THE MACROECONOMIC CONSEQUENCES OF EXCHANGE RATE DEPRECIATIONS*

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We study the consequences of "regime-induced" exchange rate depreciations by comparing outcomes for peggers versus floaters to the U.S. dollar in response to a dollar depreciation. Pegger currencies depreciate relative to floater currencies and these depreciations are strongly expansionary. The boom is associated with a fall in net exports, and (if anything) an increase in interest rates in the pegger countries. This suggests that expenditure switching and domestic monetary policy are not the main drivers of the boom. We show that a large class of existing models cannot match our estimated responses and develop a model with imperfect financial openness that can. Following a depreciation, uncovered interest parity deviations lower the costs of borrowing from abroad and stimulate the economy, as in the data. The model is consistent with (unconditional) exchange rate disconnect and the Mussa fact, even though exchange rates have large effects on the economy. *JEL codes:* F33, F41.

I. Introduction

How does an exchange rate depreciation affect the economy? Is it expansionary? Is it contractionary? Or does it perhaps have little or no effect? Surprisingly, the answers to these questions are unclear. Simple textbook models imply that a depreciation is expansionary due to expenditure switching in goods markets (Dornbusch 1980; Obstfeld and Rogoff 1996). But there is a long

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literature discussing the theoretical possibility that exchange rate depreciations may be contractionary due to a contractionary real income effect (Diaz Alejandro 1963; Cooper 1969; Krugman and Taylor 1978; Auclert et al. 2021) or a contractionary balance sheet effect (Krugman 1999; Aghion, Bacchetta, and Banerjee 2001; Kalemli-Ozcan, Kamil, and Villegas-Sanchez 2016).[1] Finally, there is a prominent literature in international macroeconomics that argues that exchange rates are largely disconnected from other macroeconomic aggregates (Meese and Rogoff 1983; Baxter and Stockman 1989; Flood and Rose 1995; Obstfeld and Rogoff 2000; Devereux and Engel 2002; Itskhoki and Mukhin 2021a). Lacking clear guidance from empirical evidence, there is precious little consensus.

These questions are difficult to answer because of the endogeneity of exchange rate movements. Consider a country that is hit by a negative shock. This may lead the exchange rate to depreciate and output growth to be unusually low. Using this type of variation to assess the effect of exchange rate depreciations on output will yield misleading results because the direct effect of the negative shock on the economy is a confound (which in this case would bias results toward finding that exchange rate depreciations are contractionary). Since all exchange rate changes happen for a reason, it is not clear that it is truly possible to measure the causal effect of an exchange rate depreciation.

Our approach to tackling this challenge is to compare outcomes for countries that peg their currency to the U.S. dollar to outcomes in countries with currencies that float versus the U.S. dollar when the U.S. dollar exchange rate changes. A concrete example is useful. Since 2000, the South African rand (ZAR) has floated versus the U.S. dollar, while the Egyptian pound (EGP) has been pegged or has been on a crawling peg versus the U.S. dollar. This has meant that when the U.S. dollar depreciates relative to its main trading partners, the EGP has tended to depreciate relative to the ZAR. The question we ask is: how does this

1. Bianchi and Coulibaly (2023) present a third type of model that can generate a contractionary devaluation. In their model, a devaluation reduces the value of collateral and thereby tightens borrowing constraints. A large literature has also considered how stabilization plans (i.e., the prevention of further depreciation) can be expansionary in high-inflation countries (Dornbusch 1982; Rodriguez 1982; Calvo 1986; Helpman and Razin 1987; Mendoza and Uribe 2000).

depreciation of EGP relative to ZAR affect macroeconomic outcomes in Egypt relative to South Africa?[2]

Importantly, we are not using all variation in the exchange rate of the EGP and ZAR. We are only using a component of the variation in these exchange rates that arises because they have different preexisting exchange rate regimes versus the U.S. dollar (about 8% of the total variation in exchange rates in our sample). We refer to this variation as "regime-induced" variation in the exchange rate. Notice that this approach excludes all variations in exchange rates that arise from idiosyncratic shocks to each country (such as the bad shock just discussed) because such shocks do not move the U.S. dollar exchange rate. We measure the U.S. dollar exchange rate relative to 24 relatively advanced economies and exclude these countries from our baseline sample. This means that our baseline sample consists mainly of middle- and low-income countries.

Our empirical results are easiest to interpret if the following assumption holds: pegs are not differentially exposed (relative to floats) to aggregate shocks that are correlated with the U.S. dollar exchange rate. If this is true, the direct effects of the shocks that drive the U.S. dollar exchange rate will affect pegs and floats symmetrically and will be absorbed by time fixed effects in our empirical specification. What is left is the "regime-induced" effect of the exchange rate of the pegs comoving with the U.S. dollar.

The choice of exchange rate regime is, of course, an endogenous policy decision. Considering deviations from the no-differential-exposure assumption is important. Perhaps the most likely scenario is that peggers to the U.S. dollar may tend to be countries that share more shocks with the United States than do floaters (a standard assumption in the literature on optimal currency areas). A battery of robustness checks suggests this is unlikely to drive our results, which remain virtually unchanged after controlling for differential exposure to changes in U.S. GDP, U.S. monetary policy, a global financial cycle indicator, and commodity price fluctuations. Also, if pegs are differentially exposed to the same negative shocks that depreciate the U.S. dollar, one

2. Notice that in this case Egypt's exchange rate with respect to all countries will depreciate relative to South Africa's.

might expect them to do poorly in the wake of a U.S. dollar depreciation, but we find the opposite.[3]

There are relatively few "true floats" in our sample. Many of the countries that we classify as floats versus the U.S. dollar are pegs to other currencies, such as the euro. Since the euro floats versus the U.S. dollar, currencies that peg to the euro float versus the U.S. dollar. The choice of which currency a country pegs to in many cases has deep historical roots relating to colonial origins (e.g., the French franc zone in West Africa). Roughly 20% of the variation in our peg-float dummy is explained by colonial origins. We show that our pegs and floats are quite similar on observable characteristics, which lends credence to the view that they have similar exposure to macroeconomic shocks.

Our main empirical finding is that regime-induced depreciations are strongly expansionary. Consider a case when the U.S. dollar depreciates. This results in both the nominal and real exchange rates of pegging countries depreciating relative to floating countries. These depreciations are quite persistent. (They last roughly five years.) Output, consumption, and investment in pegging countries boom relative to floating countries. The boom builds gradually over several years and peaks after about five years. Quantitatively, our estimates imply that a 10% regime-induced depreciation results in a 5.5% increase in GDP over five years.

We consider the effects on a number of other macroeconomic outcomes. Two of these are particularly important for interpreting our results. First, we find that net exports fall in response to a regime-induced depreciation. This rules out an export-led boom due to expenditure switching as the main driver of our results. Second, our point estimates indicate that interest rates rise in response to a regime-induced depreciation (these estimates are noisy). This is inconsistent with the depreciation resulting from looser monetary policy in pegging countries relative to floating countries. Together, these results rule out a large set of standard models that might be used to explain our results.

3. If pegs are differentially exposed to positive shocks that depreciate the U.S. dollar (e.g., productivity shocks), then the bias could go in the opposite direction. However, productivity shocks yield very little exchange rate variability in standard models. Moreover, controlling for U.S. variables has little impact, as we discuss.

We present a simple four-country model (United States, Euro area, peggers to the U.S. dollar, and peggers to the euro) that can match our empirical results. The model features imperfect financial openness that manifests in two ways. First, financial shocks result in uncovered interest parity (UIP) deviations. Second, households can borrow in foreign currencies, but their portfolio weights are sticky, which implies that they do not arbitrage away cross-currency expected return differentials.

The model helps clarify why focusing on regime-induced variation in exchange rates is valuable. We show that for this type of exchange rate variation, the relative response of all macroeconomic outcomes (output, consumption, net exports, etc.) for peggers versus floaters are functions only of the relative response of the real interest rate and the real exchange rate. In other words, the relative response of real interest rates and the real exchange rate are sufficient statistics for the relative response of other macro variables. Intuitively, the peggers and floaters differ only in their monetary regimes and the monetary regime is summarized by the path of the real interest and the real exchange rate. Furthermore, since our estimated response for the real interest rate is close to zero, the difference in macroeconomic outcomes we estimate for peggers versus floaters must be due to differences in the path of the real exchange rate—hence our title.

In our model, a regime-induced depreciation of the U.S. dollar (driven, for example, by a UIP shock) makes the currencies of peggers "cheap" in the sense that expected future returns from investing in these currencies are higher than for floater currencies. (We show that this is indeed the case empirically in response to regime-induced exchange rate variation.) This return differential causes capital to flow into pegging countries, stimulating a domestic boom.

Our empirical results raise the following question: if regime-induced exchange rate depreciations have large stimulatory effects, why don't we see a strong unconditional correlation between exchange rates and output? It is well known that the correlation of exchange rates with most macroeconomic aggregates is very low. Exchange rates are often said to be "disconnected" from macroeconomic aggregates. Furthermore, when countries shift from a fixed to a flexible exchange rate, this can lead to a dramatic change in the volatility of their real exchange rate (Mussa 1986) apparently without having much of an effect on the volatility on output, consumption, and other macroeconomic outcomes (Baxter and Stockman 1989; Flood and Rose 1995; Itskhoki and Mukhin 2021b). How can regime-induced depreciations have large effects, while exchanges rates are more generally disconnected from macroeconomic outcomes?

We show that this apparent contradiction can be resolved by allowing for multiple shocks, some of which yield a positive correlation between the exchange rate and output, while others yield a negative correlation. We consider a case with two shocks: a UIP shock and a discount-factor shock. The UIP shock yields a positive correlation between the exchange rate and output for the reasons discussed already. A discount rate shock that reduces domestic demand induces monetary policy to ease. This will depreciate the currency, but if the monetary response is not sufficiently strong to fully offset the shock, output will fall. The combination of these two shocks can then result in a low correlation between the exchange rate and output.

In this environment, moving from a floating exchange rate to a peg has two opposing effects on output volatility. On the one hand, pegging eliminates the UIP shocks. This reduces output volatility. On the other hand, pegging makes the contractionary effects of discount rate shocks larger since peggers cannot ease monetary policy. These opposing effects imply that the overall effect of pegging on exchange rate volatility is ambiguous. Our model, thus, captures both the potentially destabilizing effects of flexible exchange rates articulated by Nurkse (1944, 1945) and the stabilizing role of flexible exchange rates articulated by Friedman (1953).

The trade-offs a country faces in adopting a fixed versus flexible exchange rate look fundamentally different when viewed from the perspective of models in which financial shocks play a central role in driving the exchange rate. In traditional open economy models, the primary effect of pegging one's currency is for monetary policy: pegging to the U.S. dollar implies a country must follow U.S. interest rate policy. Our empirical findings suggest, however, that a first-order consequence of pegging to the U.S. dollar is that a country imports the financial shocks that drive the U.S. exchange rate, while potentially reducing its exposure to home-grown financial shocks. The importance of this financial-shock trade-off may greatly outstrip the importance the traditional monetary trilemma.

Our analysis relates to a literature that has sought to estimate the effect of changes in exchange rates on macroeconomic outcomes. Rodrik (2008) shows that an "undervaluation" of the real exchange rate correlates with GDP growth. Obstfeld and Zhou (2022) estimate the effect of changes in the U.S. dollar exchange rate on a sample of 26 emerging market and developing countries from 1990 to 2019. They focus on the aggregate effect but also find as we do that pegs are affected more by movements in the U.S. dollar than floats. Eichengreen and Sachs (1985) and Bouscasse (2022) exploit the difference in the timing of the abandonment of the gold standard in the 1930s and find that depreciations are strongly expansionary.

Our empirical strategy relates to a strand of literature that explores heterogeneous responses of macroeconomic outcomes by exchange rate regime. Tenreyro (2007) and Barro and Tenreyro (2007) use regime-induced volatility in exchange rate rates to study trade and the comovement of price and GDP across countries. Di Giovanni and Shambaugh (2008) and Cloyne, Hürtgen, and Taylor (2022) study the effect of anchor country monetary policy on peggers. Jordà, Schularick, and Taylor (2020) interact the exchange rate regime, capital account openness, and anchor currency's monetary policy to construct an instrumental variable for changes in a country's monetary policy based on the classic monetary trilemma. Importantly, their empirical specification does not include time fixed effects. Broda (2004) assesses the effects of terms of trade shocks on peggers versus floaters. Carare et al. (2022) assess the effect of a country's exchange rate regime for global demand shocks, and Cesa-Bianchi, Ferrero, and Rebucci (2018) consider global supply shocks. We investigate arguably the most direct consequence of choosing one exchange rate regime versus the other: differential exposure to movements in the anchor currency's exchange rate.

