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ABSTRACT

This paper finds that limited exchange rate flexibility in the form of "fear of appreciation" slows adjustment of current account imbalances, providing a novel perspective on Friedman's conjecture regarding exchange-rate flexibility. We present evidence that countries classified as more flexible have faster convergence than peggers for current account deficits, but not so for surpluses. An implication is that current account surpluses are more persistent than deficits on average. Evidence indicates that this asymmetry is associated with a one-sided muting of exchange rate appreciations. We develop a multi-country DSGE model augmented with a "fear of appreciation" policy rule, solved as an occasionally binding constraint. It can explain greater persistence of current account surpluses compared to deficits in general equilibrium where surpluses and deficits must cancel in aggregate.

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1. Introduction

Does greater exchange rate flexibility help facilitate adjustment of current account imbalances? This idea has been prevalent in economics since Friedman (1953), and it has been the basis for policy recommendations made by the IMF and the G20 that emerging economies move to a more flexible exchange rate regime to deal with global imbalances. The U.S., in particular, has put pressure on countries with large trade surpluses against the U.S. to eschew currency manipulation. However, the academic literature has not offered clear empirical support for the idea that floating exchange rates promote current account adjustment. Most notably, Chinn and Wei (2013) find no evidence in autoregressions that the speed of current account adjustment differs by exchange rate regime. Gervais *et al*. (2016) find a similar result with an event-study analysis. Other papers find mixed evidence, some more supportive than others.[1]

This paper provides a novel perspective on this question. It finds supportive evidence for faster current account adjustment for countries with more flexible exchange rates—but only conditional on the sign of the current account imbalance. In particular, we find that countries classified broadly as a floating exchange rate regime exhibit faster convergence of current account deficits toward balance than countries with a pegged regime, but they exhibit no faster convergence in the case of current account surpluses. We present additional evidence pointing to a "fear of appreciation" in exchange rate policies as a key mechanism driving this asymmetric speed of current account adjustment. Finally, we develop a novel dynamic stochastic general equilibrium (DSGE) model embodying fear of appreciation. Analytical solution and stochastic simulations demonstrate that asymmetric exchange rate responses in a multi-country environment can explain the asymmetry in current account adjustment of surpluses and deficits in general equilibrium, even while surpluses and deficits must cancel in aggregate.

Our empirical analysis is twofold. First, we estimate autoregressions for the current account on annual data for 162 countries from 1971 to 2014, distinguishing between countries with a *de facto* flexible or fixed exchange rate regime. We include an indicator for current accounts of a positive sign as well as an interaction of this indicator variable with the autoregressive parameter. By doing so, we estimate the different speed of current account adjustment not only according to exchange rate regime, but also according to whether the current account balance is in surplus or deficit. Our results indicate that for cases of current account deficits, countries with floating exchange rates have significantly faster current account convergence than countries with pegs; in contrast, for cases of current account

[1] See Ghosh *et al*. (2010, 2013, 2019), Herrmann (2009), and Martin (2016) which finds positive evidence specifically for non-industrial countries.

surpluses, the speeds of convergence for floaters are the same as, or slower than for peggers. For our full sample and benchmark specification, the half-life of current account adjustment rises from 0.80 years for deficits to 11.36 years for surpluses.

When we further decompose the sample of more flexible countries into two groups: stricter floaters and intermediate floaters, the asymmetry of higher persistence of surpluses is associated in particular with the intermediate regimes. The intermediate category includes the countries most often associated with fear of appreciation behavior, thought broadly to float, but which do sometimes intervene to support trade surpluses or reserves balances. The finding offers motivation for our focus on fear of appreciation as a potential explanation. It also suggests a novel perspective on the general Friedman conjecture: within the set of intermediate regimes, convergence of external balances can be faster in the cases where these countries act more like floaters, and slower in the cases where these same countries act more like peggers.

Our second empirical analysis studies the role of exchange rate dynamics in asymmetric current account adjustment by estimating the joint dynamics of the exchange rate and current account using local projections for a narrower set of countries for which quarterly data are available. Local projection allows us to distinguish between current account surplus and deficit shocks. An asymmetry by sign of current account is again observed for exchange rate dynamics: while a negative shock to the current account leads to a feedback loop of real exchange rate depreciation, a positive shock to the current account does not lead to significant real exchange rate appreciation. This result suggests that the mechanism driving the asymmetric response of ostensibly flexible exchange rates to current account deficits and surpluses may be related to a "fear of appreciation," as discussed in Levy-Yeyati *et al*. (2013). Further, we also find that this asymmetric behavior in exchange rates for current account surpluses is specific to floaters that have less capital account openness and higher reserves accumulation. These empirical findings help guide our theoretical exploration.

We develop a three-country DSGE model to explore how fear of appreciation could explain our empirical result of slower adjustment in current account surpluses compared to deficits. An innovation in the model is a foreign exchange policy rule that embodies an asymmetric response to exchange rate appreciations and depreciations: foreign exchange reserves are accumulated to help counteract an appreciation, but reserves are unchanged in the case of depreciation. The model is solved using a piecewise linear solution, treating the asymmetric policy rule as a constraint that binds only in the case of appreciation. Intuition for persistent current account surpluses is provided by analytical solution of a simplified version of the model. A progressively rising stock of reserves during the period the policy is in effect implies interest earnings that drive a trend of exchange rate appreciation, requiring ever larger new reserves accumulation, and hence current account surpluses, to offset. Simulation of the three-country model demonstrates that, even though at an aggregate world level total current account surpluses must equal current account deficits at each point in time, the dynamics of current account surpluses nonetheless can differ from that of deficits on average in a multi-country setting. This occurs as one country tends to run only current account surpluses, while the other two countries incur both surpluses and deficits in response to a variety of global shocks.

The mechanism at work in our model differs from the common retelling of Friedman's argument, in that we do not rely on price stickiness as a source of real exchange rate deviations, but instead focus on a capital account policy involving capital controls and reserve accumulation. In the appendix, we report detailed experiments with a more standard New Keynesian model with sticky prices and no capital controls, showing that it cannot explain our main empirical finding of persistent current account surpluses. One of the reasons is the well-known difficulty that sticky price models have in explaining high levels of persistence in the real exchange rate and other real variables; our finding shows this failing extends to persistence of current accounts as well. The other reason is that a model with a globally integrated financial market has difficulty explaining asymmetry of current accounts across countries, as required to generate our empirical regularity.

While our mechanism does not rely on price stickiness, it nonetheless has direct precedent in the original writing of Friedman (1953), and more importantly, the broader implication is the same—that policies preventing exchange rate flexibility can prolong balance of payments adjustment. In fact, Friedman specifically addressed a case similar to ours, in which the authorities "accumulate foreign exchange indefinitely" in forms that do not affect domestic price levels (see pages 170-172). We argue that the historical experience over recent decades has proved this scenario to be relevant and a contributor to global external imbalances.

Our results contribute most directly to the literature estimating the effect of exchange rate regimes on current account dynamics. Foremost, Chinn and Wei (2013) show using autoregressions that the effect of exchange rate regime changes on the adjustment of the current account balance is nonlinear: the transition from a fixed exchange rate to an intermediate level of exchange rate flexibility does not necessarily contribute to improving the current account balance. Gervais *et al*. (2016) examine whether a flexible nominal exchange rate facilitates real exchange rate adjustment and the maintenance of current account balances. Using an event-study analysis for a large set of emerging economies over the 1975–2008 period, they show that current account reversions are typically accompanied by large real exchange rate movements, regardless of the exchange rate regime. These two studies do not find a significant distinction in the speed of current account reversion between floating and fixed regimes.[2]

However, other studies such as Herrmann (2009), Martin (2016), and Ghosh *et al*. (2010, 2013, 2019) support Friedman's hypothesis that flexible exchange rate arrangements deliver a faster current account adjustment by using different measures for exchange rate regime classifications.[3] Similar to the method applied in Chinn and Wei (2013), Ghosh *et al*. (2010, 2013, 2019) examine the relationship between exchange rate flexibility and current account adjustment. In particular, Ghosh *et al.* (2013, 2019) focus on a bilateral classification of exchange rate flexibility between pairs of countries (or bilateral exchange rate volatility measure). Lane and Milesi-Ferretti (2012) find that countries that had an excess current account gap in the pre-crisis period, 2005-2008, had the largest contractions in their external balance in 2010. They find that among countries opting for the peg, those with large negative current account gaps have experienced real exchange rate appreciation instead of depreciation, which implies the real exchange rate had a very modest effect on the external adjustment process after the crisis.[4] In sum, previous studies do not reach a consensus and provide mixed findings.

Relative to this literature, our paper makes three contributions. First, we find evidence of a surprising feature, *asymmetric* current account adjustment across different exchange rate regimes and the sign of current account positions. This finding may help explain why some previous findings in the literature tended to be inconclusive: a flexible exchange rate seems to be working well to balance a current account deficit, whereas it does not help clear a current account surplus (by allowing for appreciation).[5] Second, we provide empirical evidence suggesting that this asymmetric response is related to "fear of appreciation." Third, we provide a theoretical model demonstrating the conditions under which fear of appreciation can generate the empirical results we uncover. More broadly, the

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[2] They argue that nominal exchange rate flexibility does not guarantee helpful "real" exchange rate adjustment.

[3] Herrmann (2009) uses the degree of exchange rate volatility. Martin (2016) employs *de facto* exchange regime classification proposed by Ilzetzki *et al*. (2019).

[4] While they examine the role of exchange rate regime together with initial current account gap in the current account adjustment between, before, and after the global financial crisis, our analysis is not limited to the financial crisis period, and focuses more on closure of the current account gap depending on exchange rate flexibility.

[5] This asymmetric pattern of closing current account balance is also related to Ghosh *et al*. (2010), which finds nonlinearities in the adjustment of the current account in relation to the size of current account imbalances. They show that current account surpluses and deficits are much more persistent in fixed and intermediate regimes than in floating regimes. However, a floating regime does not exhibit the lowest persistence, but instead an intermediate regime does so for the case of large deficits. Alberola *et al*. (2020) documents a related empirical finding that supports our main mechanism: countries with a positive stock of net foreign assets tend to have current accounts that are positive and hence destabilizing, due to positive net interest income; in contrast, countries with a negative stock of net foreign assets tend to have current accounts that move in a stabilizing direction, since a fall in wealth tends to raise the trade balance. This empirical finding provides support for the mechanism in our analytic model section 6.2. Our work differs in providing a full theoretical model, including how current account asymmetries can exist in a general equilibrium environment where global balances sum to zero, and in providing an explanation that distinguishes countries by exchange rate regime, which Alberola *et al*. (2020) does not study.

paper highlights an implication of the recently identified phenomenon of fear of appreciation: namely, that it can prolong global financial imbalances.

Our findings support calls in several papers in the current account literature for a more refined classification of exchange rate regimes, such as distinguishing among varying degrees of exchange rate flexibility (Herrmann 2009) or distinguishing between the many bilateral exchange rate pairings of a country (Ghosh *et al*., 2019). Adding to this list, we find it is particularly important to distinguish between cases based on the signs of exchange rate movement and the current account.

Our work is also related to the recent literature discussing various implications of "fear of appreciation." Foremost, Levy-Yeyati *et al*. (2013) find that the policy stance of many emerging market countries, even those opting for the flexible exchange rate regime, indicates a reluctance to let their currency appreciate. This behavior might be driven by a desire to use a depreciated exchange rate to promote competitiveness to foster growth (e.g., Rodrik, 2008, Hausmann *et al*., 2005, labeled as the "development" view of exchange rate policies, Daude *et al*., 2016).[6] Or it might reflect an aim to accumulate reserves (Korinek and Serven, 2016; Choi and Taylor, 2022; and Benigno *et al.*, 2022) or to foster domestic saving (Levy-Yeyati *et al*., 2013). While there is growing evidence of the existence of this behavior, there is not yet consensus on its motivation, and resolving this question is beyond the scope of the current paper.[7] From a more macroeconomic perspective, Han and Wei (2018) also find evidence of fear of appreciation from the monetary policy viewpoint: when the center country such as the United States loosens its monetary policy, the periphery emerging countries often pursue similarly expansionary monetary policy even though the domestic Taylor rule suggests otherwise, in order to avoid appreciation of their currencies relative to center currency. Han and Wei (2018) argue that while a flexible exchange rate and capital mobility do not offer full insulation from foreign monetary policy

[6] Another view of intervention is that it postpones or limits a devaluation (as in the "fear of floating" view, see Hausmann *et al*., 2001 and in Calvo and Reinhart, 2002). An interesting finding on real exchange rate depreciation and growth is that Choi and Pyun (2018), using Korean firm level data, provide an ambivalent view on the role of exchange rate depreciation in shaping productivity. They show that while in the short run, real exchange rate depreciation helps increase productivity, a persistent depreciation rather decreases productivity. In particular, a favorable price condition driven by depreciation deprives firms of the incentive for innovation. Indeed, the negative effect of persistent depreciation on productivity was more pronounced in an industry with negative R&D growth.

[7] Fear of appreciation stands in contrast with the more familiar concept of fear of floating, in which depreciations pose a problem for balance sheets (Calvo and Reinhart, 2002 and Bianchi and Lorenzoni, 2022). We view fear of appreciation as relevant for one set of countries, in particular Emerging Asia, which have exhibited positive and persistent current accounts, while fear of depreciation is relevant for a different set of developing countries in the Global South, which have had problems with recurring current account deficits. Our claim is that the countries with fear of appreciation are useful for explaining why current account surpluses are so persistent in our data sample. A conjecture is that fear of appreciation may have a larger effect on estimates of current account persistence since reserve accumulation can be sustained for longer periods; in contrast, spells of losses in reserves tend not to last an extended time before depleting reserves and becoming unsustainable. Further, Levy-Yeyati *et al*. (2013) argue that fear of appreciation appears in the post 2000 period to be more prominent than fear of depreciation in the data.

shocks, capital controls offer a buffer from foreign policy shocks regardless of exchange rate regimes.[8]

Finally, our findings are also related to Corsetti *et al*. (2021), discussing the related claim of Friedman that exchange rate flexibility promotes macroeconomic adjustment and insulation in the face of foreign shocks. Our paper provides illustration of their general argument, that exchange rate flexibility does not guarantee adjustment automatically, but only provides a necessary precondition in terms of freedom of macroeconomic policies; the degree to which the benefits of flexibility are realized depends crucially upon the macroeconomic policy choices made.[9]

The remainder of this paper is organized as follows. In Section 2, we provide the data used and our empirical methodology. Section 3 presents the main empirical results of a current account autoregression and local projection. A theoretical model is presented in Section 4. Analytical solution of a simplified version of the model is studied in Section 5, and simulation results for the full model are reported in Section 6. Concluding remarks follow in Section 7.

2. Empirical Models and Data

2.1. Data

Annual data for the current account (as a share of GDP) are obtained from the World Development Indicators of the World Bank for 162 countries from 1971 to 2014. In addition to reporting results for the full sample, we also divide the sample into subsamples for industrial and non-industrial countries, and for the latter, we present subsamples that separate out three sub-groups: sub-Saharan African (SSA) countries, the Caribbean and South Pacific island (CSP) countries, and oil exporters.[10] See Appendix Table 1 for the list of sample countries and their subsample classifications.

To measure exchange rate flexibility, we consider alternative classification schemes common in the literature. One is the *de facto* exchange rate regime of Shambaugh (2004) and Klein and Shambaugh (2008)[11], hereafter Shambaugh classification. Shambaugh provides *de facto* "peg" definition for a country year observation from 1960 to 2014 based on either staying within 2% bands against the base

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[8] Kim and Pyun (2018) focus on the role of capital controls among peggers (fixed exchange rate) in buffering international transmission of business cycles (via independent monetary policy), which supports the trilemma.

[9] Born *et al.* (2022) studies a related but distinct asymmetry, the asymmetric effect of government spending shocks comparing floats and pegs. In particular, they found the negative spending shocks under pegs and downward nominal rigidity cannot lead to real depreciation.

[10] SSA countries were found by Chinn and Prasad (2003) to have distinctive current account behavior from other non-industrial countries. Many CSP countries that relied heavily on the tourism industry exhibited chronic current account deficits (Alleyne *et al*., 2011). When checking the current account position for the CSP sample in our data, about 85% of current account observations show the deficits. Many oil exporters tend to show persistent current account surplus, as discussed in Chinn and Wei (2013).

[11] https://iiep.gwu.edu/jay-c-shambaugh/data/

currency or zero volatility in all months except for a one-off devaluation. Four types of peg are provided; i) a zero change, ii) 1% band, iii) 2% band, and iv) one-time devaluation or revaluation. Also, it includes an additional criterion that countries must be pegged for two consecutive years (to be counted as a peg) to avoid spuriously classifying observations. For our two-way classification, we follow Shambaugh in classifying all four types of peg (i – iv) as pegged, whereas all others are classified as non-pegged. When we use a three-way classification, we divide non-pegged countries into soft peg (intermediate regime) and free floaters. Obstfeld, Shambaugh and Taylor (2010) created a soft peg classification for the intermediate regime country (or mid-range policy country). A soft peg is defined if its exchange rate stays within a ±5% band with respect to its base country, or if its exchange rate changes by less than 2% in every month. A country-year observation classified as a soft peg must satisfy one of the criteria set out above for two years in a row. The soft pegs are generally crawling pegs, loose basket pegs, or tightly managed floats (Obstfeld *et al*. 2010).

