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ABSTRACT

The dominant currency paradigm posits that dollar invoicing reduces the potency of exchange rate depreciations in boosting export volumes. This implies that export elasticities with respect to the exchange rate are small, rendering even large depreciations ineffectual in the short term. We incorporate two innovations versus existing work. First, we allow for nonlinearities, permitting large depreciations to disproportionately lift exports. Second, we control for banking crises, which accompany many depreciations. Our baseline export elasticity—without nonlinearities or banking crisis controls—is -0.3, consistent with prevailing “elasticity pessimism.” This elasticity rises to between -0.5 and -0.8 within two years for depreciations above 20 percent without banking crises.

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I. Introduction

Flexible exchange rates were for a long time viewed as a useful macroeconomic shock absorber, helping open economies adjust to both domestic and external shocks. Most major emerging market economies (EMEs) have adopted inflation targeting regimes with exchange rates that are flexible or, in most cases, lightly managed to reduce short-term volatility. The benefits of flexible exchange rates have, however, come to be questioned, especially in the face of large adverse shocks. Firstly, average trade elasticities have been found to be quite low, suggesting that depreciations do not have much effect on domestic economic activity. This implies that depreciations might have negative effects such as higher domestic inflation that outweigh the benefits. Secondly, the *"dominant currency paradigm"* (DCP) literature has made the case that the predominance of dollar invoicing in global trade means that large depreciations provide little competitiveness boost, especially in the short term, because export prices are set globally and not locally (Gopinath et al., 2020).

The DCP, which helps rationalize the low export elasticities prevalent in the literature, has come under intense scrutiny. For instance, Gagnon and Sarsenbayev (2023) find that exporters do in fact have substantial pricing power. They argue that the regressions of Gopinath et al. (2020) might simply be proxying for high inflation episodes across EMEs, as these tend to be associated with strengthening of the dollar. Mcleay and Tenreyro (2024) construct an open economy model to show that a limited response of export prices during depreciations—consistent with commoditized exports where prices are set globally—do not necessarily inhibit rising export volumes, as exporters ramp up production post-depreciation and move up their cost curves. Their model is driven by the intuition that – even if exports are dollar-invoiced – costs are denominated in local currency, so that large depreciations boost profitability. This is consistent with the empirical evidence in Alessandria et al. (2015) who find that export volumes do rise after depreciations, although they do so only slowly, as well as Champagne and Sekkel (2018) and De Gregorio et al. (2024), who focus on the commodity-exporters Canada and Chile, respectively. In contrast, Fukui et al. (2023) find that countries with dollar pegs do not experience a rise in net exports even when the dollar depreciates, dragging down their own trade-weighted exchange rates. In short, the role of exchange rates in external rebalancing remains hotly contested, at a time when—given the mounting frequency of large depreciations—the question is more important than ever.

In this paper, we introduce two innovations relative to the prior literature. First, we study the extent to which large, persistent exchange rate depreciations, rather than just more normal exchange rate fluctuations, affect export and import volumes. Adapting an approach by Kappler et al. (2012), who study the economic impact of large appreciations, we construct a dummy variable that identifies large depreciations that persist for multiple years and do not reverse earlier appreciations. We focus on large depreciations because they are less likely to be reversed in short order and could therefore have disproportionate effects on export and import volumes. We are obviously not the first to focus on large depreciations (see, for example, Burstein et al., 2005, Burstein et al., 2007, and De Gregorio, 2016). However, this literature has mainly focused on exchange rate passthrough into inflation. Second, we explicitly account for the overlap of large depreciations with banking crises (using a measure developed by Laeven and Valencia, 2012). Large depreciations often coincide with banking crises, which can impair the ability of exporters to expand production capacity in the aftermath of a large depreciation. This nexus is an increasing focus in the literature, with Alessandria et al. (2015) and Kohn et al. (2019) examining the role that interest rate shocks and financial constraints play in limiting export growth during depreciations. We are, however, the first to explicitly control for banking crises using the Laeven and Valencia (2012) crisis dummy.

Our baseline export elasticity—without nonlinearities and without controlling for banking crises—is -0.3, which is consistent with the *"elasticity pessimism"* in the existing literature. When we allow for nonlinearities, this elasticity rises to -0.8 within two years for persistent depreciations above 20 percent that do not overlap with banking crises. This estimate is substantially larger than in the existing literature and is mainly driven by EMEs, with two sources of idiosyncratic variation: (i) the 2016 depreciation in Egypt led to a surge in tourism, materially boosting our elasticity estimate; and (ii) commodity exporters—who are price takers on global markets—pull this elasticity towards zero. Excluding both leaves an elasticity of -0.5 across the remaining EMEs, which is still larger than in the existing literature.

Our analysis is most closely related to Ahmed et al. (2015) and Leigh et al. (2017). Ahmed et al. (2015), using a sample of 46 countries from 1996 to 2012, report an elasticity of export volumes with respect to the REER that is close to our baseline estimate. They do not allow for nonlinearities with respect to the size of depreciation, nor do they control for banking crises. Leigh et al. (2017) filter a panel of advanced and emerging markets for big depreciation episodes and exclude cases that overlap with banking crises. They find 66 such episodes for a sample from 1980 to 2014, with 17 of these in advanced economies and the rest in EMEs. The real exchange rate falls on average 25 percent during these episodes, while export volumes rise 10 percent. Their estimated elasticity of around -0.4 is higher than our baseline but below our nonlinear estimates.

We use the full distribution of data to uncover how export elasticities differ during large depreciation episodes that do not overlap with banking crises. This is likely why we find larger export elasticities than Leigh et al. (2017) who—by focusing only on a subset of data—effectively discard this variation. We also extend our analysis to import volumes, given that the underlying drivers may be quite different. Indeed, the nonlinearities that are so important for exports are not evident for imports. Our estimate of the import elasticity with respect to exchange rate changes is 0.3 for large, persistent depreciations, no matter whether we control for banking crises or not.

An important issue that bedevils the literature is the endogeneity of the exchange rate. For example, a positive shock to domestic demand may cause a real exchange rate appreciation and pull in more imports, generating a positive correlation between the exchange rate and imports that says nothing about the expenditure switching channel of interest to us. The same goes for a rise in exports due to a positive demand shock abroad, which may be associated with depreciation of the exporting country's exchange rate. Our focus on large depreciations may mitigate this concern. Large depreciations may have a larger exogenous component than lower-amplitude fluctuations in exchange rates, making them better suited for estimating the relationship between exchange rates and trade.

The paper is structured as follows. Section II outlines how we construct our dummy variables for large depreciations and describes our dataset. Section III presents our main results and Section IV examines their robustness. Section V concludes.

II. Identifying Large Depreciation Episodes

We follow the approach of Kappler et al. (2012), who study the impact of large, permanent appreciations on export and import volumes as well as current account balances. They construct a dummy variable that uses three criteria to flag large, long-lasting appreciations that do not simply reverse an earlier depreciation, thereby isolating persistent level shifts in the exchange rate.

Let $REER_{it}$ denote the trade-weighted real effective exchange rate of country i in period t. For our purposes, where our focus is on large depreciations, not appreciations, the first criterion can be written as:

$$\ln(REER_{i,t}) - \ln(REER_{i,t-2}) \leq m \quad (1)$$

We define a depreciation event if the average level of the real exchange rate in year t falls more than a certain threshold (m) from two years ago. The two-year window allows us to capture a series of smaller moves in the exchange rate, which—taken together—end up amounting to a sizable depreciation. The second criterion ensures that the depreciation is sustained for three years after the start of the depreciation episode:

$$\text{(2)} \qquad \ln\left(\frac{(REER_{i,t}+REER_{i,t+1}+REER_{i,t+2})}{3}\right) - \ln\left(REER_{i,t-2}\right) \leq m$$

The average level of the REER in the three years from the start of the depreciation episode is required to remain substantially below the level that prevailed before the episode begins. We again use our threshold (m) to denote cases that meet this criterion. We use a slightly weaker version of this condition than Kappler et al. (2012), who define the three-year average over $REER_{i,t+1}$, $REER_{i,t+2}$ and $REER_{i,t+3}$. The third criterion ensures that a depreciation episode does not follow an earlier appreciation:

$$\text{(3)} \qquad \ln\left(REER_{i,t-2}\right) - \ln\left(\frac{(REER_{i,t-3}+REER_{i,t-4}+REER_{i,t-5})}{3}\right) \leq -m$$

This criterion posits that the average level of the REER in period t-2, i.e. the year before the start of the depreciation episode, cannot be more than the threshold level ($-m$) above the average level of the real exchange rate in the three years prior. In our context, this rules out the possibility that any of the depreciation episodes that we identify simply represent the gradual unwinding of an earlier sharp appreciation.

In our analysis, we count as a depreciation episode only those instances where all three criteria are satisfied. We consider three levels for the threshold (m): -10, -20, and -30 percent. In each instance, our dummy variable flags instances where the real exchange rate falls by at least this threshold, stays at or below this level on average for three years after the initial fall, and does not reverse an earlier overvaluation.

Our sample consists of annual data for 10 advanced countries and 26 EMEs from 1990 to 2022. Unlike many previous studies, which include individual euro zone countries in their sample, we use only overall euro zone data, with a real effective exchange rate that is based on a synthetic euro prior to its introduction in 1999. In addition to real effective exchange rates, which are CPI-based and constructed by J.P. Morgan, we collect annual data from the national accounts of each country on real GDP, export and import volumes of goods and services, private consumption and gross fixed capital formation plus the current account balance in percent of GDP from the balance of payments.[2]

Table 1 lists all years in which our three criteria are satisfied for the -10 percent, -20 percent, and -30 percent thresholds. For the -10 percent threshold, there are 110 cases in which our large depreciation dummy *"switches on,"* with 27 instances for advanced countries and 83 for EMEs. For the -20 percent threshold, the overall number of cases falls to 37, with five of those in advanced countries and the remainder in EMEs. For the -30 percent threshold, the number of cases falls to 12, all of which are in EMEs. These cases are non-nested, because the third criterion makes it possible for a country to show up under the -20 percent threshold, but not under the -10 percent threshold. This can happen if the third criterion is -15 percent, for example, which is violated for the -10 percent threshold but not for the -20 percent threshold. There are only 4 instances, however, where this is the case going from the -10 percent to -20 percent threshold (Brazil in 1999, Egypt

[2] REERs constitute the most comprehensive measure of an exchange rate versus a country's major trading partners. Indeed, REERs have a much stronger correlation with export and import volumes than other exchange rate measures. Note that an increase in the REER represents an appreciation of the domestic currency; a decrease represents a depreciation. For completeness, Appendix D presents regression results using alternative exchange rates, including trade-weighted nominal effective exchange rates as well as bilateral real and nominal exchange rates versus the US dollar.

in 2017, Korea in 2008 and Mexico in 1995) and only one case where this happens going from -20 percent to -30 percent (Russia in 1999).