Our model draws most directly on Itskhoki and Mukhin (2021a) and indirectly on the pioneering work of Gabaix and Maggiori (2015). These papers build on much earlier literature, for example, Branson et al. (1970) and Kouri (1976). Papers emphasizing UIP shocks include Devereux and Engel (2002), Gourinchas and Tornell (2004), Kollmann (2005), Bacchetta and Wincoop (2006), and Eichenbaum, Johannsen, and Rebelo (2021). Also related is the literature on the carry trade (see Burnside, Eichenbaum, and Rebelo 2011). Models that generate similar shocks are developed by Bianchi and Lorenzoni (2021), Kekre and Lenel (2021), and Engel and Wu (2023) and build on Calvo (1998). A growing empirical literature documents a strong association between financial market variables and exchange rates (Jiang, Krishnamurthy, and Lustig 2018; Engel and Wu 2023; Lilley et al. 2022; Jiang, Richmond, and Zhang 2022). Our empirical results—when interpreted through the lens of our theoretical model—provide additional support for the view that financial shocks are a dominant driver of exchange rate fluctuations.

II. New Evidence on the Effect of Exchange Rate Depreciations

The basic idea of our empirical approach is to compare outcomes in countries that peg their exchange rate to the U.S. dollar to outcomes in countries with a currency that floats versus the U.S. dollar when the U.S. dollar exchange rate moves. We start this section by discussing how we measure movements in the U.S. dollar exchange rate. Next, we discuss how we classify countries into pegs and floats. We then discuss our main empirical specification and the data we use, before presenting our empirical results.

II.A. U.S. Dollar Nominal Effective Exchange Rate

Our sample is annual data over the period 1973 to 2019. When assessing the response of pegs and floats to movements in the U.S. dollar exchange rate, we use a trade-weighted U.S. exchange rate constructed by the Bank of International Settlements (BIS) relative to 24 countries.[4] We exclude these 24 countries from our sample of pegs and floats. We sometimes refer to this exchange rate as the nominal effective exchange rate of the U.S. dollar. Figure I plots the evolution of this exchange rate over our sample period. We define the exchange rate as the domestic currency price of foreign currency. This implies that an increase in the exchange rate is a depreciation. The U.S. dollar's exchange rate experienced several large swings during our sample period. Its value rose sharply in the early 1980s and fell sharply in the late 1980s. It rose in the late 1990s and fell in the 2000s. It then rose, again, substantially in the 2010s.

4. The countries are Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Hong Kong, Ireland, Italy, Japan, Korea, Mexico, Netherlands, New Zealand, Norway, Portugal, Singapore, Spain, Sweden, Switzerland, and the United Kingdom.

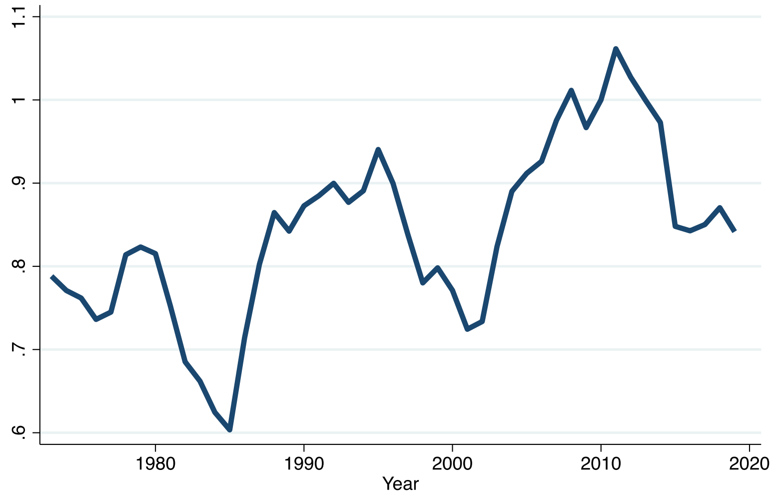

FIGURE I

U.S. Dollar Trade-Weighted Exchange Rate

This figure plots the BIS's trade-weighted exchange rate of the U.S. dollar against 24 countries. The countries are Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Hong Kong, Ireland, Italy, Japan, Korea, Mexico, Netherlands, New Zealand, Norway, Portugal, Singapore, Spain, Sweden, Switzerland, and the United Kingdom. Lower values indicate a more appreciated U.S. dollar.

II.B. Exchange Rate Regimes

Exchange rate classification is notoriously difficult. Many countries follow a policy that is neither a strict peg nor a free float and often de facto policy differs sharply from de jure policy. We classify the exchange rate regime for each country-by-year observation as either a peg or a float versus the U.S. dollar based on Ilzetzki, Reinhart, and Rogoff's (2019) classification of exchange rate regimes. They develop a "coarse" 6-category classification, and a "fine" 15-category classification. These classifications attempt to provide a detailed breakdown of the spectrum of de facto policy from a strict peg to a free float. Their coarse categories are (1) peg, (2) narrow band, (3) broad band and managed float, (4) freely floating, (5) freely falling, and (6) dual market with missing parallel-market data. We list the fine categories in Online Appendix Table A.2. Ilzetzki, Reinhart, and Rogoff also assign an anchor currency to each country-by-year observation. The anchor currency for most observations is the U.S. dollar. A minority of observations have the euro, British pound, French franc, German mark, and other major currencies as anchors. (See Online Appendix A.1 for details.)

From our perspective, what matters is the extent to which currencies in different categories comove with the U.S. dollar. We can assess this with the following regression

$$\Delta e_{i,t} = \alpha_i + \alpha_{r(i),t} + \sum_k \gamma_k \mathbb{I}_{i,t}(k) \times \Delta e_{USD,t} + \epsilon_{i,t}, \quad (1)$$

where $\Delta e_{i,t}$ denotes the log change in the exchange rate of country i from time $t-1$ to t, α_i denotes country fixed effects, $\alpha_{r(i),t}$ denotes region-by-time fixed effects, $\mathbb{I}_{i,t}(k)$ is an indicator for the exchange rate regime k of country i at time t, $\Delta e_{USD,t}$ denotes the log change in the U.S. dollar effective exchange rate, and $\epsilon_{i,t}$ denotes unmodeled influences on the change in the exchange rate of country i at time t. The region-by-time fixed effects are for four regions: Europe, Americas, Africa, and Asia/Oceania.

In this analysis, we define $\Delta e_{i,t}$ for all countries relative to the same currency (say, the U.S. dollar). This simplifies the exposition, since a perfect peg to the U.S. dollar moves exactly one-for-one relative to a perfect U.S. dollar float. The same holds (identically) if we define $\Delta e_{i,t}$ relative to any other currency, as long as it is the same currency for all countries (due to the presence of time fixed effects). The level of the coefficients γ_k are determined by the omitted category (which we choose to be the free floats, category 13). In Section II.F, in contrast, we use the trade-weighted exchange rate (with country-specific trade weights). In practice, both approaches yield similar results, as we describe later.

For country-by-year observations anchored to the U.S. dollar, we define $\mathbb{I}_{i,t}(k)$ using Ilzetzki, Reinhart, and Rogoff's fine classification. We exclude observations from categories 14 (freely falling) and 15 (dual market/missing data). We assign country-by-year observations that Ilzetzki, Reinhart, and Rogoff assess as being anchored to a currency other than the U.S. dollar (or to a basket) to one of three categories based on their coarse classification of these observations vis-à-vis that anchor. In particular, categories 13.1, 13.2, and 13.3 in Figure II are currency-by-year observations with an anchor other than the U.S. dollar which are classified in coarse categories 1 (peg), 2 (narrow band), and 3 (broad band and managed float), respectively. We exclude the 24 countries that the U.S. dollar nominal effective exchange rate is defined relative to and

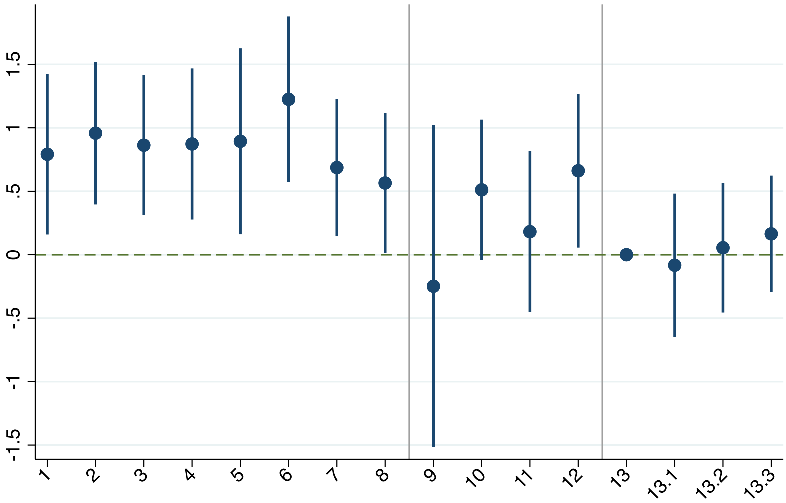

FIGURE II

Comovement with U.S. Dollar by Category

This figure plots our estimates of the γ_k's from equation (1). These are estimates of the comovement of the exchange rate of currencies with different exchange rate regimes as classified by Ilzetzki, Reinhart, and Rogoff's (2019) fine classification. We normalize the γ_k for category 13 (freely floating) to zero. The vertical lines extending from each point estimate represent 95% confidence intervals. The two thin vertical lines denote the splits between categories we classify as pegs (1 through 8) and floats (13 through 13.3).

restrict the sample to country-by-year observations for which real GDP data from the World Bank are available.

Figure II plots the γ_k coefficients from this regression along with 95% confidence intervals. The key conclusion that we draw from this figure is that Ilzetzki, Reinhart, and Rogoff's classification works. Currencies in categories on the left in the figure (the "hardest" pegs) depreciate strongly relative to currencies in category 13 ("free floats") when the US$ depreciates. A second observation is that currencies that are anchored to countries other than the U.S. dollar (categories 13.1, 13.2, and 13.3) behave quite similarly to the free floats (category 13). The reason for this is simply that the other anchor countries (mostly the euro and its predecessors) are for the most part free floats versus the U.S.

dollar. Countries that peg to these other anchors therefore also float versus the dollar.[5]

Interestingly, the degree to which the coefficients in Figure II fall as we move from left to right is quite modest for the first 12 categories. Even currencies that Ilzetzki, Reinhart, and Rogoff classify as managed floats comove by similar amounts with the U.S. dollar at an annual frequency as currencies that they classify as very hard pegs. This suggests that "fear of floating" is pervasive (Calvo and Reinhart 2002).

Based on these results, we classify observations into pegs and floats as follows. We classify observations in categories 1–8 in Figure II as pegs and observations in categories 13–13.3 as floats. We drop observations in categories 9 through 12 and observations in categories 14 (freely falling) and 15 (dual market/missing data). Categories 9–12 (coarse category 3) are intermediate categories that fit poorly in either the peg or float group. Our results are robust to handling these categories differently.[6]

We classify roughly half of our sample as floats (see Online Appendix Figure A.3 and Figure A.4 for the fraction of pegs in each region). Most of the countries that we classify as floats versus the U.S. dollar are strongly linked to other currencies (categories 13.1, 13.2, and 13.3). For example, a number of West African countries peg to the euro (and before that the French franc), which floats relative to the U.S. dollar. These currencies are classified as "floats" in our analysis. Therefore much of the variation we exploit comes from which currency a country pegs to, rather than whether a country pegs or floats. Table I lists the countries in our baseline sample and the number of years each country is classified as pegs or floats.

Our classification of observations into pegs and floats is likely far from perfect in that many of our pegs are not completely "hard" pegs and many of our floats are not completely "free" floats.

5. Online Appendix Figure A.1 presents results separately for observations anchored to baskets (that include the U.S. dollar) and for observations anchored to the South African rand, the Indian rupee, or the Singapore dollar—currencies that have not always floated freely relative to the U.S. dollar. Online Appendix Figure A.2 presents results analogous to Figure II for Ilzetzki, Reinhart, and Rogoff's coarse categories.

6. As robustness, we present results for both the case where we include these categories as pegs and the case where we include them as floats (see Online Appendix Figures A.17 and A.18). Both sets of results are similar to our baseline results.

