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Dominant currencies and the export supply channel

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Abstract

Dominant currency pricing (DCP) weakens the demand-side effects of exchange rate changes on exports (Gopinath et al., 2020). However, adjustment in the export sector can still occur through other supply-side channels. With bilateral trade data at the HS2-product level, panel fixed-effects regressions and an instrumental variables (IV) approach, this paper presents several novel findings: (1), a depreciation of an exporter's currency against the US-dollar increases total export volumes between non-US countries, whereas bilateral exchange rates matter very little. (2), there is no statistically significant increase in average exports per firm (the intensive margin), while the aggregate export response is mainly driven by an increase in the number of exporting firms (the extensive margin). (3), there is substantial heterogeneity in the export response to exchange rates against dominant currencies. Market concentration, approximated by the Herfindahl-Hirschman Index (HHI), reduces the response of both the extensive and intensive margins to the US-dollar exchange rate. These results highlight an "export supply channel" of exchange rates in a world with dominant currencies, deepen our understanding of aggregate export adjustment and further underline the heterogeneous export response in different sectors to exchange rate changes.

Keywords: Exchange rates, dominant currencies, extensive margins of trade, intensive margins of trade, export heterogeneity.
JEL codes: F14, F31, F41.

Non-technical summary

A few currencies play an out-sized role in global trade and the US-dollar is often highlighted as the dominant currency (Boz et al., 2020). Trade prices set in the US-dollar, in combination with ”sticky prices” in that currency, has implications for how exchange rate changes affect external trade between non-US economies. The reason is that a depreciation of the value of the exporter's currency against the US-dollar do not prompt foreigners to increase their demand for exported goods and services, as the price is fixed in US-dollars. From the exporter's point of view, this means that the effect of exchange rate changes on average exports per firm (the intensive margin) are muted, whereas export profits in the domestic currency changes.

Although some exporters do not change their foreign export price following an exchange rate change, new exporters are not necessarily bound by the (sticky) prices set by incumbent firms and might find it profitable to enter the export market. Incumbent exporters might also start selling more products when profits in the export sector increases. These extensive margins of trade tend to be important in both theoretical models and empirically.

This paper presents several new findings on the export effect of exchange rates changes: (1), bilateral trade between non-US economies increases when the exporter's currency depreciates against the US-dollar, whereas the bilateral exchange rate tends to matter very little. (2) average exports per firm (the intensive margin) does not seem to react to the bilateral or the US-dollar exchange rate, which is what one would expect if prices are sticky and set in a dominant currency. The aggregate export response is instead driven by an increase in the number of exporting firms (the extensive margin), highlighting an ”export supply channel” of exchange rates against dominant currencies. (3), export adjustment to exchange rates against dominant currencies is highly heterogeneous across exporters. Higher concentration reduces the reaction of total export volumes, the number of exporters and average exporters per firm to a depreciation of the US-dollar exchange rate and thus underline the heterogeneous response across different exporters.

1. Introduction

Global trade is invoiced in a small number of currencies and the US-dollar is the most commonly used (Goldberg and Tille 2008, Gopinath 2015 and Boz et al. 2020). This fact has given rise to the dominant currency pricing (DCP) (Gopinath et al., 2020), as an alternative to producer currency pricing (PCP) or local currency pricing (LCP), commonly used in modern macro models. With DCP and sticky prices, a depreciation of the exporter's currency does not alter export prices for foreigners and, in turn, does not lead them to increase their demand for exports, at least in the short run (Gopinath et al., 2020). Instead, exporters tend to keep their foreign export price stable and absorb exchange rate movements in their mark-up's (Berman et al., 2012). Since domestic consumers also face a sticky foreign price, the exchange rate channel operate primarily through the adjustable domestic price of imported products (IMF, 2019).

The reasoning of weak or non-existent export adjustment to exchange rate changes in the case of sticky foreign prices applies primarily to the reaction of average exports per firm (the intensive margin). Tenreyro (2019) and Obstfeld (2020) rightly point out that new exporters are not necessarily bound by the (sticky) prices set by incumbent exporters and might find it profitable to enter the export market when profits in the domestic currency rises. Incumbent exporters might also opt to expand the number of products they sell as it becomes more profitable. These extensive margins are important in both theoretical models of trade (Melitz 2003 and Bernard et al. 2011) and empirically (Hummels and Klenow 2005 and Fernandes et al. 2018).

This paper explores empirically how various export margins adjust to changes in bilateral exchange rates and the US-dollar exchange rate with data from the World Bank's Exporter Dynamics Database (EDD) (Fernandes et al., 2016). The database contains information on average exports per firm, average unit export values and crucially, the number of exporting firms and number of products exported for a large sample of mainly emerging market economies. The sample of exporters is different from much of the related literature to date, which has focused primarily on firm-level data for single, largely advanced, economies (Berthou and Fontagné 2008, Berman et al. 2012 and Tang and Zhang 2012) or on aggregate data (Giordano and Lopez-Garcia, 2019) and on the effect of bilateral exchange rates or effective exchange rates on export margins.

Several novel findings emerge from the empirical analysis. First, bilateral trade between non-US countries increase when the exporter's currency depreciates against the US-dollar, whereas bilateral exchange rates tend to matter very little.[1] Second, the intensive margin of exports (average exports per firm) does not seem to react to a depreciation of the US-dollar exchange rate, which is what one would expect if prices are sticky and set in a dominant currency. Instead, the export response is driven by the extensive margin (the number of exporting firms) and is evidence for the "export supply channel" of exchange rates as highlighted by Tenreyro (2019) and Obstfeld (2020).[2] In an attempt to deal with endogeneity, an instrumental variables (IV) approach is used with US monetary policy shocks as an instrument for the US-dollar exchange rate (Matheson and Stavrev 2014, IMF 2014b and IMF 2019). The 2SLS-estimates confirm the baseline results: if the exporter's currency depreciates against the US-dollar, export production is expanded, but mainly through the extensive export margin.

While the results are suggestive of an active firm extensive margin to exchange rates against dominant currencies, there is no evidence for the "product extensive margin", that is that incumbent exporters increase the number of products exported following a depreciation of the bilateral or US-dollar exchange rate.

Third, export adjustment to exchange rates against dominant currencies is highly heterogeneous across exporters. Like the findings in Berman et al. (2012), the estimated export response to the US-dollar exchange rate are affected by the degree of market concentration, approximated by the Herfindahl-Hirschman Index (HHI). Higher concentration reduces the reaction of total export volumes, the number of

[1] This focus is different from Gopinath et al. (2020), who focus on the change in trade when the importers currency change against the US-dollar, whereas this paper focuses on the trade adjustment when the exporters currency change against the US-dollar.

[2] Cooke (2014) also show in a two-country general equilibrium model that under incomplete pass-through, a depreciation of the exchange rate generates firm entry and an expansion in the extensive margin of exports because increased demand dominates the rising costs of production.

exporters and average exports per firm to a depreciation against the US-dollar.

Finally, export adjustment appears to be asymmetric to exchange rate depreciation's (export volumes increase) and appreciations (exports do not change significantly) against the US-dollar, driven by the extensive margin. This finding can be rationalized by that fact that entry costs are usually substantial and that exporters tend to continue exporting when their current net profits are negative, thus avoiding the costs of re-establishing themselves in foreign markets when conditions improve (Das et al., 2007).

For policy makers at central banks, the findings in this paper suggest that conventional demand-side effects of exchange rate changes through export activity are muted, in line with the DCP-paradigm (Gopinath et al., 2020). Instead, an exchange rate depreciation that lead to higher profits in the domestic currency can stimulate export supply. This channel of export adjustment to exchange rate changes is rarely emphasised, but appear to be important for small open economies that use dominant currencies in trade.

The rest of the paper is organized as follows: Section 2 briefly presents the decomposition of exports into the various export margins and the data used to match the decomposition. Section 3 presents the econometric framework, baseline results and several robustness checks. Section 4 concludes.

2. Method and data

A country's exports can be decomposed into an intensive and extensive margin. As the purpose of this paper is to examine the response of these margins to bilateral exchange rates and exchange rates against dominant currencies, the export decomposition used in this paper is first briefly presented and mapped into a simple gravity framework. Then, the data used to match the export decomposition are described.