We also report full results when using the exchange regime classification from Ilzetzki, Reinhart, and Rogoff (2019, henceforth IRR).[12] IRR's *coarse* classification ranges from 1 to 4, from less to more flexibility. The more detailed *fine* classification ranges from 1 to 13.[13] In accordance with the two-way classification, IRR can be divided into fixed and floating. The fixed corresponds to 1 (ranging from no legal tender to *de facto* peg), whereas the not fixed includes both 2 and 3 (representing intermediate regimes from preannounced crawling to managed floats) and 4 (representing freely floating currencies). Note that IRR provides a narrative classification that separates freely floating currencies from managed floats, which is only conducted for country-years where a currency fluctuates outside a 5% band. The narrative account comes from central bank minutes, reports, and statements; the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions, etc. In the appendix, we report results for the alternative classification, by Levy-Yeyati and Sturzenegger (2001, 2005, 2016, hereafter LYS)[14] and Couharde and Grekou (2021, henceforth CG), which proposes the synthesis classification using both IRR and LYS.[15] As discussed in CG, the LYS classification significantly

[12] https://www.ilzetzki.com/irr-data

[13] Index values 5 and 6 in the coarse classification (14 and 15 for the fine classification) indicate freely falling and dual market in which parallel market data is missing, respectively.

[14] https://www.hks.harvard.edu/centers/cid/publications/faculty-working-papers/classifying-exchange-rate-regimes

[15] LYS (2001, 2005) first identifies *de facto* classification by accounting for the relative behavior of three classification variables: changes in the nominal exchange rate, the volatility of those changes, and the volatility of international reserve changes. They use cluster analysis to identify the regime groups, which is a multivariate procedure according to similarities (distances) along certain quantitative dimensions. LYS (2016) also update their classification up to 2013. We find a significantly different coding between LYS and the other two. For example, Korea has opted for *de jure* floating regime since 1997, and Shambaugh and IRR both coded Korea as non-peg in the years after 1999. However, LYS (2016) showed a different coding that Korea was a pegger (*de facto*, hard-fixer) in 2004, 2009, and 2011.

reduces the size of the sample (see our discussion in section 3.1.4 below for more details and relevance to our research question).

To compare these *de facto* classification measures, especially the original three measures, we report a percentage of different codings from the other two for each classification: For the period 1974-2013 (common for all three classifications), Shambaugh shows 2.7%, IRR shows 6.3%, and LYS shows 12%. Thus, LYS shows a significant discrepancy from the other two. We report the correlation of the three measures: the correlation between Shambaugh and IRR is 0.7512, that between Shambaugh and LYS is 0.6382, and that between IRR and LYS is 0.5641.[16] Note that CG examines the disagreement between IRR and LYS when deriving their synthesis regime.

We also collect trade openness (total trade over GDP) and financial openness from Chinn and Ito (2006). The data sources and descriptive statistics for variables used in the analysis are reported in Appendix Tables 2 and 3.

When we turn our attention to the study of current account and real exchange rate dynamics, which calls for higher frequency data than the annual data in the World Bank data set above, we use quarterly data for current account balances collected from the OECD. We believe that some price adjustment likely would occur within an annual period, so we turn to data sources with a higher frequency to address real exchange rate changes in response to the shocks on the current account. Among countries with floating and intermediate exchange rate regimes in Table 1, we use the subset of 21 countries with quarterly data available for the period 1987Q1-2014Q4. Quarterly real effective exchange rates are sourced from BIS, and we modify it to make an increase in the real exchange rate denote real depreciation.

2.2. Empirical Model

We estimate two empirical models to investigate the role of exchange rates in current account adjustment. First is a panel regression to examine differences in current account adjustment by (*de facto*) exchange rate regime. Second is a local projection model to investigate how real exchange rate levels respond to a current account shock. In both estimation methods, we distinguish between cases of current account deficit and surplus.

[16] Correlation table among the three *de facto* classifications is as follows:

	Shambaugh	IRR (2019)	LYS (2016)
Shambaugh	1.000		
IRR (2019)	0.7512	1.000	
LYS (2016)	0.6382	0.5641	1.000

2.2.1. Differences in Autoregression by Exchange Rate Regime

Our initial regression specification is an autoregression:

$$CA_{it} = \varphi_0 + \varphi_1 CA_{it-1} + \varphi_2 CA_{it-1} \cdot posCA_{it-1} + year_t + \varepsilon_{it}, \quad (1)$$

where CA_{it} is the current account relative to GDP for country *i* in year *t*, and $posCA_{it-1}$ is an indicator for cases where current account was in surplus (coded as 1 if CA>0 at t-1 and 0 otherwise). The regression also features a term interacting the lagged current account with the indicator of positive current account.[17] To determine how the autoregressive coefficient varies with the exchange rate regime, our main specification estimates equation (1) separately for floaters and peggers as two distinct subsamples (a two-way classification).

A second regression specification expands upon the first by including controls such as trade and financial openness common in the literature:

$$CA_{it} = \varphi_0 + \varphi_1 CA_{it-1} + \varphi_2 CA_{it-1} \cdot posCA_{it-1} + Controls_{it}\gamma + year_t + \varepsilon_{it}. \quad (2)$$

A third approach estimates over a sample combining floaters and peggers:

$$CA_{it} = \rho_0 + \rho_1 CA_{it-1} + \rho_2 CA_{it-1} \cdot Floating_{it} + \rho_3 CA_{it-1} \cdot Floating_{it} \cdot posCA_{it-1}$$
$$+\rho_4 Floating_{it} + \rho_5 posCA_{it-1} + year_t + e_{it}, \quad (3)$$

where $Floating_{it}$ is a binary indicator coded as 1 if country *i* was classified as non-pegger at year *t*. Equation (3) includes three-way interaction among $Floating_{it}$, CA_{it-1} and the indicator of positive current account, $posCA_{it-1}$.

2.2.2. Local Projection Estimating Real Exchange Rate Channel

Given that the estimation in Section 2.2.1 tests for differences in current account adjustment by exchange rate regime, we next investigate further the role of exchange movements in the countries with a flexible regime by estimating impulse responses of the real exchange rate to current account shocks using the local projection method of Jorda (2005). This exercise is intended to examine the mechanism we think is at work behind the heterogeneous adjustment of current account surpluses and deficits, and by linking this to exchange rate behavior, to help motivate our explanation in terms of fear of appreciation policy limiting a country's exchange rate flexibility. While exchange rates are

[17] Our benchmark specification does not include the indicator of positive CA as a separate regressor, but only interacted with CA_{it-1}, since a separate indicator regressor would imply that cases with positive and negative current accounts would converge to different steady states. Our specification can be viewed as an application of the threshold autoregression (TAR) approach. Nonetheless, we show in the appendix that our conclusions are entirely robust to using a specification that does include the positive CA indicator as a separate regressor (see Appendix Tables 23 to 25).

noisy variables, by conditioning on a shock to the current account, we try to zero in exchange rate movements in response to financial imbalances. We focus analysis on the dynamic feedback relationship between the real exchange rate and current account balance that arises after a current account shock.

To identify current account shocks, we follow an idea by Morgan *et al.* (2004) by estimating the following equation on our panel of countries:[18]

$$CA_{it} = \alpha + \mu_i + q_t + tr_{it} + tr_{it}^2 + u_{it}. \tag{4}$$

To control for unobserved country characteristics, we include country fixed effect, μ_i. We also include a quarter-time fixed effect, q_t to control for common quarterly shocks on CA of sample countries.[19] tr_{it} is a country-specific linear time trend computed by a country dummy multiplied by a time trend to capture a specific CA trend (e.g., Germany's widened CA surplus during the sample period). tr_{it}^2 is also included to capture non-linear trend in CA. u_{it} is an error term that we extract from CA_{it}. According to distributional information of u_{it}, we define a one-standard-deviation of u_{it} from zero as a positive and negative current account shock, respectively: upper 16% of u_{it} as a positive attribute to the current account and lower 16% of u_{it} as a negative attribute on the current account.[20] In addition, we pool u_{it} for the all-country sample and check their upper and lower 16%. Then, we finally identify a positive (negative) shock on the current account if the value of u_{it} belongs to the upper (lower) 16% in not only country *i* but also the pooled sample. Lastly, we exclude cases where the current account shock is positive (negative) but where the current account itself is not positive (negative).[21] Please see Appendix Table 4 for the number of identified positive and negative current account shocks by year.

The local projection method requires estimation of the following regression for each horizon *h* for each variable:

$$REER_{it+h} - REER_{it-1} = \alpha_h + \rho_h \cdot CA\ Shock_{it} + \sum_{l=1}^{r} \gamma'_{lh} Z_{it-l} + \mu_i + q_t + \varepsilon_{it+h},$$
$$for\ \ h = 0,1, \ldots, \tag{5}$$

where *i* indexes country, *t* represents quarter, and *h* denotes the period that the current account shocks materialize. $REER_{it}$ is real effective exchange rate. But we modify the definition so that an increase in $REER_{it}$ indicates currency *depreciation* of country *i* at *t*-th quarter. $CA\ Shock_{it}$ is the identified current

[18] For seasonal adjustment of CA, we also include quarter dummy, which is distinct from quarter time fixed effects.
[19] One may argue that the average CA in the world needs to be zero by identity, so residualizing the current account from its average across countries is economically meaningless. But our sample in this analysis focuses on selective countries, thus their average CA would not be zero. Also the quarterly time fixed effect can capture a common shock in a specific time period, such as Great trade collapse in 2008, that influences the degree of CA.
[20] Assuming a normal distribution, the 16% tails represent one-standard deviation from the mean of the distribution.
[21] The purpose is to help avoid conflating shocks causing a current account imbalance from changes in current account that are correcting a current account imbalance (Our results are robust to whether or not we exclude such cases.)

account shock in equation (4). Z_{it-l} is a vector of control variables; First, we include a lagged REER variable. To consider uncovered interest rate parity, we control for the policy interest rate for a country *i* and its base country *j* (Shambaugh, 2004) collected from BIS. Lagged variables up to 8 quarters ($r = 8$) are included. In the specification, μ_i is country fixed effect and q_t is time fixed effect that captures any seasonal or common quarterly characteristics, and $\varepsilon_{i,t+h}$ is an error term.

Since we are interested in the asymmetric nature of the current account shock, we adapt the local projection method to estimate a state-dependent model as follows:

$$\begin{aligned} REER_{it+h} - REER_{it-1} \\ &= I_{it}\left[\alpha_{Ph} + \rho_{Ph} \cdot CA\,Shock_{it} + \sum_{l=1}^{r} \gamma'_{lPh} Z_{it-l}\right] \\ &+ (1 - I_{it})\left[\alpha_{Nh} + \rho_{Nh} \cdot CA\,Shock_{it} + \sum_{l=1}^{r} \gamma'_{lNh} Z_{it-l}\right] + \mu_i + q_t + \varepsilon_{it+h}, \\ &for\;\; h = 0,1,\ldots, \qquad (5') \end{aligned}$$

where I_{it} is a dummy variable that indicates the state where either positive CA shock or negative CA shock hits. We allow all of the coefficients to vary according to the state, so the forecast of $REER_{it+h}$ differs according to the state when the shock hits. To take into account serial correlation in the error term induced by the successive leading of the dependent variable, we employ robust standard errors clustered at the country level.

We implement a sub-sample analysis by dividing our sample into three detailed exchange rate regimes: floating, intermediate, and peg.[22] Further, a sub-sample analysis is also conducted by dividing our broad floating (floating and intermediate) sample into two groups—high capital control and low capital control countries—by considering capital controls and reserves accumulation. (Please see Appendix Tables 5 and 6 for the list of countries.) Appendix Table 7 also shows the descriptive statistics for our sub-sample analysis according to the level of capital account openness (KA) and reserves accumulation. By doing so, we examine whether countries with high capital controls and relatively high reserves accumulation (low capital account openness) are expected to show current account adjustment correlated with real exchange rate movements.

[22] To classify these three groups of countries for panel LP method, we used the following criteria: first, for pegged countries, we chose those whose peg observations were greater than 80%. For intermediate cases, we chose those who had pegged observations during the sample period, but their percentage was less than 33% (such as Switzerland). Lastly, those who did not have any pegged observations but softpeg were classified as floating. See Appendix Table 5 for a listing of the countries in each sample.

3. Empirical Results

3.1. Differences in Autoregression by Exchange Rate Regime

This section presents empirical evidence for our claim that countries with floating and intermediate exchange rates tend to have significantly faster convergence than peggers for the case of current account deficits, but that this is not true for current account surpluses.

3.1.1. Benchmark Specification

We begin with results from the simplest regression, equation (1), as shown in Table 1. A first observation is that the coefficient on the interaction term indicating a positive current account (second row of coefficients in the table) is positive and significant. This result implies that current account surpluses are more persistent than current account deficits for flexible exchange rate countries. The interaction term is significant at the 1%-5% significance level for floaters in all subsamples of countries when floating is determined under the IRR classification; it is at least marginally significant (5%-10% significance level) for floaters in all subsamples of countries under the Shambaugh classification. Significance is at the 1% level for both classifications for the subsample of industrial countries and also the complementary subsample of non-industrial countries once SSA countries and CSP countries are excluded. We conclude that the sign of the current account is a determinant of the speed of current account convergence for countries with flexible exchange rates. The difference in convergence speeds is economically as well as statistically significant. Applying the standard formula for half-lives for an autoregression, the estimates from our full sample and benchmark specification imply a half-life for current account surpluses that is fourteen times that of current account deficits, 11.36 years versus 0.80 years.[23]

[Insert Table 1 about here]

The second observation is that the coefficient on lagged current account (first row in Table 1) is much smaller for floaters than peggers in most country subsamples, indicating faster convergence of current account imbalances for floaters, conditional on the current account imbalances being deficits. Table 1 also provides a formal statistical test of the hypothesis that the coefficient on lagged current account for floaters is the same as that for peggers, and statistically rejects this hypothesis in most cases reported in the table. Statistical significance is strong both for the industrial countries subsample and the complementary sample of non-industrial countries once SSA and CSP countries are excluded. This result is supportive of Friedman's claim that flexible exchange rates can help promote international

[23] Computed as ln(0.5)/ln(0.4183+0.5225) and ln(0.5)/ln(0.4183), respectively.

adjustment. The estimates from our full sample and benchmark specification imply a half-life for current account deficits of 2.61 years for pegs, compared to the value of 0.80 noted above for floaters. However, the fact that the result is conditional on the sign of the current account imbalance, a distinction not included in the standard Friedman mechanism, motivates the need for further investigation of the mechanism below.

A third observation is that if one sums the coefficients on the interaction term with the coefficient on the lagged current account, the larger value of the interaction term for surpluses more than compensates for the smaller coefficient on the lagged current account. In other words, while floaters adjust faster for current account deficits, this advantage in adjustment speed is fully eliminated for current account surpluses. For example, the estimates from our full sample and benchmark specification imply a half-life for current account surpluses of 3.02 years for pegs, which now is smaller than the value of 11.36 years noted above for floating exchange rate countries. The result is similar for the IRR classification and for other country samples in Table 1. We also implement statistical tests of the hypothesis that the sum of the two autoregressive coefficients (on lagged current account and on the interaction term) for floaters is not less than the sum for peggers. Table 1 shows the tests do not reject the null in all cases.

The overall picture implied by these findings is that floating promotes faster convergence, specifically in the case of deficits, but not in the case of surpluses. This result suggests one potential reason why many past estimates in the literature, which did not make this distinction based on the sign of the current account, did not find evidence that flexible exchange rates promoted faster current account corrections.

3.1.2. Robustness

To check the robustness of these results, we estimate several additional versions of the regression. Table 2 reports results from equation (2) including controls common in the literature for trade and financial openness. Results support the earlier conclusions, and statistical significance is stronger in some respects. First, the interaction term for a positive current account for floaters now is significant at the 5% for the full sample for both regime classifications. While this coefficient is not significant for industrial countries with the additional controls, it is strongly significant for non-industrial countries, excluding SSA countries and CSP countries. Second, conditional on a current account balance that is negative, the coefficient on lagged current account is still smaller for floaters than peggers, indicating faster convergence of current account deficits with flexible exchange rates. And third, the difference in speeds of convergence disappears or even is flipped when conditioned on a positive current account balance by adding the autoregressive coefficient with that on the interaction term for positive current account. Table 2 provides additional information, in that the interaction of financial openness with lagged current account indicates that floaters with more financial openness have a lower sum of coefficients, indicating a faster speed of convergence than floaters with less financial openness. This last conclusion applies to all country samples except that excluding industrial countries and oil exporters, suggesting it is driven by information from industrial and oil-exporting countries classified as having flexible exchange rates.[24]

[Insert Table 2 about here]

A potential explanation for our finding of faster convergence conditional on a negative sign for the current account is the presence of currency crises, in which a current account deficit and external imbalance due to a peg of an overvalued currency prompts a switch to a float and a currency devaluation, along with a sudden stop of capital flows which forces balancing of the current account. We check for the role of this mechanism by estimating our equation on a sample of countries that excludes those experiencing a currency crisis identified by Laeven and Valencia (2020).[25] This is because we are interested in cases where the current account imbalance is large, not where a large change in the current account is most likely to occur driven by a crisis shock. Our sample of countries decreases from 155 to 130, and our observations for floating and peg exchange rate regime countries shrink from 2,499 and 2,015 to 1,816 and 1,441, respectively. Table 3 shows that the results are very similar to the main results in Table 2. Appendix Table 10 also shows results for a regression that retains currency crisis observations but includes an indicator variable for them along with an interaction term of this indicator with lagged current account. Again, the results are similar to our benchmark case.

[Insert Table 3 about here]

To provide a more precise way to test for differences in coefficients across regimes, we pool the samples of fixed and floating countries, and include a three-way interaction of lagged current account, indicators of positive current account, and an indicator for floating regime (equation (3)). While the interpretation of the proliferation of coefficients can be subtle, the main point for our purposes is that the triple-interaction term is statistically significant at the 1% level both for the sample

[24] While the regressions in Table 3 include year fixed effects, the Appendix also reports results from a regression specification that excludes this like Chinn and Wei (2013) (see Appendix Table 8), and also from one which includes both year fixed effects and country fixed effects (Appendix Table 9). Results in both cases are similar to those in Table 3, though the gap between coefficients on lagged current account across regimes appears to be reduced.