Table 1: Large Depreciation Dummy for Different Thresholds (1990-2022)

		10% threshold	20% threshold	30% threshold
G10	Australia	1992 1993 2014 2015		
	Canada	1993 1994 1995 2015		
	EU	2000		
	Japan	2006 2007 2013 2014 2022	2013 2014 2022	
	New Zealand	1992 1999 2000		
	Norway	2015		
	Sweden	1993 1994 2015	1993	
	Switzerland			
	Great Britain	1993 1994 2008 2009 2017	2009	
	United States	2004		
EM	Argentina	2002 2003 2018 2019 2023	2002 2003 2019	2002 2003
	Brazil	2000 2002 2015 2016 2019 2020 2021	1999 2000 2002 2020	1999 2000
	Chile	2001 2002 2014 2015 2020		
	China			
	Colombia	1990 2000 2001 2015 2016 2020 2021	2015 2016	
	Czech Rep.			
	Egypt	2002 2003 2004 2018	2002 2003 2004 2017	2003 2017
	Hungary			
	India	1990 1991 1992 1993	1991 1992	
	Indonesia	1998 1999	1998 1999	1998 1999
	Israel	2002 2003 2004		
	Korea	1998 1999 2009	1998 2008 2009	
	Malaysia	1998 1999 2016	1998	
	Mexico	1996 2004 2009 2015 2016 2017	1995 2016	1995
	Pakistan	1990 2019	2019	
	Peru			
	Philippines	1999 2001		
	Poland			
	Russia	2000 2015 2016	2015	1999
	Saudi Arabia	2003 2004 2005		
	South Africa	1996 1999 2001 2008 2013 2014		
	Taiwan			
	Thailand	1998 1999	1998	
	Turkey	1994 1995 2017 2018 2019 2020 2021 2022	2018 2021 2022	
	Ukraine	2003 2009 2010 2014 2015	2014 2015	2014
	Uruguay	2002 2003 2004	2003	2003

Notes: This table lists all years in which our large depreciation dummy takes the value of 1 for the -10, -20 and -30 percent thresholds. This is when three conditions are met: (i) the REER falls by at least this threshold over two years; (ii) this fall is sustained over the subsequent three years; and (iii) the fall does not reverse an earlier sharp rise in the REER. The dummy is zero in all years not listed.

III. Panel Regression Results

Our baseline panel regression has an Autoregressive Distributed Lags (ARDL) structure , similar to Leigh et al. (2017), Bussiere et al. (2020), and others.

$$(4) \quad x_{i,t} = \beta_0 + \beta_1 REER_{i,t} + \beta_2 REER_{i,t-1} + \beta_3 REER_{i,t} \cdot NBC_{i,t} \cdot FX_{i,t} + \beta_4 REER_{i,t-1} \cdot NBC_{i,t} \cdot FX_{i,t} + \beta_5 DD_{i,t} + \beta_6 BC_{i,t} + \beta_7 x_{i,t-1} + \alpha_i + \delta_t + \mu_{i,t}$$

Equation (4) can be read as follows. $x_{i,t}$ is the annual average percent change in export volumes of goods and services for country *i* at time *t*. $REER_{i,t}$ is the annual average percent change of the REER, where a positive (negative) sign signals appreciation (depreciation). $NBC_{i,t}$ is the reverse of the Laeven and Valencia (2012) banking crisis dummy for country *i* in year *t*, meaning that it takes a value of one if there is no banking crisis (it is zero otherwise). $FX_{i,t}$ is our large depreciation dummy for country *i* in year *t* for one of our -10 percent, -20 percent, or -30 percent thresholds. $REER_{i,t} \cdot NBC_{i,t} \cdot FX_{i,t}$ is then a double slope dummy that captures the added impact on exports from a depreciation that is larger than our threshold and that also doesn't coincide with a banking crisis. $REER_{i,t-1} \cdot NBC_{i,t} \cdot FX_{i,t}$ is a similar dummy, except that the real exchange rate change is lagged one year. These two slope dummies therefore modify the two main *REER* coefficients in the event of large depreciations that do not overlap with banking crises. $DD_{i,t}$ is the trade-weighted domestic demand annual average growth in countries' export destinations. $BC_{i,t}$ is the Laeven and Valencia (2020) banking crisis dummy. Our regression includes country fixed effects, α_i, and time dummies, δ_t, which control for the global business cycle. We run the same regression for import volumes, where the only change on the right-hand-side is that $DD_{i,t}$ reflects annual average domestic demand growth in the importing country, not that in the export destinations.

Table 2 summarizes our main regression results. Model (1) regresses export or import growth on the contemporaneous change in the real effective exchange rate and one lag thereof. When exports are the dependent variable, model (2) adds a control for trade-weighted domestic demand growth in countries' export destinations and a lagged dependent variable. When imports are the dependent variable, model (2) adds a control for domestic demand in the importing country in place of trade-weighted domestic demand in the export destinations. There is also a lagged dependent variable in this case. Model (2) is our baseline specification before adding nonlinearities with respect to depreciation size or incidence of banking crisis. Model (3) adds the Laeven and Valencia (2012) banking crisis dummy. Model (4) adds slope dummies for the REER variables for the 10 percent threshold. Model (5) adjusts these slope dummies for non-banking crisis depreciations, interacting the slope dummies with a dummy variable that takes the value of one when there is no banking crisis. Models (6)-(7) and (8)-(9) repeat these two exercises for the 20 and 30 percent depreciation thresholds, respectively.

For the sake of brevity, Table 2 reports only the estimates for $\beta_1 + \beta_2$ for Models (1) through (3) and – in addition – $\beta_1 + \beta_2 + \beta_3 + \beta_4$ for models (4) through (9). Detailed estimation results are shown in Appendix A, along with scatter plots that highlight the main patterns in the data that we discuss below. Columns (A) and (B) show estimates for $\beta_1 + \beta_2$ and associated t-statistics, respectively, based on specifications in which the dependent variable is the annual average growth in export volumes. Columns (C) and (D) show estimates for $\beta_1 + \beta_2 + \beta_3 + \beta_4$ and associated T-statistics, respectively, again with export growth as the dependent variable, for models (4) through (9). We use the Delta method to derive the joint significance of $\beta_1 + \beta_2$ and $\beta_1 + \beta_2 + \beta_3 + \beta_4$. Columns (E) through (H) repeat the same format for regressions that have annual average growth in imports as the dependent variable.

Table 2. Panel Regressions: Non-Linear Effects of Large Depreciations on Export and Import Volumes (1990 - 2022)

	Export Volumes				Import Volumes			
	b1 + b2		b1 + b2 + b3 + b4		b1 + b2		b1 + b2 + b3 + b4	
	Coef. (A)	T-stat. (B)	Coef. (C)	T-stat. (D)	Coef. (E)	T-stat. (F)	Coef. (G)	T-stat. (H)
Model (1)	-0.27	-5.20			0.32	3.47		
Model (2)	-0.26	-5.79			0.10	1.39		
Model (3)	-0.29	-5.96			0.10	1.40		
Model (4)	-0.35	-4.54	-0.22	-4.21	0.09	1.58	0.10	0.56
Model (5)	-0.27	-3.94	-0.40	-3.16	0.08	0.92	0.15	2.09
Model (6)	-0.29	-5.88	-0.28	-2.11	0.04	1.06	0.22	0.92
Model (7)	-0.23	-5.62	-0.69	-3.25	0.06	0.81	0.23	2.21
Model (8)	-0.32	-6.09	-0.15	-0.69	0.04	1.23	0.33	0.95
Model (9)	-0.27	-7.09	-0.80	-2.03	0.09	1.17	0.18	1.30

Notes: This table summarizes regression results for models (1) through (9) for export volumes (columns A through D) and import volumes (columns E through H). For models (1) through (3), it shows $\beta_1 + \beta_2$ and associated t-statistics (we use Newey-West standard errors throughout). For models (4) through (9), it shows $\beta_1 + \beta_2$ and $\beta_1 + \beta_2 + \beta_3 + \beta_4$ plus accompanying t-statistics, calculated using the delta method. Model (1) regresses annual average export or import growth on the contemporaneous change in the real effective exchange rate and one lag thereof. When exports are the dependent variable, model (2) adds a control for trade-weighted domestic demand growth in countries' export destinations and a lagged dependent variable. When imports are the dependent variable, model (2) adds a control for domestic demand in the importing country in place of trade-weighted domestic demand in the export destinations. It also has a lagged dependent variable. Model (3) adds the Laeven and Valencia (2012) banking crisis dummy. Model (4) adds slope dummies for the REER variables for the 10 percent threshold. Model (5) adjusts these slope dummies for non-banking crisis depreciations, interacting the slope dummies for 10 percent or greater depreciations with a dummy variable that takes the value of one when there is no banking crisis. Models (6)-(9) repeat this exercise for the 20 and 30 percent depreciation thresholds.

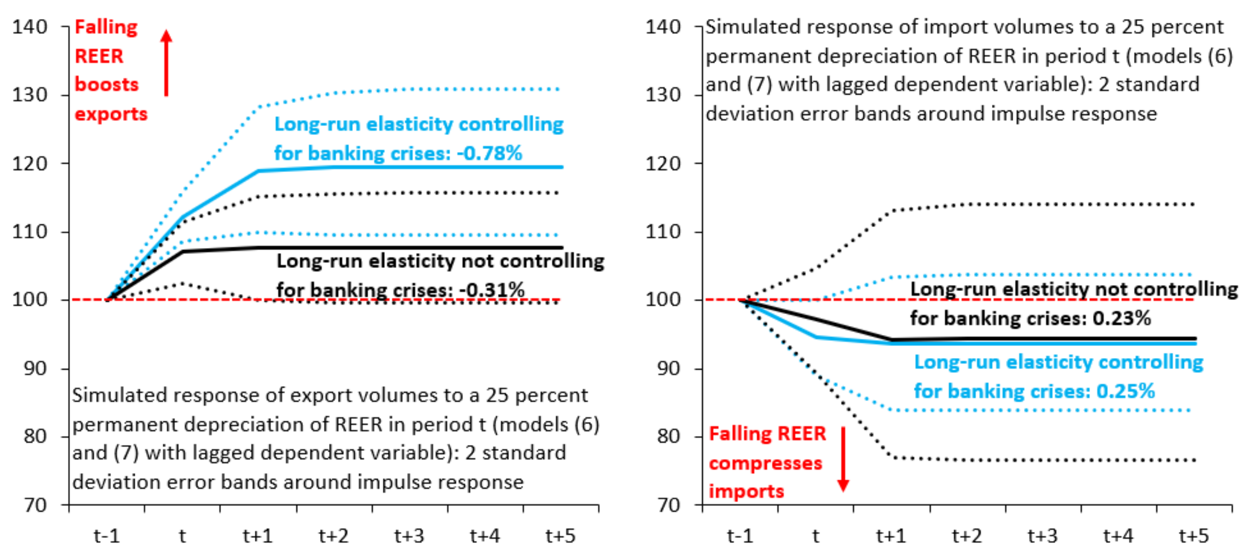
Table 2 shows that $\beta_1 + \beta_2$ in our baseline model (2) export regression in column (A) equals -0.26, which is highly significant at conventional levels. A 10 percent persistent decline in the REER therefore boosts export volumes by only 2.6 percent. This low elasticity is consistent with the *"elasticity pessimism"* in the existing literature, where estimates average around -0.30. This elasticity starts to rise in absolute value as we allow for nonlinearities from progressively bigger depreciations. $\beta_1 + \beta_2 + \beta_3 + \beta_4$ in model (4) in column (C) is -0.22, essentially unchanged from model (2). However, this number starts to rise as we control for the incidence of banking crises in model (5), with $\beta_1 + \beta_2 + \beta_3 + \beta_4$ rising to -0.40. Our 10 percent threshold dummy starts to pick up nonlinearities once we control for banking crises. This effect becomes more pronounced as we move to models (6) and (7), with $\beta_1 + \beta_2 + \beta_3 + \beta_4$ going from -0.23 to -0.69, respectively, three times larger in absolute value. The 20 percent depreciation threshold thus appears to be a critical one once we control for banking crises. Our estimate for the overall export elasticity rises further for the 30 percent threshold in models (8) and (9), but--unsurprisingly given the small number of observations--statistical significance starts to fall. We conclude that nonlinearities with respect to size of depreciation are important in influencing export elasticities, with the critical threshold being around 20 percent once banking crises are considered.

