
				(0.149)	(0.164)	(0.160)
Peg				-0.002	-0.013	-0.011
				(0.004)	(0.011)	(0.011)
Constant	-0.001	-0.001	-0.003+	-0.001	0.003	0.020*
	(0.002)	(0.004)	(0.001)	(0.004)	(0.004)	(0.008)
Country FE	no	no	no	no	yes	yes
Year FE	no	no	no	no	no	yes
Observations	1854	1166	688	1854	1854	1854
R^2	0.020	0.019	0.053	0.022	0.146	0.170

Notes: The table gives OLS estimates of the effect of the base country nominal interest rate on domestic nominal interest rates. The sample period is 1973–2002. Estimates in columns (1)-(4) do not include any additional controls. Robust standard errors are clustered at the country level. + significant at 10%; * significant at 5%; ** significant at 1%.

Table 9. Exports to Base/GDP and the Base Interest Rate

	(1) Full Sample	(2) Nonpegs	(3) Pegs	(4) Full Sample	(5) Full Sample	(6) Full Sample
Base R	-0.002	-0.194*	0.165	-0.194*	-0.113*	-0.039
	(0.077)	(0.088)	(0.119)	(0.088)	(0.057)	(0.073)
Base R × Peg				0.359*	0.235+	0.229+
				(0.153)	(0.129)	(0.126)
Peg				-0.012	-0.021+	-0.024+
				(0.010)	(0.011)	(0.013)
Constant	0.059**	0.066**	0.054**	0.066**	0.068**	0.060**
	(0.006)	(0.009)	(0.007)	(0.009)	(0.006)	(0.009)
Country FE	no	no	no	no	yes	yes
Year FE	no	no	no	no	no	yes
Observations	3657	1997	1660	3657	3657	3657
$\mathbf{R^2}$	0.000	0.009	0.003	0.011	0.572	0.580

Notes: The table gives OLS estimates of the effect of the base country nominal interest rate on domestic nominal interest rates. The sample period is 1973–2002. Estimates in columns (1)-(4) do not include any additional controls. Robust standard errors are clustered at the country level. + significant at 10%; * significant at 5%; ** significant at 1%.

Table 10. Capital Flows and the Base Interest Rate

	%Δ in Liabilities		Δ(Liabilities/GDP)	
	(1)	**(2)**	**(3)**	**(4)**
Base R	0.204	-0.103	-0.097	0.272
	(0.149)	(0.238)	(0.110)	(0.196)
Base R × Peg	-0.136	-0.123	-0.692+	-0.325
	(0.224)	(0.240)	(0.414)	(0.363)
Peg	0.033	0.033	0.033	0.024
	(0.020)	(0.022)	(0.033)	(0.033)
Constant	0.090**	0.175**	0.041**	-0.043*
	(0.012)	(0.028)	(0.010)	(0.021)
Country FE	no	yes	no	yes
Year FE	no	yes	no	yes
Observations	1959	1959	1954	1954
$\mathbf{R^2}$	0.009	0.293	0.009	0.211

Notes: The table gives OLS estimates of the effect of the base country nominal interest rate on domestic nominal interest rates. The sample period is 1973–2002. Estimates in columns (1)-(4) do not include any additional controls. Robust standard errors are clustered at the country level. + significant at 10%; * significant at 5%; ** significant at 1%.

Table 11. Change in Exchange Rate and the Base Interest Rate

	(1) **Full Sample**	**(2)** **Nonpegs**	**(3)** **Pegs**	**(4)** **Full Sample**	**(5)** **Full Sample**	**(6)** **Full Sample**
Base R	-0.267+	-0.124	-0.166*	-0.124	0.089	-0.327
	(0.141)	(0.283)	(0.072)	(0.283)	(0.278)	(0.254)
Base R $\times$ Peg				-0.042	-0.355	-0.308
				(0.297)	(0.295)	(0.281)
Peg				-0.109**	-0.104**	-0.088**
				(0.022)	(0.026)	(0.026)
Constant	0.102**	0.145**	0.036**	0.145**	0.138**	0.085**
	(0.012)	(0.021)	(0.007)	(0.021)	(0.020)	(0.025)
Country FE	no	no	no	no	yes	yes
Year FE	no	no	no	no	no	yes
Observations	4045	2122	1923	4045	4045	4045
R^2	0.002	0.000	0.002	0.067	0.261	0.289