[25] The currency crises were identified based on Frankel and Rose's (1996) approach, which indicates a nominal depreciation of the currency vis-a-vis the U.S. dollar of at least 30 percent that is also at least 10 percentage points higher than the rate of depreciation in the year before (see Laeven and Valencia, 2020).

of industrial countries and for the complementary sample of non-industrial countries, once sub-Saharan Africa and the Caribbean countries are excluded. We also provide more robustness checks using LYS (2016) and CG (2021) *de facto* classifications in Appendix Tables 11 and 12.[26] Appendix Table 13 shows results are robust to treating exchange rate regime as endogenous.[27]

[Insert Table 4 about here]

3.1.3. Estimating Over Three Regimes

In order to dig deeper into what drives the asymmetry of higher persistence of surpluses among *de facto* floaters, we further decompose the sample into *three* categories: the *de-facto* floaters are broken into strict floaters and intermediate floaters. According to the Shambaugh classification, intermediate floaters are classified as a soft peg, which allows for a wider range of exchange rate movement, with bands of up to 5%. In the case of IRR, intermediate floaters include the variations of the crawling band/peg or managed floating, which corresponds to 2 and 3 in the IRR coarse classification).[28]

The main results from estimating equation (1) are reported in Table 5 (Appendix Table 14 shows robustness to including additional controls in panels A and B, excluding crises in Panel C, and a three-way interaction in panel D). The striking properties associated with the floaters in the benchmark regression of Table 2, now are attributed to the intermediate floater regime's subsample rather than the strict floaters. The coefficient on the interaction term indicating a positive current account (second row of coefficients in the table) is positive and significant. This result implies that current account surpluses are more persistent than current account deficits. The interaction term is significant at the 1% significance level in all subsamples of countries when floating is determined under the Shambaugh

[26] Including unemployment (demeaned by country) in a three-way interaction term augments somewhat the effect of current account surplus on its persistence. See Appendix Table 26. This finding supports a conjecture that fear of appreciation is stronger when governments fear exacerbating cyclically high unemployment.

[27] We follow the two-stage procedure used in Chinn and Wei (2013) for their results in Table 9. In the first stage, we estimate a probit model for the regime indicator variable, using as regressors the initial foreign exchange reserve to GDP ratio, the ratio of the country's GDP over the United States', a regional exchange rate indicator, which is the average exchange rate regime of the country's neighbors in the region (LYS 2003), a dummy variable for islands and year dummies. This generates probabilities that we then use in the second-stage regressions with a three-way interaction term for positive current account.

[28] Coarse index 2 includes from 5 to 8 of the fine index and index 3 does from 9 to 12. 5: pre-announced crawling peg (*de facto* moving band narrower than or equal to +/-1%), 6: pre-announced crawling band (narrower than or equal to +/-2% or *de facto* horizontal band that is narrower than or equal to +/-2%), 7: *de facto* crawling peg, 8: de-facto crawling band (narrower than or equal to +/-2%), 9: pre-announced crawling band (wider than or equal to +/-2%), 10: *de facto* crawling band (narrower than or equal to +/-5%), 11: moving band that is narrower than or equal to +/-2% (allows for both appreciation and depreciation over time). 12: *De facto* moving band +/-5%/ Managed floating (See IRR, 2019).

classification; it is significant at least at the 5% in all subsamples of countries under the IRR classification. A second observation is that the coefficient on lagged current account is much smaller for intermediate floaters than peggers in most country subsamples, indicating faster convergence of current account imbalances for floaters, conditional on the current account imbalances being deficits.

[Insert Table 5 about here]

We note that the convergence speed for strict floaters tends to be somewhat smaller than for peggers, but the gap is greatly narrowed compared to benchmark results; the strongest contrast is between intermediate floaters and peggers. This may be surprising, as one might assume that if floating is to promote adjustment of external imbalances, it should be most noticeable when floating is most strict. But this is not the case in our sample. Our theoretical model will take up this issue, suggesting a different explanation for how a "fear of appreciation" foreign exchange intervention rule affects the dynamics of external imbalances. Countries in the intermediate floating regime have fast convergence in the case of current account deficits, when the "fear of appreciation" policy is likely to be inactive, which suggests they act like floaters. But they have slow convergence of external imbalances in the case of current account surpluses, when a "fear of appreciation" policy is likely to be active and they act like peggers. This interpretation provides novel evidence supporting the general Friedman conjecture, broadly defined, that floating promotes adjustment of external imbalances. That is, rather than comparing across two groups of countries, if we compare within the set of intermediate countries that sometimes act like floaters and sometimes like peggers, we find faster convergence of external balances in the cases these countries act more like floaters, and distinctly slower convergence in the cases they tend to act like peggers.

This interpretation coincides with the fact that the intermediate regime category includes many Emerging Asian countries typically identified with fear of appreciation, which often allow the exchange rate to float, but intervene intermittently in order to support certain objectives. The IRR and Shambaugh intermediate category for many periods includes Korea, Indonesia, Malaysia, and Thailand, as well as the Philippines, Singapore, Vietnam, and even China in the post-2000 period. An IMF report of the first four of these countries fits well our characterization of these countries as fear of appreciation floaters: "While all have adopted flexible exchange rates, they intervene in the foreign exchange market on occasion to counter excessive exchange rate volatility and maintain a high level of foreign exchange reserves." (Everaert and Genberg, 2020).

3.1.4. Comparison with Chinn and Wei (2013)

Chinn and Wei (2013) briefly considered our question in their Table 7, regressing current account on its lag interacted with an indicator of surplus. Their finding differs from us, and they concluded that "the floating regime and fixed regime rates of reversion [of the current account] are about the same regardless of whether these countries are running a surplus or a deficit" (p. 177). We highlight that the sample for this table consisted exclusively of data for which there is a regime classification from LYS. This fact is important, since the sample size of LYS is much smaller than that for IRR or Shambaugh. This fact has been detailed in Couharde and Grekou (2021). They noted that IRR and LYS differ considerably regarding their data, key statistics, and methodology: IRR and LYS show disagreement for the regime classification of about 40% of observations. The reason is that while IRR is based on exchange rate variations, calculated as the absolute percent changes in the monthly nominal exchange rate averaged over a five-year rolling window, LYS combines available information not only on the official exchange rate but also on reserves' movements. LYS's approach is more comprehensive by looking at reserves accumulation to capture the effect of interventions on the exchange rate, however, the lack of (monthly) data about reserves for some countries leads to missing or inconclusive observations in LYS more than in other regimes.

In our own comparison of samples in Appendix Table 16, we find an omission of 635 observations in LYS relative to IRR, which represents approximately 15% of the IRR sample. Further, the intermediate-regime countries, identified in the preceding section as particularly important to our result, represent a disproportionate share of the missing observations. For example, 84% of the missing observations are identified as intermediate cases by IRR. This includes Emerging Asian countries likely to exhibit fear of appreciation, such as the Philippines, Singapore, Vietnam, and even China in the post-2000 period.

We conduct a series of experiments confirming that the reason the result of Chinn and Wei (2013) differs from our result can be attributed to the omissions from the LYS sample. Following the spirit of Chinn and Wei's (2013) Table 7, we report the results of the adjustment of the current account balance between floating and fixed using their time period from 1974 to 2005. We also use the two LYS (2005) and LYS (2016), respectively, for comparison.[29]

[Insert Table 6 about here]

Panel A of Table 6 echoes Chinn and Wei's results qualitatively, especially for the sign and significance of the interaction terms of CA(-1) and positive dummy for CA(-1). We do not find the

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[29] There are two important notes: 1) LYS regime is only available from 1974. 2) LYS regime was also updated recently: LYS (2005)'s classification is different from LYS (2016)'s for some countries. Some data points in LYS (2005) become missing or have been updated in LYS (2016). For instance, South Africa in 1974 was classified as fixed in LYS (2005), but is now categorized as intermediate (dirty float) in LYS (2016).

current adjustment asymmetry in terms of current account surplus or deficit in any regimes, confirming the result of Chinn and Wei of using only LYS.[30] However, when using other exchange rate regime classification data, such as Shambaugh and IRR, for the same period 1975-2005, we have different results between LYS and these two regimes (see Panel B). Panel B of Table 6 supports our main results that floating promotes faster convergence, specifically in the case of deficits, but not in the case of surpluses mainly for non-industrial countries.

We next do some experiments in Appendix Table 17 by filling in the specific observations missing in the LYS dataset using the corresponding observations in the Shambaugh and IRR data but retaining the rest of the LYS data and retaining the 1975-2005 date range. The results support our original findings of CA adjustment asymmetry: floaters have faster convergence than peggers for current account deficits, but not for surpluses.

Lastly, Table 7 reports results when we estimate equation (1) without separating countries by regime. Even here we see evidence of our main result that current account surpluses are more persistent than deficits on average, in the full sample of countries and especially among non-industrialized countries. This result demonstrates that this key part of our empirical result is not dependent on the choice of any particular regime classification.

[Insert Table 7 about here]

3.1.5. Size of the Current Account Balance: Comparison with Ghosh *et al.* (2010)

Ghosh *et al.* (2010) found support for Friedman's conjecture by considering threshold effects jointly for the sign and the size of current account imbalances. In particular, the regression reported in their final table (Table 5) introduces indicator variables for current account balances greater than the 75th percentile and less than the 25th percentile. The authors conclude that large surpluses are more persistent in fixed and intermediate regimes than floating regimes, and they emphasize the importance of threshold effects of large relative to moderate imbalances. A similar regression setup and result is reported also in Ghosh *et al*. (2019), Table 7, which uses a novel regime classification based on bilateral exchange rate relationships. Our result is related, but differs in several respects.

Most importantly, we find evidence that differences in sign rather than size drive asymmetry in current account adjustment speed. As preface, we note that the identification of "large" current account is tricky. In our data set, for example, a country with zero current account balance coincides

[30] We also replicate Chinn and Wei's Table 7 and see appendix Table 15. Chinn and Wei (2013) use over 170 countries from 1971-2005, however, our sample is 144 countries from 1974-2005.

with the 71st percentile rather than something close to the 50th; when we limit the sample to the years in Ghosh *et al*. (2010), surpluses begin similarly in the 71st percentile.[31] See our Appendix Table 19 for the distribution of current account balances by decile. Table 3 of Ghosh *et al*. (2010) seems to reflect this distribution, as it reports that the mean current account balance among countries in their sample is negative (-3.6%). An implication is that Ghosh et al.'s indicator variable for the 75 percentile in the distribution of current account balances, rather than capturing just large current account surpluses, likely captures nearly all current account surpluses. This cautions against a simple interpretation of these results as indicating threshold effects reflecting size rather than sign.

Next, we ourselves, demonstrate that heterogeneity based on size is not significant to our finding, with a modification of the specification of Ghosh *et al.* (2010) that takes account of the fact that current account balance coincides with the 71st percentile. We divide CA positive dummy into two dummies when CA/GDP is between the 71st percentile and 85th percentile (small surplus) and CA/GDP is greater than the 85th percentile (large surplus), respectively. By examining both of these dummies interacted by lagged CA, we analyze whether the persistent CA surpluses in floating and intermediate regimes are (un)conditional on the CA size.

Table 8 shows the results with two CA surplus dummies. We find that persistent CA surpluses in floating regimes classified by Shambaugh (2004), particularly for non-industrial countries excluding SSA, CSP, and Oil exporters, are unconditional on the CA size (see column (9)). Moreover, regardless of the exchange rate regimes, both CA interaction terms with two CA surplus dummies (small surplus and large surplus) are statistically significant in two panels of Table 8 for non-industrial countries, indicating that persistent CA surpluses are observed in both floating and fixed regimes unconditional on the size of CA surpluses (see also Appendix Table 20 for the results with LYS and CG regimes).

[Insert Table 8 about here]

The finding of sign rather than size as the key determinant, supports our papers' focus on an explanation based on fear of appreciation, rather than one based on sudden reversals associated with large imbalances as in Ghosh *et al*. (2010). In addition, the distribution of imbalances in the data set of Ghosh *et al.* (2010), as well as our own dataset, with a large number of moderate deficits and smaller number of persistent surpluses, is supportive of our theoretical model in the section to follow, as it shows that the proposed model of fear of appreciation implies such a distribution.

[31] Ghosh *et al*. (2010) use the IMF *de facto* classification scheme, but footnote number 4 of Ghosh *et al*. (2010) claims there is broad consensus of this with the Shambaugh classification. We also replicate Ghosh *et al*. (2010) in Appendix Table 18.

3.2. Local Projection: Estimating Real Exchange Rate Channel

This section presents estimates of our local projections model, aimed at investigating how exchange rates among more flexible exchange rate regime countries actually respond to current account shocks. Specifically, we examine whether the responses of real effective exchange rate (REER) to the CA shock are state-dependent, especially whether positive or negative CA shocks have different effects on REER adjustment (here, an increase in REER indicates a real depreciation). This exercise is intended to examine the mechanism we think is at work behind the slower adjustment of current account surpluses compared to deficits, and by linking this to exchange rate behavior, to help motivate our explanation in terms of fear of appreciation policy limiting a country's exchange rate flexibility. While exchange rates are noisy variables, by conditioning on a shock to the current account, we try to zero in on exchange rate movements in response to financial imbalances. Figure 1 shows impulse response functions for the REER in response to different types of shocks to the current account balance, both for more flexible regimes and fixed regimes.

The impulse response functions in the state-dependent cases are derived from the estimates, ρ_{Ph} and ρ_{Nh} in equation (5'). Panel A of Figure 1 shows the impulse responses of the positive CA shocks identified at the upper 16 percentiles, and Panel B of Figure 1 illustrates the case for negative CA shocks at the lower 16 percentiles (from one standard deviation). We find that responses of the REER to a positive CA shock (solid blue line) are not significantly different from zero at the 10% level at any period after the shock. However, the REER significantly increases (real depreciation) in response to the negative CA shocks, and it is significantly different from zero starting from the period of shock impact through the first year afterward. This indicates that real exchange rates move in the right direction to promote the adjustment of current account deficits, but they do not move to promote the adjustment of current account surpluses. This suggests that failure of an ostensibly flexible exchange rate to respond to a current account surplus may be contributing to the longer time it was found above for this imbalance to be resolved.[32]

[Insert Figure 1 about here]

Panel B reports results for fixed exchange rate regimes. Not surprisingly, the real exchange rate does not serve a useful function in facilitating current account adjustment of imbalances of either sign. (If anything, the real exchange rate appreciates in the case of a deficit, moving in the wrong direction to return to balance).

[32] Appendix Figure 1 reports LP results when splitting the floating sample into pure floats and intermediate floats. Results are similar, but the asymmetry across positive and negative current accounts is stronger for the intermediates countries.

To further examine why the current account surplus did not bring about real exchange rate appreciation, we consider a country's policy characteristics that influence REER and CA adjustments, such as individual countries' capital account openness (inverse of capital controls) and reserves accumulation in Figure 2. See also Appendix Tables 6 and 7 for descriptive statistics of the variables used in the local projection method.

Figure 2 shows sub-sample regressions regarding capital account openness (KA). Panel A and Panel B show KA-low countries (countries with capital controls) and KA-high countries, respectively. First, the results in Panel A show that a negative CA shock leads to REER depreciation significantly, but a positive CA shock doesn't lead to a significant REER response. It thus shows a more distinct asymmetric REER response to negative CA shocks, which is similar to those in Figure 1. However, when looking at Panel B for KA-high countries in Figure 2, there is no longer asymmetry; we show that CA positive and negative shocks lead to the right direction of REER responses (even if it takes three or four quarters for this effect to become significant).

[Insert Figure 2 about here]

This evidence indicates that we focus on countries that employ some degree of capital controls on international asset flows, as a mechanism to help avoid undesired currency appreciations. Examination of the group of countries identified in Appendix Table 6 suggests candidates for the countries that fit our profile for driving the earlier result of persistent current account surpluses. It suggests that we not focus just on noted cases of current account surplus like China, but other countries like Indonesia, Korea, and Russia.[33]

4. Theoretical Model

This section develops a three-country dynamic stochastic general equilibrium monetary model to explore conditions under which a nominal exchange rate policy embodying fear of appreciation can explain the asymmetric persistence of current account surpluses found in the empirical results. The goods market structure includes traded and nontraded sectors where the real exchange rate is

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[33] Following Chinn and Wei (2013) in their Table 10, we also estimate autoregessions of real exchange rates, to measure the speed of real exchange rate convergence. We further augment this regression with an interaction term of for a positive current account and regime classification. See Appendix Tables 21 and 22 for results, which indicate that for some groups of countries (especially nonindustrial countries excluding SSA), a current account surplus implies greater persistence in the real exchange rate. However, we maintain that our LP regression is a better test of our hypothesis. The speed of convergence to a long run level (a version of PPP) estimated in the autoregression is a distinct issue from whether the real exchange rate moves in the short to medium run in the direction consistent with reducing current account imbalances. In fact, current account adjustment might well involve short to medium run changes in relative prices that imply greater deviations from PPP.

determined by cross-sector relative price, as in Jeanne (2013) and Korinek and Serven (2016).[34] This approach is well-suited for studying cases of protracted real exchange rate undervaluation, which is important for explaining the current account dynamics observed above. In contrast, a standard New Keynesian nominal model where real effects of the nominal exchange rate depend on short-run price rigidities is not consistent with the high degree of persistence in real exchange rate undervaluation needed to explain our current account persistence. In the notation below, the three countries will be indexed by i = 1, 2, 3.