Turning to imports in column (E), $\beta_1 + \beta_2$ equals 0.10 in model (2), which is not significant at conventional levels. A 10 percent permanent fall in the REER therefore reduces import volumes by 1.0 percent—the sign here is positive rather than negative as for our export elasticities—with considerable uncertainty around this number. This is again evidence in favor of *"elasticity pessimism."* Much as for exports, this elasticity starts to rise in absolute value as we allow for nonlinearities from progressively bigger depreciations. The sum of the cofficients $\beta_1 + \beta_2 + \beta_3 + \beta_4$ in model (4) is still 0.10 in column (G). However, this number starts to rise as we control for the incidence of banking crises in model (5), with $\beta_1 + \beta_2 + \beta_3 + \beta_4$ rising to 0.15, a number that is statistically significant at conventional levels. Our 10 percent threshold dummy starts to pick up nonlinearities and controlling for banking crises boosts statistical significance. Models (6) and (7) put the estimates for $\beta_1 + \beta_2 + \beta_3 + \beta_4$ at 0.22 to 0.23, respectively, with the latter significant at conventional levels. Unlike our export regressions, banking crises seem less important for imports, but with large depreciations yielding a bigger elasticity regardless. Our estimate for the overall import elasticity rises further for the 30 percent threshold in model (8), but statistical significance deteriorates sharply, so that—as for exports—the key nonlinearity in our elasticity estimates appears to be around 20 percent.

Since models (6) and (7) include lagged dependent variables, we can calculate the long-run effect from depreciations on exports, which is $(\beta_1 + \beta_2 + \beta_3 + \beta_4)/\beta_7$. Panel A in Figure 1 shows the cumulative rise in export volumes for a 25 percent permanent fall in the REER in period *t*. The dotted lines are two standard deviation error bands around the impulse responses. The long-run elasticity is -0.78 percent when we control for banking crises, while it is -0.31 percent without controlling for such crises. A 25 percent depreciation leads to a 20 percent rise in export volumes controlling for banking crises over multiple years (blue lines), based on coefficient estimates from model (7) in Table 2. A 25 percent depreciation produces only an 8 percent rise in exports when we do not control for banking crises (black lines), based on model (6) in Table 2. Panel B repeats this exercise for import volumes and shows that controlling for banking crises is less important. The long-run elasticity is near 0.25 percent regardless, based on models (6) and (7) in Table 2. Our bottom line is that large depreciations boost exports sizably. However, that effect is far larger when we control for banking crises. Depreciations also constrict imports, but there is less of a link to banking crises and elasticities are smaller.

Figure 1. Impulse Responses for a 25 Percent Permanent REER Fall on Export and Import Volumes

Panel A | Panel B



Notes: This figure uses coefficient estimates from models (6) and (7) in Table 2 to simulate the impact of a 25 percent permanent fall in the REER. We generate two-standard deviation error bands by bootstrapping 1000 outcomes using the estimated variance-covariance matrix of the standard errors. Panel A shows this for exports. Black lines are for model (6), which does not control for banking crises. Blue lines are for model (7), which controls for banking crises. Panel B does the same thing for imports.

Appendix B examines whether large appreciations have similar nonlinear effects. Consistent with our results for large depreciations, there is evidence that large appreciations weigh disproportionately on export volumes, but that nonlinearity, not surprisingly, does not depend on banking crises. There is evidence that large appreciations boost imports, but any nonlinearity kicks in only for very large appreciations of 30 percent or more.

IV. Robustness Tests

The export elasticities we estimate are larger than those in the existing literature. We now explore the robustness of our estimates along different dimensions. We re-estimate equation (4) for different cuts of the data, to examine if certain countries, regions or time periods disproportionately influence our results: (i) we shorten the sample to 2000-2022 (the full sample covers 1990-2022) to see whether our nonlinear export elasticities are *"stale,"* i.e., driven by long-ago data; (ii) we drop the years 2008 and 2009, in case trade displacement during the global financial crisis is driving the results; (iii) we look separately at the G10 (advanced economies), EMEs, and three subsets of EMEs: Latin America (LatAm), EMEs in Asia (EM Asia), and CEEMEA (Central and Eastern Europe, Middle East and Africa); (iv) Egypt (EG) will turn out to be of critical importance, so we re-estimate equation (4) for CEEMEA excluding Egypt (x/ EG), the full sample excluding Egypt, and EMEs excluding Egypt; (v) in addition to excluding Egypt, we exclude well-known commodity exporting countries among the EMEs (Argentina, Brazil, Chile, Colombia, Indonesia, Malaysia, Peru, Russia, Saudi Arabia and Uruguay), based on the classification in Aslam et al. (2016), as these countries take global commodity prices as given for many of their exports; and (vi) we estimate equation (4) for commodity exporting EMEs only.

Table 3. Robustness: b1 + b2 + b3 + b4 for Export and Import Elasticities

	Exports				Imports			
	A	B	C	D	E	F	G	H
	Model (6)		Model (7)		Model (6)		Model (7)	
	Coef.	T-stat.	Coef.	T-stat.	Coef.	T-stat.	Coef.	T-stat.
1 All: 1990 - 2022	-0.28	-2.11	-0.69	-3.25	0.22	0.92	0.23	2.21
2 All: 2000 - 2022	-0.40	-2.88	-0.76	-3.32	0.25	1.91	0.23	2.31
3 All: drop 2008 & 2009	-0.29	-2.07	-0.72	-3.08	0.26	1.01	0.29	2.62
4 G10: 1990 - 2022	-0.21	-2.22	-0.21	-2.66	-0.36	-3.52	-0.23	-4.65
5 EMEs: 1990 - 2022	-0.29	-1.93	-0.72	-3.10	0.30	1.17	0.31	2.86
6 LatAm: 1990 - 2022	-0.26	-3.15	-0.34	-1.97	0.29	1.85	0.43	4.86
7 EM Asia: 1990 - 2022	0.11	0.91	-0.21	-2.90	0.29	1.50	-0.15	-2.08
8 CEEMEA: 1990 - 2022	-0.87	-2.45	-1.10	-2.64	0.17	1.01	0.24	1.29
9 CEEMEA x/ EG: 1990 - 2022	-0.11	-0.42	-0.57	-1.89	0.40	1.92	0.61	2.18
10 All x/ EG: 1990 - 2022	-0.07	-0.59	-0.26	-3.25	0.27	1.01	0.37	3.39
11 EMEs x/ EG: 1990 - 2022	-0.05	-0.43	-0.26	-2.98	0.34	1.20	0.46	4.14
12 EMEs x/ EG & Com: 1990 - 2022	-0.21	-1.39	-0.38	-2.52	0.21	1.26	0.31	1.39
13 Com exporters: 1990 - 2022	-0.09	-0.55	-0.32	-2.22	0.26	0.69	0.38	3.55

Notes: This table summarizes regression results for models (6) and (7) for export volumes (columns A through D) and import volumes (columns E through H). For each regression, it shows $\beta_1 + \beta_2 + \beta_3 + \beta_4$ and associated t-statistics (we use Newey-West standard errors throughout), which we calculate using the delta method. Row 1 repeats our baseline results in Table 3 for the full sample of 36 countries from 1990 to 2022. Row 2 is for a more recent sample from 2000 to 2022. Row 3 drops the global financial crisis years 2008 and 2009 from the full sample. Row 4 is for advanced economies (G10) only. Row 5 is for EMEs only. Rows 6, 7 and 8 are for Latin America (LatAm), emerging markets in Asia (EM Asia) and Central and Eastern Europe, the Middle East and Africa (CEEMEA), respectively. Egypt (EG) disproportionately impacts our results. Row 9 thus shows CEEMEA without EG, while rows 10 and 11 are the full sample and EMEs without EG, respectively. Row 12 excludes EG and commodity exporters (Com), where we follow the classification of Aslam et al. (2016). Row 13 looks at commodity exporting EMEs only.

Table 3 reports model (6) and (7) estimates of $\beta_1 + \beta_2 + \beta_3 + \beta_4$ for export and import elasticities. Columns A through D report results for export volumes as the dependent variable. Columns E to H show results for import volumes. Since our import elasticity estimates are—except for the G-10 advanced economies—in line with our baseline estimates in Table 4, we focus the ensuing discussion on export elasticities.

The top row repeats our baseline estimates from the bottom row in Table 2. Model (6) puts the export elasticity at -0.23, which rises to -0.69 in model (7). The second row shows that shortening the sample to 2000–2022 results in even more negative elasticities, so it is not the case that our estimates are driven by *"stale"* data. The third row shows that trade displacement during the global financial crisis does not drive our results. Contrasting the G10 (fourth row) with EMEs (fifth row) shows that the nonlinearity result emanates from EMEs. The G10 export elasticity does not rise (in absolute value) as we go from model (6) to (7), perhaps because G10 governments are better able to buffer their economies from banking crises. The sixth, seventh, and eighth rows examine LatAm, EM Asia and CEEMEA, respectively. Latin America has export elasticities that are closer to zero and evidence of nonlinearity with respect to banking crises is less pronounced. EM Asia does not have a significant elasticity in model (6). Only controlling for banking crises yields a statistically significant coefficient, though it is small in absolute magnitude. The biggest elasticities are in CEEMEA, where models (6) and (7) deliver very large elasticities (in absolute value). Within CEEMEA, Egypt has a disproportionate effect. The ninth row shows CEEMEA excluding data for Egypt. Our model (6) estimate is no longer significantly different from zero, but model (7) yields an elasticity of -0.57, which is significant at conventional levels. In 2016, Egypt devalued its exchange rate substantially, setting off a boom in tourism in 2017 (see Appendix C). This data point is therefore genuine, but highly idiosyncratic, since Egypt had considerable spare capacity in its tourism sector after the Arab Spring. The tenth and eleventh rows re-estimate the full sample and sample of EMEs, respectively, excluding Egypt. Model (6) yields an elasticity that is no longer significantly different from zero. It is only in model (7) that we find—in both cases—a significant elasticity, but it is small (-0.26). Finally, we explore the importance of commodity exporters. The twelfth row excludes Egypt as well as commodity exporting countries from the sample of EMEs. The model (6) elasticity is not significantly different from zero. Model (7) however yields an elasticity of -0.38, which is statistically significant and larger than most estimates in the previous literature. The bottom row in Table 5 shows that commodity exporters have a lower export elasticity across models (6) and (7).