TABLE I
LIST OF COUNTRIES AND NUMBER OF PERIODS OF PEGS VERSUS FLOATS TO US$

Country	Peg	Float	Country	Peg	Float	Country	Peg	Float
Afghanistan	15	0	Ethiopia	23	0	Nicaragua	33	2
Albania	0	21	Fiji	0	47	Niger	0	47
Algeria	8	14	Gabon	0	47	Nigeria	10	3
Angola	7	0	Gambia, The	16	13	North Macedonia	0	28
Antigua and Barbuda	42	0	Georgia	16	19	Oman	47	0
Argentina	20	0	Ghana	8	4	Pakistan	35	0
Armenia	22	2	Grenada	42	0	Palau	20	0
Aruba	32	0	Guatemala	39	0	Panama	47	0
Azerbaijan	17	3	Guinea	26	0	Paraguay	7	0
Bahamas, The	47	0	Guinea-Bissau	0	43	Peru	12	0
Bahrain	40	0	Guyana	36	3	Philippines	24	0
Bangladesh	35	10	Haiti	30	0	Poland	0	25
Barbados	43	1	Honduras	34	0	Qatar	20	0
Belarus	7	2	Hungary	0	29	Romania	0	19
Belize	40	5	Iceland	0	25	Russian Federation	2	13
Benin	0	47	India	28	6	Rwanda	41	1
Bermuda	47	0	Indonesia	27	0	Samoa	19	17
Bhutan	0	40	Iran, Islamic Rep.	14	0	San Marino	0	23
Bolivia	30	0	Iraq	20	0	São Tomé and Principe	8	10
Bosnia and Herzegovina	0	25	Israel	0	13	Saudi Arabia	47	0
Botswana	1	42	Jamaica	37	0	Senegal	0	47

TABLE I
CONTINUED

Country	Peg	Float	Country	Peg	Float	Country	Peg	Float
Brazil	2	6	Jordan	25	12	Serbia	0	21
Brunei Darussalam	0	46	Kazakhstan	18	1	Seychelles	36	3
Bulgaria	0	23	Kenya	25	14	Sierra Leone	16	0
Burkina Faso	0	47	Kiribati	0	47	Slovak Republic	0	28
Burundi	12	0	Kuwait	28	0	Slovenia	0	25
Cabo Verde	0	40	Kyrgyz Republic	18	5	Solomon Islands	40	0
Cambodia	23	0	Lao PDR	23	0	Somalia	0	7
Cameroon	0	47	Latvia	0	18	South Africa	0	20
Central African Republic	0	47	Lebanon	26	0	Sri Lanka	39	3
Chad	0	47	Lesotho	0	47	St Kitts and Nevis	42	0
Chile	2	0	Liberia	12	5	St Lucia	42	0
China	27	1	Libya	12	3	St Vincent & Grenadines	42	3
Colombia	8	0	Lithuania	6	16	Sudan	15	0
Comoros	0	40	Luxembourg	0	47	Suriname	14	0
Congo, Dem. Rep.	8	0	Macao SAR, China	38	0	Tajikistan	15	7
Congo, Rep.	0	47	Madagascar	0	40	Tanzania	24	0
Costa Rica	32	0	Malawi	7	21	Thailand	25	0
Côte d'Ivoire	0	47	Malaysia	24	6	Togo	0	47
Croatia	0	25	Maldives	25	0	Tonga	0	39
Curaçao	20	0	Mali	0	47	Trinidad and Tobago	42	3
Cyprus	0	45	Malta	0	47	Tunisia	0	47
Czech Republic	0	29	Marshall Islands	39	0	Turkey	0	10

TABLE I
CONTINUED

Country	Peg	Float	Country	Peg	Float	Country	Peg	Float
Djibouti	7	0	Mauritania	33	1	Turkmenistan	15	6
Dominica	42	0	Mauritius	15	12	Uganda	3	1
Dominican Republic	32	0	Moldova	14	0	Ukraine	12	8
Ecuador	27	0	Mongolia	17	12	United Arab Emirates	45	0
Egypt, Arab Rep	26	0	Morocco	0	47	Uruguay	6	0
El Salvador	38	0	Mozambique	11	0	Uzbekistan	10	6
Equatorial Guinea	0	40	Myanmar	13	1	Vanuatu	0	41
Estonia	0	25	Namibia	0	40	Vietnam	26	0
Eswatini	0	47	Nepal	8	29	Yemen, Rep.	12	0

Notes. The table lists the countries in our baseline sample and the number of periods (years) they are classified as pegs to US$ and floats against US$.

However, a key insight is that while this issue may reduce the statistical power of our methodology, it is not a source of bias. Misclassification of pegs and floats will lead to a smaller differential response of pegs versus floats for both the exchange rate and other outcome variables. We are interested in the size of, say, the output response relative to the exchange rate response to our shock. Since misclassification of pegs and floats leads both the numerator and the denominator in this ratio to be smaller, the classification of exchange rate regimes need not be perfect. This is analogous to the fact that a first-stage regression need not have an R-squared of one (or even a high R-squared) in an instrumental variables regression, since it is the ratio of the reduced-form to first-stage regression coefficients that matters. An instrument need not capture all the random variation, only a piece of it.

II.C. How Do Pegs Differ from Floats?

Our empirical results are simplest to interpret if the following identifying assumption holds: pegs are not differentially exposed (relative to floats) to shocks that are correlated with the U.S. nominal effective exchange rate. We can assess the plausibility of this assumption by comparing observable characteristics of pegs and floats. Table II reports the average differences in various observable characteristics between pegs and floats. We estimate this difference by regressing the characteristics on an indicator variable for whether the country-by-year observation is a peg. In each case, we report unconditional differences (i.e., no other controls), differences conditional on time fixed effects, and differences conditional on region-by-time fixed effects.

Conditional on region-time fixed effects, pegs and floats are quite well-balanced on most observable dimensions. The average difference in their real GDP per capita is not statistically significantly different from zero. They are roughly equally open economies on average, their export and import shares to the United States are similar, as are their net foreign asset positions and their exports and imports of commodities as a share of GDP.[7] The only observable differences conditional on region-time fixed effects are that pegs have somewhat higher inflation, somewhat higher short-term interest rates, are larger in terms of

7. This last result is based on a relatively coarse measure of commodity exports: the sum of agriculture and mining exports.

TABLE II
HOW DO PEGS DIFFER FROM FLOATS?

Variable	No controls	Time fixed effects	Region × time fixed effects
Log population	−0.02	−0.09	0.74*
	(0.31)	(0.31)	(0.39)
Log real GDP per capita	0.36	0.32	−0.17
	(0.22)	(0.22)	(0.23)
Export to GDP	−0.01	−0.01	0.00
	(0.04)	(0.04)	(0.04)
Import to GDP	−0.03	−0.03	−0.03
	(0.04)	(0.04)	(0.04)
Export share to the U.S.	0.04***	0.04***	−0.00
	(0.01)	(0.01)	(0.01)
Import share to the U.S.	0.05***	0.05***	0.00
	(0.01)	(0.01)	(0.00)
NFA to GDP	0.05	0.06	−0.10
	(0.18)	(0.19)	(0.26)
Inflation rate (p.p.)	−0.89	−0.65	2.21***
	(1.51)	(1.41)	(0.69)
T-bill rate (p.p.)	1.01	0.89	2.86***
	(0.84)	(0.90)	(0.96)
Commodity exports to GDP	0.05*	0.06**	0.04
	(0.03)	(0.03)	(0.03)
Commodity imports to GDP	0.01	0.01	−0.01
	(0.02)	(0.02)	(0.02)
Capital account openness	0.14***	0.14***	0.13**
	(0.04)	(0.04)	(0.05)

Notes. The table reports regression coefficients for regressions of various country characteristics on an indicator variable for whether the country-by-year observation is a peg. The dependent variables are listed on the left. For each dependent variable we report results of a regression with no additional control variables, results when time fixed effects are included, and results when region-by-time fixed effects are included. The inflation and T-bill rates are measured in percentage points. Standard errors clustered by country are reported in parentheses. * $p < .1$, ** $p < .05$, *** $p < .01$.

population,[8] and have higher capital account openness as measured by Chinn and Ito (2008). In Section II.I, we consider a specification where we control for the interaction between capital account openness and the U.S. dollar exchange rate and find that this does not affect our results, suggesting this is not an important confounder.

8. This may, at first, seem to contradict the findings of Hassan, Mertens, and Zhang (2023), who document that large countries tend to float. The difference comes from the fact that we exclude 24 relatively advanced economies and our definition of floats include pegs to other currencies than the U.S. dollar.

II.D. Empirical Specification

We seek to estimate the differential response of various outcome variables in pegging countries versus floating countries at different horizons to a change in the U.S. dollar exchange rate. For this purpose, we run the following regression:

$$y_{i,t+h} - y_{i,t-1} = \alpha_{i,h} + \alpha_{r(i),t,h} + \beta_h \text{Peg}_{i,t} \times \Delta e_{USD,t} + \Gamma_h' \mathbf{X}_{i,t-1} + \gamma_h \text{Peg}_{i,t} + \epsilon_{i,t,h}, \tag{2}$$

where $y_{i,t+h}$ denotes an outcome variable in country i at time $t+h$, $\text{Peg}_{i,t}$ is an indicator for whether country i at time t is a peg, $\Delta e_{USD,t}$ denotes the log change in the U.S. dollar nominal effective exchange rate from time $t-1$ to time t, $\alpha_{i,h}$ is a country fixed effect, $\alpha_{r(i),t,h}$ is a region-by-time fixed effect, $\mathbf{X}_{i,t-1}$ denotes additional control variables, and $\epsilon_{i,t,h}$ denotes unmodeled influences on the outcome variable. This type of empirical specification is often called a local projection (Jordà 2005). The region-by-time fixed effects are for the following four regions: Europe, Americas, Africa, and Asia/Oceania. The coefficient of interest is β_h. We run this regression on annual data for different horizons h.[9]

We report standard errors that are two-way clustered on time and country. We drop the largest and smallest 0.5% of observations for each outcome variable. This avoids our results being highly sensitive to extreme events such as severe wars (e.g., Iraq in 2004). We also drop country-by-year observations during which the country switches from being a peg to a float or vice versa and the following year.

II.E. Data

Our main data sources are the World Bank's World Development Indicators (WDI) database, the database of the United

9. An alternative approach would be to instrument for the local exchange rate with $\text{Peg}_{i,t} \times \Delta e_{USD,t}$. However, this would presuppose that the only channel through which the shocks that move the U.S. dollar exchange rate affect peggers versus floaters is these countries' exchange rates. This might not be the case (e.g., interest rates might drive both exchange rates and affect the economy directly). Hence, we run direct regressions. However, if the exchange rate is truly the only channel through which changes in the exchange rate of the U.S. dollar affect peggers versus floaters, our regressions with the nominal exchange rate as the outcome variable are akin to first-stage regressions in an IV empirical strategy and our output regressions are akin to reduced-form regressions. The IV estimate is then the ratio of the two.

Nations Conference on Trade and Development (UNCTAD), and the International Financial Statistics (IFS) database of the International Monetary Fund (IMF). We use data on GDP, consumption, investment, exports, and imports from the WDI, all measured in constant 2015 U.S. dollars. We use data on export unit values, import unit values, and the terms of trade from UNCTAD. We use data on short-term nominal interest rates and inflation from IFS. In addition to these sources, we use data on nominal and real effective exchange rates from Darvas (2012, 2021) (series NEER_65 and REER_65), data on the ratio of net foreign assets to GDP from the External Wealth of Nations Database (Lane and Milesi-Ferretti 2018), the Bloomberg Commodity Price Index, and capital account openness measures from Chinn and Ito (2008).

For the nominal interest rate, we choose among the T-bill rate, the policy rate, and the money market rate. For each country, we use the one of these series with the longest sample in the IFS database. We construct a measure of net exports from data on exports and imports. We construct a measure of the ex post real interest rate from data on the nominal interest rate and inflation. Online Appendix Table A.3 provides an overview of our data sources.

As already noted, all our data are annual and our sample period is 1973 to 2019. However, our panel data set is unbalanced and differs in size from variable to variable. One of the robustness exercises we do below is to rerun our empirical analysis on the largest sample for which we have all our main variables of interest available.