2.1 Decomposition of exports

To fix ideas for the empirical investigation, (1) provides a simple decomposition of total bilateral exports into the firm extensive and intensive margin, following Mayer and Ottaviano (2008). Let X be total exports between two countries i and j, which consist of two margins: the number of exporting firms N_{ij} and the average exports per exporting firm x_{ij}.

$$X_{ij} = \underbrace{N_{ij}}_{\text{Number of firms}} \times \underbrace{x_{ij}}_{\text{Average exports per firm}} \tag{1}$$

Consider, for example, the case where exporters set their prices in a dominant currency like the US-dollar, and prices are ”sticky” for some period (as in Calvo 1983). If all export prices are sticky in the foreign currency, they do not change following a depreciation of the exporter's currency (but prices obviously change in the exporter's currency). There is therefore no reason for foreigners to demand more exports, leaving x_{ij} unchanged in (1). At the same time, the exchange rate depreciation leads to higher profits in the export sector which incentivizes previous non-exporters to become exporters, thus increasing N in (1).[3]

Regressions that utilizes aggregate trade data could mask the true exchange rate effects on exports. In Section 3, I therefore first examine the response of total export volumes (X) to bilateral exchange rates and the US-dollar exchange rate and then split the response across the number of exporting firms (N) and average exports per firm (x).

There are additional margins through which exporters might adjust beyond exporter entry or increases in average exports per firm. For example, exporters might be induced to expand the number of products sold if profits in the exporting sector increases.[4] In (2), total export volumes are therefore further decomposed into the

[3] Of course, other general equilibrium effects are at play. Workers in the domestic sectors might demand higher wages to compensate for the increase in domestic prices brought on by higher import prices. This would offset the competitiveness gains brought on by the currency depreciation in the longer run. However, wages tend to be ”sticky” for longer than trade prices.

[4] For example, Hummels and Klenow (2005), looking at products exported, find that around 60 percent of global trade is driven by new products rather than more exports of existing products.

number of products exported, Z_{ij}.

$$X_{ij} = \underbrace{N_{ij}}_{\text{Number of firms}} \times \underbrace{Z_{ij}}_{\text{Number of products}} \times \underbrace{x_{ij}}_{\text{Average exports per firm by each product}} \quad (2)$$

Note that there are now two extensive margins: the number of firms and the number of products exported. Moreover, the intensive margin is now defined more narrowly as average exports per firm by each product sold. To fully examine the reaction of the extensive margin of exports, the response of the number of products exported to bilateral and dominant exchange rates is also investigated in Section 3.

The export decomposition can easily be mapped into a simple gravity framework. This can be shown by taking logs of the variables in (1) as in (3). In this simple panel gravity equation, total bilateral exports, the number of exporters or average exports per firm is explained by conventional gravity determinants captured by α_{ij} (e.g, language, border, distance or the initial level of trade) and the economic mass of the exporters and importer (GDP_i and GDP_j) that capture supply and demand conditions, as well as the exchange rates between the exporter's and importer's currency and the US-dollar exchange rate.[5]

$$\ln X_{ij,t} = \ln N_{ij,t} + \ln x_{ij,t} = \alpha_{ij} + \beta_1 \ln GDP_{i,t} + \beta_2 \ln GDP_{j,t} + \beta_3 \ln e_{ij,t} + \beta_4 \ln e_{i\$,t} \quad (3)$$

This simple gravity equation will be used in Section 3 to estimate the export response of the various export margins to bilateral and US-dollar exchange rates.

2.2 The Export Dynamics Database (EDD)

Until recently, data on the micro-structure of a country's exports has been sparse. Researchers have mostly relied on firm-level data for single countries in mainly advanced economies (Berthou and Fontagné 2008, Berman et al. 2012 and Tang and

[5] In Section 3, controls for other relative prices are also added as robustness checks.

Zhang 2012) or aggregate country exports (Giordano and Lopez-Garcia, 2019).

As this study is interested in examining the reaction of several export margins to exchange rate changes for a broader set of economies, very specific data are required. Fortunately, the World Bank has developed a database with exactly the data needed, the Exporter Dynamics Database (EDD) (Fernandes et al., 2016). The EDD contains a number of structural characteristics and dynamics of exporters at an aggregate, product and bilateral level and is based on the universe of export transactions directly from customs data.[6] The database is available at many levels of aggregation and covers a large number of exporting countries (mainly emerging market economies) and an even greater number of importers.[7] The database used in this paper has observations for the combination of exporter $\times$ HS2 product $\times$ importer $\times$ year. This version contains measures on the basic characteristics and dynamics of the export sector (e.g., number of exporters, average exports per firm and average unit export values). The data stretches over 1997–2014 and the panel is unbalanced. The exporting countries used, their share in the number of observations, their currency and exchange rate regime is outline in Table A.1 in Appendix A.

The main variables of interest in this paper is bilateral total export volumes, the number of exporting firms and average exports per firm. I follow the decomposition in (1) to construct total nominal exports ($X^n_{ij} = N_{ij} \times x^n_{ij}$) between two countries i and j from the data in the EDD (dropping product subscript p for simplicity). Since the export values are nominal, average unit export values are used to obtain total export volumes. This is done by first defining $x_{ij} = x^n_{ij}/p^x_{ij}$ as real average exports per firm, where p^x is average unit export values. Total export volumes is $X_{ij} = N_{ij} \times x_{ij}$.

Like Gopinath et al. (2020), I focus on non-commodities in the analysis, thereby excluding HS2-product codes below 28, as well as the HS2-codes 71-83 as these are largely internationally traded commodities. In addition, the United States as an importing country is excluded in the estimations. This yields a data set with

[6] In this sense, the EDD is very similar to other databases that are based on firm-level data, like the ESCB/Halle Institute CompNet https://www.comp-net.org/.

[7] https://www.worldbank.org/en/research/brief/exporter-dynamics-database

$\sim$ 410,000 observations. In Appendix B I also present baseline estimates where all HS2-product codes are included.

3. An empirical exploration

Armed with the export decomposition and data from Section 2, this section estimates the impact of bilateral and US-dollar exchange rates on total export volumes and export margins.[8] Table 1 outlines the main variables and controls used in the baseline regressions. Exchange rates against the US-dollar and the bilateral exchange rates are expressed in currency units of the exporting economy. This means that an increase in e_{ij} or $e_{i\$}$ represents a depreciation of the exporting economy's currency relative to the importers' currency or the US-dollar. The focus on the exporter's currency is natural, given that the purpose of the paper is to examine how the different export margins adjust to exchange rate changes.

Real GDP of the exporter and importer attempt to capture supply and demand conditions of the exporter and importing country respectively. Moreover, gross imports at the HS2-product level of the importer is included to further capture specific import demand in narrow product groups. Exchange rates and real GDP are obtained from the World Development Indicators. Total imports in HS2-products of the importer is retrieved from the World Trade Integrated Solution (WITS) and utilizes the HS1996 vintage that covers the whole period included in the EDD.

The regression in (4) is a panel representation of the simple gravity framework in (3) (adding the time-subscript t to denote years), where Y is either nominal exports (X^n) in the exporters currency, average unit export values (P^x) in the exporters currency or export volumes (X) from exporting country i to an importing country j:

$$\ln Y_{ijp,t} = \beta \ln e_{ij,t-1} + \beta_{\$} \ln e_{i\$,t-1} + Controls + FE_{ijp} + FE_{pt} + \varepsilon_{ijp,t} \qquad (4)$$

[8] While other currencies than the US-dollar could potentially be dominant within certain regions, like the euro in the EU, US-dollar invoicing shares point to strong global dollar dominance (Boz et al., 2020). This is also the case in the EDD, see Figure A.1 Nonetheless, I also examine the role of the euro in Appendix A.

Table 1: Variables used in the baseline regressions

Variable	Description	Unit
X^n_{ijp}	Nominal exports	i's currency
P^x_{ijp}	Average unit export values	i's currency
X_{ijp}	Export volumes	Volumes
N_{ijp}	Number of exporters	Count
x_{ijp}	Average export volumes	Volumes
e_{ij}	Bilateral exchange rate	i's currency unit / j's
$e_{i\$}$	US-dollar exchange rate	i's currency unit / $
GDP_i	Real GDP of i	Volumes
GDP_j	Real GDP of j	Volumes
M_{jp}	Imports by HS2-product	Values, in $

Note: Data on exports are from the EDD, exchange rates and real GDP are obtained from the World Development Indicators and gross imports at HS2-product-level per importing country is from the World Integrated Trade Solution (WITS).