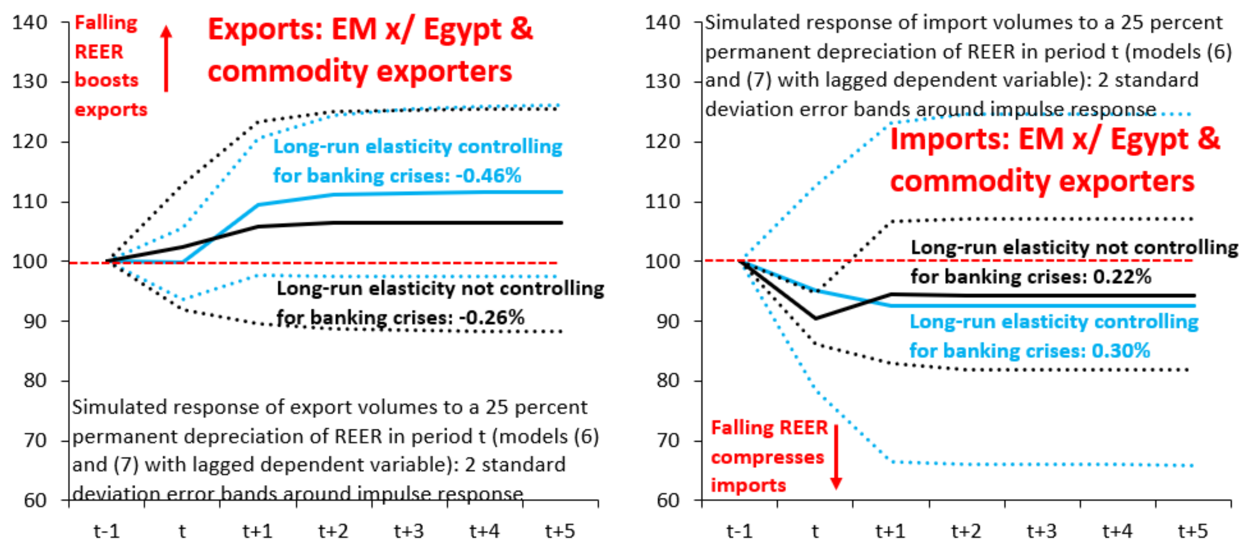
Several conclusions emerge from these robustness checks. First, while there is substantial evidence of nonlinear elasticities for exports, there is no similar evidence for imports, indicating that large depreciations matter disproportionately only for export volumes. Second, the nexus of large depreciations and banking crises—on the export side—is more important for EMEs than it is for advanced economies. Intuitively, this makes sense, given that the G10 countries have more policy space to buffer their economies from banking crises. Third, there is considerable heterogeneity in export elasticities. Commodity exporters tend to have lower export elasticities, while Egypt—a notable outlier—plays an outsize role. Our best guess of a *"robust"* elasticity is the estimate of model (7) in the sample that excludes Egypt and commodity exporting countries. That elasticity of -0.38 is above most previous estimates (in absolute value) and statistically significant.

As before, since models (6) and (7) have lagged dependent variables, we can calculate the long-run effects of depreciations on exports and imports for the sample of EMEs that excludes Egypt and commodity exporters. Panel A in Figure 2 shows the cumulative rise in export volumes for a 25 percent persistent decline in the REER in period *t*. The dotted lines are two standard deviation error bands around the impulse responses. The long-run elasticity is -0.46 percent when we control for banking crises, while it is only -0.26 percent without controlling for such crises. A 25 percent REER depreciation leads to a 12 percent rise in export volumes controlling for banking crises over multiple years (blue lines), based on coefficient estimates from model (7) in Table 3. A 25 percent depreciation lifts export volumes by only 7 percent when we do not control for banking crises (black lines), based on model (6) in Table 3. Panel B repeats the exercise for import volumes and confirms that controlling for banking crises is less important. The long-run elasticity is around 0.20-0.30 percent regardless, based on models (6) and (7) in Table 3. As before, based on what we think is a more robust cut of the data, our bottom line is that large depreciations boost exports sizably and the effect is larger when we control for banking crises. Depreciations also constrict imports, but there is less of a link to banking crises and the elasticities are smaller.

Figure 2. Impulse Responses for a 25 Percent Permanent REER Fall on Export and Import Volumes

Panel A

Panel B



Notes: This figure uses coefficient estimates from models (6) and (7) in Table 3 to simulate the impact of a 25 percent permanent fall in the REER on export and import volumes for the sample of EMEs excluding Egypt and commodity exporters. We generate two-standard deviation error bands by bootstrapping 1000 outcomes using the estimated standard errors. Panel A shows this for exports. Black lines are for model (6), which does not control for banking crises. Blue lines are for model (7), which controls for banking crises. Panel B does the same thing for imports.

V. Conclusion

Export elasticities with respect to the exchange rate are widely thought to be small, so that even large depreciations do little to boost export volumes. We re-examine the empirical evidence on this issue with two innovations relative to the existing literature. Firstly, we focus on disproportionate effects on export volumes from large depreciations. Secondly, we also control for banking crises, which often coincide with large depreciations.

Our baseline export elasticity—without nonlinearities and without controlling for banking crises—is -0.3, which is consistent with the *"elasticity pessimism"* in the existing literature. When we allow for nonlinearities, this elasticity rises to -0.8 for depreciations above 20 percent that do not overlap with banking crises. This estimate is driven by EMEs rather than the G10 and reflects two sources of idiosyncratic variation: (i) the 2016 depreciation in Egypt gave tourism a massive lift, materially boosting our elasticity estimate; and (ii) commodity exporters—who are price takers on global markets—pull this elasticity towards zero. Excluding both leaves an elasticity of -0.5 across the remaining EMEs, which is still a larger elasticity than in the existing literature.

Overall, in the spirit of Obstfeld et al. (2019) and Obstfeld and Zhou (2022), our results are a strong endorsement of flexible exchange rates as helping to insulate economies, especially EMEs, from external shocks. In particular, our results suggest that large currency depreciations are in fact effective at remedying balance of payments imbalances but only when steps are taken to avoid concomitant banking crises.

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Online Appendixes: Not Intended for Publication

Appendix A: Detailed Baseline Regression Results

This appendix reports our detailed baseline regression results which underpin the key results summarized in Table 2 in the paper.

Table A.1. Panel Regression Results: Non-Linear Effects of Large Depreciations on Export Volumes (1990 - 2022)

	Model (1)		Model (2)		Model (3)		Model (4)		Model (5)		Model (6)		Model (7)		Model (8)		Model (9)	
	Coef.	T-stat.	Coef.	T-stat.	Coef.	T-stat.	Coef.	T-stat.	Coef.	T-stat.	Coef.	T-stat.	Coef.	T-stat.	Coef.	T-stat.	Coef.	T-stat.
C	0.05	6.46	0.01	0.67	0.01	0.94	0.01	1.08	0.01	0.83	0.01	1.06	0.01	1.21	0.01	1.16	0.01	1.15
REER	-0.20	-4.27	-0.22	-5.16	-0.23	-5.58	-0.25	-4.22	-0.22	-3.90	-0.19	-6.47	-0.19	-4.50	-0.21	-6.43	-0.20	-5.83
REER_1	-0.07	-1.62	-0.05	-1.23	-0.06	-1.57	-0.09	-2.85	-0.05	-1.23	-0.10	-2.69	-0.04	-1.09	-0.11	-3.14	-0.06	-1.50
Int10							0.06	0.63										
Int10_1							0.07	0.83										
Int10BC									-0.10	-0.76								
Int10BC_1									-0.03	-0.41								
Int20											-0.09	-1.06						
Int20_1											0.10	0.66						
Int20BC													-0.31	-1.18				
Int20BC_1													-0.16	-1.50				
Int30															-0.03	-0.21		
Int30_1															0.20	1.06		
Int30BC																	-0.41	-1.06
Int30BC_1																	-0.13	-1.13
DD			1.07	3.79	1.01	3.78	1.01	3.94	1.02	3.94	1.03	3.84	1.00	4.10	1.00	3.84	1.00	3.92
BC					-0.02	-2.37	-0.02	-2.10	-0.02	-2.40	-0.02	-2.26	-0.02	-2.19	-0.02	-2.12	-0.02	-2.29
Exports_1			0.13	1.83	0.12	1.66	0.11	1.62	0.11	1.50	0.10	1.38	0.10	1.33	0.10	1.37	0.09	1.20
R2		0.48		0.50		0.51		0.51		0.51		0.51		0.52		0.51		0.51
Delta method	Coef.	T-stat.	Coef.	T-stat.	Coef.	T-stat.	Coef.	T-stat.	Coef.	T-stat.	Coef.	T-stat.	Coef.	T-stat.	Coef.	T-stat.	Coef.	T-stat.
b1 + b2	-0.27	-5.20	-0.26	-5.79	-0.29	-5.96	-0.35	-4.54	-0.27	-3.94	-0.29	-5.88	-0.23	-5.62	-0.32	-6.09	-0.27	-7.09
b1 + b2 + b3 + b4							-0.22	-4.21	-0.40	-3.16	-0.28	-2.11	-0.69	-3.25	-0.15	-0.69	-0.80	-2.03