4.1. Households

The representative household in country i derives utility from consumption (C_{it}), which is an aggregate of traded ($C_{T,it}$) and nontraded goods ($C_{N,it}$), and from real money balances (M_{it}/P_{it}). In addition to money, the household can purchase home currency bonds, which are only traded domestically, or the international bond, issued by country 2, its national currency (We assume that country 2 bonds are the only internationally traded bond.) Output of each good arrives as an endowment. The home household maximizes $\sum_{t=0}^{\infty}\beta^t U\left(C_{it}, M_{it}/P_{it}\right)$ where $U_{it}=C_{it}^{1-\sigma}\big/(1-\sigma)+\chi\ln\left(M_{it}/P_{it}\right)$ and $C_{it}\equiv\left(\nu^{\frac{1}{\eta}}C_{T,it}^{\frac{\eta-1}{\eta}}+(1-\nu)^{\frac{1}{\eta}}C_{N,it}^{\frac{\eta-1}{\eta}}\right)^{\frac{\eta}{\eta-1}}$ with $\nu\in[0,1]$ accounting for the weight on domestic goods and η, the elasticity of substitution, subject to a budget constraint. The constraint is specified as

$$\begin{aligned}&P_{1t}C_{it}+\left(M_{it}-M_{it-1}\right)+\left(B_{it}-\left(1+i_{it-1}\right)B_{it-1}\right)+e_{2it}\left(B_{2it}-\left(1+i_{2t-1}\right)B_{2it-1}\right)\\&=P_{T,it}Y_{T,it}+P_{N,it}Y_{N,it}+T_{it}-AC_{B,it}-\tau_{it}\end{aligned}\qquad \text{for } i=1,3 \qquad (6)$$

for countries 1 and 3, which issue only domestically traded bonds, and specified as

$$P_{1t}C_{it}+\left(M_{it}-M_{it-1}\right)+\left(B_{2it}-\left(1+i_{2t-1}\right)B_{2it-1}\right)=P_{T,it}Y_{T,it}+P_{N,it}Y_{N,it}+T_{it}-AC_{B,it}-\tau_{it}\qquad \text{for } i=2 \quad (6')$$

for country 2, which issues bonds that are internationally traded. Here B_{it} is household holdings of the domestically traded bond, with interest rate i_{1t-1}; B_{2it} is holding by country i households of the international bond issued by country 2 in currency units of country 2, with interest rate $i_{2,t-1}$. e_{jit} is the exchange rate between countries i and j (country i currency units per country j currency). T_{it} is a lump sum transfer. The term $\tau_{it}=\psi_{\tau i}\left(e_{2it}B_{2it}\right)^2\big/\left(2P_{T,it}Y_{T,it}\right)$ is a capital control tax, scaled by the parameter

[34] The general structure of goods and asset markets are drawn from Jeanne (2013), with modifications for a stochastic environment, nominal variables, and for three countries. The specification of government policy rules embodying fear of appreciation is unique to our model.

$\psi_{\tau i}$: for $\psi_{\tau i}$ = 0 capital is internationally mobile, and as $\psi_{\tau i} \to \infty$ the capital market approaches being fully closed. The term, $AC_{B,it} = \psi_B \left(e_{2it}B_{2it}\right)^2 / \left(2P_{T,it}Y_{T,it}\right)$ is a small bond holding adjustment cost to ensure stationarity of steady state bond allocations even in the case of no capital control tax with scaling parameter ψ_B set to a small value. $P_{T,1t}$ and $P_{N,1t}$ are prices of traded and nontraded goods, respectively.

The first order conditions imply an intertemporal Euler equation:

$$\frac{1}{P_{it}C_{it}^{\sigma}} = \beta\left(1+i_{it}\right)E_t\left[\frac{1}{P_{it+1}C_{it+1}^{\sigma}}\right], \tag{7}$$

a money demand equation

$$M_{it}/P_{it} = \chi C_{it}^{\sigma}\left(1+i_{it}\right)/i_{it}, \tag{8}$$

and an uncovered interest rate parity condition for countries 1 and 3:

$$\left(1+i_{it}\right)E_t\left[\frac{1}{P_{it+1}C_{it+1}^{\sigma}}\right] = \left(1+i_{2t}\right)E_t\left[\frac{1}{P_{it+1}C_{it+1}^{\sigma}}\frac{e_{2it+1}}{e_{2it}}\right]\left(1+\frac{\left(\psi_B+\psi_{\tau i}\right)e_{2i}B_{2it}}{P_{T,it}Y_{T,it}}\right)^{-1} \text{ for } i=1,3. \tag{9}$$

Intra-temporal optimization implies the usual allocation condition between the two types of goods: $\frac{C_{N,it}}{C_{Tit}} = \frac{1-\nu}{\nu}\left(\frac{P_{N,it}}{P_{T,it}}\right)P_{it}^{-\eta}$. Combined with the consumption index, this implies the following demands, and price index (where the price of traded goods is equal in all countries).

$$C_{T,it} = \nu\left(P_{T,it}/P_{it}\right)^{-\eta}C_{it}, \tag{10}$$

$$C_{N,it} = (1-\nu)\left(P_{N,it}/P_{it}\right)^{-\eta}C_{it}, \tag{11}$$

$$P_{it} = \left((1-\nu)P_{N,it}^{1-\eta} + (\nu)P_{T,it}^{1-\eta}\right)^{\frac{1}{1-\eta}}, \tag{12}$$

4.2. Government Policies

Governments issue money (M_{it}) and domestic currency bonds (B_{it}^s), and conduct transfers to households (T_{it}). The government of country 1 also purchases bonds of country 2 to hold as foreign reserves (R_{1t}). The government budget constraint of country 1 is:

$$\left(M_{1t}-M_{1t-1}\right)+\left(B_{1t}^s-\left(1+i_{1t-1}\right)B_{1t-1}^s\right)-T_{1t} = e_{21t}\left(R_{1t}-\left(1+i_{2t-1}\right)R_{1t-1}\right), \tag{13}$$

The term on the right represents new purchase of reserves beyond the rollover of maturing reserves with interest. This will be referred to as "primary reserves" accumulation, denoted

$DR_{1t} \equiv R_{1t} - \left(1 + i_{2t-1}\right) R_{1t-1}$. Constraints for the other two governments are analogous, except they hold no reserves.

$$\left(M_{it} - M_{it-1}\right) + \left(B_{it}^{s} - \left(1 + i_{it-1}\right) B_{it-1}^{s}\right) = T_{it} \text{, for } i=2,3. \tag{13'}$$

The government of country 1 pursues a foreign exchange intervention policy between dates t_1 and t_2, in which it purchases reserves to moderate nominal exchange rate appreciation as follows, and it takes no foreign exchange intervention in the case of no appreciation:

$$\begin{array}{ll} R_{1t} - R_{1t-1} = \xi\left(\bar{e}_1 - \hat{e}_{1t}\right) & \text{if } \hat{e}_{1t} < \bar{e}_1 \text{ and } t_1 \le t \le t_2 \\ R_{1t} - R_{1t-1} = 0 & \text{otherwise} \end{array} \tag{14}$$

where $\hat{e}_{1t} \equiv \frac{1}{n}\sum_{i=1}^{n} e_{1,t+1-i}$ is a moving average of the multilateral exchange rate, e_{1t}, which is defined as an equally weighted average of exchange rate with both of the other countries (e_{21} and e_{31}). In the main specification, the exchange rate target, $\bar{e}_1$, will be set in the benchmark model at the steady state equilibrium value in the absence of shocks or foreign exchange intervention. But we also consider an alternative where the target set during the period of the policy is an undervaluation relative to the steady state.[35]

Since the benchmark specification assumes full capital controls in country 1, its foreign exchange intervention policy can be sterilized and combined with an independent monetary policy. We will consider alternative monetary policy rules. Given that the benchmark specification has no nominal frictions, the policy in the benchmark specification simply targets stable price levels: $P_{it} = \bar{P}$ for each country i = 1…3, adjusting money supply accordingly. This has the benefit of transparently implying that the real exchange rate is the same as the nominal exchange rate. For simplicity, bond supplies are held constant, $B_{it}^{s} = 0$ for i = 1, 2, 3. The government budget constraint then implies transfers are adjusted to finance changes in money supply, and in the case of the home country, pays for reserves purchases to achieve an exchange rate target.[36]

[35] Microfoundations for such a policy rule potentially could be found in the models of several recent papers featuring a mercantilist motive, in which a learning by doing externality motivates an optimizing government to engineer a trade surplus. See Korinek and Serven (2016) and Benigno, Fornaro and Wolf (2022). Another potential microfoundation for the reserve hoarding implied by our policy rule could be a precautionary motive. See Jeanne and Ranciere (2011) as well as Benigno, Fornaro and Wolf (2022).

[36] Given the transfers are lump-sum, Ricardian Equivalence renders this simplifying assumption innocuous.

4.3. Market Clearing

Market clearing for nontraded goods requires:

$$C_{Nit} = Y_{Nit} \text{ for } i\text{=1,2,3.} \tag{15}$$

Clearing of the global market for traded goods:

$$C_{T1t} + C_{T2t} + \omega_3 C_{T3t} = Y_{T1t} + Y_{T2t} + \omega_3 Y_{T3t}, \tag{16}$$

where ω_3 represent the population of country 3 relative to that of countries 1 and 2, which are normalized to unity. Arbitrage in the traded goods market requires:

$$P_{T,1t} = e_{21t} P_{T,2t},\ P_{T,1t} = e_{31t} P_{T,3t}. \tag{17}$$

Bond market clearing requires:

$$B_{it} = B_{it}^{s} \quad \text{for} \quad i = 1,3 \tag{18}$$

$$B_{21t} + B_{22t} + \omega_3 B_{23t} + R_{1t} = B_{2t}^{s}. \tag{18'}$$

Combining budget constraints for households and governments with goods market-clearing conditions implies the balance of payments constraint for country 1:

$$\left[P_{T,1t}\left(Y_{T,1t} - C_{T,1t}\right) + e_{21t} i_{2t-1}\left(B_{21t-1} + R_{1t-1}\right)\right] = \left[e_{21t}\left(B_{21t} - B_{21t-1}\right) + e_{21t}\left(R_{1t} - R_{1t-1}\right)\right], \tag{19}$$

where the left-hand side defines the current account, and the right-hand side is the inverse financial account. We track the current account as the inverse of the financial account in country 1:

$$CA_{1t} = e_{21t}\left(B_{21t} - B_{21t-1}\right) + e_{21t}\left(R_{1t} - R_{1t-1}\right) \tag{20}$$

and analogously for other countries: $CA_{2t} = \left(B_{22t} - B_{22t-1}\right) - \left(B_{2t}^{s} - B_{2t-1}^{s}\right)$ and $CA_{3t} = \left(e_{21t}/e_{31t}\right)\left(B_{23t} - B_{23t-1}\right)$.

4.4. Shock Processes

Endowments follow a stochastic process with log-normal shocks, assumed for simplicity to be independent across countries and sectors:

$$\left(\ln Y_{kit} - \ln \overline{Y}_{ki}\right) = \rho\left(\ln Y_{kit-1} - \ln \overline{Y}_{ki}\right) + \varepsilon_{kit},\ \varepsilon_{kit} \sim N\left(0, \sigma_{ki}\right), \text{ for } i \in \{1,2,3\},\ k \in \{T, N\}.$$

4.5. Equilibrium Definition and Solution

Equilibrium is a sequence of 41 endogenous variables: for each of the three countries i=1..3 P_{it}, P_{Tit}, P_{Nit}, C_{it}, C_{Tit}, C_{Nit}, M_{it}, i_{it}, B_{it}, B_{it}^{s}, T_{it}, CA_{it}, along with B_{21t}, B_{23t}, e_{21t}, e_{31t}, R_{1t}. These variables satisfy 41 equilibrium conditions, which include the following for each of the three countries: equations (7), (8), (10)-(13), (15), (18), (20), policy rules for price and bonds. Equilibrium conditions also include the following for countries 1 and 3: equations (6), (9) and (17), as well as the following two equations (14) and (16).

Numerical solution of the model uses the methodology (OCCBIN) for solving a piece-wise linear approximation to a stochastic model subject to an occasionally binding constraint, developed in Guerrieri and Iacoviello (2017). See Appendix A for more detailed explanation.[37]

4.6. Calibration

Parameter values are listed in Table 9. Risk aversion is set to the standard value of $\sigma = 2$. Consistent with annual frequency, time discounting is set to $\beta = 0.96$. The traded goods share is set to $\nu = 0.5$, and the elasticity of substitution between traded and nontraded goods is set to $\eta = 0.5$, as in chapter 8 of Uribe and Schmitt-Grohé (2017). Standard deviation of annual supply shocks is $\sigma_{ki} = 0.01$, and autoregressive parameter $\rho = 0.84$ from Uribe and Schmitt-Grohé (2017). The relative size of country 3 is set to 4, reflecting the share of world GDP not represented by Emerging Asia (country1) and the U.S. (country 2).

The values of the policy parameter governing the response of reserve accumulation to currency undervaluation, $\xi = 1.8$, is chosen to maximize the value of the regression coefficient on positive current account indicator variable in regressions with simulated data.[38] Optimization is subject to the constraint that the level of reserves accumulated by country 1 at the end of the burn-in period matches the empirical value for China for the last 10 years of our data sample, which is 41%. Simulations also are reported calibrated to reserve holdings of Korea, at 25%. The number of lags in the moving average of the exchange rate used in the policy rule, *n*, is set at 5 to maximize the value of the regression coefficient; sensitivity analysis is reported. Benchmark results are reported for a fully closed capital account in country 1, with capital control parameter ($\psi_{\tau 1}$) set to an arbitrarily high value. An alternative calibration is also reported, based on private international asset holding in Korea, implying $\psi_{\tau 1} = 0.1$.[39]

[Insert Table 9 about here]

[37] Some state variables, such as stock of reserves, grow during the simulation period and can deviate substantially from their steady state values of 0; however, the simulation model is rewritten in terms of differences and quasi-differences of these variables to preserve accuracy of the linear approximation. See Appendix A for more details.
[38] Optimization was conducted by grid search, with results averaged over 100 iterations.
[39] Using balance of payments data from Korea, we compute that the private net foreign asset position in debt instruments (in absolute value) as a ratio to government reserves averages 0.11 over the last 10 years of our sample.

5. Simplified Model for Analytical Solution

Before proceeding to simulation analysis, we first characterize by analytical solution the key mechanism linking a policy of "fear of appreciation" and persistence of the current account.

5.1. Model Simplification

To facilitate analytical solution, we work with a simplified version of the model. Regard country 1 as a small open economy, dropping the country index '1', and using a '*' for the foreign "world" counterparts. Take the exogenous foreign price of traded goods and overall price level as constant and normalize the latter: $P^*_{Tt} = \overline{P}^*_T$ and $\overline{P}^*_t = \overline{P}^* = 1$. Take the foreign interest rate (both nominal and real since price level is constant) as constant at the value $\overline{i}^*_t = \overline{i}^* = (1-\beta)/\beta$. In this context, home government holdings of reserves, R_t, are in units of world currency, and the nominal exchange rate, e_t, is home currency per unit of world currency. Assume full capital controls where the household has no access to the global financial market. For simplicity, assume perfect foresight. Finally assume preferences over traded and nontraded goods that are Cobb-Douglas with parameter θ, so that the intratemporal preference equation (10) and price index (12) are replaced by $C_{Tt} = \left(\theta/(1-\theta)\right) P_{Nt} C_{Nt} / P_{Tt}$ and $P_t = \theta^{-\theta}(1-\theta)^{\theta-1} P^{\theta}_{T,t} P^{1-\theta}_{N,t}$, respectively, and the arbitrage condition (17) becomes: $P_{T,t} = e_t \overline{P}^*_T$.

Under a fully closed private capital market, the balance of payments condition (19) determines the current account as the new purchases of reserves. This solution may be simplified using (10), (12), (15) and (17) (see Appendix B for details):

$$R_t - R_{t-1} = \overline{P}^*_T Y_{Tt} - \theta^{\frac{1}{1-\theta}} e_t^{\frac{-1}{1-\theta}} \overline{P}^{*\frac{-\theta}{1-\theta}}_T \overline{P}^{\frac{1}{1-\theta}} Y_{Nt} + \overline{i}^* R_{t-1} = CA_t , \tag{21}$$

which specifies the current account as a function of the current exchange rate, along with exogenous and predetermined variables.

5.2. Equilibrium Exchange Rate

Condition (21) may be solved for the exchange rate (see Appendix B):

$$e_t = \frac{\theta \overline{P} Y_{Nt}^{1-\theta}}{\overline{P}^{*\theta}_T \left(\overline{P}^*_T Y_{Tt} - \left(R_t - \left(1+\overline{i}^*\right) R_{t-1}\right)\right)^{1-\theta}} . \tag{22}$$

We can use this result to compute the "no intervention (*NI*)" exchange rate in equilibrium in the absence of foreign exchange intervention $R_s = 0 \ \forall s$:

$$e_t^{NI} = \theta \left(\frac{\overline{P}}{\overline{P}_T^*} \right) \left(\frac{Y_{Nt}}{Y_{Tt}} \right)^{1-\theta}.$$

It can further be used to compute the steady-state equilibrium exchange rate in the absence of any shocks to endowments ($Y_{Tt} = \overline{Y}_T$, $Y_{Nt} = \overline{Y}_N$) or foreign exchange intervention:

$$\bar{e} = \theta \left(\frac{\overline{P}}{\overline{P}_T^*} \right) \left(\frac{\overline{Y}_N}{\overline{Y}_T} \right)^{1-\theta}. \tag{23}$$

We take this steady state value of the exchange rate as the reference point by which the government sets its exchange rate target, and determines if its current exchange rate in the absence of intervention is overvalued ($e_t^{NI} < \bar{e}$). Note that either a shock raising the endowment of traded goods or one lowering the endowment of nontraded goods will induce an exchange rate appreciation. This is because a rise in consumption of traded goods relative to nontraded will imply a rise in the relative price of nontraded goods and hence the home price index.

Note also from (22) that even in the absence of shocks to goods endowments, a positive value of reserves holdings accumulated as a result of intervention in past periods exerts pressure for exchange rate appreciation. Differentiating (22):

$$\frac{\partial e_t}{\partial R_{t-1}} = -\frac{\left(1+\bar{i}^*\right)(1-\theta)\dfrac{\theta \overline{P} Y_{Nt}^{1-\theta}}{\overline{P}_T^{*\theta}}}{\left(\overline{P}_T^* Y_{Tt} - \left(R_t - \left(1+\bar{i}^*\right) R_{t-1}\right)\right)^{2-\theta}} < 0 \cdot$$

This arises since repatriation of interest earnings on reserve holdings to households raises traded goods consumption, which raises the price of nontraded goods.