Bilateral HS2-product trade data are used to obviate the risk of reverse causality, i.e. that exports at the aggregate level cause exchange rates to move. Therefore, subscript p denotes HS2-product groups. e_{ij} is the bilateral exchange rate and $e_{i\$}$ the US-dollar exchange rate (recall that an increase in the exchange rate denotes a depreciation of the exporter's currency). Both exchange rates are lagged one year to diminish concerns of endogeneity. $Controls$ are a vector of coefficients and variables capturing demand or supply conditions in the exporting and importing economy, namely real GDP of the exporter and importer country, as well as the total imports at HS2-product-importer level, all in natural logs.

To capture time-invariant heterogeneity in a given market, FE_{ijp} is added which is a exporter $\times$ HS2-product $\times$ importer pair fixed-effect (controlling for, for example distance, language or the initial level of trade in HS2-products). In an attempt to also control for global product level shocks that could cause both exchange rates, unit export values and export volumes to move, FE_{pt} is added, which is a HS2-product $\times$ year fixed-effect and $\varepsilon_{ijp,t}$ is the error term.

Although the regressions include the fixed-effects, the level of GDP of the exporter and importer, and gross imports of HS2-products, it might not be enough to capture supply and demand conditions affecting the relationship between exports and exchange rates. Moreover, not all relevant relative prices are considered. The preferred empirical gravity equation (see Bergstrand et al. 2015) would add exporter $\times$ year and importer $\times$ year (or even exporter $\times$ HS2-product $\times$ year and importer $\times$ HS2-product $\times$ year) fixed-effects to better capture time-varying importer demand and supply factors of the exporter as well as relative prices.[9] However, these fixed-effects would absorb the bilateral and US-dollar exchange rates of interest to this study. The interpretation of the regression results in the following should thus be seen as predictive relationships, rather than structural estimates.

3.1 Exchange rate effects on nominal exports

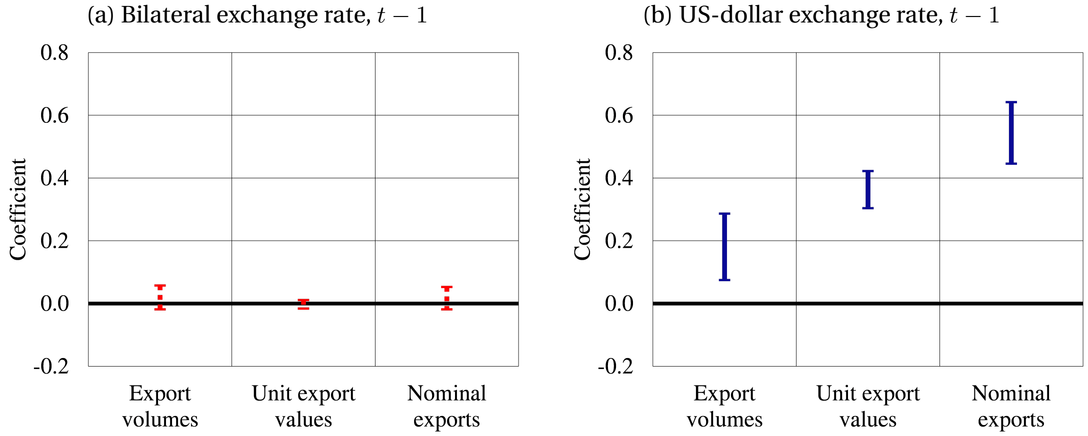
The DCP paradigm predicts that export prices (in the exporter's currency) should react to the exchange rate against the dominant currency, in this case the US-dollar, and not the bilateral exchange rate. Moreover, most adjustment in nominal exports (again in the exporter's currency) should come from price adjustment, and not from quantities.

Estimating (4) for nominal exports, export volumes and average unit export values reveals that in the exporter's currency, nominal exports are not statistically significant related to the bilateral exchange rate, see Figure 1 which plots the point estimates and 95 % confidence intervals (Table A.2 in Appendix A shows the full results).

All controls are used for quantity, price and unit value regressions and the sample is held the same across regressions. This means that the estimated exchange rate effects on prices and quantities sums up to the exchange rate response of nominal

[9] In Appendix A, robustness checks are performed when exporter and importer price levels (unit export values or GDP deflators) are taken into account in the estimations.

Figure 1: Exchange rate impact on export volumes, prices and values



Note: The dashed (solid) high-low bars are 95 percent confidence intervals for the bilateral exchange (US-dollar exchange rate) retrieved from estimating (4). Robust standard errors are clustered at the exporter×importer level (3,572). All regressions include 362,165 observations and exporter×importer×product and HS2-product×year fixed-effects, as well as controls for (natural log of) the exporting and importing country GDP as well as total imports of HS2-products in the importing country.

exports.

Following a depreciation of the US-dollar exchange rate by one percent however, nominal exports increase by 0.54 percent. Export volumes increase by 0.18 percent and average unit export values in the exporter's currency increase by close to 0.36 percent, more than two thirds of the impact on total nominal exports. This result is evidence for a "DCP-centric" view of export pricing for the countries included in the EDD: export prices react little – or not at all – to bilateral exchange rates, but react strongly to the US-dollar exchange rate which drive the response of nominal exports. The control variables (real GDP of the exporter, importer and total imports at the HS2-product-level of the importer) are significant and of the expected signs.

3.2 Exchange rate effects on export margins

As seen in Figure 1, total export volumes do adjust to the US-dollar exchange rate. To further investigate the details of the response, Y in (4) is now either total export volumes (X), the number of exporters (N) or the average exports per firm (x). The baseline OLS estimates are presented in Figure 2 with 95% confidence intervals.[10] The number of exporters, average exports per firm and total export volumes are not statistically significant related to the bilateral exchange rate (left panel).

The right panel shows the estimated coefficient for the US-dollar exchange rate. A depreciation of the exporter's currency against the US-dollar with one percent is associated with an increase in total export volumes of 0.18 percent. This result is driven by the number of exporting firms that increase by 0.19 percent. Again, average exports per firm is not statistically significantly related to the US-dollar exchange rate.

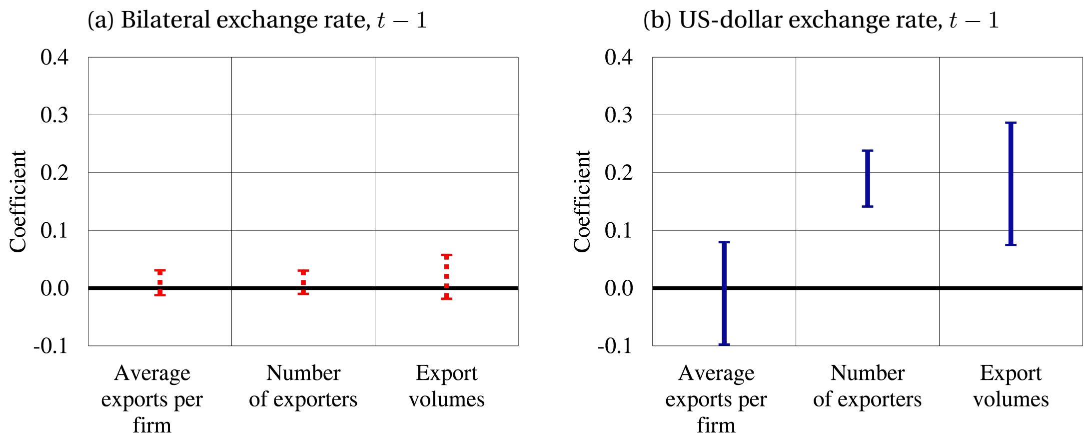
For a smaller sample of exporting countries where invoicing data is available at a country-level (from Boz et al. 2020), the results in Figure 2 are replicated with exchange rate interactions for the US-dollar ($S_i^{\$}$) invoicing share in Table A.4 in Appendix A. Increasing the country-level invoicing share increases the sensitivity of export values, the number of exporters and average exports per firm to the US-dollar exchange rate.[11]

In Appendix C, robustness checks are also performed where a dynamic lag specification as well as a dynamic lag specification in log-changes, similar to Gopinath et al. (2020), are used. The baseline results of export volumes being driven by the number of exporters to changes in the US-dollar exchange rate are not altered by the choice of specification or variable transformation.

[10] The full regression table is available in appendix A Table A.3.

[11] The included exporting countries in this smaller sample are Albania, Bulgaria, Botswana, Chile, Colombia, Costa Rica, Croatia, Denmark, Morocco, Mauritius, Norway, Spain, Romania, Thailand and Timor-Leste.