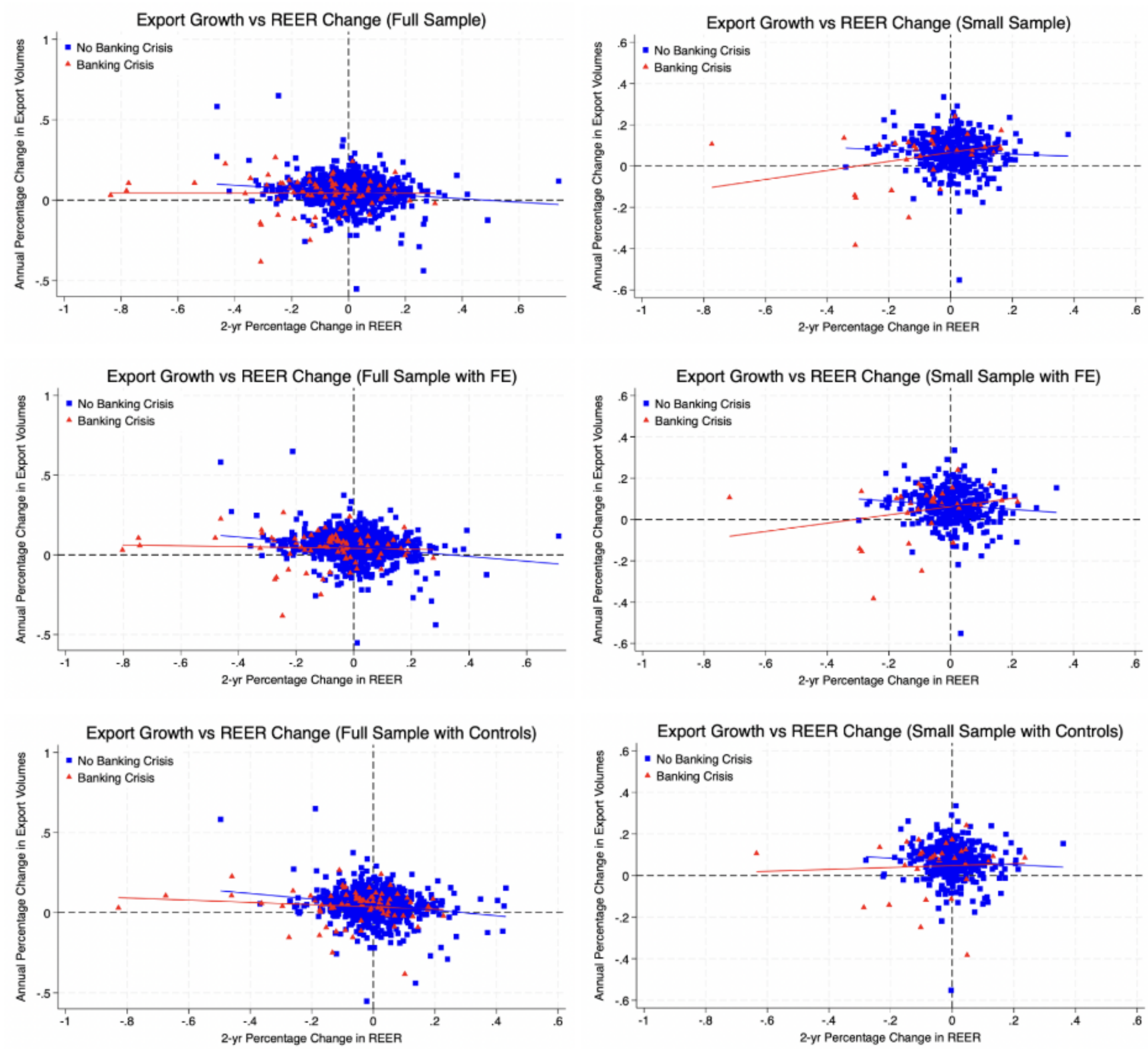
Notes: This table shows our export panel regressions using annual data from 1990 to 2022 for 36 advanced countries and EMEs. Model (1) regresses growth in export volumes on the contemporaneous REER change (REER) and its one-year lag (REER_1). Model (2) adds contemporaneous trade-weighted domestic demand growth (DD) in the export destination countries and a lagged dependent variable (Exports_1). Model (3) adds the Laeven and Valencia (2012) banking crisis dummy (BC). Model (4) adds contemporaneous (Int10) and one-year lagged (Int10_1) slope dummies for depreciations 10 percent or greater. Model (5) replaces these simple slope dummies with double slope dummies that ensure there is no overlap with banking crisis (Int10BC and Int10BC_1). Models (6) and (7) replicate models (4) and (5) for the 20 percent threshold, while models (8) and (9) do the same for the 30 percent threshold. Coefficient estimates are always the first column in each model. T-statistics are the second column (we use Newey-West standard errors throughout). The next-to-last row uses the Delta method to calculate the sum of both REER coefficients and the t-statistic of this sum. The last row does the same for all REER coefficients, including the slope dummies.

Table A.1. summarizes our export regression results. Model (1) regresses annual export growth on the contemporaneous change in the real effective exchange rate (REER) and one lag thereof (REER_1). Model (2) adds a control for trade-weighted domestic demand growth in a country's export destinations (DD) and the lagged dependent variable (Exports_1). Model (2) is in effect the baseline specification before adding nonlinearities with respect to depreciation size or incidence of banking crisis. Model (3) adds the Laeven and Valencia (2012) banking crisis dummy

(BC). Model (4) adds slope dummies for the REER variables for the 10 percent threshold (Int10 and Int10_1). Model (5) adjusts these slope dummies for non-banking crisis depreciations (Int10BC and Int10BC_1). Models (6)-(9) repeat this exercise for the 20 and 30 percent depreciation thresholds, respectively. We use the Delta method to derive the joint significance of $\beta_1 + \beta_2$ and $\beta_1 + \beta_2 + \beta_3 + \beta_4$ in the bottom rows of Table A.1. The first sum gives the combined effect of the real exchange rate and its lags without nonlinearities from large depreciations. The second sum captures such nonlinearities. It is these sums that are reported in Table 3 in the main text.

Our other control variables are statistically significant and in line with the literature. Trade-weighted foreign domestic demand growth ($DD_{i,t}$) is a positive driver of export growth and highly statistically significant across specifications. The banking crisis dummy $BC_{i,t}$ is negatively related to export growth, a sign that banking crises may act as a financing constraint for exporters. The lagged dependent variable has a small positive coefficient, which is not significant at conventional levels.

Figure A.1. Impact of Depreciations on Export Volumes: The Role of Banking Crises

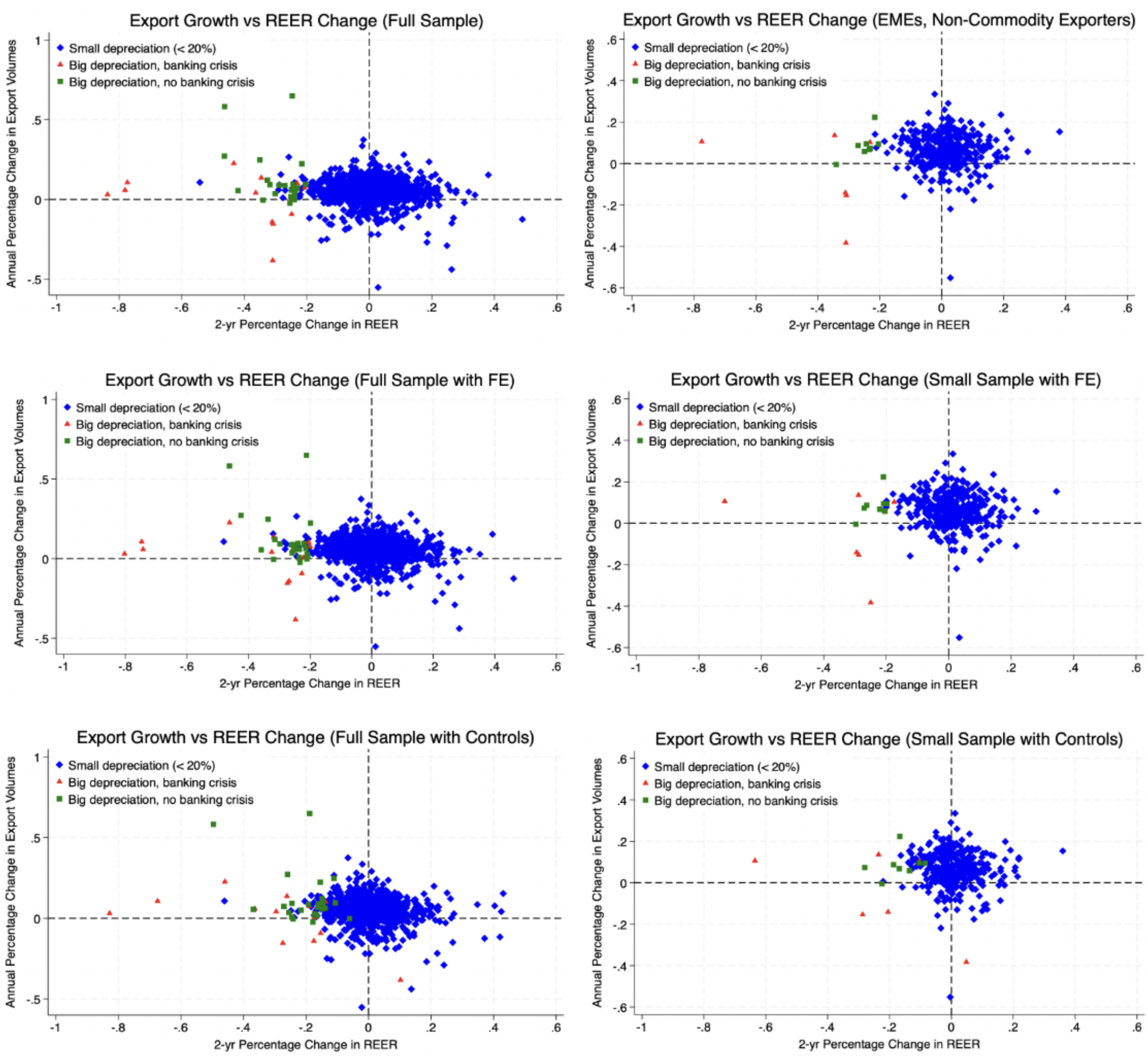


Notes: This figure shows the relationship between 2-year changes in the REER (year t-2 to t) and annual changes in export volumes (year t-1 to year t), with observations coinciding with a banking crisis shown in red. A fitted line in red is shown for those observations, and a fitted line in blue is shown for observations that do not coincide with a banking crisis. The panels on the left side use annual data from 1990 to 2022 for 36 advanced countries and EMEs; those on the right side limit the sample to 14 EMEs, excluding commodity exporters and Egypt. The panels in the top row show the unconditional relationship between the two variables, the panels in the middle row residualize REER changes with respect to country and time fixed effects, and the panels in the bottom row residualize REER changes with respect to country and time fixed effects as well as its own lag, lagged export growth, and trade-weighted domestic demand growth (DD) in the export destination countries.

We now provide a pictorial description of our main result. Figure A.1. presents scatter plots of export volume changes (in percent, year t-1 to year t) on the vertical axis and REER changes (in percent, year t-2 to year t to reflect the fact that we have contemporaneous and lagged REER changes in our regression). The scatter plots differentiate between non-banking crisis data points (blue squares) and banking crisis data points (red triangles). The top two charts are with simple REER changes on the horizontal axis, the second row of charts is for the residuals from a simple fixed effects regression, and the third row shows residuals from regressions controlling for fixed effects and our other controls.

The left chart in each row is always the full sample. The right chart is for a subset of countries that focuses on non-commodity exporting emerging market economies that also excludes Egypt (which has a big outlier datapoint). For the smaller subsample, which we emphasize in our results because it omits commodity exporters (where dollar invoicing is most prevalent and prices are set globally), these charts show that there is a counterintuitive positive association between export growth and REER changes for banking crises data points, which is exactly the variation our regressions aim to take out.

Figure A.2. Impact of Depreciations on Export Volumes: Banking Crises and Large Depreciations



Notes: This figure shows the relationship between 2-year changes in the REER (year t-2 to t) and annual changes in export volumes (year t-1 to year t). Large depreciations (20 percent or larger) coinciding with a banking crisis are shown in red, while large depreciations without a banking crisis are shown in green. The panels on the left side use annual data from 1990 to 2022 for 36 advanced countries and EMEs; those on the right side limit the sample to 14 EMEs, excluding commodity exporters and Egypt. The panels in the top row show the unconditional relationship between the two variables, the panels in the middle row residualize REER changes with respect to country and time fixed effects, and the panels in the bottom row residualize REER changes with respect to country and time fixed effects as well as its own lag, lagged export growth, and trade-weighted domestic demand growth (DD) in the export destination countries.

Figure A.2. is similar to Figure A.1., except that we single out depreciations of more than 20 percent with simultaneous banking crises (red triangles) and without banking crises (green squares). This chart comes closest to our regressions in Table 2 and confirms the negative relationship between export volumes and REER changes for non-banking crisis episodes, i.e., depreciations are associated with higher export growth in these episodes. This is less obviously true for large depreciation episodes that coincide with banking crises.