II.F. Empirical Results

Figure III plots our estimates of β_h for four outcome variables: the nominal effective exchange rate, the real effective exchange rate, real GDP, and consumption. For the nominal and real effective exchange rates, the dependent variable is the $h+1$-period change in the log of the country's trade-weighted exchange rate (nominal or real). For GDP, the dependent variable is $\frac{Y_{i,t+h}-Y_{i,t-1}}{Y_{i,t-1}}$ where $Y_{i,t}$ denotes the level of GDP in country i at time t. For consumption, the dependent variable is $\frac{C_{i,t+h}-C_{i,t-1}}{Y_{i,t-1}}$, where $C_{i,t}$ denotes the level of consumption in country i at time t. The independent variable of interest $\Delta e_{US,t}$ is the change in the log of the U.S. dollar nominal effective exchange rate. We include three controls in addition to the fixed effects: the lagged growth rate

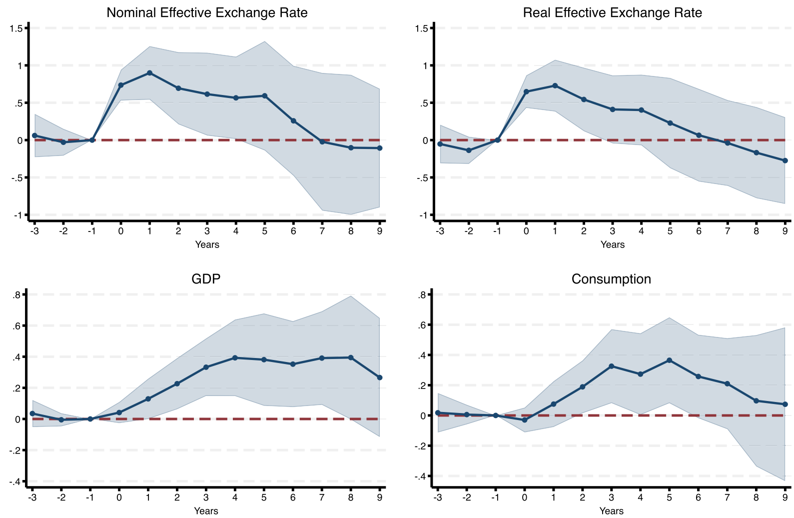

FIGURE III

Response of Pegs Versus Floats for Exchange Rate, Output, and Consumption

This figure plots the response of the nominal effective exchange rate, real effective exchange rate, real GDP, and consumption for pegs versus floats in response to a change in the U.S. dollar exchange rate. For the exchange rates, the dependent variable is the change in the log of the variable. For GDP, the dependent variable is the percentage change, while for consumption it is $\frac{C_{i,t+h}-C_{i,t-1}}{Y_{i,t-1}}$. These are our estimates of β_h in equation (2) for different horizons h when these four variables are the outcome variables. These results are for the case with our baseline set of controls: one lag of the outcome variable, one lag of the treatment variable, and one lag of GDP growth. The shaded areas are 95% confidence intervals.

of the outcome variable, a lag of the treatment variable (more specifically, a lag of $\text{Peg}_{i,t} \times \Delta e_{USD,t}$ and $\text{Peg}_{i,t}$), and a lag of GDP growth.[10] Recall that we define the exchange rate as the domestic currency price of foreign currency, which implies that an increase in the exchange rate is a depreciation. The responses in Figure III should thus be interpreted as responses of pegs relative to floats to a 1% depreciation in the U.S. dollar.

In response to a 1% depreciation of the U.S. dollar, the trade-weighted nominal effective exchange rate of pegs depreciates by 0.74% relative to floats. This depreciation persists for a number of

10. For the periods before the treatment period ($h < 0$), we include these controls at time $h - 1$.

years, first rising slightly to 0.9% and then falling to about 0.6% in the three to five years after the U.S. depreciation. The reason the response is not fully one for one is that our pegs are not perfectly hard pegs and our floats are not perfectly free floats. The real effective exchange rate of pegs depreciates by only slightly less relative to floats than the nominal effective exchange rate. The response of the real effective exchange rate is also persistent, although somewhat less persistent than the response of the nominal exchange rate.[11] Online Appendix Table A.4 shows that the regime-induced variation in exchange rates we use for identification represents roughly 8% of the total variation in exchange rates in our data.

The bottom two panels in Figure III show that the U.S. dollar depreciation results in a gradual but quite substantial increase in GDP and consumption in pegger countries relative to floater countries. In response to a 1% U.S. dollar depreciation, GDP eventually rises by about 0.4%. To get a better sense for the quantitative magnitude of the GDP response, note that these estimates imply that a 10% depreciation of the domestic currency results in a 5.5% increase in GDP over five years.[12] Recall that the consumption response we plot is the change in consumption as a fraction of time $t-1$ GDP. The consumption response peaks at almost 0.4% of GDP a few years after the depreciation.

Figure IV presents results for investment, net exports, exports, and imports. All four variables are measured as a fraction of GDP. For example, the dependent variable for investment is $\frac{I_{i,t+h}-I_{i,t-1}}{Y_{i,t-1}}$, where $I_{i,t}$ is the level of investment in country i at time t. The depreciation results in an increase in investment that is modest to begin with but builds over time and reaches a maximum after five years. Exports increase one year after the depreciation but then fall back to zero for several years before increasing again. Contrary to the simple logic of expenditure switching, the depreciation results in an increase in imports that builds gradu-

11. Online Appendix Figure A.5 compares the response of the trade-weighted nominal and real exchange rate (the baseline in this section) to the response of the nominal exchange rate to the U.S. dollar. These yield similar responses of pegs versus floats to US$ depreciations, although the exchange rate versus the US$ is more persistent at long horizons.

12. The GDP response is gradual and peaks after five years at 0.4. The average nominal exchange rate response is roughly 0.7 over the first five years. We get 5.5 as $10 \times 0.4 \div 0.7$.

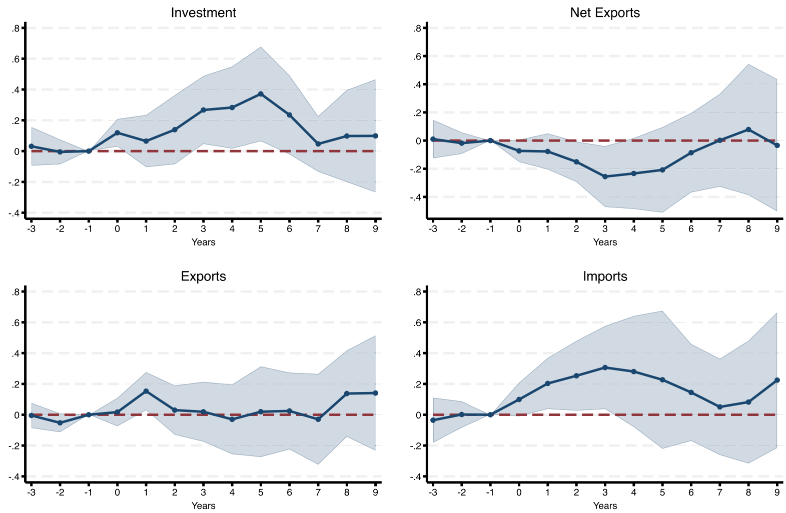

FIGURE IV

Response of Pegs Versus Floats for Investment and Trade

This figure plots the response of investment, net exports, exports, and imports for pegs versus floats in response to a change in the U.S. dollar exchange rate. All four variables are measured as a fraction of initial GDP (e.g., $\frac{I_{i,t+h}-I_{i,t-1}}{Y_{i,t-1}}$ for investment). These are our estimates of β_h in equation (2) for different horizons h when these four variables are the outcome variables. These results are for the case with our baseline set of controls. The shaded areas are 95% confidence intervals.

ally over time. For several years, the increase in imports is larger than the increase in exports, which implies that net exports fall.

The left two panels of Figure V present the response of the short-term nominal interest rate and the CPI in pegger countries relative to floaters. For the CPI, the dependent variable is the change in the log of the CPI. For the nominal interest rate, the dependent variable is the change in the level of the interest rate. The nominal interest rate rises modestly in response to the depreciation (by less than 0.1 percentage points in response to a 1% depreciation). The price level also increases, modestly at first, but more later on (by about 0.5% in response to a 1% depreciation).[13]

13. Online Appendix Figure A.7 presents results on the ex post real interest rate that are implied by the responses of the nominal interest rate and prices in Figure V. The response of the real interest rate fluctuates around zero and is statistically insignificant throughout.

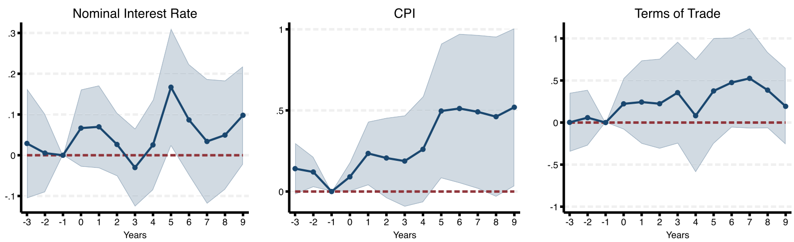

FIGURE V

Response of Pegs Versus Floats for the Nominal Interest Rate, CPI, and Terms of Trade

This figure plots the response of short-term nominal interest rates, the CPI, and the terms of trade for pegs versus floats in response to a change in the U.S. dollar exchange rate. For the nominal interest rate, the dependent variable is the level of the interest rate (i.e., 0.02 denotes 2%). For the CPI and the terms of trade, the dependent variables are the change in the log of the variables. These are our estimates of β_h in equation (2) for different horizons h when these two variables are the outcome variables. These results are for the case with our baseline set of controls. The shaded areas are 95% confidence intervals.

These results help distinguish between different possible underlying shocks that might be driving the variation in the U.S. dollar exchange rate in our regressions. If loose monetary policy were the reason for the U.S. dollar depreciation, we would expect to see a negative relative response of the nominal interest rate for pegs relative to floats (since pegs share U.S. monetary policy more strongly). The fact that our estimated response for the nominal interest rate is positive, therefore, provides evidence against the notion that the U.S. depreciations in our regressions are driven by monetary policy.[14] We develop this idea more fully in Section III.

Put differently, the joint responses of nominal exchange rates and nominal interest rates show substantial ex post deviations from UIP. After the pegs' initial depreciation, their nominal exchange rates appreciate and their nominal interest rates are (if anything) higher than before (relative to floats). This implies that the return to holding assets denominated in the currencies of the

14. Our empirical analysis cannot rule out the possibility that exchange rate changes are due to changes in expectation about far future nominal interest rates, $\ln(1 + i_{P,t+T}) - \ln(1 + i_{F,t+T})$ for T greater than 10 years. Such shocks are hard to distinguish from financial shocks. Chahrour et al. (2022) argue that far future fundamental shocks are the source of a substantial fraction of volatility in exchange rates. In contrast, Miyamoto, Nguyen, and Oh (2025) find that the dominant drivers of the real exchange rate are largely orthogonal to macro aggregates.

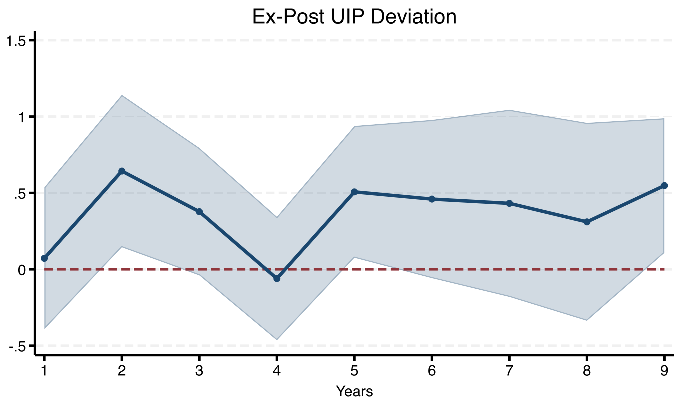

FIGURE VI

Ex Post UIP Deviations

The figure plots the response of ex post UIP deviations for pegs versus floats in response to a change in the U.S. dollar nominal effective exchange rate. The dependent variable is $\Delta e_{i,t}^{USD} + \ln(1 + i_{i,t}) - \ln(1 + i_{U,t})$, where $\Delta e_{i,t}^{USD}$ denotes log changes in the exchange rate of country i to the US\$ from time $t-1$ to t, $i_{i,t}$ is the nominal interest rate of country i from time $t-1$ to t, and $i_{U,t}$ is the U.S. nominal interest rate. The results in blue plot estimates of β_h for $h = 1, \ldots, 9$ from equation (2) for different horizons h when ex post UIP deviations are the outcome variable. These results are for the case with our baseline set of controls. The shaded areas are 95% confidence intervals.

pegs are higher ex post than returns of assets denominated in floating currencies. Figure VI shows this by plotting the impulse response of ex post UIP deviations of pegs relative to floats. The presence of these UIP deviations are at the core of the theoretical channel we propose in Section III for why depreciations are expansionary in response to regime-induced exchange rate variation.

The right panel of Figure V presents the response of the terms of trade. The dependent variable, in this case, is the change in the log of the terms of trade. We define the terms of trade as the price of exports divided by the price of imports (our data are unit values). We estimate that the terms of trade of peggers improves modestly relative to floaters at short horizons in response to the U.S. dollar depreciation. Further out, the improvement in the terms of trade is larger (though statistically insignificant). In a world with sticky prices that are set in the producer's currency, the terms of trade would deteriorate in response to a depreciation

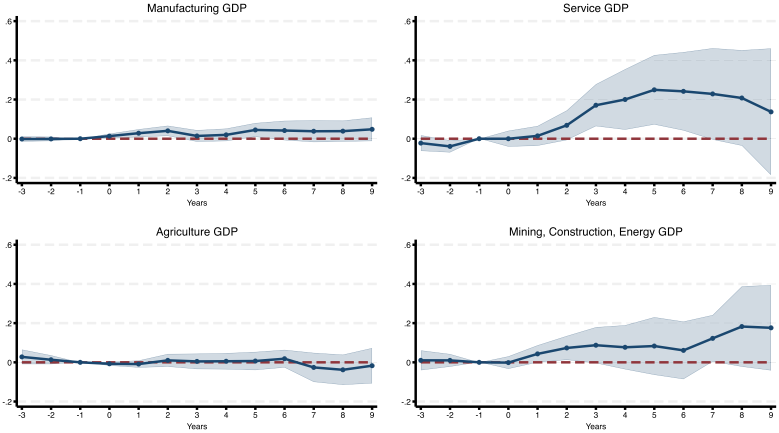

FIGURE VII

Response of Pegs versus Floats by Sector

This figure plots the response of output by sector for pegs versus floats in response to a change in the U.S. dollar exchange rate. In all cases, the dependent variable is the change in the variable in question as a fraction of initial GDP. These are our estimates of β_h in equation (2) for different horizons h when these four variables are the outcome variables. These results are for the case with our baseline set of controls. The shaded areas are 95% confidence intervals.