Notes: The table gives OLS estimates of the effect of the base country nominal interest rate on domestic nominal interest rates. The sample period is 1973–2002. Estimates in columns (1)-(4) do not include any additional controls. Robust standard errors are clustered at the country level. + significant at 10%; * significant at 5%; ** significant at 1%.

Table A1. Countries in the Sample

Afghanistan, I.S. of[8]	Czech Republic[4]	Kuwait[8]	Poland[4]
Albania[4]	Denmark[4]	Kyrgyz Republic[8]	Portugal[4]
Algeria[3]	Djibouti[8]	Lao People's Dem. Rep.[8]	Romania[8]
Angola[8]	Dominican Republic[8]	Latvia[8]	Russia[8]
Argentina[8]	Ecuador[8]	Lebanon[8]	Rwanda[8]
Armenia[8]	Egypt[8]	Lesotho[10]	Saudi Arabia[8]
Australia[8]	El Salvador[8]	Liberia[8]	Senegal[3]
Austria[4]	Equatorial Guinea[3]	Libya[8]	Sierra Leone[8,9]
Azerbaijan[8]	Estonia[4]	Lithuania[12]	Singapore[6]
Bahamas,The[8]	Ethiopia[8]	Luxembourg[2]	Slovak Republic[4]
Bahrain[8]	Fiji[8,9]	Macedonia[4]	Slovenia[4]
Bangladesh[8,9]	Finland[4]	Madagascar[3]	Solomon Islands[9]
Barbados[8,9]	France[4]	Malawi[8]	Somalia[8]
Belarus[8]	Gabon[3]	Malaysia[8]	South Africa[8]
Belgium[4]	Gambia, The[8,9]	Maldives[8]	Spain[4]
Benin[3]	Georgia[8]	Mali[3]	Sri Lanka[5,8,9]
Bhutan[5]	Germany[8]	Malta[3]	Sudan[8]
Bolivia[8]	Ghana[8]	Mauritania[3,8]	Suriname[8]
Bosnia & Herzegovina[4]	Greece[4,8]	Mauritius[9]	Swaziland[10]
Botswana[8,10]	Guatemala[8]	Mexico[8]	Sweden[4]
Brazil[8]	Guinea[8]	Moldova[8]	Switzerland[4]
Bulgaria[4,8]	Guinea-Bissau[3,7]	Mongolia[8]	Syrian Arab Rep.[8]
Burkina Faso[3]	Guyana[8,9]	Morocco[3]	Tajikistan[8]
Burundi[8]	Haiti[8]	Mozambique[8]	Tanzania[8]
Cameroon[3]	Honduras[8]	Myanmar[8]	Thailand[8]
Canada[8]	Hungary[4,8]	Namibia[10]	Togo[3]
Cape Verde[7]	Iceland[4,8]	Nepal[5,8]	Trinidad & Tobago[8,9]
Central African Rep.[3]	India[8,9]	Netherlands[4]	Tunisia[3]
Chad[3]	Indonesia[8]	New Zealand[1]	Turkey[8]
Chile[8]	Iran, I.R. of[8]	Nicaragua[8]	Turkmenistan[8]
China, People's Rep.[8]	Iraq[8]	Niger[3]	Uganda[8]
China, People's Rep.[8]	Ireland[4,9]	Nigeria[8]	Ukraine[8]
Colombia[8]	Israel[8]	Norway[4]	United Arab Emirates[8]
Comoros[3]	Italy[4]	Oman[8]	United Kingdom[4]
Congo, Democratic Rep.[8]	Jamaica[8]	Pakistan[8]	Uruguay[8]
Congo, Republic of[3]	Japan[8]	Panama[8]	Venezuela[8]
Costa Rica[8]	Jordan[8]	Papua New Guinea[9]	Vietnam[8]
Cote D'Ivoire[3]	Kazakhstan[8]	Paraguay[8]	Yemen[8]
Croatia[4]	Kenya[8]	Peru[8]	Zambia[8]
Cyprus[3]	Korea[8]	Philippines[8]	Zimbabwe[8]
Base Countries			
Australia (1)	Germany (4)	Portugal (7)	South Africa (10)
Belgium (2)	India (5)	United States (8)	
France (3)	Malaysia (6)	United Kingdom (9)	