Table A.2. Panel Regression Results: Non-Linear Effects of Large Depreciations on Import Volumes (1990 - 2022)

	Model (1)		Model (2)		Model (3)		Model (4)		Model (5)		Model (6)		Model (7)		Model (8)	
	Coef.	T-stat.	Coef.	T-stat.	Coef.	T-stat.	Coef.	T-stat.	Coef.	T-stat.	Coef.	T-stat.	Coef.	T-stat.	Coef.	T-stat.
C	0.08	11.22	0.03	5.70	0.03	5.82	0.03	5.65	0.03	5.48	0.03	6.01	0.03	5.76	0.03	6.13
REER	0.29	3.62	0.08	1.43	0.08	1.42	0.06	1.49	0.06	0.97	0.07	1.81	0.06	0.86	0.06	2.23
REER_1	0.03	0.34	0.01	0.20	0.01	0.19	0.02	0.70	0.02	0.22	-0.03	-1.34	0.00	0.07	-0.03	-1.26
Int10							0.04	0.18								
Int10_1							-0.02	-0.16								
Int10BC									0.13	1.54						
Int10BC_1									-0.06	-0.59						
Int20											0.04	0.19				
Int20_1											0.14	0.65				
Int20BC													0.15	1.59		
Int20BC_1													0.02	0.15		
Int30															0.08	0.48
Int30_1															0.22	0.71
Int30BC																
Int30BC_1																
DD			1.22	12.56	1.22	12.22	1.22	11.17	1.23	12.23	1.22	12.51	1.23	12.28	1.23	11.92
BC					0.00	-0.21	0.00	-0.07	0.00	-0.08	0.00	0.17	0.00	-0.29	0.00	0.42
Exports_1			-0.01	-0.19	-0.01	-0.21	0.00	-0.08	0.00	-0.10	-0.01	-0.33	-0.01	-0.20	-0.02	-0.47
R2		0.48		0.72		0.72		0.72		0.72		0.72		0.72		0.73
Delta method	Coef.	T-stat.	Coef.	T-stat.	Coef.	T-stat.	Coef.	T-stat.	Coef.	T-stat.	Coef.	T-stat.	Coef.	T-stat.	Coef.	T-stat.
b1 + b2	0.32	3.47	0.10	1.39	0.10	1.40	0.09	1.58	0.08	0.92	0.04	1.06	0.06	0.81	0.04	1.23
b1 + b2 + b3 + b4							0.10	0.56	0.15	2.09	0.22	0.92	0.23	2.21	0.33	0.95

Notes: This table shows our import panel regressions using annual data from 1990 to 2022 for 36 advanced countries and EMEs. Model (1) regresses growth in import volumes on the contemporaneous REER change (REER) and its one-year lag (REER_1). Model (2) adds contemporaneous domestic demand growth (DD) in the importing country and a lagged dependent variable (Exports_1). Model (3) adds the Laeven and Valencia (2012) banking crisis dummy (BC). Model (4) adds contemporaneous (Int10) and one-year lagged (Int10_1) slope dummies for depreciations 10 percent or greater. Model (5) replaces these simple slope dummies with double slope dummies that ensure there is no banking crisis (Int10BC and Int10BC_1). Models (6) and (7) replicate models (4) and (5) for the 20 percent threshold, while models (8) and (9) do the same for the 30 percent threshold. Coefficient estimates are always the first column in each model. T-statistics are the second column (we use Newey-West standard errors throughout). The next-to-last row uses the Delta method to calculate the sum of both REER coefficients and the t-statistic of this sum. The last row does the same for all REER coefficients, including the slope dummies.

Table A.2. shows the regression results for imports. Annual growth in import volumes is now the left-hand-side variable, while the $DD_{i,t}$ controls for domestic demand in the importing country, rather than trade-weighted domestic demand in the export destinations. In model (2), $\beta_1 + \beta_2$ equals 0.10, which is not significant at conventional levels. A 10 percent permanent fall in the REER therefore reduces import volumes by 1.0 percent – the sign here is positive rather than negative as for our export elasticities – with lots of uncertainty around this number. This is again evidence in favor of *"elasticity pessimism."* Much as for exports, this elasticity starts to rise in absolute value as we allow for nonlinearities from progressively bigger depreciations. $\beta_1 + \beta_2 + \beta_3 + \beta_4$ in model (4) is still 0.10. However, this number starts to rise as we control for the incidence of banking crises in model (5), with $\beta_1 + \beta_2 + \beta_3 + \beta_4$ rising to 0.15, a number that is statistically significant at conventional levels. Our 10 percent threshold dummy is starting to pick up nonlinearities and – unlike for export volumes – controlling for banking crises boosts statistical significance. Models (6) and (7) put estimates for $\beta_1 + \beta_2 + \beta_3 + \beta_4$ at 0.22 to 0.23, respectively, with the latter significant at conventional levels. Unlike our export regressions, banking crises seem less important for imports, with large depreciations having a bigger elasticity regardless. Our estimate for the overall export elasticity rises further for the 30 percent threshold in model (8), but statistical significance deteriorates sharply, so that – as for exports – the key nonlinearity in our elasticity estimates appears to be around 20 percent.

As far as our control variables go, domestic demand growth ($DD_{i,t}$) in the importing country is highly significant with the expected positive sign, while the banking crisis dummy $BC_{i,t}$ and lagged dependent variable have coefficients that are near zero and are statistically insignificant.

Appendix B: Nonlinear Effects of Large Appreciations

This appendix examines whether large appreciations have nonlinear effects on export and import volumes. We run the same specifications we ran for depreciations, except that we change our thresholds for our slope dummies from -10, -20 and -30 percent to +10, +20 and +30 percent. We keep the interaction with the Laeven and Valencia (2012) banking crisis dummy for symmetry, though banking crises are typically associated with depreciation episodes, not large appreciations.

Table B.1 presents our results for export volumes. It parallels Table A.1, except that the slope dummies for the 10 percent threshold (Int10 and Int10_1) are now for REER appreciations of 10 percent or more, while the double slope dummies (Int10BC and Int10BC_1) capture 10 percent appreciations that do not overlap with banking crises. The slope dummies for 20 and 30 percent appreciations are defined in the same manner. All other variables and the layout of Table B.1 are the same as Table A.1.

Table B.1. Panel Regression Results: Non-Linear Effects of Large Appreciations on Export Volumes (1990 - 2022)

	Model (1)		Model (2)		Model (3)		Model (4)		Model (5)		Model (6)		Model (7)		Model (8)		Model (9)	
	Coef.	T-stat.	Coef.	T-stat.	Coef.	T-stat.	Coef.	T-stat.	Coef.	T-stat.	Coef.	T-stat.	Coef.	T-stat.	Coef.	T-stat.	Coef.	T-stat.
C	0.05	6.46	0.01	0.67	0.01	0.94	0.01	0.94	0.01	0.97	0.01	1.08	0.01	1.08	0.01	1.27	0.01	1.30
REER	-0.20	-4.27	-0.22	-5.16	-0.23	-5.58	-0.23	-4.74	-0.23	-4.82	-0.22	-5.19	-0.22	-5.27	-0.23	-5.34	-0.23	-5.40
REER_1	-0.07	-1.62	-0.05	-1.23	-0.06	-1.57	-0.06	-1.43	-0.06	-1.47	-0.06	-1.47	-0.06	-1.54	-0.06	-1.53	-0.06	-1.56
Int10							-0.01	-0.07										
Int10_1							-0.02	-0.19										
Int10BC									-0.01	-0.14								
Int10BC_1									-0.01	-0.15								
Int20											-0.16	-1.42						
Int20_1											-0.02	-0.26						
Int20BC													-0.17	-1.37				
Int20BC_1													0.00	-0.06				
Int30															-0.24	-3.15		
Int30_1															0.02	0.28		
Int30BC																	-0.25	-3.78
Int30BC_1																	0.01	0.19
DD			1.07	3.79	1.01	3.78	1.02	3.94	1.02	3.96	1.02	3.89	1.02	3.90	1.01	3.82	1.01	3.85
BC					-0.02	-2.37	-0.02	-2.36	-0.02	-2.45	-0.02	-2.23	-0.02	-2.37	-0.02	-2.25	-0.02	-2.35
Exports_1			0.13	1.83	0.12	1.66	0.11	1.61	0.11	1.62	0.12	1.65	0.12	1.66	0.12	1.66	0.12	1.66
R2		0.48		0.50		0.51		0.51		0.51		0.51		0.51		0.51		0.51
Delta method	Coef.	T-stat.	Coef.	T-stat.	Coef.	T-stat.	Coef.	T-stat.	Coef.	T-stat.	Coef.	T-stat.	Coef.	T-stat.	Coef.	T-stat.	Coef.	T-stat.
b1 + b2	-0.27	-5.20	-0.26	-5.79	-0.29	-5.96	-0.29	-4.78	-0.29	-4.99	-0.28	-5.34	-0.28	-5.55	-0.28	-5.49	-0.29	-5.61
b1 + b2 + b3 + b4							-0.31	-3.47	-0.32	-3.29	-0.46	-3.53	-0.45	-3.03	-0.50	-8.26	-0.52	-8.66

Notes: This table shows our export panel regressions using annual data from 1990 to 2022 for 36 advanced countries and EMEs. Model (1) regresses growth in export volumes on the contemporaneous REER change (REER) and its one-year lag (REER_1). Model (2) adds contemporaneous trade-weighted domestic demand growth (DD) in the export destination countries and a lagged dependent variable (Exports_1). Model (3) adds the Laeven and Valencia (2012) banking crisis dummy (BC). Model (4) adds contemporaneous (Int10) and one-year lagged (Int10_1) slope dummies for appreciations 10 percent or greater. Model (5) replaces these simple slope dummies with double slope dummies that ensure there is no overlap with banking crisis (Int10BC and Int10BC_1). Models (6) and (7) replicate models (4) and (5) for the 20 percent threshold on appreciations, while models (8) and (9) do the same for the 30 percent threshold. Coefficient estimates are always the first column in each model. T-statistics are the second column (we use Newey-West standard errors throughout). The next-to-last row uses the Delta method to calculate the sum of both REER coefficients and the t-statistic of this sum. The last row does the same for all REER coefficients, including the slope dummies.

As in Table A.1, there is evidence that large appreciations have nonlinear effects on export volumes. The last row in Table B.1 shows the sum of all REER coefficients. This sum rises slightly as we move from model (3) to models (4) and (5), but the big jump comes for models (6) and (7), i.e., it is depreciations of 20 percent or greater that are associated with nonlinear effects. Unlike Table A.1, there does not appear to be a link to banking crises. Across specifications, our export elasticities are similar whether we control for banking crises or not. Intuitively, this make sense, as banking crises—and the financing constraints they impose on exporters—should not matter during large appreciation episodes, when capital inflows are usually strong and the banking system should be flush with liquidity.