(imports would become more expensive in domestic currency). With local-currency pricing, however, a depreciation results in an improvement in the terms of trade. In a world with a dominant currency (e.g., import and export prices sticky in U.S. dollars) the terms of trade would not respond to a change in the exchange rate. Online Appendix Figure A.6 presents our estimates of the response of export and import unit values. Measured in U.S. dollars, the price of exports is little changed, while the price of imports falls modestly in pegging countries relative to floating countries in response to the U.S. dollar depreciation.

Figure VII presents the response of output by sector for pegs relative to floats. The dependent variable for these four sets of results is the change in the variable in question divided by initial GDP. For example, for the service sector, the dependent variable is $\frac{Y^S_{i,t+h}-Y^S_{i,t-1}}{Y_{i,t-1}}$, where $Y^S_{i,t}$ is service sector output in country i at time t. Strikingly, the bulk of the response comes from the service sector. The response of manufacturing and agriculture are very close to zero. This is also the case for the response of the mining,

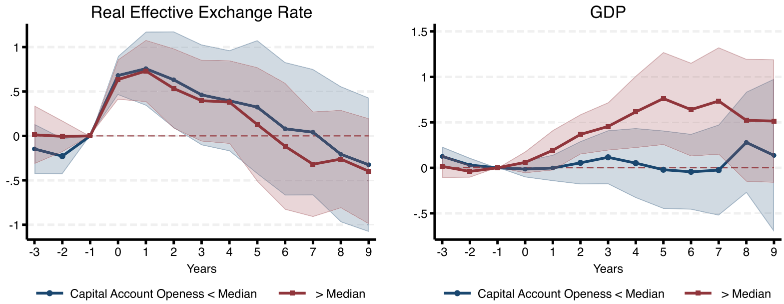

FIGURE VIII

Heterogenous Response by Capital Account Openness

This figure plots the response of the real exchange rate and output for pegs versus floats in response to a change in the U.S. dollar exchange rate. We report this separately for countries with average capital account openness below versus above the median across countries. For the real exchange rates, the dependent variable is the change in its log. For GDP, the dependent variable is a percentage change. These are our estimates of β_h in equation (2) for different horizons h when the variables described above are the outcome variables. These results are for the case with our baseline set of controls. The shaded areas are 95% confidence intervals.

construction, and energy sectors except for a boom at very long horizons. This pattern of responses suggests that the depreciation kicks off a domestic boom, as opposed to an export-led boom.

II.G. Heterogeneity by Openness and Time Period

Our finding that a regime-induced depreciation results in a fall in net exports indicates that capital is flowing into these countries. This raises the question whether our results differ by a country's capital account openness and openness to trade. Figure VIII reestimates equation (2) for countries with above- versus below-average capital account openness over the sample period when the country's data are available. Here we measure capital account openness by the Chinn-Ito index (Chinn and Ito 2008). We find that the relative response of GDP is entirely driven by a set of countries with high capital account openness, despite the fact that the relative response of real exchange rates are similar. In contrast, the response of GDP is similar for countries with above- versus below-median levels of trade openness, as measured by the sum of exports and imports over GDP (see Online Appendix Figure A.8). The heterogeneity in the results by capital account openness and the lack of heterogeneity by trade openness are both consistent with the model we develop in Section III. This model puts international capital flows at center stage. Online Appendix Figure A.9 splits the sample period into an early period (1973–1995) and a later period (1996–2019). We find similar responses in both periods.

II.H. The Plaza Accord

It is perhaps useful to have a concrete example of the stimulatory effects of exchange rate depreciations that we have documented in general terms in the preceding sections. The Plaza Accord of 1985—named after the hotel where it was announced in New York City—provides such an example. The Plaza Accord was an agreement between France, Germany, Japan, the United Kingdom, and the United States (G5 countries) to depreciate the U.S. dollar. The announcement was a culmination of a larger policy shift by the Reagan administration regarding the dollar, which started when James Baker became Treasury Secretary in January 1985 (Frankel 2015). This policy shift helped trigger a rapid depreciation of the U.S. dollar. Here, we use this event as a case study of a regime-induced depreciation of pegs to the U.S. dollar versus floats.

Figure IX plots the evolution of the real exchange rate and real GDP for pegs versus floats against the US$ in the years surrounding the Plaza Accord. The left panel shows that the real exchange rate of floats appreciated relative to pegs following the Accord. The timing of the Accord was arguably orthogonal to macroeconomic conditions in the pegs versus floats in our sample (none of which were parties to the agreement). The right panel shows that GDP grew less quickly in the floats relative to the pegs in the years after the Accord. To quantify the response for this episode, we regress changes in real GDP and the real exchange rate starting in 1985 on a peg indicator for 1985. The differential response in the log real exchange rate in the first year is 12% (std. err. 2.7%) and the difference in log GDP after five years is 7.4% (std. err. 3.1%). This implies a GDP response to a 10% exchange rate depreciation of 6.2% ($\approx 7.4 \times 10 \div 12$), which roughly lines up with the estimates from our baseline empirical analysis.[15]

15. We also consider a regression where we include all time periods in our data set and country and time fixed effects to account for any country-specific growth

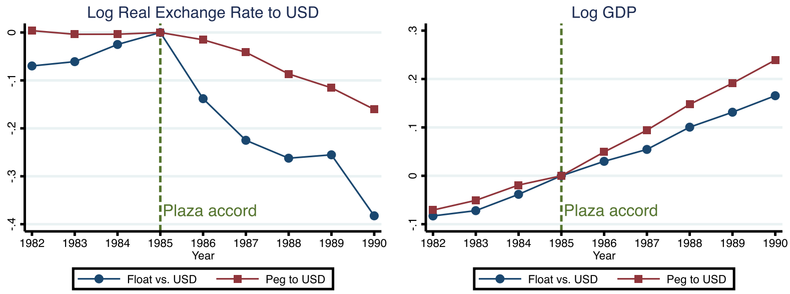

FIGURE IX

Case Study of the Plaza Accord

The left figure plots the average of changes in the log real exchange rate relative to 1985 for countries that float and peg against the US$. The right panel is analogous for GDP. We exclude G5 countries and country-by-year observation with Ilzetzki, Reinhart, and Rogoff classification 14 and 15 from the sample in constructing the figure. We define countries that peg to the US$ the same way as before (Ilzetzki, Reinhart, and Rogoff classification 1–8 with anchor currency US$), while other countries are classified as floats versus the US$. Pegs and floats are defined in this figure based on their status in 1985.

II.I. Robustness

We have explored a number of variations on our baseline specification. Results for 13 such variations are presented in Table III and Online Appendix Figures A.10–A.22. We start with several specifications analogous to our baseline specification except that we add controls for variables interacted with the peg indicator. Columns (2) and (3) of Table III and Online Appendix Figure A.10 add interactions of contemporaneous values of U.S. GDP growth, U.S. inflation, and the change in the U.S. T-bill rate with the peg indicator as controls. Adding these controls helps control for economic conditions in the United States (e.g., U.S. monetary policy shocks). Columns (4) and (5) of Table III and Online Appendix Figure A.11 adds an interaction of the change in the log of commodity prices with the peg indicator as a control.[16] Columns (6) and (7) of Table III and Online Appendix Figure A.12

differentials. According to this regression, a 10% initial depreciation is associated with an 8% increase in GDP after five years.

16. Since 2000, commodity prices have tended to comove negatively with the U.S. dollar. This is less true before 2000 and is potentially spurious given the high persistence of both series—see Online Appendix Figure A.25. The correlation between the log changes in the trade-weighted U.S. dollar exchange rate and the

TABLE III
ROBUSTNESS TO POTENTIAL CONFOUNDS

	GDP response at $h = 4$						
	Baseline	U.S. controls		Com. prices		GFC	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Peg × ΔUS$	0.43		0.43		0.51		0.43
	(0.11)		(0.11)		(0.14)		(0.15)
Peg × Δ(U.S. GDP)		0.53	0.06				
		(0.54)	(0.11)				
Peg × Δ(Com. P.)				−0.00	−0.09		
				(0.04)	(0.14)		
Peg × ΔGFC						0.01	−0.01
						(0.01)	(0.15)
Region × time fixed effects	✓	✓	✓	✓	✓	✓	✓
Country fixed effects	✓	✓	✓	✓	✓	✓	✓
Controls	✓	✓	✓	✓	✓	✓	✓

Notes. The table shows coefficients of regression (2) for $h = 4$, where the outcome variable is GDP. Column (1) shows our baseline estimates of the coefficient of the interaction between peg and log changes in the U.S. dollar effective exchange rate (Peg × ΔUS$). Column (2) replaces Peg × ΔUS$ with three alternative variables: the interaction between a peg and the log change in U.S. GDP (Peg × ΔU.S. GDP), a peg and the change in U.S. inflation (Peg × ΔU.S. Inflation), and a peg and the change in U.S. interest rate (Peg × ΔU.S. Interest Rate). Column (3) includes both Peg × ΔUS$ and the three before-mentioned variables. Column (4) replaces Peg × ΔUS$ with the interaction between peg and log changes in commodity price index (Peg × ΔCom. P). Column (5) includes both Peg × ΔUS$ and Peg × ΔCom. P. Column (6) replaces Peg × ΔUS$ with the interaction between peg and changes in the global financial cycle indicator (Peg × ΔGFC). Column (7) includes both Peg × ΔUS$ and Peg × ΔGFC. Standard errors in parentheses are two-way clustered by time and country. All regression specifications include the baseline set of controls as well as time and country fixed effects.

add the interaction of the change in the global factor in risky asset prices of Miranda-Agrippino and Rey (2015, 2020) and the peg indicator as a control.[17] This addresses the concern that our results might be driven by peggers being systematically more exposed to global financial cycles, which are correlated with the movements in U.S. dollar exchange rate. In all three of these cases, the results are very similar to our baseline result.

The region-by-time fixed effects in our baseline specification imply that the variation we use to identify our main results is within-region variation. Online Appendix Figure A.13 presents results for a case that is identical to our baseline specification

log change in the Bloomberg commodity price index is 0.22 before 2000 but 0.71 after 2000.

17. We use the updated version of their standardized measure for the period of 1980–2019. We downloaded these data from Hélène Rey's website.

except that the region-by-time fixed effects are replaced by time fixed effects. This allows us to exploit variation in exchange rate regimes not only within but also between continents. For example, in the baseline version, pegs in Latin America are not being compared with floats in Europe (this variation is absorbed by the region-by-time fixed effects). This specification yields similar point estimates, with smaller standard errors. One difference is that the response of net exports is less negative.

Online Appendix Figures A.14 and A.15 consider alternative sets of controls (no controls other than fixed effects and two lags of the outcome variable, the treatment variable, and GDP, respectively). Online Appendix Figure A.16 presents results where we drop the largest and smallest 1% of observations for each variable (instead of 0.5% in the baseline). Online Appendix Figures A.17 and A.18 consider alternative assumptions about how to categorize Ilzetzki, Reinhart, and Rogoff's coarse category 3 (included among floats or pegs, respectively, rather than dropped). Online Appendix Figure A.19 presents results for the case where we replace the BIS trade-weighted nominal effective exchange rate for the U.S. dollar as our treatment variable with a U.S. dollar exchange rate that is constructed using GDP weights for the same set of countries. Online Appendix Figure A.20 presents results for the case where we include the 24 countries that the U.S. dollar nominal effective exchange rate is defined relative to in the sample of floats. Online Appendix Figure A.21 adds the interaction of capital account openness and the U.S. dollar exchange rate as a control. This addresses the concern that our results might be driven by heterogeneity in capital account openness rather than by the difference in exchange rate regime.[18] In all of these cases, the responses are very similar to our baseline case.

Online Appendix Figure A.22 presents results for the largest sample where we have data on all nine of our main variables. In this case, the response of the nominal and real effective exchange rates is estimated to be more transient, although the standard

18. Figure VIII shows that the effect we estimate for pegs versus floats is driven by countries with open capital accounts. This is different from the insensitivity we are showing in Online Appendix Figure A.21. Figure VIII runs our baseline regression separately for high versus low values of capital account openness, that is, separate coefficients on $\text{Peg}_{i,t} \times \Delta e_{USD,t}$. In contrast, in Online Appendix Figure A.21 the coefficient of interest remains $\text{Peg}_{i,t} \times \Delta e_{USD,t}$ but we add KA $\text{Open}_i \times \Delta e_{USD,t}$ as an additional control.

errors are very large. The estimated response for output, consumption, investment, and net exports is similar to our baseline. The estimated response of the terms of trade is larger than in our baseline. The large standard errors arise because the sample size in this case is only about 20% of the sample size in our baseline specification. The primary constraint here is the availability of the interest rate data.