Notes: Superscript refers to base country. A country may have multiple bases over the sample period. Furthermore, all base countries, except for the United States, have a base country. Approximately 60% of the countries in the sample have the U.S. as a base vs. 40% that are non-U.S. based.

Table A2. Sample Summary Statistics

	Full Sample	**Pegs**	**Nonpegs**
Observations	3831	1753	2078
Mean GDP Growth	0.033	0.033	0.033
Std Dev GDP Growth	0.047	0.052	0.043
Mean Base R	0.072	0.075	0.070
Std Dev Base R	0.034	0.036	0.033

Notes: Data summarized reflect the sample used in estimation of the baseline results in Table 1. The sample period is 1973–2002.

Table A3. The Effects of the Base and U.S. Interest Rates on Real Investment Growth

	(1) Full Sample	(2) Full Sample	(3) Full Sample	(4) Full Sample	(5) Full Sample	(6) Non-Dollar Base	(7) Non-Dollar Base
Base R	-0.235*	-0.066	0.021	-0.188	-0.191	-0.047	
	(0.095)	(0.099)	(0.143)	(0.198)	(0.198)	(0.196)	
Base R × Peg		-0.360+	-0.394*	-0.589**	-0.588**	-0.686*	
		(0.184)	(0.189)	(0.211)	(0.211)	(0.328)	
Peg		0.032*	0.033*	0.053**	0.053**	0.029	-0.003
		(0.015)	(0.015)	(0.018)	(0.018)	(0.028)	(0.038)
Base GDP Growth					-0.046		
					(0.199)		
U.S. R							-0.085
							(0.146)
U.S. R × Peg							-0.119
							(0.318)
Constant	0.053**	0.038**	0.065**	0.085**	0.086**	0.047**	0.043*
	(0.007)	(0.007)	(0.020)	(0.025)	(0.025)	(0.016)	(0.017)
Country FE	no	no	yes	yes	yes	yes	yes
Year FE	no	no	no	yes	yes	yes	yes
Observations	3089	3089	3089	3089	3089	1275	1318
R^2	0.002	0.004	0.031	0.096	0.096	0.072	0.064

Notes: The table gives OLS estimates of the effect of the base country nominal interest rate on domestic nominal interest rates. The sample period is 1973–2002. Robust standard errors are clustered at the country level. + significant at 10%; * significant at 5%; ** significant at 1%.