Figure 2: Exchange rate impact on export volumes and the extensive and intensive margin



Note: The dashed (solid) high-low bars are 95 percent confidence intervals for the bilateral exchange (US-dollar exchange rate) retrieved from estimating (4). Robust standard errors are clustered at the exporter×importer level (3,572). All regressions include 362,165 observations and exporter×importer×product and HS2-product×year fixed-effects, as well as controls for (natural log of) the exporting and importing country GDP as well as total imports of HS2-products in the importing country.

One final econometric issue should be highlighted. As discussed in detail by Silva and Tenreyro (2006), the OLS estimation of (4) can be biased because of log-linearizing the error term. I follow their recommendation and also use a PPML-estimator (as in 5) that allows the dependent variable to be expressed in levels, and hence, to include zero trade flows and avoids inconsistent estimations as a consequence of log-linearizing the error term.[12]

$$Y_{ijp,t} = \exp\left(\beta \ln e_{ij,t-1} + \beta_{\$} \ln e_{i\$,t-1} + Controls + FE_{ijp} + FE_{pt}\right) + \varepsilon_{ijp,t} \quad (5)$$

Estimating (5) yields qualitatively the same results as the OLS estimates. The results are in Table A.5 in Appendix A. The number of observations and clusters are higher with the PPML-estimator than with OLS due to the inclusion of zero trade flows and the estimates of the exchange rate coefficients are a bit higher, both for

[12] I use the Stata command ppmlhdfe created by Correia et al. (2019).

the bilateral exchange rates (upper row, column 1-3) and the specification that includes the US-dollar (lower row, column 4-6). A depreciation of the US-dollar exchange rate with one percent is associated with an increase in total export volumes of roughly 0.43 percent. Again, the result and is mainly driven by an increase in the number of exporters of 0.29 percent, with no statistically significant impact on average exports per firm.

These results highlight how exporters adjust when their currency depreciates against an importer's currency and against a dominant currency like the US-dollar. For the sample of exporters in the EDD, the intensive margin does not seem to react to a depreciation of the bilateral exchange rate or the US-dollar exchange rate, which is what one would expect if export prices are sticky and set in a dominant currency like the US-dollar. However, there is still extensive margin adjustment to the US-dollar exchange rates, which expands export production as pointed out by Tenreyro (2019) and Obstfeld (2020).

That the extensive margin drives the export response to exchange rate changes contrast with some of the earlier literature. For example, Campa (2004) find with Spanish firm-level data that trade adjustments due to exchange rates mainly occur through quantities sold by incumbents, rather than through changes in the number of exporting firms. In a more recent study, Berman et al. (2012) show on the other hand with French firm-level data that an exchange rate depreciation increases the probability of becoming and exporter, and for incumbents to remain an exporter, like the analysis in this paper.

3.3 Additional robustness

In an attempt to control for relative prices, robustness checks are presented in Appendix A, where the exporter's and importer's unit export values are added to the regression, as producer prices are generally not available for the countries included in the EDD. Results are in column (1)-(3) in Table A.6. The coefficient on the US-dollar is a bit smaller than the baseline results, but the pattern of number of exporters increasing and average exports per firm not reacting remain.

To fully control for demand factors, the bilateral exchange rate is dropped and importer×HS2-product×time fixed-effects are added in column (4)-(6) in Table A.6.[13] The results are of somewhat smaller magnitude when importer×HS2-product×time fixed-effects are added, but the baseline result of export volumes being driven by the number of exporters remain.

Other variables could better reflect relative price levels than unit export values. As such, the GDP deflator of the exporter and importer are thus added in lieu of the unit export values as a robustness check. The results are in Table A.7 and compared to the baseline results and results which control for export unit values, the regressions with GDP deflators deliver stronger coefficients on both the extensive and intensive exports margins. Qualitatively however, the baseline results are robust: a depreciation increases strongly the number of exporters and less so average exports per firm.

Other currencies than the US-dollar are also used to settle international trade transactions. The euro have risen in prominence over the past decades and the euro area currently comprises of 19 member states. In Table A.8 in Appendix A, the euro is added as an explanatory variable alongside the bilateral exchange rate and the US-dollar. Moreover, euro area countries as destination countries are excluded from the estimation. Global controls for world real GDP, world export volumes, the world price level (GDP-deflator), real oil prices and the VIX are added in lieu of the HS2-product×year fixed-effects. Quantitatively, the US-dollar appear to be the dominant currency for the EDD sample, mirroring the findings of Gopinath et al. (2020). However, the euro exchange rate is strongly correlated with the US-dollar exchange rate. Certainly, the euro is the dominant currency in the EU and Europe, as visible in Figure A.1 in Appendix A. The difference is that the US-dollar represent a large invoicing share for countries that do not trade much with the US, whereas the euro is important in invoicing largely due to reasons related to direct trade and participation in global value chains, see Georgiadis et al. (2020).

[13]When these set of fixed-effects are added, it is no longer possible to identify both the bilateral and the US-dollar exchange rate and thus, the bilateral exchange rate is dropped.

3.4 Identification with US monetary policy shocks

Although disaggregated product-level data diminishes concerns of reverse causality (i.e. that exports cause changes in the exchange rate) and the baseline regression utilizes one exchange rate lag to diminish concerns about endogeneity (and also includes exporter $\times$ HS2-product $\times$ importer and product $\times$ year fixed-effects as well as controls for supply conditions in the exporting economy and demand of the importers), the US-dollar exchange rate is still an endogenous variable. Some omitted variables not captured by the fixed-effects or controls could potentially affect both the US-dollar exchange rate and exports between non-US countries.

In an attempt to deal with endogeneity, an IV-estimation strategy is used that relies on the identification of high-frequency US monetary policy shocks as an instrument for the US-dollar exchange rate, obtained through a sign-restricted VAR (see Matheson and Stavrev 2014 and IMF 2014b).[14] The three-variable VAR utilizes daily data for 10-year bond yields in the United States, the S&P500 stock market index and the US nominal effective exchange rate. The identifying contemporaneous sign-restrictions are set so a monetary tightening leads to higher bond yields, weaker stock market and an appreciation of the US nominal effective exchange rate.[15]

The US monetary policy shocks lead to US-dollar exchange rates movements that are likely exogenous to trade flows among non-US countries. The estimated daily shocks are accumulated to the annual frequency to match the data in the EDD and are interacted with exporters and importers reserves as a share of GDP, similar to IMF (2019). Table 2 shows the results from the second stage of the 2SLS estimates. As is evident from the table, a depreciation of the US-dollar exchange rate leads to an increase in total export volumes, driven by an increase in the number of exporters and with a smaller effect on average exports per firm.

While the US monetary policy shocks pass several standard tests (weak instrument, underidentification and test for over-identifying restrictions) for the extensive margin, the instrument is weaker for total export volumes and average exports per firm.

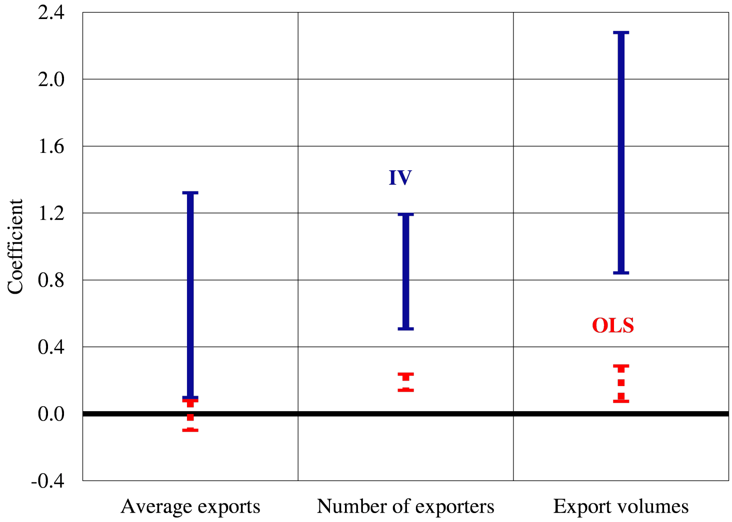
[14] The author thanks Gustavo Adler and Carolina Osorio Buitron for sharing these estimates.
[15] For more details, see Appendix D.

Table 2: 2SLS estimates

	$\ln X_{ijp}$	$\ln N_{ijp}$	$\ln x_{ijp}$
$\ln e_{ij,t-1}$	-0.029	-0.013	-0.016
	(0.026)	(0.013)	(0.016)
$\ln e_{i\$,t-1}$	1.561***	0.851***	0.710**
	(0.366)	(0.175)	(0.312)
Underidentification test^{a}	0.000	0.000	0.000
Hansen J-test^{b}	0.040	0.290	0.062

The first thing to note is that the IV estimates are magnitudes larger than the OLS estimates, see Figure 3. This could be because the estimated 2SLS coefficient is the local average treatment effect (LATE) as compared to the OLS attempt of estimating the average treatment effect (ATE). The presence of heterogeneous groups in the EDD database could be one cause of this difference. However, it could also be a sign that the US monetary policy shocks are not are not exogenous to trade between non-US countries and thus not a valid instrument.