5.3. Dynamics of Reserves Accumulation and Current Account

Condition (21) is also useful for specifying the quantity of reserves accumulation needed to prevent exchange rate appreciation. Recall the specification of foreign exchange intervention policy from (14): if the equilibrium exchange rate without intervention is equal to or above $\bar{e}$ (depreciation), then reserves are held constant; if the equilibrium exchange rate without intervention is above $\bar{e}$ (appreciation), then sufficient reserves will be accumulated that there is no appreciation ($e_t = \bar{e}$). Use (21), where we specify $e_t = \bar{e}$ as defined in (23), to solve for the implied change in reserves (see Appendix B for derivation):

$$R_t - R_{t-1} = \overline{P}_T^* Y_{Tt} - \left(\frac{\overline{P}_T^* \overline{Y}_T}{\overline{Y}_N} \right) Y_{Nt} + \overline{i}^* R_{t-1} = CA_t . \qquad (23')$$

Let us focus on shocks to endowment of traded goods, where nontraded endowment is taken to be constant. The condition above simplifies to:

$$R_t - R_{t-1} = \overline{P}_T^* \left(Y_{Tt} - \overline{Y}_T \right) + \overline{i}^* R_{t-1} = CA_t . \qquad (24)$$

This makes clear that net reserves must be accumulated to offset pressure for exchange rate appreciation, arising either from a rise in the endowment of traded goods, or from interest earnings on reserve holdings arising from past foreign exchange intervention. The implications for current account dynamics will be analyzed in the section below.

5.4. Impulse Response to Single Shock

Begin with tracing the impulse response to a single shock to traded goods endowment lasting just one period. In particular, suppose path for traded endowment: $Y_{Ts} = (1+\varepsilon)\overline{Y}_T$ for $s = 1$, and $Y_{Ts} = \overline{Y}_T$ for $s > 1$. With zero initial reserves ($R_0 = 0$), $Y_{T1} > \overline{Y}_T$ is enough to ensure that the home currency would appreciate in the absence of foreign exchange intervention ($e_1^{NI} < \overline{e}$) in the initial period, and thus trigger foreign exchange market intervention.

Condition (24) indicates that in the initial period, reserve accumulation is needed to counteract the direct effect of a rise in traded goods endowment on the exchange rate (assuming $R_0 = 0$): $R_1 = \overline{P}_T^* \left(Y_{T1} - \overline{Y}_T \right)$. Continued reserve accumulation is required in period 2, even though traded output has returned to its steady state level, to counteract the effect of the positive stock of reserves on the current exchange rate. Otherwise, interest from accumulated reserves would raise C_T if rebated back to households, which would cause P_N to rise and $e_t < \overline{e}$. Condition (24) shows that to maintain $e_t = \overline{e}$, the country will need to retain the foreign currency earning from interest as additional reserves. Using Condition (24), with $Y_{T2} = \overline{Y}_T : R_2 = \left(1+\overline{i}^*\right) R_1 = \left(1+\overline{i}^*\right) \overline{P}_T^* \left(Y_{T1} - \overline{Y}_T \right)$. This principle carries over to period 3 and all future periods, so to maintain $e_t = \overline{e}$ will require in all future periods $s > 1$: $R_s = \left(1+\overline{i}^*\right) R_{s-1} = \left(1+\overline{i}^*\right)^{s-1} \overline{P}_T^* \left(Y_{T1} - \overline{Y}_T \right)$. This indicates that reserves grow at the rate of the world interest rate.

It is a simple matter to trace the implied path of the current account, given that it equals reserve accumulation under the assumption of full capital controls. In period 1 $CA_1 = -KA_1 = R_1 - R_0 = \overline{P_T^*}\left(Y_{T1} - \overline{Y_T}\right)$; in period 2 $CA_2 = R_2 - R_1 = \left(1+\overline{i}^*\right)\overline{P_T^*}\left(Y_{T1} - \overline{Y_T}\right) - \overline{P_T^*}\left(Y_{T1} - \overline{Y_T}\right) = \left(\overline{i}^*\right)\overline{P_T^*}\left(Y_{T1} - \overline{Y_T}\right)$; thereafter $CA_s = R_s - R_{s-1} = \left(\left(1+\overline{i}^*\right)^{s-1} - \left(1+\overline{i}^*\right)^{s-2}\right)\overline{P_T^*}\left(Y_{T1} - \overline{Y_T}\right)$. The behavior of the current account depends on the term: $\left(1+\overline{i}^*\right)^{t} - \left(1+\overline{i}^*\right)^{t-1}$ for an infinite sequence of periods *s*: $\left(1+\overline{i}^*\right)^{s} - \left(1+\overline{i}^*\right)^{s-1} = \left(1+\overline{i}^*\right)^{s-1}\left(\overline{i}^*\right)$. This term is explosive at the rate of world interest rate.[40]

This analysis indicates that reserves policy aimed at preventing any exchange rate appreciation in periods following a single traded goods endowment shock will imply a current account that remains in surplus in all future periods, and, in fact, grows over the periods that the exchange rate policy remains in effect. Once the policy ends, and the country refrains from foreign exchange intervention, where $R_s = R_{s-1}$, then by definition the current account returns to zero thereafter.

5.5. Sequence of random shocks

We here characterize aspects of the dynamics of reserves holdings and current account for a general sequence of mean-zero fluctuations in Y_{Ts}. For simplicity, suppose Y_{Ts} is subject to i.i.d. shocks: $Y_{Ts} = (1+\varepsilon)\overline{Y_T}$, $\varepsilon \sim N\left(0,\sigma^2\right)$.[41] Using the result of the equilibrium exchange rate from (22) and (24) above, the reserves policy may be specified for a draw of traded endowments, Y_{Tt}:

$$R_t - R_{t-1} = \begin{cases} \overline{P_T^*}\left(Y_{Tt} - \overline{Y_T}\right) + \overline{i}^* R_{t-1} & if\ \overline{P_T^*}\left(Y_{Tt} - \overline{Y_T}\right) + \overline{i}^* R_{t-1} > 0 \\ 0 & if\ \overline{P_T^*}\left(Y_{Tt} - \overline{Y_T}\right) + \overline{i}^* R_{t-1} \leq 0 \end{cases}. \tag{25}$$

Solving for the full dynamics of reserves and current account in a stochastic environment is beyond the scope of this analytical solution, and characterizing these dynamics will be left to simulations in the next section. Nonetheless, we can draw two key conclusions from the dynamics implied by the rule (25) above.

The first conclusion is that reserves are always growing and the current account is always non-negative. This is implied by policy in the state where foreign exchange intervention is active (when the

[40] This mechanism is similar to that described in Alberola *et al.* (2020), except that in our model the result is driven by exchange rate policy, which the accounting exercise and empirical investigation does not study.
[41] We maintain the assumption of perfect foresight in the simplified model, which has no bearing on the equilibrium here since the household has no intertemporal decision under full capital controls.

condition is met that $\vec{P}_T^* \left(Y_{Tt} - \overline{Y_T} \right) + \vec{i}^* R_{t-1} > 0$), and since in the alternative state there is no change in reserves and current account is zero.

The second conclusion is that the probability the constraint is binding, and triggers active foreign exchange intervention, rises over time. This conclusion follows from the first: if the reserves are never falling but only rising over time, the condition for active intervention is $\vec{P}_T^* \left(Y_{Tt} - \overline{Y_T} \right) + \vec{i}^* R_{t-1} > 0$, is more likely to hold due to the rise in the last term. The accumulation of past reserves implies higher interest rate income, which puts upward pressure on the current account and adds pressure for real exchange rate appreciation. So even for some degree of falling traded endowment, the combined surplus in international income may be positive due to interest income, and trigger intervention to prevent exchange rate appreciation.

The overall conclusion is that over time a policy of foreign exchange intervention embodying fear of appreciation will imply current accounts that tend to be persistently positive.

6. Simulation of full model

Model simulations are conducted to demonstrate how the logic from the previous section for persistent current account surpluses implied by fear of appreciation plays out in a general equilibrium with multiple countries. A standard two-country environment necessarily implies that a persistent current account surplus in one country would be mirrored by an equally persistent current account deficit in the other, so that surpluses would not exhibit greater persistence. A three-country framework can break this symmetry. The main intuition is that while the current account of country 1 is dominated by the persistent surpluses implied by its one-directional reserves accumulation, the offsetting deficit in the other countries is masked by the volatile and shorter-lived private asset flows among each other in response to normal business cycle fluctuations.

6.1. Impulse responses

Figure 3 presents impulse responses to shocks (both positive and negative) to traded goods endowment in country 2 by 1%. The first column presents the case where country 1 follows a fear-of-appreciation rule that responds to the current period exchange rate (equation (14) with *n*=1).

[Insert Figure 3 about here]

Consider first the case of a positive shock, raising traded goods endowment in country 2, shown in the figure with dashed (black) lines. It induces a current account surplus in country 2 and deficit in country 3, as agents in country 2 save to smooth consumption intertemporally. As consumption of traded goods in countries 2 and 3 rise jointly to absorb the higher supply, the intratemporal optimality conditions ((10) and (11)) imply a rise in relative price of nontraded goods in these two countries. This implies a real exchange rate depreciation in country 1 relative to the other two countries, since its capital controls rule out borrowing to absorb extra traded goods; this real depreciation is passed on to a nominal exchange rate depreciation, given monetary policies stabilizing aggregate price levels. Finally, there is no movement in current account of country 1, since capital controls prevent private borrowing, and the fear of appreciation rule calls for no official reserves transactions in the cases of a currency depreciation.

The opposite case of a fall in traded goods endowment in country 2 is quite different, depicted by solid (red) lines. Now, the pressure for currency appreciation in country 1 activates the fear-of-appreciation rule and mandates reserve accumulation; this implies a capital account deficit, and hence current account surplus. This current account surplus tends to be persistent for the reasons discussed in the analytical section above: as the accumulation of reserves generates ever higher interest earnings, this tends to push up future values of the current account.[42] If one considers the six impulse responses for current accounts in the first column of the figure (the two cases for each of the three countries), the distinctly greater persistence of surplus in country 1 would suggest that current account surpluses are more persistent than deficits on average, conditional on this type of shock.

The other columns of Figure 3 demonstrate that current account dynamics in country 1 can be even more persistent for other specifications of the reserves policy rule. The second column (Moving average rule) shows the benchmark case, where the policy rule targets a five-year moving average of the exchange rate rather than just the current value ($n = 5$ in equation (14)). This rule dampens the initial degree of reserve accumulation and hence the current account surplus in the initial period, but allows the reserve accumulation and current account to grow larger over the subsequent 4 periods. Once the five-year period ends, there is more rapid adjustment in the current account since reserve accumulation falls.

The third column (Autoregressive rule) smooths out this adjustment by adopting a reserve accumulation rule in which the change in reserves is a positive function of the lagged change:

$$\begin{array}{ll} R_{1t} - R_{1t-1} = \rho_R \left(R_{1t-1} - R_{1t-2} \right) + \left(1 - \rho_R \right) \xi \left(\bar{e}_1 - e_{1t} \right) & \text{if } e_{1t} < \bar{e}_1 \\ R_{1t} - R_{1t-1} = 0 & \text{otherwise.} \end{array} \tag{14'}$$

[42] The persistent current account surplus in country 1 implies corresponding current account deficits in the other two countries at the end of the sample period. But the magnitude of this longer-run current account imbalance appears small in the figure for country 2, compared to the much larger impact of the shock on the country's current account in the initial periods. And the impact on the current account for country 3 is small, since country 3 (rest of world) is large.

When calibrated with to $\rho_R = 0.95$, reserve accumulation is initially small and then rises gradually; this implies a current account surplus that rises for several periods before smoothly declining. All these cases imply current account surpluses that are more persistent on average than deficits.[43]

6.2. Stochastic simulation results

Table 10 reports results from stochastic simulations. The model is run for 44 periods, reflecting the time-dimension of our empirical sample, after a 100-period burn-in. The simulated data are then used to estimate the empirical regression of equation (1), producing regression coefficients on lagged current account, φ_1, and the coefficient on the interaction term for a positive current account, φ_2. This process is replicated 300 times, and the averages of the regression coefficients are reported in Table 10. Of primary interest is whether the estimate of φ_2 is positive, which indicates greater persistence for current account surpluses compared to deficits. Given the simplified nature of the model and parameterization, simulations are best regarded as an illustrative numerical experiment of the mechanism rather than a formal calibration exercise.[44]

The benchmark calibration of the model generates simulation results reported in Row (1), with the estimate of $\varphi_2 = 0.26$. This value does not fully replicate the empirical estimate of φ_2 for the full sample reported in panel A of Table 1 (0.52), but it does compare well with estimates in that table for the subsample of industrial countries (0.24) and also the subsample of non-industrial countries that excludes oil exporters (0.26). In any case, the estimate from the simulated data implies a substantial degree of asymmetry in the persistence of current account surpluses compared to deficits; together with the estimate of $\varphi_1 = 0.72$, the estimate of $\varphi_2 = 0.26$ implies the half-life of surpluses that is more than ten times that of deficits.[45]

[Insert Table 10 about here]

Stochastic simulations also provide an estimate for ergodic means of variables, computed as the average over simulation replications. The resulting mean of current account in country 1 is 2.27% as a share of its GDP, and those for countries 2 and 3 are -0.46% and -0.45%, respectively; this implies an asymmetry where country 1, on average, has current account surpluses while the other countries on

[43] The appendix shows corresponding figures for shocks to the traded goods endowments of countries 3 and 1. Shocks for country 3 produce current account dynamics very similar to those in figure 3. Shocks to country 1 differ, in that the current account deficits in countries 2 and 3 fully mirror the surplus of country 1, thus implying no asymmetry between deficits and surpluses on average.

[44] Appendix Table 28 provides a comparison of standard moments from the model to those for data from Korea, as a representative candidate country for fear of appreciation.

[45] Computed as ln(0.5)/ln(0.7156+0.2555) = 23.63 versus ln(0.5)/ln(0.7156) = 2.071.

average have deficits.[46] Since the current account of country 1 accounts for a larger share of observations of surpluses in the full sample of all three countries, the fact that its current account tends to be persistent contributes to the positive coefficient on the surplus indicator variable in the regression.

The next two rows of Table 10 confirm that the higher persistence of surpluses arises from the foreign exchange intervention policy. Row (2) eliminates intervention by setting to zero the parameter, ξ , governing the reserves policy response to exchange rate deviations. Eliminating this policy response eliminates the main result of greater persistence of current account surpluses (φ_2 becomes near zero). The persistence of surpluses also evaporates if we fully eliminate capital controls in country 1 (set $\psi_x = 0$), as seen in Row (3). As usual, private capital inflows cancel out the effects of official capital outflows engineered by reserve accumulation.

Nonetheless, only modest frictions in the international capital market are needed to support our result. If we calibrate the capital control parameter to match the level of private international trade in debt assets in Korean data, it requires a modest parameter value of ψ_x =0.1, as explained in the calibration section. Row (4) of the table reports results, showing that the regression coefficient estimates are only modestly affected, with the estimate of φ_2 of 0.20.

Row (5) shows that if the reserves policy rule follows the autoregressive specification in (14') rather than the moving average specification in (14) used in the benchmark specification, it implies similar regression output, with φ_2 = 0.23. Both specifications confer persistent dynamics to the reserve accumulation, which drives country 1's current account. Results are diminished if the policy rule is assumed to respond only to the current value of the exchange rate with no lags (φ_2 = 0.15 in Row 6).

While the benchmark model simulation includes shocks only to the traded sector, Row (7) shows that the numerical result is little changed when shocks are included also to the nontraded sector of each country.[47] Row (8) shows that reducing the persistence of shocks to the traded sector (from the benchmark value of 0.84 to 0.60.) substantially improves the result. This specification nearly doubles the coefficient on the interaction term with CA surplus dummy, to a value of φ_2 = 0.53, which is fully able to match the empirical value observed for the full sample of countries in Table 1. As is well

[46] The positive and persistent current account of country 1 in the model compares well to means and serial correlations of current account data among several Emerging Asian countries sometimes associated with fear of appreciation. For Korea, the mean current account ratio to GDP is 2.3% in the post 2000 sample period, with a serial correlation of 0.50; for Malaysia the mean and serial correlation are 10.6% and 0.72; for China 4.1% and 0.82; Indonesia 1.1% and 0.81.
[47] The table does not include a case with shocks only to country 1, since the current accounts of the other two countries in this case are collinear with each other, precluding regression analysis. Likewise, while we can simulate a case with only two countries (by specifying the size of country 3 goes to zero), the current accounts of countries 1 and 2 are inverses of each other, as implied by our discussion at the beginning of this section, and hence produce collinear data.

understood in intertemporal theory of the current account, private agents with access to the global financial market will borrow more to smooth over fluctuations in output that are more transitory, implying greater volatility of current account fluctuations. So shocks that are less persistent further contribute to the lower persistence of current accounts in countries 2 and 3, where the current account is driven by intertemporal smoothing of private agents. This contributes to reducing the coefficient of lagged CA. However, capital controls insulate the current account of country 1 from such private behavior, so its current account dynamics continue to reflect official reserve accumulation dynamics. Thus, its interaction term coefficient remains large.[48]

Appendix C studies a New Keynesian version of the model, featuring sticky prices and a Taylor-rule monetary policy that includes exchange rate stabilization in the case of appreciations, rather than a policy of capital controls and reserve accumulation as in the benchmark model (See Appendix C for a full description of changes in model specification.) The main finding from the experiments described in Appendix C is that we did not find a scenario in the New Keynesian model that can generate substantially greater persistence for current account surpluses. There are two obstacles to satisfactory results with this model. First, as is well known in the open economy New Keynesian literature, it is difficult for such models to generate persistent effects on real variables like the real exchange beyond the horizon of price stickiness. We find that this limitation applies also to generating current account persistence, since it depends in this model upon price stickiness significantly prolonging the adjustment in relative prices.