Table B.2. Panel Regression Results: Non-Linear Effects of Large Appreciations on Import Volumes (1990 - 2022)

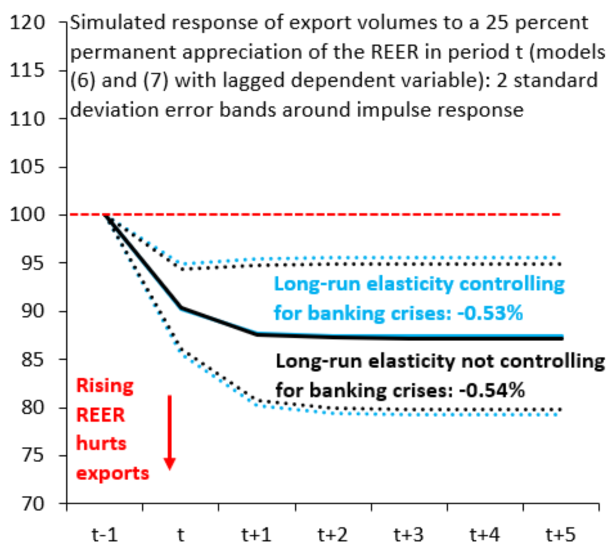
	Model (1)		Model (2)		Model (3)		Model (4)		Model (5)		Model (6)		Model (7)		Model (8)		Model (9)	
	Coef.	T-stat.	Coef.	T-stat.	Coef.	T-stat.	Coef.	T-stat.	Coef.	T-stat.	Coef.	T-stat.	Coef.	T-stat.	Coef.	T-stat.	Coef.	T-stat.
C	0.08	11.22	0.03	5.70	0.03	5.82	0.03	5.39	0.03	5.43	0.03	5.00	0.03	4.94	0.02	5.03	0.03	5.06
REER	0.29	3.62	0.08	1.43	0.08	1.42	0.09	1.28	0.09	1.34	0.08	1.31	0.08	1.37	0.07	1.15	0.07	1.21
REER_1	0.03	0.34	0.01	0.20	0.01	0.19	0.02	0.27	0.02	0.30	0.01	0.09	0.01	0.13	0.01	0.09	0.01	0.14
Int10							-0.06	-0.54										
Int10_1							-0.01	-0.14										
Int10BC									-0.09	-0.77								
Int10BC_1									-0.02	-0.22								
Int20											-0.07	-0.52						
Int20_1											0.14	1.23						
Int20BC													-0.12	-0.79				
Int20BC_1													0.12	1.00				
Int30															0.25	2.13		
Int30_1															0.02	0.16		
Int30BC																	0.20	2.70
Int30BC_1																	-0.02	-0.22
DD			1.22	12.56	1.22	12.22	1.22	12.40	1.22	12.43	1.22	12.33	1.22	12.34	1.23	12.33	1.23	12.35
BC					0.00	-0.21	0.00	0.02	0.00	-0.10	0.00	-0.14	0.00	-0.05	0.00	-0.16	0.00	-0.02
Exports_1			-0.01	-0.19	-0.01	-0.21	-0.01	-0.20	-0.01	-0.22	-0.01	-0.19	-0.01	-0.20	0.00	-0.07	0.00	-0.09
R2		0.48		0.72		0.72		0.72		0.72		0.72		0.72		0.72		0.72
Delta method	Coef.	T-stat.	Coef.	T-stat.	Coef.	T-stat.	Coef.	T-stat.	Coef.	T-stat.	Coef.	T-stat.	Coef.	T-stat.	Coef.	T-stat.	Coef.	T-stat.
b1 + b2	0.32	3.47	0.10	1.39	0.10	1.40	0.11	1.27	0.11	1.34	0.09	1.18	0.09	1.27	0.08	1.01	0.08	1.11
b1 + b2 + b3 + b4							0.03	0.41	0.01	0.07	0.16	0.98	0.09	0.54	0.35	3.70	0.26	4.37

Notes: This table shows our import panel regressions using annual data from 1990 to 2022 for 36 advanced countries and EMEs. Model (1) regresses growth in import volumes on the contemporaneous REER change (REER) and its one-year lag (REER_1). Model (2) adds contemporaneous domestic demand growth (DD) in the importing country and a lagged dependent variable (Exports_1). Model (3) adds the Laeven and Valencia (2012) banking crisis dummy (BC). Model (4) adds contemporaneous (Int10) and one-year lagged (Int10_1) slope dummies for appreciations 10 percent or greater. Model (5) replaces these simple slope dummies with double slope dummies that ensure there is no banking crisis (Int10BC and Int10BC_1). Models (6) and (7) replicate models (4) and (5) for the 20 percent threshold on appreciations, while models (8) and (9) do the same for the 30 percent threshold. Coefficient estimates are always the first column in each model. T-statistics are the second column (we use Newey-West standard errors throughout). The next-to-last row uses the Delta method to calculate the sum of both REER coefficients and the t-statistic of this sum. The last row does the same for all REER coefficients, including the slope dummies.

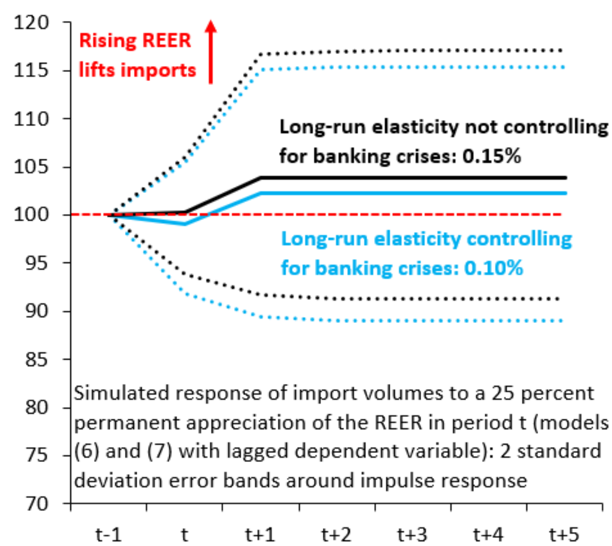
Table B.2 examines whether large appreciations have nonlinear effects on import volumes. The bottom row in the table shows that there is little link between large appreciations and growth in import volumes, except for appreciations of 30 percent or more. This is different from Table A.2, where we find significant import elasticities at the 10 and 20 percent threshold levels when controlling for banking crises. Appreciations only seem to impact import volumes when they are very large.

Figure B.1. Impulse Responses for a 25 Percent Permanent REER Rise on Export and Import Volumes

Panel A



Panel B



Notes: This figure uses coefficient estimates from models (6) and (7) in Tables A.1 and A.2 to simulate the impact of a 25 percent permanent rise in the REER. We generate two-standard deviation error bands by bootstrapping 1000 outcomes using the estimated variance-covariance matrix of the standard errors. Panel A shows this for exports. Black lines are for model (6), which does not control for banking crises. Blue lines are for model (7), which controls for banking crises. Panel B does the same thing for imports.

Since models (6) and (7) include lagged dependent variables, we can calculate the long-run effect from depreciations on exports, which is $(\beta_1 + \beta_2 + \beta_3 + \beta_4)/\beta_7$. Panel A in Figure B.1 shows the cumulative fall in export volumes for a 25 percent permanent rise in the real exchange rate in period *t*. The dotted lines are two standard deviation error bands around the impulse responses. The long-run elasticity is -0.53 percent when we control for banking crises, almost the same as when we do not control for banking crises. Panel B does the same thing for import volumes, where there is no significant effect at the 20 percent threshold.

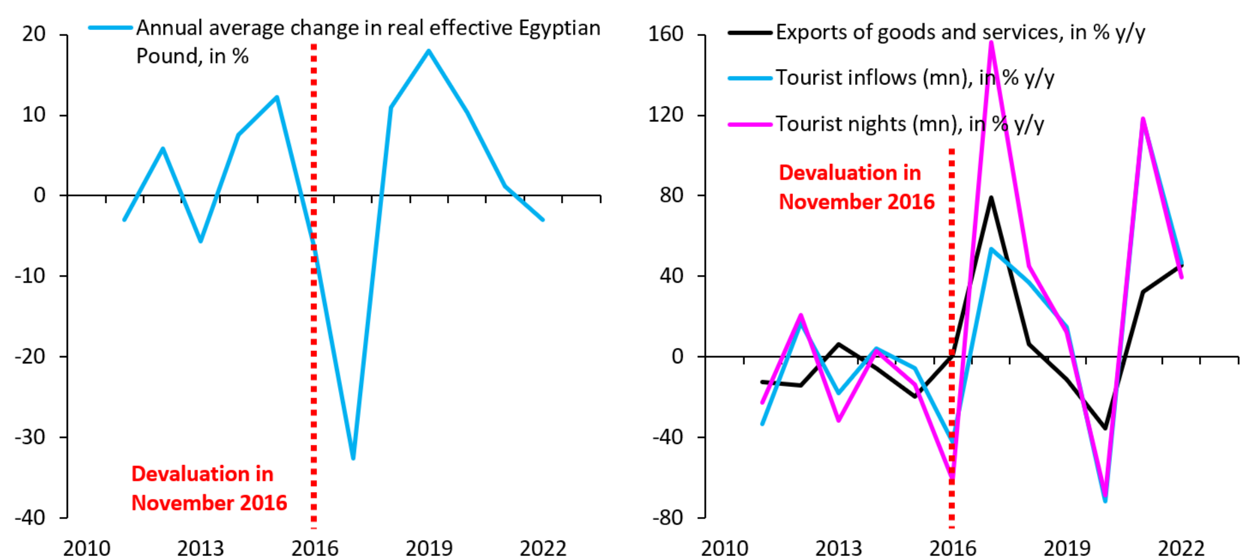
Overall, there appears to be a nonlinear effect of large depreciations on export volumes, so there is some symmetry with our results for large depreciations. There is, however, no connection to banking crises, which makes intuitive sense, since appreciation episodes often coincide with big capital inflows, while it is *"sudden stops"* in capital inflows that coincide with large depreciations, which is what impairs the ability of exporters to boost volumes. Only very large appreciations look like they boost imports. There is no discernible link for appreciations of less than 30 percent.

Appendix C: Goods versus Services Exports

As our robustness tests show, the devaluation of the Egyptian pound against the dollar in November 2016 is a key data point, because export volumes rose substantially. In real effective terms, the average level of the pound in 2017 was 30 percent below that in 2016 (Figure C.1, Panel A). Since there was considerable spare capacity in the tourism sector following the Arab Spring and associated protests, there was room for the tourism sector to boom. Export volumes of goods and services rose by 80 percent in 2017 from the previous year (Figure C.1, Panel B), powered by a sharp increase in tourist visits and tourist nights spent in Egypt. This episode is a legitimate data point underscoring the benefits from depreciation, but it is also somewhat idiosyncratic, due to the many empty hotel rooms that allowed Egypt to benefit from depreciation.

Figure C.1. Egypt's Large REER Depreciation in 2016 and Subsequent Tourism Arrivals

Panel A Panel B



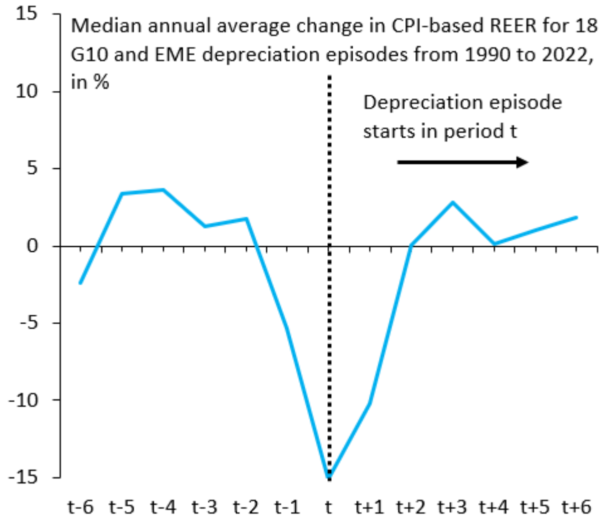
Notes: This figure examines the large depreciation that took place in Egypt in November 2016. Panel A shows the percent change in the annual average level of the REER for Egypt between 2012 and 2022. Panel B shows annual average growth in export volumes from the national accounts alongside the change in the number of tourists and tourist nights over the same period.