Figure 3: IV estimates vs OLS



3.5 Other measures of the extensive margin

The baseline result that entry is affected by the US-dollar exchange rate is also replicated for other measures of entry by replacing the dependent variable in (4) for these other measures, namely the entry rate of new exporting firms ($\times$ 100) and the share of entrants in total export value (TEV) ($\times 100$). The results are presented in Table 3. Similar to the baseline results using the number of exporters as a measure of the extensive margin, a depreciation against the US-dollar also increase the *rate* of entry of new exporters as well as the *share* of entrant's exports in TEV.

Although a depreciation against the US-dollar is estimated to induce entry into the exporting sector, there is no evidence for the "product extensive margin" of incumbents or surviving entrants as outlined in (2). That is, that incumbents introduce new products following a depreciation of the exporter's currency against the importer's currency or the US-dollar. If anything, the number of HS6-products is *negatively* correlated with the US-dollar exchange rate, see Table 4.

Table 3: Other measures of exporter entry

	Firm entry rate	Share of entrants in TEV
$\ln e_{ij,t-1}$	-0.300	-0.325**
	(0.185)	(0.155)
$\ln e_{i\$,t-1}$	0.527**	0.837***
	(0.263)	(0.264)
Obs	256,590	230,494
Clusters	3,541	3,066

Note: *, **, and *** denote $p < 0.10$, $p < 0.05$, and $p < 0.01$, respectively. Robust standard errors are clustered at the exporter × importer level and are reported in parenthesis. All regressions include exporter × HS2-product × importer and HS2-product × year fixed-effects, as well as controls for (natural log of) the exporting and importing country's GDP as well as total imports of HS2-products in the importing country.

3.6 Heterogeneous export adjustment

The baseline results are average exchange rate effects estimated across the whole sample. Heterogeneity across different types of exporters and market conditions might however affect the exchange rate impact. One way of examining the heterogeneity of export adjustment is to explore the role of market concentration. If a market (defined as a exporter×HS2-product×importer×year combination) is characterized by a higher proportion of exports that are dominated by a few firms, the exchange rate response should be weaker. For example, Berman et al. (2012) show with French firm-level data that the response of export quantities to exchange rate changes are strongly affected by the degree of market concentration, approximated by the Herfindahl-Hirschman Index (HHI). There are several reasons for this prediction. Fixed costs to enter the export market can lead to only high-performance firms exporting. These firms tend to absorb exchange rate movements in their markup. More performance heterogeneity can also reduce the impact of exchange rate changes on the extensive margin. If concentration is initially high, there might be

Table 4: Other measures of the extensive margin

	HS6-products per exporter	Product entry, incumbents	Product entry, survivors	New products in TEV, incumbents	New products in TEV, survivors
$\ln e_{ij,t-1}$	-0.001	-0.291**	-0.272	-0.212	-0.206
	(0.001)	(0.137)	(0.188)	(0.143)	(0.196)
$\ln e_{i\$,t-1}$	-0.009***	-0.005	0.187	-0.081	0.082
	(0.003)	(0.220)	(0.286)	(0.221)	(0.296)
Obs	231,069	256,514	256,799	256,514	256,799
Clusters	3,190	3,539	3,542	3,539	3,542

Note: *, **, and *** denote $p < 0.10$, $p < 0.05$, and $p < 0.01$, respectively. Robust standard errors are clustered at the exporter × importer level and are reported in parenthesis. All regressions include exporter × HS2-product × importer and HS2-product × year fixed-effects, as well as controls for (natural log of) the exporting and importing country's GDP as well as total imports of HS2-products in the importing country.

less scope to enter the market and successfully compete with incumbent firms.

In regression (6), the HHI is therefore added as a control alongside its interactions with the bilateral and US-dollar exchange rate to explore how market concentration affects the exchange rate impact.

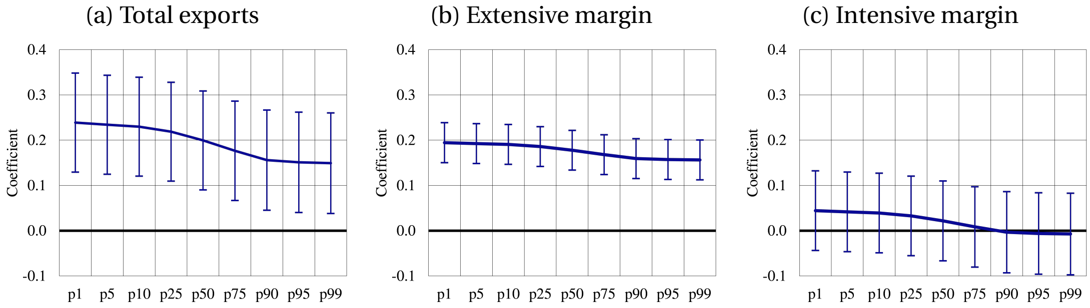
$$\ln Y_{ijp,t} = \beta \ln e_{ij,t-1} + \beta_{\$} \ln e_{i\$,t-1} + Controls + FE_{ijp} + FE_{pt} + \\ \delta \text{HHI} + \delta_{HHI} \ln e_{ij,t-1} \times \text{HHI} + \delta_{HHI,\$} \ln e_{i\$,t-1} \times \text{HHI} + \varepsilon_{ijp,t} \tag{6}$$

Figure 4 plots the estimated 95% confidence intervals of the US-dollar effect across percentiles of the HHI distribution. The results show that higher concentration reduces the reaction of total export volumes, the number of exporters and average exports to a depreciation against the US-dollar.[16]

Another important factor governing the export response to exchange rate

[16]The HHI at the 10^{th} percentile is 0.14 and 0.92 at the 90^{th}, computed across the whole sample. Table A.9 in Appendix A reports the results.

Figure 4: Role of HHI for US-dollar impact



Note: The point estimates are the solid lines and the high-low bars represent 95 percent confidence intervals.

changes is participation in global value chains (GVCs). To fully examine how GVC-participation affect how the various export margins respond to exchange rate changes, one would need data at a bilateral HS2-product-level and preferably indices based on currencies and not countries (De Soyres et al., 2021). These types of data are not readily available for the mainly emerging market economies in EDD. There are however aggregate data on the exporting country's participation in GVCs for a large sample of countries available from the database UNCTAD-EORA.[17] While imperfect, these data can serve as proxy for GVC participation at these more granular levels. Table A.10 in Appendix A shows that the HHI interactions are still significant with the inclusion of measures of GVCs. The GVC interactions with the exchange rates are also negative as expected, but the results are imprecise with large standard errors.[18]

[17] https://worldmrio.com/unctadgvc/

[18] Additional factors beyond market concentration or GVCs might affect the exchange rate response. For example, Berman and Berthou (2009) show that the aggregate exchange rate impact on export volumes can also be dampened by the degree of financial market imperfections. While this is certainly an interesting channel to investigate, the HS2-product level data in the EDD does not easily match with conventional measures of financial market imperfections and I thus leave it to future studies to investigate this channel for the export margin response to (dominant) exchange rates.

3.7 Asymmetric export adjustment

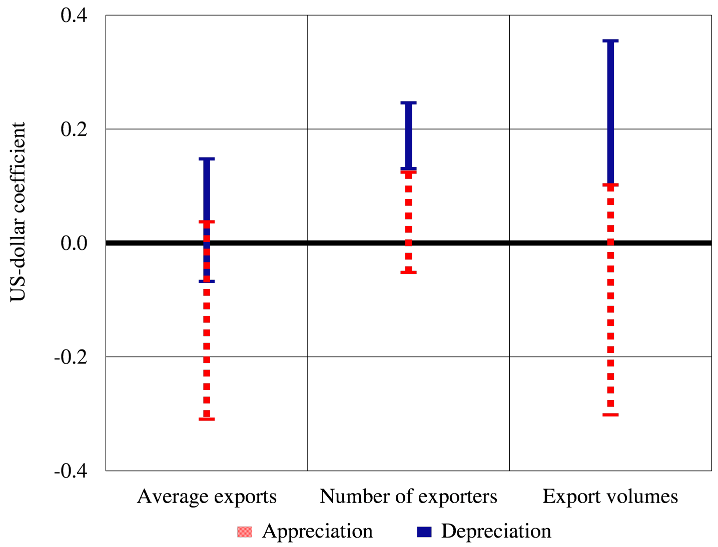
Is the response of the various export margins different to exchange rate depreciation's or appreciations against the US-dollar? Baldwin and Krugman (1989) show that there can be asymmetry in the entry/exit decision of firms in the presence of sunk entry costs, and that not all new entrants exit when an exchange rate appreciates. Empirically, Demian and di Mauro (2018) find that aggregate export volumes tend to react only to periods of appreciations, and not periods of depreciations. Moreover, they find that only large episodes of exchange rate changes tend to affect exports.