Table A4. Different Cuts of the Data to Exclude Outlier Periods and Observations

	(1) Full Sample	(2) Full Sample	(3) No Transition	(4) No Transition	(5) No Crisis	(6) No Crisis	(7) No Free Fall	(8) No Free Fall	(9) No Bases	(10) No Bases
Base R	0.046	-0.046	0.058	-0.045	0.037	-0.064	0.052	-0.035	0.046	-0.050
	(0.039)	(0.045)	(0.041)	(0.049)	(0.040)	(0.046)	(0.039)	(0.046)	(0.042)	(0.048)
Base R × Peg	-0.183**	-0.137**	-0.186**	-0.121*	-0.176**	-0.131*	-0.194**	-0.168**	-0.192**	-0.143**
	(0.055)	(0.053)	(0.062)	(0.060)	(0.056)	(0.053)	(0.056)	(0.054)	(0.058)	(0.054)
Peg	0.014**	0.010*	0.013**	0.006	0.011*	0.007	0.013**	0.011*	0.015**	0.011*
	(0.004)	(0.004)	(0.005)	(0.005)	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)
Constant	0.030**	0.052**	0.029**	0.055**	0.033**	0.034**	0.032**	0.053**	0.029**	0.055**
	(0.003)	(0.007)	(0.003)	(0.007)	(0.003)	(0.007)	(0.003)	(0.007)	(0.003)	(0.007)
Country FE	no	yes	no	yes	no	yes	no	yes	no	yes
Year FE	no	yes	no	yes	no	yes	no	yes	no	yes
Observations	3831	3831	3290	3290	3599	3599	3521	3521	3561	3561
$\mathbf{R^2}$	0.005	0.177	0.005	0.183	0.007	0.188	0.007	0.196	0.006	0.174

Notes: The table gives OLS estimates of the effect of the base country nominal interest rate on domestic nominal interest rates. The sample period is 1973–2002. “No Transition” refers to periods where a country moves from peg to float or vice versa. In this case, the year before pegging the first year of pegging, the last year of pegging and the first year after pegging are all dropped. “Crisis” is based on the definition suggested by Frankel and Rose (1996): any year where depreciation is greater than 25% and is at least 10% more than the previous year’s depreciation. “Free Fall” refers to observations deemed to be freely falling (large depreciation and high inflation) by Reinhart and Rogoff. “No Bases” drops base countries from the analysis. The U.S. is automatically dropped in all regressions, but, other bases, such as France, are both a base country for some other countries and a domestic country (with Germany as the base). Robust standard errors are clustered at the country level. + significant at 10%; * significant at 5%; ** significant at 1%.

Table A5. Examination of Different Exchange Rate Regimes Classifications

	(1) R&R Sample	(2) R&R Sample	(3) R&R Sample	(4) R&R Sample	(5) De Jure	(6) De Jure	(7) Consensus w/R&R	(8) Consensus w/R&R
Base R	0.039	-0.068	-0.015	-0.117*	0.000	-0.101*	0.038	-0.100+
	(0.048)	(0.052)	(0.055)	(0.056)	(0.043)	(0.046)	(0.051)	(0.055)
Base R × Peg	-0.210**	-0.118+					-0.202*	-0.063
	(0.068)	(0.060)					(0.080)	(0.069)
Peg	0.015**	0.007					0.016*	0.008
	(0.005)	(0.005)					(0.006)	(0.007)
Base R × R&R Peg			-0.129+	-0.032				
			(0.077)	(0.065)				
R&R Peg			0.012*	0.009				
			(0.006)	(0.006)				
Base R × De Jure Peg					-0.096	-0.036		
					(0.063)	(0.054)		
De Jure Peg					0.004	-0.001		
					(0.005)	(0.005)		
Constant	0.031**	0.054**	0.034**	0.054**	0.034**	0.059**	0.031**	0.057**
	(0.004)	(0.007)	(0.004)	(0.007)	(0.003)	(0.007)	(0.004)	(0.009)
Country FE	no	yes	no	yes	no	yes	no	yes
Year FE	no	yes	no	yes	no	yes	no	yes
Observations	2940	2940	2940	2940	3830	3830	2415	2415
$\mathbf{R^2}$	0.008	0.209	0.005	0.209	0.003	0.175	0.007	0.216

Notes: The table gives OLS estimates of the effect of the base country nominal interest rate on domestic nominal interest rates. The sample period is 1973–2000. R&R stands for Reinhart and Rogoff's classification scheme, De Jure refers to codes from the International Monetary Fund's Annual Report on Exchange Arrangements and Exchange Restrictions where countries self report their exchange rate regime status, and the Consensus sample includes observations only where Shambaugh's and Reinhart and Rogoff's classifications match. Robust standard errors are clustered at the country level. + significant at 10%; * significant at 5%; ** significant at 1%.