Finally, one might ask whether either tourism or government expenditures are driving our results. Online Appendix Figure A.23 shows the response of tourist inflows and outflows in our baseline specification. Neither of them is statistically significantly different from zero. Online Appendix Figure A.24 shows the response of government expenditures. The response is positive suggesting government spending is procyclical.

III. A Model of Regime-Induced Depreciations

In Section II we demonstrate that regime-driven exchange rate depreciations lead to macroeconomic booms. We also highlight two features of these booms that make them difficult to match using standard models: net exports fall, implying that the booms are not export led, and nominal interest rates do not seem to fall (if anything, they rise) implying that the booms do not arise from easy monetary policy. Here we introduce a model with financial shocks and imperfect financial openness and show that this model can match the responses we estimate to regime-driven exchange rate depreciations while standard models cannot. We also show how this model is consistent with unconditional exchange rate disconnect and the Mussa fact.

III.A. A Model with Imperfect Financial Openness

Consider a world economy with a continuum of small open economies. Suppose time is discrete and the horizon is infinite. Each small open economy, indexed by $j \in [0, 1]$, belongs to one of four regions: the United States (U), the Euro area (E), pegs to the U.S. dollar (P^U), or pegs to the euro (P^E). (U, E, P^E, P^U are sets that partition the interval [0,1].) All small open economies in a region are symmetric.

Economies in the Euro area use a single currency, the euro. Economies in the United States use the U.S. dollar. Each small open economy in the other two regions has its own currency, but these currencies are all pegged to either the U.S. dollar or the euro. We define the nominal exchange rate $\mathcal{E}_{ijt}$ as the price of currency i in terms of currency j at time t. An increase in $\mathcal{E}_{ijt}$ then represents a depreciation of currency j against the currency i. Since the currencies of economies in P^E are pegged to the euro, while the currencies of economies in P^U are pegged to the U.S. dollar, we have that

$$\mathcal{E}_{ijt} = \begin{cases} \mathcal{E}_{EUt} & \text{if } i \in \{E, P^E\} \text{ and } j \in \{U, P^U\} \\ \mathcal{E}_{UEt} & \text{if } i \in \{U, P^U\} \text{ and } j \in \{E, P^E\} \\ 1 & \text{otherwise} \end{cases}, \tag{3}$$

where $\mathcal{E}_{EU}$ is the price of the euro in terms of the U.S. dollar, and $\mathcal{E}_{UE} = \frac{1}{\mathcal{E}_{EU}}$. An increase in $\mathcal{E}_{EU}$ is a depreciation of the U.S. dollar relative to the euro.

The central bank in the Euro area sets a path for the nominal interest rate in the Euro area $\{i_{Et}\}$, while the central bank in the United States sets a path for the nominal interest rate in the United States $\{i_{Ut}\}$. We assume that the central banks in P^E and P^U are able to peg their currencies to the euro and U.S. dollar, respectively, in a perfectly credible manner. This implies that uncovered interest rate parity holds between the euro and pegs to the euro, and between the U.S. dollar and pegs to the U.S. dollar. As a consequence, $i_{jt} = i_{Et}$ if $j \in \{E, P^E\}$ and $i_{jt} = i_{Ut}$ if $j \in \{U, P^U\}$.

We assume that a combination of frictions in international financial markets and shocks hitting market participants in these markets results in deviations from uncovered interest parity between the euro and the U.S. dollar. We denote these UIP shocks as ψ_t and assume that the following modified uncovered interest parity condition holds for the euro and U.S. dollar:

$$(1 + i_{Ut}) = (1 + i_{Et})\frac{\mathcal{E}_{EUt+1}}{\mathcal{E}_{EUt}} \exp(\psi_t). \tag{4}$$

An increase in ψ_t can be interpreted as an exogenous increase in demand for the euro relative to the U.S. dollar, which, everything else being equal, results in a depreciation of the U.S. dollar relative to the euro. We provide a microfoundation of this equation in Online Appendix B.1.

There is a representative household in each small open economy j. This representative household has time-separable preferences of the following form

$$\sum_{t=0}^{\infty}\left(\prod_{s=0}^{t-1}\beta_{js+1}\right)\left[u(C_{jt})-v(N_{jt})\right],$$

where β_{js+1} is a discount factor between periods s and $s+1$, C_{jt} is an aggregate consumption basket, and N_{jt} is labor supply. We assume constant-elasticity utility functions, $u(C)=\frac{C^{1-\sigma}}{1-\sigma}$ and $v(N)=\frac{N^{1+\nu}}{1+\nu}$, where $\sigma>0$ and $\nu>0$.

The aggregate consumption basket is given by the following constant elasticity of substitution (CES) basket over consumption goods produced in the different small open economies:

$$C_{jt}=\left[(1-\alpha)^{\frac{1}{\eta}}(c_{jjt})^{\frac{\eta-1}{\eta}}+\alpha^{\frac{1}{\eta}}\int_0^1(c_{ijt})^{\frac{\eta-1}{\eta}}di\right]^{\frac{\eta}{\eta-1}},$$

where c_{ijt} is j's consumption of goods produced in i, $\eta>0$ is the elasticity of substitution, and $\alpha\in[0,1]$ captures the degree of trade openness of the countries we model. The ideal price index is then given by

$$P_{jt}=\left[(1-\alpha)p_{jjt}^{1-\eta}+\alpha\int p_{ijt}^{1-\eta}di\right]^{\frac{1}{1-\eta}}, \tag{5}$$

where p_{ijt} is the price of goods shipped from economy i to j at time t. The demand curves of home and foreign goods are given by

$$c_{ijt}=\begin{cases}(1-\alpha)\left(\frac{p_{jjt}}{P_{jt}}\right)^{-\eta}C_{jt} & \text{for } i=j\\ \alpha\left(\frac{p_{ijt}}{P_{jt}}\right)^{-\eta}C_{jt} & \text{for } i\neq j\end{cases}. \tag{6}$$

Households in each small open economy hold both domestic bonds and foreign bonds. We assume household portfolios are sticky in the sense that they do not adjust their portfolios infinitely elastically to changes in the relative expected returns of bonds in different countries. For theoretical clarity, we make the extreme assumption that households always invest a fraction sdk of their savings into bonds issued in economy k, where dk is the measure of economy k, and $s\in[0,1]$ captures the degree of financial openness of the economy. The remaining fraction of savings $1-s$ is invested in domestic bonds. These assumptions imply that the nominal rate of return of the household's portfolio is a weighted average of the domestic nominal interest rate and the exchange-rate-adjusted nominal interest rate in other countries

$$(7) \qquad 1 + i^p_{jt} = (1 - s)(1 + i_{jt}) + s \int_0^1 (1 + i_{kt}) \frac{\mathcal{E}_{kjt+1}}{\mathcal{E}_{kjt}} dk.$$

Earlier work has typically either assumed frictionless financial markets (complete markets or bonds-only) or assumed that households and nonfinancial firms have no direct access to foreign assets (Gabaix and Maggiori 2015; Itskhoki and Mukhin 2021a).[19] Our assumptions about financial openness are intermediate relative to these two extremes. Households invest abroad but do not equalize expected returns. The models of Gabaix and Maggiori (2015) and Itskhoki and Mukhin (2021a) are nested as a special case of our model with $s = 0$, while models with frictionless financial markets are a special case of our model when UIP holds, that is, $\psi_t = 0$. Our quantitative model in Online Appendix D considers a case where portfolio shares respond (by finite amounts) to expected return differences.

The household's budget constraint is then given by

$$(8) \qquad P_{jt} C_{jt} + B_{jt} = \left(1 + i^p_{jt}\right) B_{jt-1} + W_{jt} N_{jt},$$

where B_{jt} is total bond holdings. The household's consumption-saving problem is to choose $\{C_{jt}, B_{jt}\}_{t=0}^{\infty}$ to maximize its lifetime utility subject to equation (8). The optimal consumption-saving decision yields the following consumption Euler equation:

$$(9) \qquad u'(C_{jt}) = \beta_{jt+1}\left(1 + i^p_{jt}\right) \frac{P_{jt}}{P_{jt+1}} u'(C_{jt+1}).$$

We assume that wages are sticky, following Erceg, Henderson, and Levin (2000). Unions set the wages subject to Calvo (1983) frictions, which leads to the following New Keynesian wage Phillips curve, to a first-order approximation:

$$(10) \qquad \pi^w_{jt} = \kappa_w \ln \left(\frac{v'(N_{jt})}{u'(C_{jt}) \frac{1}{\mu_w} \frac{W_{jt}}{P_{jt}}} \right) + \beta \pi^w_{jt+1},$$

where $\pi^w_{jt} \equiv \frac{W_{jt}}{W_{jt-1}} - 1$, $\kappa_w \equiv \frac{(1-\beta\gamma_w)(1-\gamma_w)}{\gamma_w}$, $\gamma_w \in [0, 1]$ is the probability that the union is unable to adjust wages, and μ_w is the markup that unions desire of real wages over $\frac{v'(N_{jt})}{u'(C_{jt})}$.

19. In the latter literature, the households own the financial intermediaries that invest in foreign assets. But the interest rate they face in their consumption-saving decisions is the domestic rate.

Firms in economy j produce goods using a linear technology in labor:

$$Y_{jt} = A_{jt} N_{jt}. \tag{11}$$

We assume that prices are fully flexible and product markets are perfectly competitive. This implies that the price of goods produced in economy i and sold in economy j is equal to

$$p_{ijt} = \frac{\mathcal{E}_{ijt} W_{it}}{A_{it}}. \tag{12}$$

The fact that wages are sticky while goods prices are flexible implies that our economy has producer-currency pricing.

Goods market clearing implies that, to a first-order approximation,

$$(1-\alpha)\left(\frac{p_{jjt}}{P_{jt}}\right)^{-\eta} C_{jt} + \alpha \int_0^1 \left(\frac{p_{jit}}{P_{it}}\right)^{-\eta} C_{it} di = Y_{jt}. \tag{13}$$

Given $\{\psi_t, i_{Ut}, i_{Et}, \{\beta_{jt+1}, A_{jt}\}\}_{t=0}^{\infty}$ and $\{W_{j,-1}, B_{j,-1}\}$, the equilibrium of this economy consists of prices $\{p_{ijt}, P_{jt}, \mathcal{E}_{ijt}, W_{jt}, \pi_{jt}^{w}, i_{jt}^{p}\}_{t=0}^{\infty}$ and quantities $\{c_{ijt}, C_{jt}, B_{jt}, N_{jt}, Y_{jt}\}_{t=0}^{\infty}$ such that equations (3)–(13) hold. We linearize around the symmetric steady-state equilibrium with zero net foreign asset position where all shocks are zero, and thereby all endogenous variables are constant over time. We focus on the equilibrium of our model in which real exchange rates are stationary, $\lim_{t\to\infty} Q_{ijt} = 0$ for all i, j.[20]

For convenience, we define the real effective exchange rate of an economy j as the size-weighted average of the bilateral real exchange rate:

$$Q_{jt} \equiv \int_0^1 \frac{\mathcal{E}_{ijt} P_{it}}{P_{jt}} di. \tag{14}$$

We define the real interest rate in economy j as

$$1 + r_{jt+1} \equiv (1 + i_{jt}) \frac{P_{jt}}{P_{jt+1}}. \tag{15}$$

20. Since net foreign asset positions change permanently in response to temporary shocks in our (incomplete markets) model, equilibria of our model are nonstationary. We assume that monetary policy is conducted so as to bring about a stationary real exchange rate. We also assume that monetary policy responds sufficiently strongly to nonfundamental shocks that there is a unique bounded equilibrium.

We denote X_{jt} and M_{jt} as the quantity of exports and the imports, respectively, of an economy j at time t:

$$X_{jt} \equiv \alpha \int_0^1 \left(\frac{p_{jjt}\mathcal{E}_{jit}}{P_{it}} \right)^{-\eta} C_{it} di,$$

$$M_{jt} \equiv \alpha \int_0^1 \left(\frac{p_{iit}\mathcal{E}_{ijt}}{P_{jt}} \right)^{-\eta} di C_{jt}. \tag{16}$$

III.B. Understanding the Effects of Regime-Induced Depreciations

We estimate the effects of regime-induced depreciations in the data in Section II. To capture these effects in our model, consider the following experiment. Suppose the economy starts in a symmetric steady state. Then a sequence of shocks hit the United States, the Euro area, and the regions P^U and P^E. This sequence of shocks can involve a combination of productivity shocks, discount-factor shocks, monetary shocks, and UIP shocks at any horizon. It can be a completely arbitrary set of such shocks except that it must satisfy the following assumption regarding the discount factor β_{jt} and productivity A_{jt}:

ASSUMPTION 1. $\beta_{jt} = \beta_{Pt}$ and $A_{jt} = A_{Pt}$ for all $j \in \{P^U, P^E\}$.