To examine this possibility, the sample is split into two groups: one, which includes only periods of depreciation's and another, containing data only for appreciations against the US-dollar exchange rate. The exchange rate response appear asymmetric and somewhat in contrast to Demian and di Mauro (2018) (Figure 5). A one percent depreciation of the US-dollar exchange rate is associated with an increase in total export volumes by 0.23 percent driven by increases the number of exporters by 0.19 percent, whereas an appreciation does not have a statistically significant effect on exports at conventional levels.

This asymmetry between periods of depreciations and appreciations is interesting. A depreciation is followed by entry into the export sector, whereas an appreciation is not followed by exporter exits and can be rationalized by that fact that entry costs are substantial. Exporters also tend to continue exporting when their current net profits are negative, thus avoiding the costs of re-establishing themselves in foreign markets when conditions improve (Das et al., 2007).

Are the asymmetric effects on the extensive margin also robust to large exchange rate movements? To investigate this possibility, large depreciation's and appreciations are classified as those US-dollar exchange rate movements that are at or above the 75^{th} percentile of depreciation's and appreciations in the full sample. Again, for total export volumes the coefficient estimates are greater and statistically significant for depreciation's against the US-dollar exchange rate, whereas periods of appreciations are largely insignificant, see Table A.11 in Appendix A.

Figure 5: Asymmetric adjustment to the US-dollar exchange rate



Note: The solid lines are the point estimates for depreciations against the US-dollar. The dashed lines are point estimates for periods of appreciations. The high-low bars are 95 percent confidence intervals. See Table A.11 in Appendix A.

4. Concluding remarks

Sticky export prices set in foreign (dominant) currencies might hamper export adjustment to exchange rate changes. This reasoning applies primarily to the intensive export margin (average exports per firm), whereas other extensive export margins are not bound by the sticky prices of incumbent firms. These margins might react to exchange rates changes, even in the case of dominant currency pricing (DCP).

With data for mainly emerging market economies (EMEs) covered by the Exporter Dynamics Database, this paper has provided empirical evidence that average exports per firm do not react to bilateral or US-dollar exchange rates, whereas a depreciation of the exporter's currency against the US-dollar induces entry into the exporting sector, highlighting a "export supply channel" of exchange rates. This effect is very different from the expenditure switching usually emphasised by policy makers at central banks.[19] For example, an exchange rate depreciation against the US-dollar might not immediately affect domestic production, but rather divert domestic production to export activity. However, entry into the exporting sector of previously domestic firms might increase production by expanding their new potential (international) market. Alternatively, new firms might enter the export sector directly without ever having any domestic production, which would lead to increasing overall production. The analysis in this paper is however silent on whether entry is driven by existing firms, new firms or whether the entry is associated with increasing domestic production overall or not.

At the same time, induced entry into the export sector might lead to productivity gains through "learning by exporting" (Girma et al. 2004 and De Loecker 2013).[20] This would increase the exporting economy's growth potential and is an effect of exchange rate movements that could be further studied in theoretical models with dominant currency pricing and sticky prices.

It should be noted that the analysis in this paper applies to the mainly emerging market economies in the EDD. Many advanced economies within the euro area, but also Europe more broadly, tend to invoice their exports in euros. An avenue for future research would be to explore intensive and extensive export margin adjustment to exchange rate changes and (perhaps different) dominant currencies for a broader sample of such advanced economies.

[19]A common way of describing the exchange rate channel among central banks goes something like this: a weaker exchange rate – a depreciation – impacts the economy in two main ways. Foreign goods become more expensive compared with domestically produced goods, decreasing imports and increasing exports. Higher demand for domestic goods contributes to a rise in economic activity, thereby contributing to inflationary pressures. With sticky prices and dominant currency pricing, the export channel would operate through entry of new exporting firms, whereas the inflationary pressures would primarily arise from a higher import price.

[20]Bernard and Jensen (1999) argue that while profitable firms tend to self-sort into exporting, the benefits of exporting for the firm are less clear.

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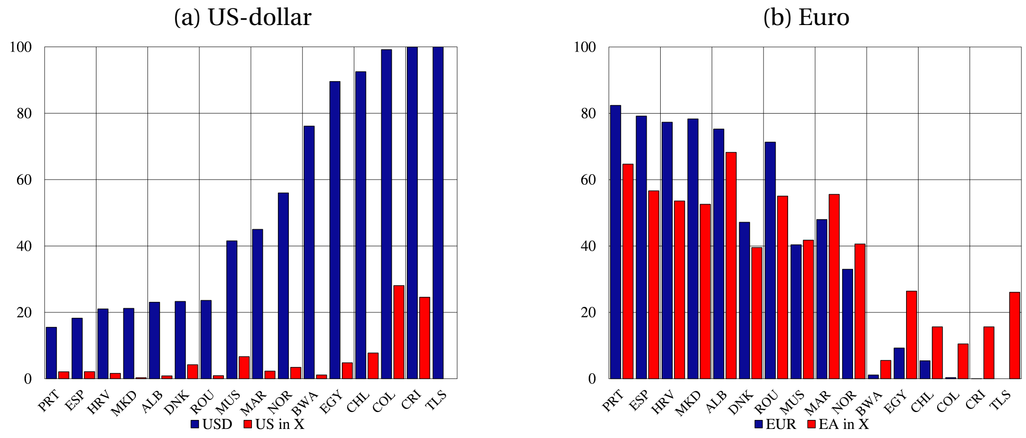
A. Additional tables and figures

Table A.1: Exporting countries in the sample

Country	ISO3	Share	Currency	FX regime in 2014 (IMF, 2014a)
Albania	ALB	0.58	ALL	Floating
Bangladesh	BGD	1.79	BDT	Stabilized arrangement, USD
Bolivia	BOL	0.5	BOB	Stabilized arrangement, USD
Botswana	BWA	0.67	BWP	Crawling peg, basket of currencies
Bulgaria	BGR	2.23	BGN	Currency board, EUR
Burkina Faso	BFA	0.36	XOF	Peg, EUR
Cambodia	KHM	0.6	KHR	Stabilized arrangement, USD
Cameroon	CMR	1.2	XAF	Peg, EUR
Chile	CHL	2.01	CLP	Free float
Colombia	COL	1.81	COP	Floating
Costa Rica	CRI	2.3	CRC	Stabilized arrangement, USD
Côte d'Ivoire	CIV	0.5	XOF	Peg, EUR
Croatia	HRV	1.49	HRK	Crawl-like arrangement, EUR
Denmark	DNK	6.65	DKK	Peg, EUR
Dominican Republic	DOM	1.65	DOP	Crawl-like arrangement, USD
Ecuador	ECU	1.91	USD	Dollarized
Egypt	EGY	2.18	EGP	Stabilized arrangement, USD
El Salvador	SLV	0.92	USD	Dollarized
Eswatini	SWZ	0.03	SZL	Peg, other currency than EUR or USD
Ethiopia	ETH	0.27	ETB	Crawl-like arrangement, USD
Gabon	GAB	0.06	XAF	Peg, EUR
Georgia	GEO	0.83	GEL	Floating
Guatemala	GTM	1.75	GTQ	Crawl-like arrangement, USD
Guinea	GIN	0.13	GNF	Stabilized arrangement, USD
Iran	IRN	1.02	IRR	Crawl-like arrangement, USD
Jordan	JOR	1.17	JOD	Peg, USD
Kenya	KEN	2.1	KES	Floating
Kuwait	KWT	0.24	KWD	Peg, basket of currencies
Kyrgyzstan	KGZ	0.41	KGS	Managed arrangement
Lao	LAO	0.11	LAK	Crawl-like arrangement, USD
Lebanon	LBN	1.6	LBP	Stabilized arrangement, USD
Madagascar	MDG	0.67	MGA	Floating
Malawi	MWI	0.49	MWK	Floating
Mali	MLI	0.13	XOF	Peg, EUR
Mauritius	MUS	1.96	MUR	Floating
Mexico	MEX	4.81	MXN	Free float
Morocco	MAR	3.2	MAD	Peg, basket of currencies
Myanmar	MMR	0.12	MMK	Managed arrangement
Nepal	NPL	0.37	NPR	Peg, other currency than EUR or USD
Nicaragua	NIC	0.76	NIO	Crawling peg, USD
Niger	NER	0.03	XOF	Peg, EUR
Norway	NOR	7.1	NOK	Free float
Pakistan	PAK	3.62	PKR	Managed arrangement
Paraguay	PRY	0.23	PYG	Floating
Peru	PER	3.77	PEN	Floating
Portugal	PRT	7.7	EUR	Free float, EUR
Rep. N. Macedonia	MKD	0.99	MKD	Stabilized arrangement, EUR
Romania	ROU	2.42	RON	Floating
Rwanda	RWA	0.39	RWF	Crawl-like arrangement
Sao Tome & Principe	STP	0.00	STN	Peg, EUR
Senegal	SEN	1.29	XOF	Peg, EUR
South Africa	ZAF	6.96	ZAR	Floating
Spain	ESP	7.19	EUR	Free float, EUR
Sri Lanka	LKA	0.29	LKR	Stabilized arrangement, USD
Tanzania	TZA	1.44	TZS	Floating
Thailand	THA	2.04	THB	Floating
Timor-Leste	TLS	0.22	USD	Dollarized
Uganda	UGA	0.38	UGX	Floating
Uruguay	URY	1.53	UYU	Floating
Yemen	YEM	0.18	YER	Stabilized arrangement, USD
Zambia	ZMB	0.67	ZMW	Floating