Table A6. Examination on Reinhart and Rogoff's Five-Way Breakdown of Exchange Rate Regimes

	(1) R&R 1	(2) R&R 2	(3) R&R 3	(4) R&R 4	(5) R&R 5	(6) R&R 1	(7) R&R 2	(8) R&R 3	(9) R&R 4	(10) R&R 5
Base R	-0.144**	0.011	-0.091	0.034	0.047	-0.146*	-0.159*	-0.211+	0.051	-0.189
	(0.054)	(0.081)	(0.067)	(0.165)	(0.118)	(0.057)	(0.066)	(0.122)	(0.540)	(0.149)
Constant	0.046**	0.039**	0.041**	0.030+	0.007	0.047**	0.060**	0.044**	0.010	0.024*
	(0.004)	(0.006)	(0.005)	(0.016)	(0.010)	(0.009)	(0.012)	(0.010)	(0.056)	(0.011)
Country FE	no	no	no	no	no	yes	yes	yes	yes	yes
Year FE	no	no	no	no	no	yes	yes	yes	yes	no
Observations	991	852	665	122	310	991	852	665	122	310
R^2	0.011	0.000	0.004	0.001	0.001	0.222	0.430	0.307	0.717	0.309

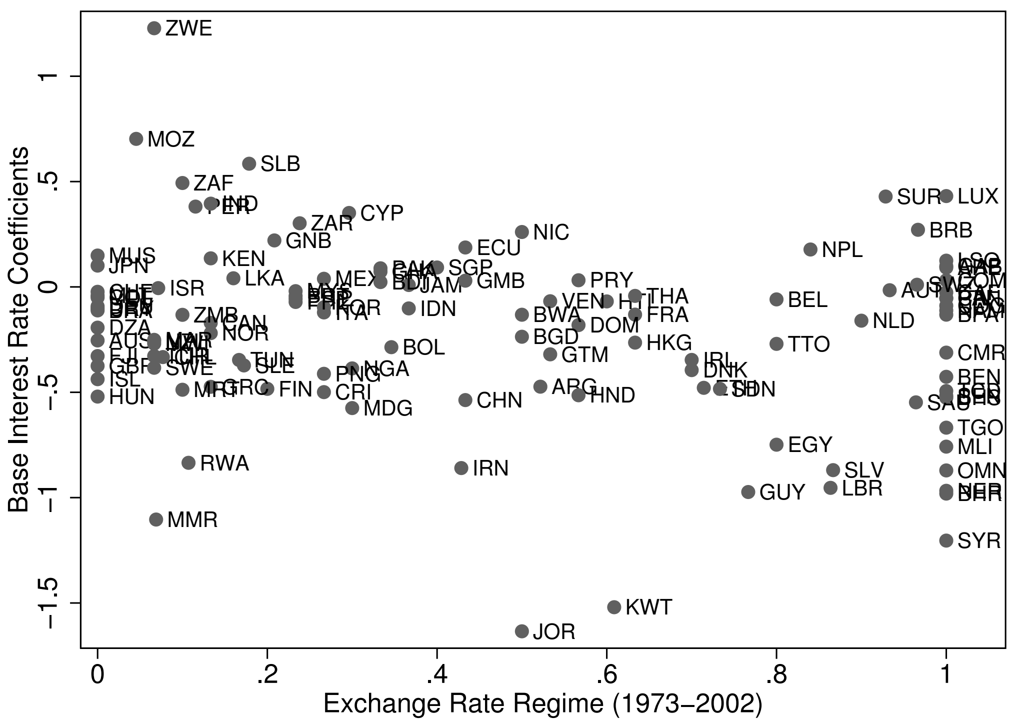
Notes: The table gives OLS estimates of the effect of the base country nominal interest rate on domestic nominal interest rates. The sample period is 1973–2000. R&R stands for Reinhart and Rogoff's classification scheme. 1 indicates a peg, 2 indicates a crawling peg, 3 indicates intermediate/managed float, 4 indicates float, and 5 indicates a freely falling. Column (10) has no year fixed effects because nearly all observations are countries based to the dollar making year effects and the base interest rate redundant. Robust standard errors are clustered at the country level. + significant at 10%; * significant at 5%; ** significant at 1%.