This assumption states that pegs to the U.S. dollar and pegs to the euro are not differentially hit by (nonmonetary) fundamental shocks. Analogously, in our empirical analysis in Section II, we assume that pegs and floats are symmetrically exposed to fundamental shocks, conditional on controls. In other words, we assume Assumption 1 holds on average, conditional on controls.

Given these shocks, we study the response of pegs to the U.S. dollar relative to pegs to the euro. To this end, we define the response of variable Z in economies pegging to the U.S. dollar relative to the response of variable Z in economies pegging to the euro to be

$$\nabla d \ln Z_t \equiv d \ln Z_{it} - d \ln Z_{jt} \quad \text{for} \quad i \in P^U, j \in P^E. \tag{17}$$

The following result then characterizes the impact of regime-induced depreciations, that is, the impact of shocks that satisfy Assumption 1 on pegs to the U.S. relative to pegs to the euro. All proofs are presented in Online Appendix B.2.

PROPOSITION 1. Consider an arbitrary sequence of shocks $\{\psi_t, i_{Et}, i_{Ut}, A_{jt}, \beta_{jt}\}$ satisfying Assumption 1. The entire path of consumption, output, export, and import responses of pegs to the U.S. dollar relative to the pegs to the euro are functions only of $\{\nabla d \ln Q_t\}_{t=0}^{\infty}$ and $\{\nabla d \ln(1+r_{t+1})\}_{t=0}^{\infty}$. The date 0 responses are given by

$$\nabla d \ln C_0 = \underbrace{-\frac{1-s}{\sigma}\sum_{t=0}^{\infty}\beta^m \nabla d \ln(1+r_{t+1})}_{\text{real interest rate channel}}$$

$$\underbrace{-\frac{s}{\sigma}\sum_{t=0}^{\infty}\beta^t\left[\nabla d \ln Q_{t+1} - \nabla d \ln Q_t\right]}_{\text{foreign credit channel}} \tag{18}$$

$$+\underbrace{\frac{1}{1-\alpha}\big((1-\alpha)\eta+\eta-1\big)\sum_{t=0}^{\infty}(1-\beta)\beta^t \nabla d \ln Q_t}_{\text{real income channel}},$$

$$\nabla d \ln Y_0 = (1-\alpha)\nabla d \ln C_0 + \underbrace{\left[\eta\frac{\alpha}{1-\alpha}+\eta\alpha\right]\nabla d \ln Q_0}_{\text{expenditure-switching channel}} \tag{19}$$

$$\nabla d \ln X_0 = \left(\eta\frac{\alpha}{1-\alpha}+\eta\right)\nabla d \ln Q_0 \tag{20}$$

$$\nabla d \ln M_0 = -\eta\nabla d \ln Q_0 + \nabla d \ln C_0. \tag{21}$$

Proposition 1 formalizes why focusing on regime-induced depreciation is useful. First, the proposition states that the relative responses of all macroeconomic aggregates are functions only of the relative response of the real interest rate $\nabla d \ln(1+r_{t+1})$ and the relative response of the real effective exchange rate, $\nabla d \ln Q_t$. In the model, different outcomes between pegs to the U.S. dollar and pegs to the euro arise only from the difference in their monetary regimes, which is summarized by the sequences of differences in the real interest rate and the real effective exchange rate. The absolute level of the response of output, consumption, and various other macroeconomic outcomes for peggers to the U.S. dollar and euro is influenced by what happens to the U.S. economy and the economy of the Euro area. However, under Assumption 1, these effects are common to pegs to the U.S. dollar and pegs to the euro, and thereby difference out when we look at the relative responses. In short, the relative paths of the real interest rate and real effective exchange rate are sufficient statistics to understand the relative responses to regime-induced depreciations.

Proposition 1 also explicitly characterizes the channels through which the relative response of the real interest rate and real effective exchange rate transmit to consumption, output, and other macroeconomic outcomes. The first term in equation (18) captures the standard intertemporal-substitution channel that higher interest rates reduce consumption. This channel is present even when the economy is closed. The second term in equation (18), which we label the foreign credit channel, is unique to our model. Holding the domestic real rate constant, expected appreciation of the real effective exchange rate ($\nabla d \ln Q_{t+1} - \nabla d \ln Q_t$) lowers the cost of borrowing from abroad. To the extent that households have access to foreign currency bonds ($s > 0$), this stimulates consumption through intertemporal substitution. The third term in equation (18) captures the real income channel recently highlighted by Auclert et al. (2021): a depreciation of the real effective exchange rate affects real incomes by increasing the relative demand for home goods and increasing the relative prices of foreign goods (the sign of this effect is ambiguous). Equation (19) shows that real output changes both because domestic consumption changes and due to expenditure switching. Finally, equations (20) and (21) show the response of exports and imports, respectively.

Figure X plots the empirical responses of the relative real interest rate and real exchange rate from our analysis in Section II. Our estimates suggest that the relative response of real interest rates is close to zero. For this reason, in what follows, we set

$$\nabla d \ln(1 + r_{t+1}) = 0 \quad \text{for all } t. \tag{22}$$

Proposition 1 then implies that the difference in macroeconomic outcomes must come from the difference in the path of the real exchange rate (hence our title). For simplicity, we approximate the relative response of the real effective exchange rate in Figure X with a process that decays at a constant rate following the initial depreciation:

$$\nabla d \ln Q_t = (\rho_Q)^t \nabla d \ln Q_0, \quad \text{with} \quad \nabla d \ln Q_0 > 0, \tag{23}$$

where $\rho_Q \in (0, 1)$. The fit of this simple process to the empirical response is quite good.

As we discussed in Section II.F, the joint response of real interest rates and real exchange rates we estimate necessarily implies substantial UIP deviations. We show in Online

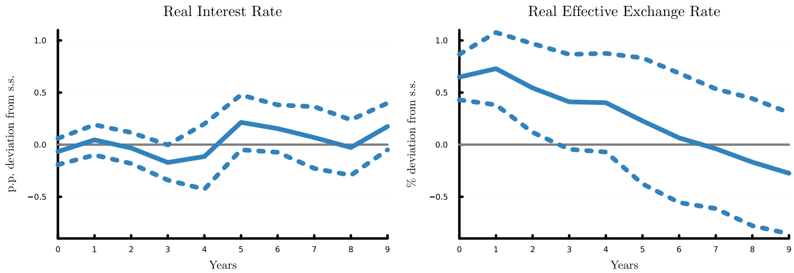

FIGURE X

Empirical Responses of the Relative Real Interest Rate and Real Exchange Rate

This figure plots the response of real interest rates and the real exchange rates for pegs versus floats in response to a change in the U.S. dollar exchange rate, that is, our estimates of β_h in equation (2) for different horizons h when these two variables are the outcome variables. For the real interest rate, the dependent variable is the level of the interest rate (i.e., 0.02 denotes 2%). For the real exchange rate, the dependent variable is the change in the log of the variables. These results are for the case with our baseline set of controls. The dashed lines are 95% confidence intervals.

Appendix B.1.1 that in our model

$$\nabla d \ln(1 + r_t) = \nabla d \ln Q_{t+1} - \nabla d \ln Q_t + \int_0^1 \nabla \psi_{kt} dk. \tag{24}$$

Given equations (22) and (23), the return on currencies in economies pegging to the U.S. dollar is higher than in economies pegging to the euro since the U.S. dollar appreciates in real terms after the initial depreciation while real interest rates in the two currencies are the same. This implies a UIP deviation. One can therefore also interpret our estimates as the macroeconomic consequence of UIP shocks.

Models with complete financial markets or frictionless trade in bonds do not feature UIP deviations. These models therefore cannot account for our empirical findings. Existing models that feature UIP deviations almost always assume that households do not have direct access to foreign assets or credit, that is, they assume $s = 0$ in our notation (e.g., Gabaix and Maggiori 2015; Auclert et al. 2021; Itskhoki and Mukhin 2021a). Our next proposition shows that this class of models cannot account for our empirical findings.

PROPOSITION 2. In Proposition 1, suppose equations (22) and (23) hold, and $s = 0$. Then, $\nabla d \ln X_0 - \nabla d \ln M_0 > 0$.

In the absence of a foreign credit channel, the combination of the expenditure-switching channel and the real income channels results in an increase in net exports (quantities). This contradicts our empirical finding that net exports fall in response to a regime-induced depreciation.[21]

In contrast to existing classes of models, our model in which households have access to foreign assets and foreign credit can explain our empirical findings as long as the share of foreign assets in the households' portfolio is sufficiently large:

PROPOSITION 3. In Proposition 1, suppose equations (22) and (23) hold. Then, for sufficiently high $\frac{s}{\sigma}$, $\nabla d \ln C_0 > 0$, $\nabla d \ln Y_0 > 0$, and $\nabla d \ln X_0 - \nabla d \ln M_0 < 0$.

Figure XI illustrates Propositions 2 and 3. We consider relative paths of real interest rates and real exchange rates that satisfy equations (22) and (23), and we plot responses for two cases: $s = 0$ and $s > 0$. The top left panel shows the path of the real exchange rate, which depreciates at time $t = 0$ and then appreciates over time back to steady state. In response to the depreciation, output increases (top right panel). The output increase is quite modest in the case without the foreign credit channel ($s = 0$). In that case, the increase in output comes entirely from an increase in net exports, while consumption is virtually unchanged. With the foreign credit channel ($s > 0$), the boom in output is much larger and is driven by a boom in domestic consumption. The response of net exports is negative in the $s > 0$ case we plot because imports rise more than exports. We provide a precise condition on $\frac{s}{\sigma}$ for this to happen in the proof to Proposition 3.

The foreign credit channel is consistent with two other facts that we have documented. First, it is consistent with the fact that booms are largely driven by the non-tradable sector (Figure VII). Unlike the expenditure-switching channel, the foreign credit channel operates through domestic demand. Once we extend our model to an environment with multiple sectors, an increase in

21. With local-currency pricing, the real income channel becomes larger and has the potential to explain the fall in net export quantity. However, using our quantitative model from Online Appendix D, we found that this effect was quantitatively too small to explain our empirical results, even when we assumed a counterfactually high marginal propensity to consume. This channel also cannot explain why the booms are predominantly driven by countries with high capital account openness, which we document in Figure VIII.

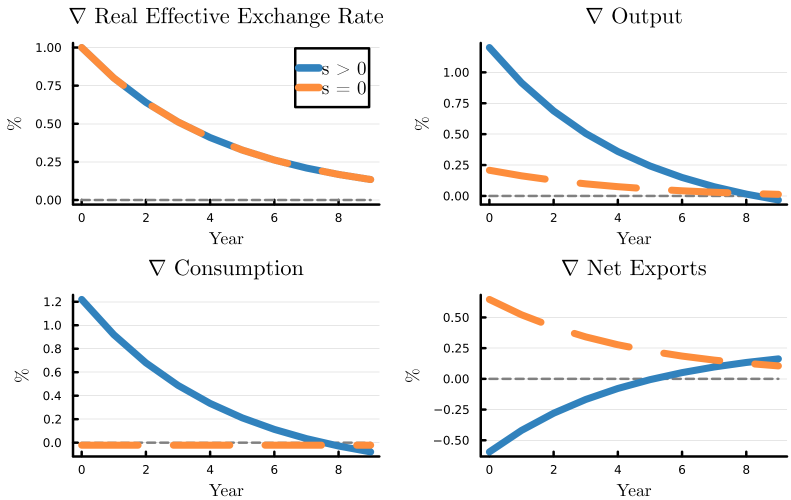

FIGURE XI

Regime-Induced Depreciation in the Model with and without the Foreign Credit Channel

The figure shows the relative response of the real effective exchange rate ($\nabla d\ln Q_t$), output ($\nabla d\ln Y_t$), consumption ($\nabla d\ln C_t$), and net exports ($\nabla d\ln X_t - d\ln M_t$) under equations (22) and (23). The solid blue line shows the case where $\frac{s}{\sigma} = 0$, and the dashed orange line sets $\frac{s}{\sigma} = 1.5$. The other parameters used in this example are $\eta = 0.5, \alpha = 0.2, \beta = 0.96$. All regions have the same size: $|U| = |E| = |P^U| = |P^E| = 0.25$.

domestic demand predominantly stimulates the non-tradable sector as opposed to the tradable sector. We formally show this in Online Appendix G.7 in the context of our quantitative model. Second, the foreign credit channel is consistent with the heterogeneity across countries with different levels of capital account openness that we document in Figure VIII. It is straightforward to extend our model to allow for heterogeneity in s, which we interpret as heterogeneity in capital account openness. In this extended model, the relative booms are larger for groups of countries with higher values of s.