Figure A.1: Dollar/EUR and US/EA export share for sample of EDD in 2010



Note: Total share of exports from IMF DOTS to US and euro area and export invoicing shares in US-dollar/euro. Invoicing shares are from Boz et al. (2020).

Table A.2: Estimates of export volumes, prices and values

	$\ln X_{ijp}$	$\ln P^x_{ijp}$	$\ln X^n_{ijp}$
$\ln e_{ij,t-1}$	0.020	-0.002	0.017
	(0.019)	(0.007)	(0.018)
$\ln e_{i\$,t-1}$	0.181***	0.363***	0.544***
	(0.054)	(0.030)	(0.050)
$\ln GDP_i$	0.520***	0.428***	0.948***
	(0.112)	(0.055)	(0.099)
$\ln GDP_j$	0.672***	0.283***	0.955***
	(0.084)	(0.046)	(0.079)
$\ln M_{jp}$	0.213***	0.012	0.225***
	(0.017)	(0.008)	(0.017)

Note: *, **, and *** denote $p < 0.10$, $p < 0.05$, and $p < 0.01$, respectively. Robust standard errors are clustered at the exporter $\times$ importer level (3,572) and are reported in parenthesis. All regressions include 362,165 observations. M represents total imports of HS2-products in the importing country and P^x_{ji} is relative export prices between the importer and the exporter.

Table A.3: OLS estimates

	$\ln X_{ijp}$	$\ln N_{ijp}$	$\ln x_{ijp}$	$\ln X_{ijp}$	$\ln N_{ijp}$	$\ln x_{ijp}$
$\ln e_{ij,t-1}$	0.026	0.017*	0.009	0.020	0.010	0.009
	(0.019)	(0.010)	(0.011)	(0.019)	(0.010)	(0.011)
$\ln e_{i\$,t-1}$				0.181***	0.190***	-0.009
				(0.054)	(0.025)	(0.045)
$\ln GDP_i$	0.594***	-0.033	0.627***	0.520***	-0.111*	0.631***
	(0.108)	(0.056)	(0.079)	(0.112)	(0.058)	(0.080)
$\ln GDP_j$	0.687***	0.570***	0.118*	0.672***	0.554***	0.118*
	(0.084)	(0.044)	(0.064)	(0.084)	(0.043)	(0.064)
$\ln M_{jp}$	0.212***	0.064***	0.149***	0.213***	0.064***	0.149***
	(0.017)	(0.007)	(0.013)	(0.017)	(0.007)	(0.013)

Note: *, **, and *** denote p $<$ 0.10, p $<$ 0.05, and p $<$ 0.01, respectively. Robust standard errors are clustered at the exporter $\times$ importer level (3,572) and are reported in parenthesis. All regressions include 362,165 observations and M represents total imports of HS2-products in the importing country.

Table A.4: With US-dollar invoicing shares

	$\ln X^n_{ijp}$	$\ln P^x_{ijp}$	$\ln N_{ijp}$	$\ln x_{ijp}$
$\ln e_{ij,t-1}$	0.032*	-0.004	0.012*	0.024**
	(0.019)	(0.010)	(0.007)	(0.011)
$\ln e_{i\$,t-1}$	1.351***	0.927***	0.444***	-0.021
	(0.173)	(0.100)	(0.081)	(0.161)
$\ln e_{i\$,t-1} \times S^{\$}_i$	0.002*	-0.002***	0.001*	0.003***
	(0.001)	(0.001)	(0.001)	(0.001)

Note: *, **, and *** denote p $<$ 0.10, p $<$ 0.05, and p $<$ 0.01, respectively. Robust standard errors are clustered at the exporter $\times$ importer level (1,502) and are reported in parenthesis. All regressions include 179,898 observations, real GDP of the exporter and the importer as well as total imports of HS2-products in the importing country. X^n is export values, P^x

Table A.5: PPML estimates

	X_{ijp}	N_{ijp}	x_{ijp}	X_{ijp}	N_{ijp}	x_{ijp}
$\ln e_{ij,t-1}$	0.028	0.020**	0.012	0.018	0.013	0.008
	(0.018)	(0.010)	(0.037)	(0.018)	(0.010)	(0.039)
$\ln e_{i\$,t-1}$				0.427***	0.287***	0.114
				(0.151)	(0.043)	(0.169)
$\ln GDP_i$	0.264	-0.240***	0.262	0.189	-0.364***	0.246
	(0.324)	(0.090)	(0.437)	(0.330)	(0.094)	(0.438)
$\ln GDP_j$	1.009***	0.718***	0.521*	0.973***	0.679***	0.516*
	(0.216)	(0.068)	(0.311)	(0.218)	(0.065)	(0.313)
$\ln M_{jp}$	0.400***	0.113***	0.285***	0.397***	0.114***	0.284***
	(0.058)	(0.015)	(0.083)	(0.058)	(0.015)	(0.083)

Note: *, **, and *** denote $p < 0.10$, $p < 0.05$, and $p < 0.01$, respectively. Robust standard errors are clustered at the exporter $\times$ importer level (4,152) and are reported in parenthesis. All regressions include 415,796 observations and M represents total imports of HS2-products in the importing country.

Table A.6: Including unit export values for i and j and importer×HS2-product×year FE

	$\ln X_{ijp}$	$\ln N_{ijp}$	$\ln x_{ijp}$	$\ln X_{ijp}$	$\ln N_{ijp}$	$\ln x_{ijp}$
$\ln e_{ij,t-1}$	0.043**	0.025***	0.018			
	(0.020)	(0.010)	(0.013)			
$\ln e_{i\$,t-1}$	0.030	0.104***	-0.074	0.049	0.139***	-0.091*
	(0.053)	(0.025)	(0.046)	(0.059)	(0.026)	(0.050)
EXPI	Yes	Yes	Yes	No	No	No
Time FE	HS2×Y	HS2×Y	HS2×Y	D×HS2×Y	D×HS2×Y	D×HS2×Y
Obs	354,361	354,361	354,361	331,573	331,573	331,573
Clusters	3,558	3,558	3,558	3,526	3,526	3,526

Note: *, **, and *** denote $p < 0.10$, $p < 0.05$, and $p < 0.01$, respectively. Robust standard errors are clustered at the exporter × importer level and are reported in parenthesis. HS2 is the HS2 product-level group, Y is year and D is the importer. EXPI is export unit values for the exporter and the importer.