Table A7. Explanation of Base Interest Rate Impact on Real Output Growth: Random Coefficients Model for the Whole Sample Including Financial Variables

	(1)	(2)	(3)	(4)	(5)	(6)
Peg	-0.366**	-0.208	-0.398**	-0.401**	-0.483**	-0.393**
	(0.141)	(0.131)	(0.155)	(0.154)	(0.155)	(0.148)
Capital Control	0.043	0.258	-0.192	-0.173	-0.208	-0.211
	(0.180)	(0.172)	(0.166)	(0.162)	(0.162)	(0.156)
Trade/GDP	-0.226	-0.214	-0.262	-0.280	-0.290	-0.276
	(0.175)	(0.152)	(0.206)	(0.207)	(0.208)	(0.194)
Exports to Base/GDP	1.117	0.927	1.891+	1.882+	2.302*	1.798
	(0.993)	(0.908)	(1.106)	(1.093)	(1.116)	(1.085)
High Income	-0.064	-0.243	-0.072	-0.065	-0.051	-0.072
	(0.194)	(0.175)	(0.145)	(0.145)	(0.147)	(0.142)
Lower Mid Income	-0.068	-0.050	0.026	0.022	0.020	0.016
	(0.160)	(0.147)	(0.147)	(0.146)	(0.148)	(0.144)
Low Income	0.029	-0.008	0.685**	0.677**	0.725**	0.661**
	(0.177)	(0.163)	(0.237)	(0.237)	(0.240)	(0.233)
M2/GDP	0.001					
	(0.003)					
Credit/GDP		0.557*				
		(0.252)				
(Asset+Liab)/GDP			-0.006			
			(0.048)			
Liab/GDP				0.005		
				(0.093)		
Debt Liab/GDP					0.006	
					(0.103)	
NFA/GDP						-0.069
						(0.133)
Constant	0.076	-0.313	0.038	0.028	0.046	0.053
	(0.243)	(0.238)	(0.223)	(0.221)	(0.222)	(0.206)
Observations	2544	2389	1710	1713	1716	1738
Countries	91	86	61	61	61	62
$\mathbf{R^2_{whole}}$	0.279	0.293	0.363	0.363	0.368	0.364
$\mathbf{R^2}_{\beta_2}$	0.136	0.182	0.371	0.371	0.405	0.395

Notes: The table give the RCM estimates of the coefficients $\hat{\gamma}$ from the model $y_{it} = \mathrm{X}_{\mathbf{1}}\beta_1 + \mathrm{X}_2 \mathrm{Z}_i \widetilde{\gamma} + \epsilon_{it}$, where X_1 is a matrix containing country specific intercepts, base country GDP growth, real oil prices, and a matrix of time dummies, X_2 is a matrix of base country interest rates, and Z_i is a matrix of the variables in the table, which have been averaged over the sample period per country. $\mathbf{R^2_{whole}}$ refers to the R^2 from estimation of equation (8). $\mathbf{R^2}_{\beta_2}$ refers to the R^2 from estimation of equation (7) — this is done using estimates from a first-step of a FGLS procedure. The sample period covers 1973–2002. Estimates are calculated using a FGLS estimator, as described in Appendix B. + significant at 10%; * significant at 5%; ** significant at 1%.

Figure 1. The Impact of the Exchange Rate Regime on the Estimated Base Interest Rate Coefficients



Notes: This figure plots the estimated impact of the base interest rate ($\hat{\beta}_{2i}$) from running regression (6) against the average of the Peg indicator over the sample period for each country.