In Online Appendix C, we show that the relative responses that we discuss in this section are the same as the response of a small open economy to a change in the future path of its real interest rate and real effective exchange rate, driven either by domestic monetary policy or financial shocks. Therefore, the relative responses we estimate are directly informative about the

TABLE IV

EXCHANGE RATE AND MACROECONOMIC VOLATILITY IN THE DATA

	Peg versus float (post-1973)		Pre- and post-1973	
	Peg	Float	Pre-1973	Post-1973
Panel A: Volatility				
Std. dev.(ΔNER)	0.082	0.114	0.070	0.090
Std. dev.(ΔRER)	0.069	0.091	0.058	0.075
Std. dev.(ΔGDP)	0.044	0.037	0.046	0.042
Std. dev.(ΔC)	0.048	0.042	0.044	0.047
Std. dev.(ΔNX)	0.039	0.032	0.034	0.038
Std. dev.($\Delta(1+i)$)	0.030	0.031	0.012	0.030
Panel B: Correlation				
Corr(ΔRER, ΔNER)	0.553	0.712	0.592	0.601
Corr(ΔRER, ΔGDP)	−0.045	−0.068	−0.042	−0.051
Corr(ΔRER, ΔC)	−0.069	−0.137	−0.017	−0.088
Corr(ΔRER, ΔNX)	0.040	0.213	0.146	0.093
Corr(ΔRER, $\Delta(1+i)$)	0.171	0.130	−0.134	0.150

Notes. The table reports the standard deviation and correlations of real and nominal effective exchange rates, GDP, consumption, net exports to GDP ratio, and nominal interest rate for each subsample. All variables are in logs except for net exports, which are relative to GDP. The sample contains all countries in our data set (including the United States and the 24 relatively advanced economies we use to define the U.S. exchange rate). The sample includes both the countries that we estimate our impulse responses for in Section II and the United States and the 24 relatively advanced countries that we exclude from the analysis in Section II. We divide countries into pegs and floats in a somewhat different way than in Section II since the focus is not on pegging versus the United States but pegging in general. We define country-year observations in Ilzetzki, Reinhart, and Rogoff's coarse categories 1 and 2 (fine categories 1 through 8) as pegs and those in coarse categories 3 and 4 (fine categories 9 through 13) as floats. As before, we exclude fine categories 14 (freely falling) and 15 (dual market/missing data). The third and fourth columns split the sample by year as opposed to by exchange rate regime. For each variable (e.g., ΔNER), we drop outlying observations (the top and bottom 0.5%) when computing these moments.

effects of real interest rates and exchange rates on an individual economy.

III.C. Exchange Rate Disconnect and the Mussa Fact Revisited

A large empirical literature demonstrates that—at least unconditionally—exchange rates are largely disconnected from other macroeconomic aggregates (Meese and Rogoff 1983; Baxter and Stockman 1989; Flood and Rose 1995; Obstfeld and Rogoff 2000; Devereux and Engel 2002; Itskhoki and Mukhin 2021a). Related to this, exchange rates are mildly negatively correlated with consumption in the data, as opposed to strongly positively correlated in traditional open economy macroeconomic models (Backus and Smith 1993). Table IV demonstrates these facts in our sample. Nominal and real exchange rates of floating countries are three to four times more volatile than GDP and consumption (i.e., they are largely “disconnected”).[22] Moreover, real exchange rates are mildly negatively correlated with both GDP and consumption.

Our evidence on the large real effects of regime-induced depreciations earlier in the article might, at first blush, seem to contradict these well-known facts. If depreciations cause booms and exchange rates are so volatile, why isn't there a strong unconditional correlation between exchange rate depreciations and booms? In this section, we argue that this apparent contradiction is a mirage arising from the distinction between conditional and unconditional moments. Crucially, not all variation in exchange rates is the regime-induced variation we focus on in Section II. Much exchange rate variation is due to domestic shocks, some of which can generate a very different conditional correlation between the exchange rate and output than regime-induced exchange rate variation. The unconditional correlation between the exchange rate and output is then a weighted average of the different conditional correlations. This can easily be small even if the conditional correlation with each structural shock is sizable. This is directly analogous to the well-known fact that the unconditional correlation between the price and quantity in a market may be small even if the correlation of these variables is strongly negative conditional on supply shocks (i.e., when the economy moves along the demand curve).

To make this argument concrete, we focus on a single small open economy j and imagine that it is subject to two types of shocks: UIP shocks to its currency, ψ_t, and domestic discount-factor shocks, β_{jt}.[23] We compare two cases for the monetary regime of this small open economy: a floating regime and a

22. We include a larger set of countries than earlier work, which has largely focused on Organisation for Economic Co-operation and Development countries. The sample used in Table IV includes both the countries that we estimate our impulse responses for in Section II and the United States and the 24 relatively advanced countries that we exclude from the analysis in Section II. In this analysis, we divide countries into pegs and floats in a somewhat different way than in Section II since the focus is not on pegging versus the United States but pegging in general. We define country-year observations in Ilzetzki, Reinhart, and Rogoff's coarse categories 1 and 2 (fine categories 1 through 8) as pegs and those in coarse categories 3 and 4 (fine categories 9 through 13) as floats. As before, we exclude fine categories 14 (freely falling) and 15 (dual market/missing data).

23. Kekre and Lenel (2024) argue that discount-factor shocks play an important role in explaining the behavior of exchange rates in advanced economies.

pegging regime.[24] When the small open economy floats, we assume that monetary policy sets the interest rate so that the real interest rate partially tracks (the inverse of) the discount factor, $d\ln(1+r_{t+1}) = \phi_\beta d\ln\left(\frac{1}{\beta_{t+1}}\right)$ for $\phi_\beta \in [0, 1]$. One rationale for this is that the monetary authority would like to fully track (the inverse of) the discount factor but doesn't manage to do this because shocks to the discount factor are difficult to observe or because the central bank is slow to react to such shocks.[25] When the small open economy pegs, the nominal interest rate tracks the anchor currency's monetary policy, as before. See Online Appendix C for a formal description of this economy.

Figure XII plots the response of the real interest rate, the real exchange rate, and output in this small open economy to these two shocks for the two cases discussed above (floating and pegging). Let's focus first on the floating case (solid blue lines). In Panel A, the economy is hit by a UIP shock, the real exchange rate depreciates, and output rises. This is analogous to our regime-induced exchange rate variation. In Panel B, however, the economy is hit by a discount-factor shock that reduces demand. Monetary policy responds by lowering interest rates to boost the economy. This depreciates the exchange rate, but if monetary policy is not sufficiently accommodative to fully offset the decline in demand (as we assume above), output will fall. These two shocks, therefore, induce opposite correlations between output and the exchange rate.

If the economy is subject to these two shocks, it is entirely possible that there is little correlation between exchange rates and the macroeconomy unconditionally. Our empirical design isolates the effects of ψ_t shocks, excluding the effects of β_{jt} shocks. As a result, we observe a strong positive conditional correlation between the exchange rate and output. But the unconditional correlation can be low because the unconditional correlation mixes the responses from the two shocks.

This analysis offers a starkly different perspective on exchange rate disconnect from, for example, Itskhoki and Mukhin (2021a). In that work, exchange rates are driven largely by UIP

24. Since the small open economy is measure zero, the rest of the world does not react to these shocks. It therefore does not matter whether the small open economy pegs to the U.S. dollar or to the euro (if it pegs).

25. Similar results would obtain if monetary policy followed an (imperfect) inflation-targeting policy, including the commonly used Taylor rule.

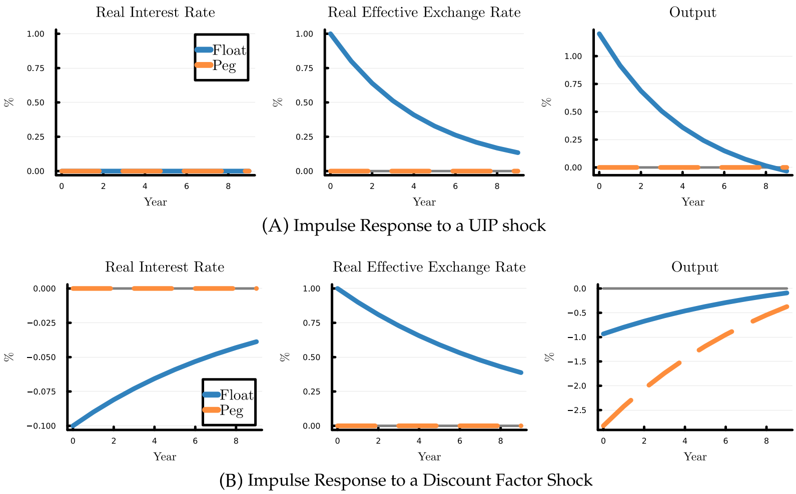

FIGURE XII

Impulse Response to a UIP Shock and a Discount-Factor Shock

Panel A plots the response of a small open economy to the UIP shock to its currency; Panel B plots the response to a discount-factor shock. In both panels, the solid blue line plots the case where the small open economy operates a floating exchange rate, and the dashed orange line plots the case where it pegs its exchange rate to the United States. The parameters used in this numerical example are $\phi_\beta = 0.8$, $\eta = 0.5$, $\alpha = 0.2$, $\beta = 0.96$, $\frac{s}{\sigma} = 1.5$, and $\kappa_w = 0$.

shocks, which have little effect on output. This implies that exchange rates are disconnected from the macroeconomy because the conditional responses of output to the shocks that drive the exchange rate are small. In our work, conditional responses are large but cancel each other out when one calculates the unconditional correlation between output and the exchange rate (as often happens with a mix of supply and demand shocks).

Our model also provides a novel interpretation of the Mussa fact: the dramatic increase in exchange rate volatility after the collapse of Bretton Woods was not accompanied by a large change in macroeconomic volatility (Mussa 1986; Itskhoki and Mukhin 2021b). Table IV illustrates this fact in our sample. Exchange rates have been much more volatile after 1973 than before and much more volatile among floaters than peggers in the post-1973 era, but macroeconomic volatility has not been higher. One interpretation of these facts, put forward by Itskhoki and Mukhin (2021b), is that exchange rates, driven by UIP shocks, have little effect on the macroeconomy. Our two-shock model offers a different perspective.

To see this, compare the response for pegs to the response of floats in Figure XII. In response to a UIP shock (Panel A), pegging the exchange rate completely insulates the economy from the shock. Without exchange rate risk, arbitragers (and the central bank) entirely absorb the UIP shock and it has no effect on the exchange rate or output. In sharp contrast, in response to a discount-factor shock (Panel B), pegging the exchange rate results in a more severe recession than in the floating case. The reason for this is that the pegging economy cannot ease monetary policy in responses to the shock. A monetary policy easing would stimulate economic activity through lower interest rates and a depreciated exchange rate. But this channel is shut down when the exchange rate is pegged.

Figure XII thus illustrates that pegging the exchange rate has two opposing effects on macroeconomic volatility. On the one hand, it stabilizes the economy by insulating it from certain financial (UIP) shocks. On the other hand, it makes the macroeconomy more volatile by constraining the ability of monetary policy to offset discount-factor shocks. In the quantitative model we consider in Online Appendix D, these two effects roughly offset each other so that moving from a fixed to a flexible exchange rate regime has little effect on macroeconomic volatility, even though exchange rate fluctuations have a large causal effect on output and other macroeconomic outcomes.

III.D. Quantification and Robustness

The model we present in this section is deliberately stylized. Our goal is to present the main forces at play as transparently as possible. The model is, therefore, not well suited to replicate all aspects of our empirical results quantitatively. In Online Appendix D, we extend the model to a richer environment and in Online Appendices E and F we show that in this case we are able to reproduce both the conditional and unconditional moments quantitatively. The model in Online Appendix D features investment with investment adjustment costs, habit formation in consumption, endogenous portfolio choices of households and firms, and a general pricing regime that allow for a combination of producer-currency pricing, local-currency pricing, and dominant-currency pricing. Importantly, we discipline the financial openness parameter, s—a key parameter that governs the size of the foreign credit channel—using the data on cross-country asset holdings. In these appendices, we also show that our results are robust to alternative considerations, including various pricing regimes, introducing hand-to-mouth households, and alternative calibration of trade elasticities.

IV. Conclusion

We estimate the effects of regime-induced depreciations on macroeconomic outcomes. Regime-induced depreciations cause large booms. However, these booms are associated with a fall in net exports and (if anything) an increase in interest rates. These facts pose a challenge for traditional open economy models, which emphasize expenditure-switching effects and monetary policy. We develop a financially driven exchange rate model to explain these facts. In this model, regime-induced depreciations cause an inflow of foreign credit that results in a boom with net exports falling and nominal interest rates rising. Despite the large stimulatory effect of exchange rates on output in our model, a version with both UIP and discount-factor shocks is consistent with unconditional exchange rate disconnect and the Mussa fact.

Supplementary Material

An Online Appendix for this article can be found at *The Quarterly Journal of Economics* online.

Data Availability

The data underlying this article are available in the Harvard Dataverse, https://doi.org/10.7910/DVN/KPX86B (Fukui, Nakamura, and Steinsson 2025).

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