This episode provides an interesting perspective on the DCP. Hotel rooms in Egypt are quoted in dollars for the most part, i.e., are dollar invoiced. That dollar invoicing did not prevent a sizable response in export volumes, because input costs into the provision of hotel services—such as wages of employees and many other services—became cheaper in hard currency terms after the Nov. 2016 devaluation. As a result, even though dollar invoicing was prevalent, hotels were able to cut prices they quoted foreigners, which in turn allowed tourism to boom. This example illustrates that dollar invoicing does not equate to irrelevance for the exchange rate as a shock absorption mechanism.

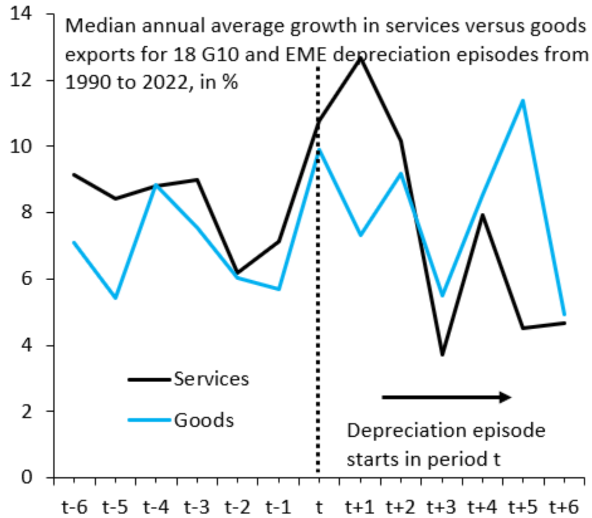
While there are certainly idiosyncratic elements to the Egypt data point, there is evidence that services exports respond more forcefully to large depreciations than goods exports. We use the large depreciation episodes in Table 2 to examine the behavior of services versus goods export volumes in the aftermath of large depreciations. Data that break out services versus goods exports are available for only a subset of the countries in our sample. We are left with 18 episodes across 10 countries from 1990 and 2022, including Canada (1993 and 2015), the euro zone (2000), Japan (2006, 2013 and 2022), Korea (1998 and 2008), Malaysia (2016), New Zealand (1992 and 1999), Norway (2015), Sweden (1993 and 2015), Thailand (1998), and the UK (1993, 2009 and 2017). Note these start dates are two years behind Table 2, as they are the peak—not start—of each episode.

Figure C.2. Impact of Large Depreciations on Services and Goods Export Volumes in the G10 and EMEs

Panel A



Panel B



Notes: This figure uses 18 large depreciation episodes in Table 2 for which separate goods and services export volume data are available to examine the behavior of services versus goods in large depreciations. Panel A shows the median annual average change in the CPI-based REER across 18 G10 and EME depreciation episodes, where time *t* is the peak of the depreciation episode. Panel B shows the associated annual average growth rates of services and goods export volumes. Services exports react more forcefully to large depreciations than goods exports.

Panel A in Figure C.2 shows the median path for the annual average change in the CPI-based REER in event time across the 18 episodes. Time *t* is the peak of the depreciation episode. The median depreciation in the real exchange rate is -15 percent at time *t*. Panel B shows annual average growth of services and goods exports on the same event time scale. Services export volumes react more forcefully to large depreciations, so there is some broader significance to the Egypt devaluation episode.

The event time analysis above has limitations, most obviously that it focuses only on large depreciation episodes. We therefore also run our model (1) regression in Table 2 in the main text, linking the annual change in export volumes of goods and services, separately, to $REER_{i,t}$ and $REER_{i,t-1}$. As before, we control for country and year fixed effects. Our sample includes 18 countries with separate data on export volumes of goods versus services. In the G10, we have data for Canada, the euro zone, Japan, New Zealand, Norway, Sweden, the UK, and the US. Among the EMEs, we cover the Czech Republic, Hungary, Chile, South Korea, Malaysia, Singapore, Thailand, Indonesia, the Philippines, and Taiwan. We run three panel regressions for this set of countries from 1990 to 2022. The first is for all countries in the sample, the second is for the G10 countries, and the third is for EMEs. In each case, we run three sets of regressions. The first is where the dependent variable is annual growth in export volumes of goods and services. The second is for volumes of goods exports only and the third is for services only.

Table C. 1. Export Elasticities for Goods versus Services

	G10 and EM Countries					
	Total		Goods		Services	
	Coef.	T-stat.	Coef.	T-stat.	Coef.	T-stat.
REER	-0.20	-2.26	-0.12	-2.56	-0.20	-2.91
REER_1	0.05	0.47	-0.12	-2.02	-0.13	-1.31
R2		0.60		0.63		0.54
Delta method						
b1 + b2	-0.15	-1.64	-0.24	-3.79	-0.33	-4.45
	G10 Countries					
	Coef.	T-stat.	Coef.	T-stat.	Coef.	T-stat.
REER	-0.11	-1.40	-0.17	-2.84	-0.25	-3.36
REER_1	-0.12	-1.99	-0.11	-1.59	-0.06	-0.65
R2		0.61		0.61		0.57
Delta method						
b1 + b2	-0.23	-2.36	-0.28	-3.39	-0.31	-3.85
	EM Countries					
	Coef.	T-stat.	Coef.	T-stat.	Coef.	T-stat.
REER	-0.21	-2.16	-0.04	-0.56	-0.24	-1.98
REER_1	0.16	1.33	-0.08	-0.94	-0.25	-1.22
R2		0.61		0.65		0.60
Delta method						
b1 + b2	-0.05	-0.44	-0.12	-1.50	-0.49	-2.66

Notes: G10: CA, EU, JP, NZ, NO, SE, GB, US. EM: CZ, HU, CL, KR, MY, SG, TH, ID, PH, TW.

Notes: This table shows our export panel regressions using annual data from 1990 to 2022 for 18 advanced countries and EMEs. Each regression links growth in export volumes to the contemporaneous REER change (REER) and its one-year lag (REER_1). The top panel is for all 18 countries. The middle panel is for 8 advanced economies. The bottom panel is for 10 EMEs. Each panel has three regressions. The first is for combined export volumes of goods and services. The second is for goods only. The third is for services only. Coefficient estimates are always the first column in each model. T-statistics are the second column (we use Newey-West standard errors throughout). The bottom row in each panel uses the Delta method to calculate the sum of both REER coefficients and the t-statistic of this sum.

Table C.1. presents our regression results. The bottom row in each set of regressions uses the Delta method to sum the two exchange rate elasticities and calculate the associated t-statistic. In general, it is true that the impact of depreciations on services is greater than on goods, but this difference is especially large for EMEs. In fact, our combined elasticity is only -0.12 for goods and not significant at conventional levels, while it is -0.49 and highly significant for services. Services exports are therefore much more sensitive to exchange rate depreciations, even if—in many cases—these exports are invoiced in dollars.

Appendix D: Alternative Definitions of the Exchange Rate

This appendix examines the sensitivity of our results to different definitions of the exchange rate. Our baseline regressions estimate trade elasticities with respect to REERs, but here we also consider bilateral dollar or nominal trade-weighted exchange rates instead.

Our baseline regressions use CPI-based REERs. This choice of exchange rate has two implications. It directly affects our elasticity estimates, since the real exchange rate enters our regressions as an explanatory variable. Separately, it indirectly affects our results, since the choice of exchange rate determines when our large depreciation dummy *"switches on."* Large nominal exchange rate depreciations often lead to a surge in domestic inflation, reversing the corresponding depreciation of the REER. For instance, the Argentinian peso's sharp depreciation relative to the dollar in late 2023 set off a spike in domestic inflation that boosted the REER back to its earlier level. In this case, our large depreciation dummy does not *"switch on"* for the REER but does so for the bilateral nominal exchange rate.

Table D.1. presents regression results that explores how the choice of exchange rates influences our export elasticity estimates. We examine four alternative definitions of the exchange rate: (i) the bilateral nominal exchange rate relative to the dollar rate, henceforth referred to as *"bilateral (nominal)"*; (ii) the bilateral CPI-based real exchange rate vis-à-vis the dollar, referred to as *"bilateral (real)"*; (iii) the nominal trade-weighted exchange rate from J.P. Morgan, referred to as NEER below; and (iv) the REER used in the earlier regressions. In the results shown in the left panel, we allow the large depreciation dummy to depend on the exchange rate used in the regression, i.e., it differs across alternative definitions of the exchange rate. The results in the right panel use the REER-based large depreciation dummy across all regressions. Each panel reports results for models (5), (7) and (9), i.e. for 10, 20, and 30 percent depreciations, respectively, that control for the incidence of banking crises. The bottom row in Table 4 repeats our baseline results for exports from Table 3 (these results are the same in both the left and right panels).

Table D.1. Regression Results for Models (5), (7) and (9) for Different Definitions of the Exchange Rate (1990 - 2022)

	Independent depreciation episodes						All the same (REER) depreciation episodes					
	10 percent		20 percent		30 percent		10 percent		20 percent		30 percent	
	Coef.	T-stat.	Coef.	T-stat.	Coef.	T-stat.	Coef.	T-stat.	Coef.	T-stat.	Coef.	T-stat.
Bilateral (nominal)	-0.14	-2.68	-0.13	-2.45	-0.14	-2.32	-0.13	-3.13	-0.32	-3.24	-0.60	-3.00
Bilateral (real)	-0.31	-3.41	-0.31	-2.95	-0.45	-2.57	-0.28	-5.65	-0.40	-3.17	-0.53	-1.82
NEER	0.00	-0.11	-0.01	-0.44	0.00	-0.16	-0.13	-2.34	-0.44	-3.40	-0.71	-3.15
REER	-0.40	-3.16	-0.69	-3.25	-0.80	-2.03	-0.40	-3.16	-0.69	-3.25	-0.80	-2.03

Notes: This table shows regression results using different exchange rate definitions. The left-hand-side panel allows the large depreciation dummy to be defined according to fluctuations in the respective exchange rate variable. The right-hand-side panel uses the same set of large depreciation dummies (based on the REER) across all regressions. Each panel shows $\beta_1 + \beta_2 + \beta_3 + \beta_4$ and the accompanying T-statistics for models (5), (7) and (9) that examine 10-, 20- and 30-percent depreciations, respectively (we use Newey-West standard errors throughout). Going from the left to the right panel highlights the role that identification of large depreciation episodes plays in our regressions.

As expected, in our sample nominal exchange rates—whether bilateral or trade-weighted—identify too many large depreciation episodes, painting a misleading picture because these episodes ignore the effects of exchange rate pass-through into inflation. Table 4 shows that real exchange rates—whether bilateral or trade-weighted—that account for post-depreciation pass-through yield larger point estimates of trade elasticities. REERs provide the most comprehensive view of exchange rate fluctuations relative to all major trading partners and, not surprisingly, yield the largest elasticity estimates.