A second obstacle is that the standard New Keynesian model has difficulty generating asymmetry in persistence in the current accounts across countries. In the absence of capital controls, a globally integrated financial market implies that a persistent current account surplus in one country is associated with persistent and offsetting current account deficits in the other two countries. As shown in the experiments above, substantial capital market segmentation is essential to our numerical result. However, once capital controls are introduced, monetary policy can be severed from exchange rate policy, obviating the need for price stickiness, and allowing countries to control their nominal exchange rate and price level independently, and hence in effect to control their real exchange rate. The introduction of capital controls essentially transforms the New Keynesian model back into our

[48] We find that if we model a “fear of depreciation” instead of appreciation by inverting the occasionally binding constraint to cover depreciations, it reverses the regression result. The estimate of φ_2 becomes negative, -0.253.

benchmark model, with reserve accumulation policy shaping current account dynamics.[49]

Although our main mechanism does not depend upon price stickiness, we nonetheless point out that our analysis is relevant to, and even sheds a new focus on, the broader argument in Friedman (1953). In Friedman's articulation of his argument on pages 160-161, he lists four mechanisms by which a balance of payments surplus can be reconciled. First on this list is exchange rate appreciation, and second is a rise in prices in the country. This pair forms the dichotomy often highlighted in subsequent summaries, where the first option is viewed as quicker as and less painful than the second. However, Friedman's list continues with two other potential mechanisms: (3) "direct controls over transactions involving foreign exchange" and (4) "the monetary authorities (or exchange equalization fund or the like) may step in with a "desire" to buy or sell the difference between the amounts demanded and supplied by others…the foreign currency acquired being added to reserves of foreign currencies." He is here describing reserve accumulation and capital controls, which comprise the main mechanism determining current account adjustment in our model. In fact, Friedman specifically addressed a case similar to ours, in which the authorities "accumulate foreign exchange indefinitely" in forms that do not affect domestic price levels (see pages 170-172); he viewed this scenario as less relevant, since he argued that citizens would not let the government "exchange indefinitely part of its product for unproductive currency hoards." We argue that historical experience over recent decades has proved that some governments have the power to pursue such policies, and that this scenario may have been a larger contributor to global external imbalances than Friedman envisioned. In any case, we view our analysis and results as fully consistent with Friedman's broader argument, namely, that policies preventing exchange rate flexibility can prolong balance of payments adjustment.

7. Conclusion

This study provides empirical results and theoretical insights into the implications of "fear of appreciation" for adjustment in international financial imbalances. Empirically, we provide evidence that, for countries with ostensibly flexible exchange rates, current account surpluses are more persistent on average than deficits. Our evidence indicates that this asymmetric current account adjustment is associated with an asymmetric exchange rate response indicative of a fear of appreciation. We provide a theoretical model showing how an exchange rate policy embodying fear of appreciation can explain these empirical findings.

[49] Appendix C demonstrates that our benchmark model's ability to generate persistent current account surpluses is compatible with introducing price stickiness in the currency of the producer into the model, but we emphasize that price stickiness does not play a central role in the mechanism.

Our findings provide a novel perspective on Friedman's conjecture that exchange rate flexibility should facilitate international financial adjustment. Our results indicate that countries with a floating exchange rate regime exhibit faster convergence of current account deficits toward balance than countries with a pegged regime, but only once one conditions on the sign of the current account imbalance. Our results also find novel support for the Friedman conjecture by noting that, for a given country exhibiting fear of appreciation, current account adjustment is faster in cases where this country acts more like a floater, and adjustment is slower in cases where it acts more like a pegger.

8. References

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Table 1. CA persistence and asymmetry between floating and fixed regimes (two-way classification)

Panel A. Shambaugh classification, 158 countries, 1971~2014

Sample, Exchange rate Regime	(1) All, Floating & Intermediate	(2) All, Peg	(3) Industrial Countries, Floating & Intermediate	(4) Industrial Countries, Peg	(5) Non-ind Countries, Floating & Intermediate	(6) Non-ind Countries, Peg	(7) Non-ind Countries excl. SSA & CSP, Floating & Intermediate	(8) Non-ind Countries excl. SSA & CSP, Peg	(9) Non-ind excl. SSA & CSP & Oil exporter, Floating & Intermediate	(10) Non-ind excl. SSA & CSP & Oil exporter, Peg
CA(-1)	0.4183**	0.7664***	0.7659***	0.9558***	0.3905*	0.7468***	0.1752	0.7952***	0.6921***	0.8056***
	(0.200)	(0.032)	(0.031)	(0.024)	(0.199)	(0.033)	(0.134)	(0.045)	(0.042)	(0.039)
CA(-1) × CA Pos	0.5225*	0.0284	0.2403***	0.0158	0.5420*	0.0498	0.8363***	0.0114	0.2554***	0.0100
	(0.270)	(0.048)	(0.061)	(0.046)	(0.277)	(0.049)	(0.139)	(0.057)	(0.070)	(0.093)
Constant	-0.0084	-0.0120**	0.0053*	-0.0159***	-0.0440***	-0.0121	-0.0559***	-0.0026	-0.0273***	-0.0107***
	(0.009)	(0.006)	(0.003)	(0.000)	(0.011)	(0.008)	(0.008)	(0.007)	(0.003)	(0.003)
H0: CA(-1) in Floating = CA(-1) in Peg	3.02* (0.0824)		29.97*** (0.0000)		3.23* (0.0722)		18.98*** (0.0000)		3.52* (0.0607)	
H0: CA(-1) + CA(-1)× CA Pos in Floating ≥ CA(-1) + CA(-1) × CA Pos in Peg	(0.936)		(0.809)		(0.907)		(0.999)		(0.983)	
Observations	2,661	2,232	500	256	2,161	1,976	1,356	809	1,268	641
R-squared	0.524	0.526	0.809	0.928	0.508	0.514	0.626	0.469	0.676	0.723

Panel B. Ilzetzki, Reinhart and Rogoff's (IRR 2019) classification, 160 countries, 1971~2014

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
CA(-1)	0.4456**	0.7401***	0.7753***	0.9602***	0.4181**	0.7162***	0.2090	0.7574***	0.7541***	0.7672***
	(0.195)	(0.039)	(0.030)	(0.024)	(0.194)	(0.040)	(0.154)	(0.046)	(0.027)	(0.043)
CA(-1) × CA Pos	0.4535**	0.1187*	0.2311***	0.0005	0.4770**	0.1476**	0.6832***	0.1749**	0.1382**	0.1882**
	(0.193)	(0.066)	(0.061)	(0.049)	(0.199)	(0.069)	(0.127)	(0.073)	(0.065)	(0.070)
Constant	-0.0275**	0.0012	-0.0047	0.0055	-0.0449***	-0.0087	-0.0562***	-0.0071	-0.0213***	-0.0195***
	(0.012)	(0.005)	(0.009)	(0.004)	(0.013)	(0.010)	(0.011)	(0.010)	(0.005)	(0.003)
H0: CA(-1) in Floating = CA(-1) in Peg	2.35 (0.1254)		31.15*** (0.000)		2.42 (0.1199)		12.66*** (0.0004)		0.08 (0.7793)	
H0: CA(-1) + CA(-1)× CA Pos in Floating ≥ CA(-1) + CA(-1) × CA Pos in Peg	(0.740)		(0.890)		(0.689)		(0.309)		(0.167)	
Observations	2,657	1,959	499	250	2,158	1,709	1,369	672	1,270	532
R-squared	0.409	0.659	0.813	0.924	0.392	0.646	0.337	0.773	0.691	0.722

Note: Clustered robust standard errors at country-level in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Year-fixed effects are included but not reported. Pos CA indicate CA>0 dummy at t-1. Statistical tests are presented to compare coefficients across two different exchange rate regimes (Non-peg vs. Peg), and p-values are in parentheses.

Table 2. CA persistence and asymmetry with more controls

Panel A. Shambaugh classification, 155 countries, 1971~2014

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Sample, Exchange rate regime	All, Floating & Intermediate	All, Peg	Industrial Countries, Floating & Intermediate	Industrial Countries, Peg	Non-ind Countries, Floating & Intermediate	Non-ind Countries, Peg	Non-ind Countries excl. SSA & CSP, Floating & Intermediate	Non-ind Countries excl. SSA & CSP, Peg	Non-ind excl. SSA & CSP & Oil exporter, Floating & Intermediate	Non-ind excl. SSA & CSP & Oil exporter, Peg
CA(-1)	0.6406***	0.7695***	0.6494***	1.0603***	0.6341***	0.7534***	0.4504***	0.8281***	0.6542***	0.7654***
	(0.086)	(0.080)	(0.131)	(0.198)	(0.095)	(0.078)	(0.095)	(0.168)	(0.038)	(0.103)
CA(-1) × Pos CA	0.5280**	0.0585	0.0191	0.1128*	0.4978**	0.0980*	0.6893***	0.0345	0.2387***	-0.0165
	(0.210)	(0.052)	(0.099)	(0.054)	(0.235)	(0.059)	(0.159)	(0.084)	(0.084)	(0.096)
CA(-1) × trade openness	0.0773*	-0.0118	-0.1023	-0.1408**	0.1104***	0.0044	0.0873***	-0.0010	-0.0126	0.0390
	(0.041)	(0.049)	(0.154)	(0.059)	(0.036)	(0.050)	(0.025)	(0.057)	(0.032)	(0.031)
CA(-1) × financial	-0.4494***	-0.0037	0.3484***	-0.0420	-0.5152***	-0.0529	-0.4258***	-0.0572	0.1405*	-0.0196
Openness	(0.160)	(0.082)	(0.097)	(0.211)	(0.122)	(0.089)	(0.070)	(0.136)	(0.079)	(0.118)
trade openness	-0.0017	-0.0062	0.0132**	0.0041	0.0015	-0.0063	0.0007	-0.0027	0.0011	0.0045**
	(0.006)	(0.005)	(0.006)	(0.003)	(0.006)	(0.005)	(0.005)	(0.004)	(0.003)	(0.002)
financial openness	0.0002	0.0101*	0.0133***	-0.0031	-0.0143**	0.0059	-0.0080	-0.0011	0.0027	-0.0035
	(0.006)	(0.005)	(0.004)	(0.009)	(0.007)	(0.006)	(0.009)	(0.008)	(0.003)	(0.005)
Constant	-0.0050	-0.0151**	-0.0065	-0.0150	-0.0305***	-0.0121	-0.0408***	-0.0003	-0.0295***	-0.0141**
	(0.007)	(0.008)	(0.005)	(0.009)	(0.005)	(0.009)	(0.005)	(0.010)	(0.002)	(0.007)
Observations	2,499	2,015	481	236	2,018	1,779	1,300	783	1,215	625
R-squared	0.604	0.513	0.819	0.934	0.600	0.501	0.666	0.463	0.686	0.718

Panel B. IRR classification, 157 countries, 1971~2014

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Sample, Exchange rate Regime	All, Floating & Intermediate	All, Peg	Industrial Countries, Floating & Intermediate	Industrial Countries, Peg	Non-ind Countries, Floating & Intermediate	Non-ind Countries, Peg	Non-ind Countries excl. SSA & CSP, Floating & Intermediate	Non-ind Countries excl. SSA & CSP, Peg	Non-ind excl. SSA & CSP & Oil exporter, Floating & Intermediate	Non-ind excl. SSA & CSP & Oil exporter, Peg
CA(-1)	0.6369***	0.7440***	0.6576***	0.7603***	0.6282***	0.7291***	0.4418***	0.7720***	0.6748***	0.7924***
	(0.054)	(0.066)	(0.115)	(0.175)	(0.059)	(0.068)	(0.084)	(0.086)	(0.042)	(0.077)
CA(-1) × Pos CA	0.4612**	0.1680***	0.0167	0.0805	0.4497**	0.2009***	0.5736***	0.2115**	0.1047*	0.1723**
	(0.185)	(0.063)	(0.110)	(0.055)	(0.206)	(0.067)	(0.161)	(0.082)	(0.055)	(0.085)
CA(-1) × trade openness	0.1084***	-0.0277	-0.0708	-0.1420***	0.1311***	-0.0108	0.1403***	0.0419	0.0228	-0.0147
	(0.032)	(0.059)	(0.133)	(0.048)	(0.025)	(0.063)	(0.033)	(0.042)	(0.020)	(0.049)
CA(-1) × financial	-0.4726***	0.0305	0.3239***	0.2717	-0.5259***	-0.0141	-0.4552***	-0.1057	0.1074	-0.0183
Openness	(0.173)	(0.091)	(0.096)	(0.192)	(0.134)	(0.099)	(0.086)	(0.071)	(0.070)	(0.091)
trade openness	-0.0053	-0.0029	0.0124**	0.0041	-0.0016	-0.0028	-0.0027	0.0011	0.0019	0.0047
	(0.007)	(0.003)	(0.006)	(0.003)	(0.007)	(0.003)	(0.007)	(0.003)	(0.003)	(0.003)
financial openness	-0.0025	0.0146***	0.0115***	0.0064	-0.0166**	0.0109*	-0.0130*	-0.0016	0.0024	-0.0040
	(0.006)	(0.005)	(0.004)	(0.005)	(0.007)	(0.005)	(0.008)	(0.005)	(0.003)	(0.005)
Constant	-0.0186**	-0.0058	-0.0207**	0.0007	-0.0316***	-0.0121	-0.0415***	-0.0065	-0.0249***	-0.0199***
	(0.009)	(0.005)	(0.008)	(0.004)	(0.004)	(0.009)	(0.005)	(0.009)	(0.005)	(0.004)
Observations	2,529	1,764	475	235	2,054	1,529	1,345	644	1,248	513
R-squared	0.444	0.682	0.821	0.929	0.434	0.670	0.363	0.788	0.696	0.717

Note: Clustered robust standard errors at country-level in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Year fixed effects are included but not reported. Pos CA indicate CA>0 dummy at t-1.
Source: Shambaugh (2004), Klein and Shambaugh (2008), Ilzetzki, Reinhart, and Rogoff (2019)

Table 3. Robustness: Excluding currency crises, 130 countries, 1971~2014

Sample, Exchange rate regime	(1) All, Floating & Intermediate	(2) All, Peg	(3) Industrial Countries, Floating & Intermediate	(4) Industrial Countries, Peg	(5) Non-ind Countries, Floating & Intermediate	(6) Non-ind Countries, Peg	(7) Non-ind Countries excl. SSA & CSP, Floating & Intermediate	(8) Non-ind Countries excl. SSA & CSP, Peg	(9) Non-ind excl. SSA & CSP & Oil exporter, Floating & Intermediate	(10) Non-ind excl. SSA & CSP & Oil exporter, Peg
CA(-1)	0.7830***	0.8198***	0.6553***	1.1022***	0.7411***	0.8058***	0.5420***	1.0298***	0.6320***	0.8805***
	(0.114)	(0.140)	(0.173)	(0.199)	(0.125)	(0.136)	(0.157)	(0.218)	(0.061)	(0.122)
CA(-1) × Pos CA	0.6212***	0.0445	-0.2693	0.1190**	0.5927**	0.1309	0.8021***	-0.0111	0.4149***	-0.0959
	(0.200)	(0.066)	(0.206)	(0.054)	(0.230)	(0.092)	(0.120)	(0.116)	(0.111)	(0.130)
CA(-1) × trade openness	-0.1496	-0.1085	-0.0474	-0.1458**	-0.0816	-0.0982	-0.1476	-0.1052	-0.1134	0.0187
	(0.125)	(0.106)	(0.226)	(0.059)	(0.124)	(0.113)	(0.172)	(0.146)	(0.102)	(0.051)
CA(-1) × financial Openness	-0.4213***	0.0747	0.5185**	-0.0825	-0.4767***	-0.0374	-0.3189***	-0.1593	0.2265**	-0.1195
	(0.142)	(0.100)	(0.198)	(0.212)	(0.116)	(0.102)	(0.084)	(0.163)	(0.100)	(0.134)
trade openness	-0.0207**	-0.0210	0.0151**	0.0042	-0.0167*	-0.0253	-0.0177**	-0.0214	-0.0112*	-0.0031
	(0.008)	(0.013)	(0.007)	(0.003)	(0.009)	(0.016)	(0.007)	(0.021)	(0.006)	(0.007)
financial openness	0.0024	0.0046	0.0116***	-0.0046	-0.0110	-0.0068	-0.0041	-0.0109	0.0065*	-0.0086
	(0.006)	(0.007)	(0.003)	(0.010)	(0.008)	(0.007)	(0.009)	(0.010)	(0.003)	(0.007)
Constant	0.0138	0.0317*	-0.0074	-0.0339***	0.0322***	0.0365**	0.0188*	0.0381	0.0293***	0.0491***
	(0.008)	(0.018)	(0.006)	(0.006)	(0.009)	(0.017)	(0.010)	(0.025)	(0.010)	(0.008)
Observations	1,816	1,441	376	230	1,440	1,211	972	537	914	488
R-squared	0.608	0.456	0.832	0.934	0.599	0.438	0.677	0.436	0.666	0.733

Note: Clustered robust standard errors at country-level in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Year fixed effects are included but not reported. Pos CA indicate CA>0 dummy at t-1.

Source: Shambaugh (2004), Klein and Shambaugh (2008)

Table 4. Three-way interaction

Sample	(1) All	(2) Industrial Countries	(3) Non-ind Countries	(4) Non-ind Countries excl. SSA & CSP	(5) Non-ind Countries excl. SSA & CSP & Oil exporters
CA(-1)	0.7217***	0.9312***	0.7131***	0.7429***	0.7725***
	(0.036)	(0.025)	(0.037)	(0.043)	(0.037)
CA(-1) × Float/Intermed.	-0.3415*	-0.1887***	-0.3557*	-0.6003***	-0.0683
	(0.203)	(0.028)	(0.201)	(0.127)	(0.065)
CA(-1) × Pos CA	0.0303	0.0316	0.0498	0.0326	0.0022
	(0.050)	(0.041)	(0.052)	(0.046)	(0.097)
CA(-1) × Float/Intermed.× Pos CA	0.4113*	0.1844***	0.4102*	0.7326***	0.2546***
	(0.236)	(0.052)	(0.240)	(0.124)	(0.094)
Float/Intermed.	-0.0132	-0.0046*	-0.0161	-0.0215***	0.0030
	(0.011)	(0.002)	(0.012)	(0.006)	(0.003)
Pos CA	0.0133***	0.0019	0.0104**	0.0097*	0.0084
	(0.004)	(0.002)	(0.005)	(0.005)	(0.006)
Float/Intermed. × Pos CA	0.0113	0.0030	0.0158	0.0172	-0.0101
	(0.013)	(0.003)	(0.014)	(0.011)	(0.007)
Constant	-0.0122**	0.0022	-0.0203***	-0.0207**	-0.0243***
	(0.006)	(0.005)	(0.007)	(0.009)	(0.005)
Observations	4,893	756	4,137	2,165	1,909
R-squared	0.523	0.850	0.507	0.490	0.688

Note: Clustered robust standard errors at country-level in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Year fixed effects are included but not reported. Pos CA indicate CA>0 dummy at t-1.
Source: Shambaugh (2004), Klein and Shambaugh (2008)

Table 5. CA persistence and asymmetry for three way classification

Panel A. Shambaugh classification, 158 countries, 1971~2014

Sample, Exchange rate Regime	(1) All, Floating	(2) All, Intermed.	(3) All, Peg	(4) Industrial Countries, Floating	(5) Industrial Countries, Intermed.	(6) Industrial Countries, Peg	(7) Non-ind Countries, Floating	(8) Non-ind Countries, Intermed.	(9) Non-ind Countries, Peg	(10) Non-ind Countries excl. SSA & CSP, Floating	(11) Non-ind Countries excl. SSA & CSP, Intermed.	(12) Non-ind Countries excl. SSA & CSP, Peg	(13) Non-ind excl. SSA & CSP & Oil exporter, Floating	(14) Non-ind excl. SSA & CSP & Oil exporter, Intermed.	(15) Non-ind excl. SSA & CSP & Oil exporter, Peg
CA(-1)	0.781***	0.271	0.766***	0.789***	0.605***	0.956***	0.770***	0.246	0.747***	0.723***	0.106	0.795***	0.710***	0.705***	0.806***
	(0.034)	(0.184)	(0.032)	(0.052)	(0.089)	(0.024)	(0.038)	(0.176)	(0.033)	(0.052)	(0.095)	(0.045)	(0.051)	(0.048)	(0.039)
CA(-1) × CA Pos	-0.229	0.786***	0.028	0.115	0.506***	0.016	-0.269	0.812***	0.050	0.057	0.932***	0.011	0.153	0.267***	0.010
	(0.169)	(0.196)	(0.048)	(0.127)	(0.117)	(0.046)	(0.189)	(0.194)	(0.049)	(0.120)	(0.081)	(0.057)	(0.107)	(0.075)	(0.093)
Constant	-0.002***	-0.013	-0.012**	-0.003***	0.006**	-0.016***	0.029	-0.052***	-0.012	0.008	-0.060***	-0.003	0.009	-0.027***	-0.011***
	(0.000)	(0.012)	(0.006)	(0.000)	(0.002)	(0.000)	(0.019)	(0.010)	(0.008)	(0.009)	(0.007)	(0.007)	(0.006)	(0.003)	(0.003)
H0: CA(-1) is the same across different regimes	(1) vs.(2)	8.07***	(0.0045)	(4) vs.(5)	11.35***	(0.0008)	(7) vs.(8)	9.35***	(0.0022)	(10) vs.(11)	35.20***	(0.0000)	(13) vs.(14)	0.01	(0.9238)
	(2) vs.(3)	7.35***	(0.0067)	(5) vs.(6)	18.59***	(0.0000)	(8) vs.(9)	8.30***	(0.0040)	(11) vs.(12)	44.50***	(0.0000)	(14) vs.(15)	2.64	(0.1041)
	(1) vs.(3)	0.09	(0.7603)	(4) vs.(6)	10.78***	(0.0010)	(7) vs.(9)	0.22	(0.6400)	(10) vs.(12)	0.91	(0.3405)	(13) vs.(15)	1.82	(0.1772)
H0: CA(-1) + CA(-1)× CA Pos in the former ≥ CA(-1) + CA(-1) × CA Pos in the latter	(1) vs.(2)	(0.001)***		(4) vs.(5)	(0.0015)***		(7) vs.(8)	(0.0011)***		(10) vs.(11)	(0.0025)***		(13) vs.(14)	(0.1316)	
	(2) vs.(3)	(0.9999)		(5) vs.(6)	(0.9999)		(8) vs.(9)	(0.9999)		(11) vs.(12)	(0.9999)		(14) vs.(15)	(0.9991)	
	(1) vs.(3)	(0.071)*		(4) vs.(6)	(0.2153)		(7) vs.(9)	(0.0545)*		(10) vs.(12)	(0.3978)		(13) vs.(15)	(0.3476)	
Observations	1,454	1,207	2,232	274	226	256	1,180	981	1,976	690	666	809	643	625	641
R-squared	0.543	0.594	0.526	0.768	0.888	0.928	0.524	0.590	0.514	0.610	0.698	0.469	0.633	0.727	0.723

Panel B. IRR classification, 160 countries, 1971~2014

Sample, Exchange rate Regime	(1) All, Floating	(2) All, Intermed.	(3) All, Peg	(4) Industrial Countries, Floating	(5) Industrial Countries, Intermed.	(6) Industrial Countries, Peg	(7) Non-ind Countries, Floating	(8) Non-ind Countries, Intermed.	(9) Non-ind Countries, Peg	(10) Non-ind Countries excl. SSA & CSP, Floating	(11) Non-ind Countries excl. SSA & CSP, Intermed.	(12) Non-ind Countries excl. SSA & CSP, Peg	(13) Non-ind excl. SSA & CSP & Oil exporter, Floating	(14) Non-ind excl. SSA & CSP & Oil exporter, Intermed.	(15) Non-ind excl. SSA & CSP & Oil exporter, Peg
CA(-1)	0.937***	0.438**	0.740***	0.865***	0.769***	0.960***	0.987***	0.416**	0.716***	0.618**	0.209	0.757***	0.618**	0.759***	0.767***
	(0.113)	(0.195)	(0.039)	(0.081)	(0.026)	(0.024)	(0.187)	(0.194)	(0.040)	(0.147)	(0.154)	(0.046)	(0.147)	(0.027)	(0.043)
CA(-1) × CA Pos	-0.623	0.470**	0.119*	0.143	0.221***	0.000	-0.163	0.484**	0.148**	1.463	0.683***	0.175**	1.463	0.133**	0.188**
	(0.502)	(0.190)	(0.066)	(0.236)	(0.060)	(0.049)	(0.324)	(0.195)	(0.069)	(0.869)	(0.128)	(0.073)	(0.869)	(0.065)	(0.070)
Constant	0.010***	-0.028**	0.001	0.009***	-0.005	0.006	0.129***	-0.045***	-0.009	-0.110***	-0.056***	-0.007	-0.110***	-0.021***	-0.019***
	(0.001)	(0.012)	(0.005)	(0.000)	(0.009)	(0.004)	(0.002)	(0.013)	(0.010)	(0.009)	(0.011)	(0.010)	(0.009)	(0.005)	(0.003)
H0: CA(-1) is the same across different regimes	(1) vs.(2)	5.60**	(0.0180)	(4) vs.(5)	2.29	(0.1298)	(7) vs.(8)	6.54**	(0.0105)	(10) vs.(11)	5.71**	(0.0169)	(13) vs.(14)	2.85*	(0.0914)
	(2) vs.(3)	2.48	(0.1150)	(5) vs.(6)	40.40***	(0.0000)	(8) vs.(9)	2.46	(0.1165)	(11) vs.(12)	12.58***	(0.0004)	(14) vs.(15)	0.03	(0.8542)
	(1) vs.(3)	3.69*	(0.0547)	(4) vs.(6)	2.41	(0.1204)	(7) vs.(9)	5.24**	(0.0221)	(10) vs.(12)	2.29	(0.1299)	(13) vs.(15)	2.72*	(0.0994)
H0: CA(-1) + CA(-1)× CA Pos in the former ≥ CA(-1) + CA(-1) × CA Pos in the latter	(1) vs.(2)	(0.0477)**		(4) vs.(5)	(0.5546)		(7) vs.(8)	(0.2078)		(10) vs.(11)	(0.9987)		(13) vs.(14)	(0.9987)	
	(2) vs.(3)	(0.7754)		(5) vs.(6)	(0.7485)		(8) vs.(9)	(0.7125)		(11) vs.(12)	(0.3101)		(14) vs.(15)	(0.1663)	
	(1) vs.(3)	(0.0646)*		(4) vs.(6)	(0.6508)		(7) vs.(9)	(0.3504)		(10) vs.(12)	(0.9982)		(13) vs.(15)	(0.9982)	
Observations	190	2,467	1,959	132	367	250	58	2,100	1,709	31	1,338	672	31	1,239	532
R-squared	0.636	0.409	0.659	0.903	0.814	0.924	0.943	0.393	0.646	0.963	0.338	0.773	0.963	0.697	0.722

Note: Clustered robust standard errors at country-level in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Year-fixed effects are included but not reported. Pos CA indicate CA>0 dummy at t-1. Statistical tests are presented to compare coefficients across two different exchange rate regimes [Floating, Intermediate (Intermed.), Peg], and p-values are in parentheses.

Source: Shambaugh (2004), Klein and Shambaugh (2008), and Ilzetzki, Reinhart, and Rogoff (2019).

Table 6. Comparison with Chinn and Wei (2013)

Panel A. LYS regimes

Exchange rate regime	LYS (2005), 1974-2005 (Pooled OLS, no year FE)						LYS (2016), 1974-2005 (Pooled OLS, no year FE)					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Subsample	All Countries		Industrial Countries		Non-industrial Countries		All Countries		Industrial Countries		Non-industrial Countries	
	Float/Interm	Peg	Float/Interm	Peg	Float/Interm	Peg	Float/Interm	Peg	Float/Interm	Peg	Float/Interm	Peg
CA(-1)	0.587***	0.594***	0.526***	0.691**	0.605***	0.574***	0.575***	0.676***	0.550***	0.584**	0.585***	0.667***
	(0.064)	(0.084)	(0.097)	(0.314)	(0.070)	(0.085)	(0.076)	(0.061)	(0.091)	(0.266)	(0.083)	(0.062)
CA(-1) × Pos CA	-0.160	0.625***	-0.070	-0.081	-0.206	0.640***	-0.061	0.072	-0.040	-0.115	-0.080	0.087
	(0.162)	(0.221)	(0.223)	(0.050)	(0.173)	(0.224)	(0.093)	(0.104)	(0.228)	(0.068)	(0.103)	(0.111)
CA(-1) × trade openness	0.076**	0.077	0.172	-0.077	0.111**	0.098*	0.035	0.028	0.107	0.133	0.055	0.048
	(0.038)	(0.053)	(0.255)	(0.326)	(0.046)	(0.051)	(0.032)	(0.040)	(0.271)	(0.275)	(0.038)	(0.043)
CA(-1) × financial openness	0.236**	-0.460***	0.387***	0.422**	0.083	-0.489***	0.297**	0.015	0.376***	0.415**	0.208	-0.043
	(0.113)	(0.148)	(0.106)	(0.142)	(0.133)	(0.129)	(0.114)	(0.096)	(0.090)	(0.145)	(0.140)	(0.105)
trade openness	0.005	-0.009	0.007	0.008	0.008	-0.006	0.001	-0.003	0.009*	0.000	0.003	-0.002
	(0.004)	(0.007)	(0.006)	(0.012)	(0.005)	(0.007)	(0.004)	(0.005)	(0.005)	(0.009)	(0.005)	(0.005)
financial openness	0.008*	0.007	0.010***	0.009	-0.001	-0.004	0.008*	0.014**	0.011***	0.012*	0.001	0.009
	(0.005)	(0.007)	(0.003)	(0.007)	(0.007)	(0.008)	(0.004)	(0.006)	(0.003)	(0.006)	(0.007)	(0.007)
Constant	-0.011***	-0.023***	-0.012**	-0.013***	-0.010**	-0.025***	-0.010***	-0.017***	-0.014***	-0.011*	-0.009**	-0.017***
	(0.003)	(0.005)	(0.004)	(0.004)	(0.004)	(0.005)	(0.003)	(0.005)	(0.004)	(0.005)	(0.004)	(0.005)
Observations	1,273	1,558	248	202	1,025	1,356	1,399	1,338	271	150	1,128	1,188
R-squared	0.549	0.515	0.816	0.820	0.517	0.506	0.551	0.556	0.804	0.858	0.522	0.533

Panel B. Alternative regimes

Exchange rate regime	Shambaugh, 1974-2005 (Pooled OLS, no year FE)						IRR (2019), 1974-2005 (Pooled OLS, no year FE)					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Subsample	All Countries		Industrial Countries		Non-industrial Countries		All Countries		Industrial Countries		Non-industrial Countries	
	Float/Interm	Peg	Float/Interm	Peg	Float/Interm	Peg	Float/Interm	Peg	Float/Interm	Peg	Float/Interm	Peg
CA(-1)	0.672***	0.743***	0.401***	1.295**	0.658***	0.727***	0.667***	0.656***	0.442***	0.706***	0.652***	0.638***
	(0.090)	(0.097)	(0.121)	(0.425)	(0.090)	(0.096)	(0.054)	(0.089)	(0.100)	(0.160)	(0.053)	(0.091)
CA(-1) × Pos CA	0.615***	0.078	-0.059	-0.135	0.601**	0.130	0.540***	0.176*	-0.082	-0.156	0.555***	0.212**
	(0.231)	(0.079)	(0.122)	(0.080)	(0.265)	(0.084)	(0.172)	(0.100)	(0.123)	(0.090)	(0.192)	(0.105)
CA(-1) × trade openness	0.040	0.009	0.132	-0.167	0.074	0.027	0.109**	0.009	0.169	-0.404	0.133***	0.032
	(0.064)	(0.073)	(0.118)	(0.213)	(0.058)	(0.074)	(0.050)	(0.084)	(0.130)	(0.280)	(0.046)	(0.088)
CA(-1) × financial openness	-0.536***	-0.124	0.537***	-0.143	-0.587***	-0.187	-0.601***	-0.012	0.480***	0.621***	-0.644***	-0.067
	(0.131)	(0.106)	(0.142)	(0.399)	(0.096)	(0.113)	(0.131)	(0.117)	(0.114)	(0.153)	(0.095)	(0.124)
trade openness	0.001	-0.011	0.011	0.013	0.006	-0.010	-0.005	-0.007	0.010	0.016	0.001	-0.006
	(0.005)	(0.009)	(0.010)	(0.008)	(0.006)	(0.009)	(0.008)	(0.006)	(0.008)	(0.010)	(0.008)	(0.006)
financial openness	-0.006	0.009	0.014***	-0.001	-0.023***	0.002	-0.009	0.018***	0.012***	0.005	-0.027***	0.013*
	(0.006)	(0.007)	(0.004)	(0.008)	(0.008)	(0.009)	(0.006)	(0.006)	(0.003)	(0.006)	(0.007)	(0.008)
Constant	-0.015***	-0.009	-0.017***	-0.006	-0.015***	-0.010	-0.011**	-0.020***	-0.015***	-0.013**	-0.012***	-0.021***
	(0.004)	(0.008)	(0.005)	(0.007)	(0.004)	(0.008)	(0.004)	(0.006)	(0.004)	(0.004)	(0.004)	(0.006)
Observations	1,849	1,350	369	130	1,480	1,220	1,801	1,153	375	117	1,426	1,036
R-squared	0.515	0.359	0.761	0.906	0.508	0.344	0.342	0.516	0.775	0.903	0.333	0.495

Note: Clustered robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Floating & intermediates includes Floating, Dirty Float, and Dirty Float/Crawling Peg

Table 7. CA surplus persistence for the whole sample

Time period	1974-2005 (Chinn and Wei's period)					1970-2014				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Sample	All Countries	Industrial Countries	Nonindustrial Countries	Non-ind Countries excl. SSA & CSP	Non-ind Countries excl. SSA & CSP & Oil	All Countries	Industrial Countries	Nonindustrial Countries	Non-ind Countries excl. SSA & CSP	Non-ind Countries excl. SSA & CSP & Oil
CA(-1)	0.6382***	0.5277***	0.6201***	0.5352***	0.6356***	0.6575***	0.6713***	0.6446***	0.5063***	0.6835***
	(0.062)	(0.093)	(0.062)	(0.058)	(0.035)	(0.053)	(0.040)	(0.055)	(0.075)	(0.031)
CA(-1) × Pos CA	0.4604**	-0.0205	0.4826**	0.6656***	0.0713	0.3897**	0.0496	0.4078**	0.5830***	0.1274**
	(0.207)	(0.070)	(0.213)	(0.121)	(0.078)	(0.195)	(0.055)	(0.200)	(0.166)	(0.049)
CA(-1) × trade openness	0.0836*	0.0331	0.1067**	0.1390***	0.0679***	0.0754**	-0.0950*	0.0970***	0.1218***	0.0256
	(0.048)	(0.101)	(0.045)	(0.042)	(0.022)	(0.034)	(0.048)	(0.032)	(0.028)	(0.018)
CA(-1) × financial openness	-0.4518**	0.4652***	-0.4974***	-0.5576***	0.0139	-0.3326	0.3153***	-0.3903**	-0.4067***	0.0716
	(0.183)	(0.066)	(0.156)	(0.120)	(0.097)	(0.203)	(0.033)	(0.186)	(0.149)	(0.055)
trade openness	-0.0075	0.0060	-0.0041	-0.0025	0.0043	-0.0049	0.0077***	-0.0031	-0.0027	0.0017
	(0.007)	(0.004)	(0.007)	(0.005)	(0.003)	(0.005)	(0.002)	(0.005)	(0.004)	(0.002)
financial openness	-0.0026	0.0123**	-0.0159**	-0.0211***	-0.0063	0.0031	0.0108***	-0.0073	-0.0129**	-0.0015
	(0.006)	(0.004)	(0.007)	(0.007)	(0.004)	(0.005)	(0.003)	(0.007)	(0.006)	(0.003)
Constant	-0.0127***	-0.0143***	-0.0133***	-0.0094***	-0.0088***	-0.0161***	-0.0145***	-0.0162***	-0.0120***	-0.0081***
	(0.004)	(0.004)	(0.004)	(0.003)	(0.002)	(0.003)	(0.004)	(0.004)	(0.003)	(0.002)
Observations	3,278	499	2,779	1,521	1,349	4,634	717	3,917	2,173	1,930
R-squared	0.400	0.822	0.390	0.350	0.620	0.519	0.851	0.507	0.473	0.683

Note: Clustered robust standard errors at country-level in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Year fixed effects are included but not reported. Pos CA indicate CA>0 dummy at t-1.

Table 8. The size of CA surplus, w/ CA Q71-85, Q>85
Panel A. Shambaugh classification

Sample, Exchange rate Regime	(1) All, Floating & Intermediate	(2) All, Peg	(3) Industrial Countries, Floating & Intermediate	(4) Industrial Countries, Peg	(5) Non-ind Countries, Floating & Intermediate	(6) Non-ind Countries, Peg	(7) Non-ind Countries excl. SSA & CSP, Floating & Intermediate	(8) Non-ind Countries excl. SSA & CSP, Peg	(9) Non-ind Countries excl. SSA & CSP & Oil exporter, Floating & Intermediate	(10) Non-ind Countries excl. SSA & CSP & Oil exporter, Peg
CA(-1)	0.6131***	0.7514***	0.6142***	1.0786***	0.6077***	0.7358***	0.4196***	0.7863***	0.6485***	0.7509***
	(0.092)	(0.079)	(0.163)	(0.192)	(0.101)	(0.078)	(0.098)	(0.156)	(0.041)	(0.108)
CA(-1) × 1(q.71≤CA(-1)<q.85)	1.2660***	0.5376***	0.1294	0.0710	1.2747***	0.6178***	1.4375***	0.7089*	0.3590*	0.1872
	(0.381)	(0.187)	(0.126)	(0.129)	(0.406)	(0.203)	(0.287)	(0.424)	(0.201)	(0.214)
CA(-1) × 1(CA(-1)≥q.85)	0.5380**	0.0800	0.0191	0.1072	0.5093**	0.1151*	0.7042***	0.0694	0.2418***	-0.0067
	(0.210)	(0.055)	(0.096)	(0.061)	(0.235)	(0.061)	(0.155)	(0.082)	(0.085)	(0.097)
CA(-1) × trade openness	0.0846**	-0.0056	-0.0699	-0.1422**	0.1154***	0.0093	0.0918***	0.0061	-0.0103	0.0416
	(0.040)	(0.049)	(0.182)	(0.058)	(0.036)	(0.050)	(0.025)	(0.055)	(0.033)	(0.032)
CA(-1) × financial openness	-0.4374***	-0.0105	0.3581***	-0.0555	-0.5004***	-0.0538	-0.4056***	-0.0465	0.1374*	-0.0152
	(0.153)	(0.082)	(0.106)	(0.211)	(0.118)	(0.089)	(0.070)	(0.134)	(0.080)	(0.118)
trade openness	-0.0017	-0.0063	0.0134**	0.0043	0.0013	-0.0065	0.0005	-0.0030	0.0011	0.0044**
	(0.006)	(0.005)	(0.006)	(0.003)	(0.006)	(0.005)	(0.005)	(0.004)	(0.003)	(0.002)
financial openness	0.0001	0.0096*	0.0136***	-0.0026	-0.0138*	0.0064	-0.0079	-0.0001	0.0025	-0.0031
	(0.006)	(0.005)	(0.004)	(0.010)	(0.007)	(0.006)	(0.008)	(0.008)	(0.003)	(0.005)
Constant	-0.0083	-0.0161**	-0.0073	-0.0154	-0.0317***	-0.0130	-0.0423***	-0.0023	-0.0298***	-0.0152**
	(0.007)	(0.008)	(0.005)	(0.009)	(0.005)	(0.009)	(0.005)	(0.010)	(0.002)	(0.007)
Observations	2,499	2,015	481	236	2,018	1,779	1,300	783	1,215	625
R-squared	0.607	0.514	0.819	0.935	0.602	0.501	0.669	0.464	0.686	0.719

Note: Clustered robust standard errors at country-level in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Year fixed effects are included but not reported.
Source: Shambaugh (2004), Klein and Shambaugh (2008)

Panel B. IRR classification

Sample, Exchange rate Regime	(1) All, Floating & Intermediate	(2) All, Peg	(3) Industrial Countries, Floating & Intermediate	(4) Industrial Countries, Peg	(5) Non-ind Countries, Floating & Intermediate	(6) Non-ind Countries, Peg	(7) Non-ind Countries excl. SSA & CSP, Floating & Intermediate	(8) Non-ind Countries excl. SSA & CSP, Peg	(9) Non-ind Countries excl. SSA & CSP & Oil exporter, Floating & Intermediate	(10) Non-ind Countries excl. SSA & CSP & Oil exporter, Peg
CA(-1)	0.6102***	0.7297***	0.6402***	0.7682***	0.6060***	0.7150***	0.4109***	0.7446***	0.6678***	0.7727***
	(0.058)	(0.068)	(0.137)	(0.185)	(0.062)	(0.071)	(0.085)	(0.089)	(0.045)	(0.077)
CA(-1) × 1(q.71≤CA(-1)<q.85)	1.1778***	0.5758***	0.0705	0.0445	1.1212***	0.6691***	1.2667***	0.8274***	0.2233	0.6015*
	(0.363)	(0.181)	(0.099)	(0.127)	(0.364)	(0.236)	(0.310)	(0.258)	(0.155)	(0.309)
CA(-1) × 1(CA(-1)≥q.85)	0.4715**	0.1853***	0.0170	0.0751	0.4584**	0.2156***	0.5867***	0.2397***	0.1088*	0.1892**
	(0.184)	(0.064)	(0.107)	(0.062)	(0.204)	(0.068)	(0.157)	(0.085)	(0.059)	(0.090)
CA(-1) × trade openness	0.1143***	-0.0221	-0.0552	-0.1424***	0.1350***	-0.0065	0.1438***	0.0477	0.0247	-0.0083
	(0.031)	(0.060)	(0.151)	(0.047)	(0.025)	(0.063)	(0.032)	(0.043)	(0.021)	(0.049)
CA(-1) × financial openness	-0.4605***	0.0245	0.3285***	0.2674	-0.5133***	-0.0154	-0.4340***	-0.1034	0.1062	-0.0202
	(0.164)	(0.091)	(0.103)	(0.197)	(0.129)	(0.099)	(0.083)	(0.067)	(0.071)	(0.086)
trade openness	-0.0051	-0.0032	0.0125**	0.0042	-0.0016	-0.0032	-0.0027	0.0005	0.0020	0.0043
	(0.007)	(0.003)	(0.006)	(0.003)	(0.007)	(0.003)	(0.007)	(0.003)	(0.003)	(0.003)
financial openness	-0.0022	0.0139***	0.0116***	0.0066	-0.0156**	0.0110**	-0.0122*	-0.0010	0.0024	-0.0036
	(0.006)	(0.005)	(0.004)	(0.005)	(0.007)	(0.005)	(0.007)	(0.005)	(0.003)	(0.005)
Constant	-0.0211**	-0.0072	-0.0211**	0.0007	-0.0329***	-0.0124	-0.0431***	-0.0074	-0.0253***	-0.0210***
	(0.009)	(0.005)	(0.008)	(0.004)	(0.004)	(0.009)	(0.005)	(0.010)	(0.005)	(0.004)
Observations	2,529	1,764	475	235	2,054	1,529	1,345	644	1,248	513
R-squared	0.446	0.683	0.821	0.929	0.435	0.670	0.365	0.789	0.696	0.718

Note: Clustered robust standard errors at country-level in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Year fixed effects are included but not reported.
Source: IRR (2019)

Table 9. Benchmark parameter values for model simulation

Preferences	
Risk aversion	$\sigma = 2$
Time preference	$\beta = 0.96$
Money balances	$\chi = 0.04$
Traded goods share	$\nu = 0.5$
Substitution elasticity between sectors	$\eta = 0.5$
Technology	
Bond holding cost	$\psi_B = 10^{-5}$
Rest of world size	$\omega_3 = 4$
Policy parameters for country 1	
Undervaluation response parameter	$\xi = 1.8$
Shocks	
Persistence	$\rho_{T,i} = \rho_{N,i} = 0.84$ for i =1,2,3
Standard deviation	$\sigma_{T,i} = \sigma_{N,i} = 0.01$ for i =1,2,3

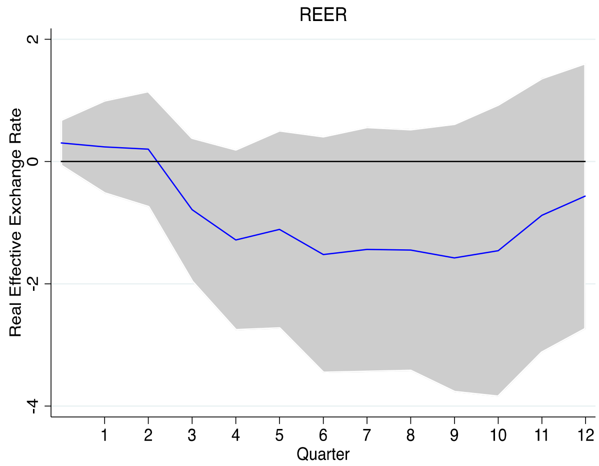
Table 10. Stochastic simulation results

Model specification	regression coefficient on interaction term (φ_2)	regression coefficient on lagged CA (φ_1)
(1) Benchmark model	0.2555	0.7156
(2) No foreign exchange intervention ($\xi = 0.0001$)	0.0082	0.7490
(3) No capital controls ($\psi_x = 0$)	0.0085	0.7651
(4) moderate capital controls ($\psi_x = 0.1$)	0.2043	0.7308
(5) Autoregressive policy rule	0.2259	0.7100
(6) no lag in exchange rate target	0.1497	0.7458
(7) Shocks to nontraded and traded sectors	0.2507	0.7270
(8) less persistent shock ($\rho_{T,i} = 0.6$)	0.5316	0.4645

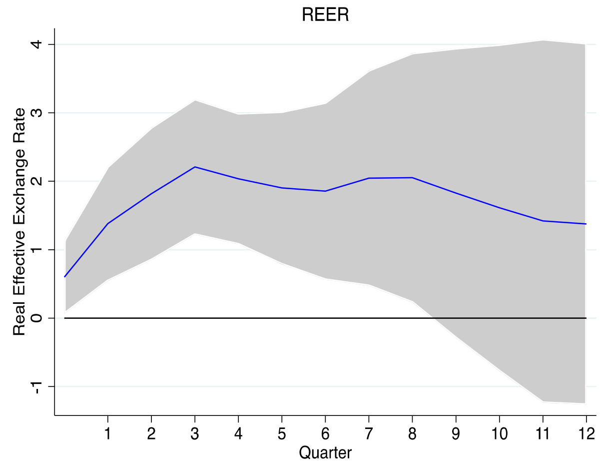
Figure 1. REER response to one-standard-deviation positive and negative CA Shocks

Panel A. Floating/intermediate regime countries

Positive CA shock (upper 16%)

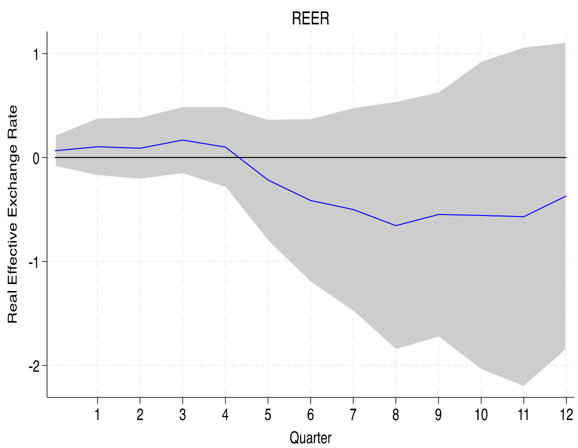


Negative CA shock (lower 16%)

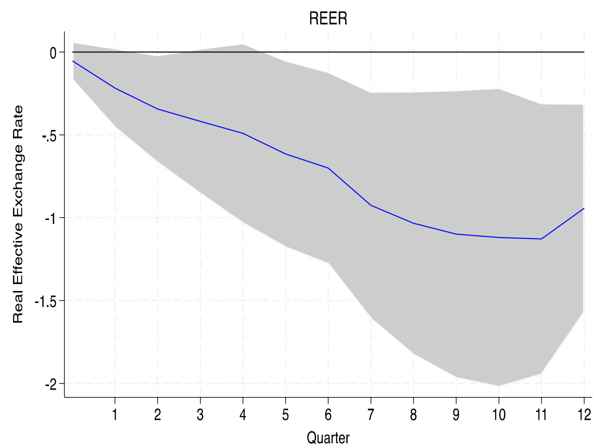


Panel B. Pegged regime countries

Positive CA shock (upper 16%)



Negative CA shock (lower 16%)

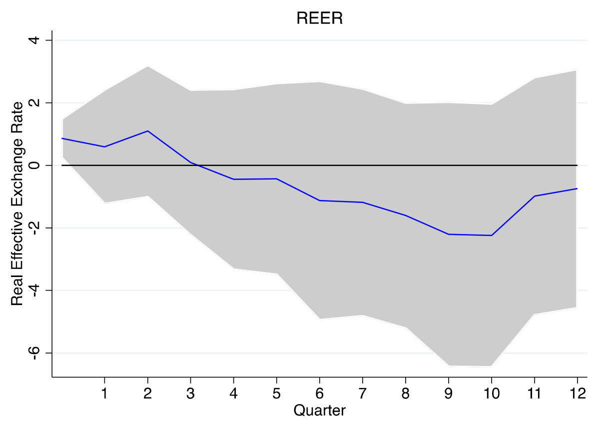


Note: We include lagged real effective exchange rate, a base country interest rate, a country's policy interest rate, a country specific time trend, country and quarter fixed effects. REER = real effective exchange rate, an increase in REER indicated home currency depreciation. Grey areas indicate 90% confidence interval.

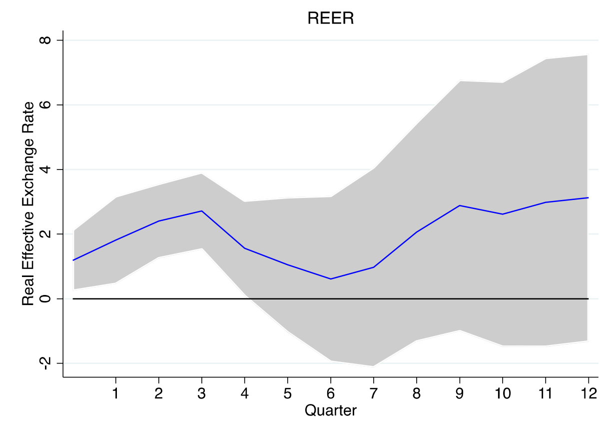
Figure 2. REER response to positive and negative CA shocks with respect to capital controls for floating/intermediate regime countries

Panel A. KA Low countries (10 countries)

Positive CA shock (upper 16%)

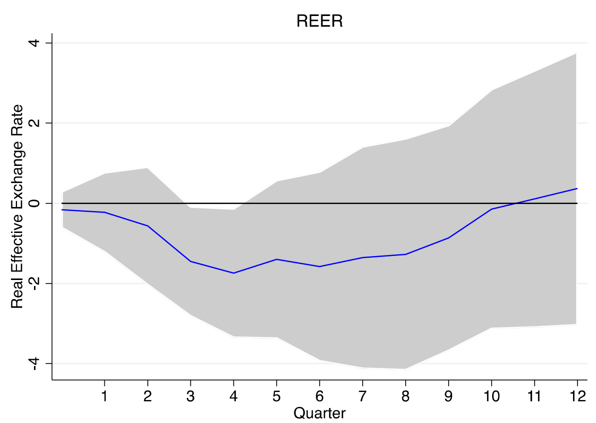


Negative CA shock (lower 16%)

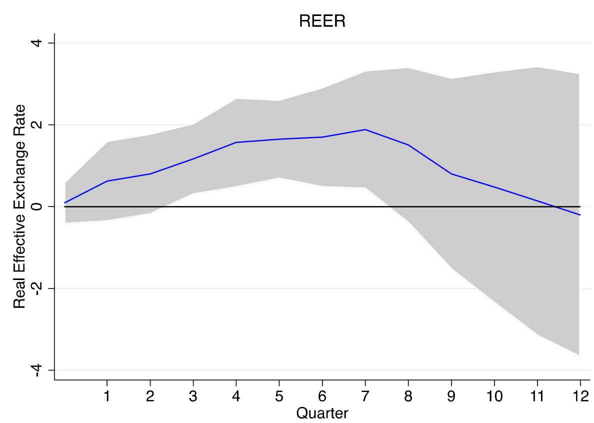


Panel B. KA High countries (11 countries)

Positive CA shock (upper 16%)



Negative CA shock (lower 16%)



Note: We include lagged real effective exchange rate, a base country interest rate, a country's policy interest rate, a country specific time trend, country and quarter fixed effects. REER = real effective exchange rate, an increase in REER indicated currency depreciation. Grey areas indicate 90% confidence interval. KA indicates capital account openness. Country lists are in Appendix Table 6.

Figure 3. Impulse responses to shock to traded endowment of country 2