Table A.7: Including GDP deflators for i and j

	$\ln X$	$\ln N$	$\ln x$	$\ln X$	$\ln N$	$\ln x$
$\ln e_{ij,t-1}$	0.042**	0.023**	0.019**	0.025	0.013	0.012
	(0.016)	(0.009)	(0.009)	(0.016)	(0.009)	(0.009)
$\ln e_{i\$,t-1}$				0.537***	0.323***	0.214***
				(0.061)	(0.031)	(0.050)

Note: *, **, and *** denote $p < 0.10$, $p < 0.05$, and $p < 0.01$, respectively. Robust standard errors are clustered at the exporter-importer level (3,572) and are reported in parenthesis. All regressions include 362,165 observations and exporter × HS2-product × importer and HS2-product × year fixed-effects, as well as controls for real GDP of the exporting and importing country as well as total imports of HS2-products in the importing country.

Table A.8: Including the euro

	$\ln X_{ijp}$	$\ln N_{ijp}$	$\ln x_{ijp}$
$\ln e_{ij,t-1}$	0.041	0.036***	0.005
	(0.025)	(0.013)	(0.021)
$\ln e_{i\$,t-1}$	0.603***	0.271***	0.332***
	(0.077)	(0.037)	(0.066)
$\ln e_{i€,t-1}$	-0.446***	-0.148***	-0.298***
	(0.076)	(0.033)	(0.066)

Note: *, **, and *** denote p $<$ 0.10, p $<$ 0.05, and p $<$ 0.01, respectively. Robust standard errors are clustered at the exporter $\times$ importer level (3,001) and are reported in parenthesis. All regressions include 272,673 observations, as well as controls for real GDP of the exporting and importing country as well as total imports of HS2-products in the importing country and global controls encompassing global real GDP, global price level, global export volumes, real oil prices and the VIX.

Table A.9: Estimates with HHI interactions

	$\ln X_{ijp}$	$\ln N_{ijp}$	$\ln x_{ijp}$
$\ln e_{ij,t-1}$	0.010	0.005	0.005
	(0.022)	(0.010)	(0.014)
$\ln e_{i\$,t-1}$	0.242***	0.196***	0.046
	(0.056)	(0.023)	(0.045)
$\ln e_{ij,t-1} \times$ HHI	0.025**	0.009***	0.016*
	(0.011)	(0.003)	(0.009)
$\ln e_{i\$,t-1} \times$ HHI	-0.093***	-0.040***	-0.054***
	(0.015)	(0.005)	(0.012)

Note: *, **, and *** denote p $<$ 0.10, p $<$ 0.05, and p $<$ 0.01, respectively. Robust standard errors are clustered at the exporter $\times$ importer level (3,572) and are reported in parenthesis. All regressions include 362,165 observations and include exporter $\times$ HS2-product $\times$ importer and HS2-product $\times$ year fixed-effects, as well as controls for the HHI, real GDP of the exporting and importing country as well as total imports of HS2-products in the importing country.

Table A.10: Estimates with HHI and GVC interactions

	$\ln X_{ijp}$	$\ln N_{ijp}$	$\ln x_{ijp}$
$\ln e_{ij,t-1}$	0.095	0.056*	0.038
	(0.063)	(0.029)	(0.040)
$\ln e_{i\$,t-1}$	0.354***	0.246***	0.108
	(0.134)	(0.046)	(0.116)
$\ln e_{ij,t-1}\times$ HHI	0.024**	0.008***	0.015*
	(0.011)	(0.003)	(0.009)
$\ln e_{i\$,t-1}\times$ HHI	-0.075***	-0.036***	-0.039***
	(0.017)	(0.005)	(0.014)
$\ln e_{ij,t-1}\times$ GVC	-0.001	-0.001**	-0.001
	(0.001)	(0.000)	(0.001)
$\ln e_{i\$,t-1}\times$ GVC	-0.002	-0.001	-0.001
	(0.002)	(0.001)	(0.002)

Note: *, **, and *** denote $p < 0.10$, $p < 0.05$, and $p < 0.01$, respectively. Robust standard errors are clustered at the exporter $\times$ importer level (3,069) and are reported in parenthesis. All regressions include 346,344 observations and include exporter $\times$ HS2-product $\times$ importer and HS2-product $\times$ year fixed-effects, as well as controls for the HHI and GVC, real GDP of the exporting and importing country as well as total imports of HS2-products in the importing country.

Table A.11: Asymmetric export response

	Appr	Large appr	Depr	Large depr
Bilateral exchange rate				
X_{ijp}	0.062*	0.086	0.012	0.015
	(0.033)	(0.052)	(0.020)	(0.018)
N_{ijp}	0.030**	0.023	0.009	0.017**
	(0.012)	(0.020)	(0.011)	(0.007)
x_{ijp}	0.032	0.062	0.003	-0.002
	(0.025)	(0.044)	(0.012)	(0.015)
US-dollar				
X_{ijp}	-0.100	-0.028	0.228***	0.805***
	(0.103)	(0.268)	(0.065)	(0.160)
N_{ijp}	0.036	-0.161*	0.188***	0.558***
	(0.045)	(0.098)	(0.029)	(0.121)
x_{ijp}	-0.136	0.134	0.040	0.246*
	(0.088)	(0.247)	(0.055)	(0.147)
Obs	143,746	37,578	196,697	94,308
Clusters	2,451	845	2,773	1,028

Note: *, **, and *** denote $p < 0.10$, $p < 0.05$, and $p < 0.01$, respectively. Robust standard errors are clustered at the exporter $\times$ importer level (3,069) and are reported in parenthesis. All regressions include 346,344 observations and include exporter $\times$ HS2-product $\times$ importer and HS2-product $\times$ year fixed-effects, as well as controls for the HHI and GVC, real GDP of the exporting and importing country as well as total imports of HS2-products in the importing country.

B. Baseline results for all products

Table B.1: All products - Exchange rate effects on total exports, the extensive margin and the intensive margin

	$\ln X_{ijp}$	$\ln N_{ijp}$	$\ln x_{ijp}$	$\ln X_{ijp}$	$\ln N_{ijp}$	$\ln x_{ijp}$
$\ln e_{ij,t-1}$	0.029*	0.018**	0.011	0.024	0.012	0.012
	(0.017)	(0.008)	(0.011)	(0.018)	(0.008)	(0.011)
$\ln e_{i\$,t-1}$				0.126***	0.147***	-0.022
				(0.046)	(0.022)	(0.039)
$\ln GDP_i$	0.672***	-0.036	0.707***	0.623***	-0.092*	0.716***
	(0.100)	(0.052)	(0.072)	(0.103)	(0.053)	(0.074)
$\ln GDP_j$	0.667***	0.518***	0.149***	0.656***	0.505***	0.151***
	(0.079)	(0.041)	(0.057)	(0.079)	(0.041)	(0.057)
$\ln M_{jp}$	0.222***	0.061***	0.161***	0.222***	0.062***	0.161***
	(0.016)	(0.006)	(0.012)	(0.016)	(0.006)	(0.012)

Note: *, **, and *** denote $p < 0.10$, $p < 0.05$, and $p < 0.01$, respectively. Standard errors are clustered at the exporter $\times$ importer level (4,074). All regressions include 552,703 observations and include exporter $\times$ HS2-product $\times$ importer and HS2-product $\times$ year fixed-effects, as well as controls for real GDP of the exporting and importing country as well as total imports of HS2-products in the importing country.

Table B.2: All products - 2SLS estimates

	$\ln X_{ijp}$	$\ln N_{ijp}$	$\ln x_{ijp}$
$\ln e_{ij,t-1}$	-0.026	-0.017	-0.009
	(0.024)	(0.012)	(0.016)
$\ln e_{i\$,t-1}$	1.515***	0.969***	0.546*
	(0.341)	(0.173)	(0.292)
Underidentification test^{a}	0.000	0.000	0.000
Hansen J-test^{b}	0.232	0.334	0.375

Note: *, **, and *** denote p $<$ 0.10, p $<$ 0.05, and p $<$ 0.01, respectively. Robust standard errors are clustered at the exporter $\times$ importer level (3,545) and are reported in parenthesis. All regressions include 517,711 and include exporter $\times$ HS2-product $\times$ importer and HS2-product $\times$ year fixed-effects, as well as controls for real GDP of the exporting and importing country as well as total imports of HS2-products in the importing country. The Kleibergen-Papp rk Wald F statistic is 56.4 in all three regressions. ^{a} and ^{b} are p-values for underidentification test and overidentifying restrictions test respectively.

C. Dynamic export adjustment

The adjustment process to exchange rate changes might be different for the various export margins. To address this question, I add contemporaneous exchange rates and one and two year lags ($k = 0$, $k = 1$ and $k = 2$) of the bilateral and US-dollar exchange rate, as well as the controls similar to Gopinath et al. (2020) in (7).

$$\ln X_{ijp,t} = \sum_{k=0}^{2} \beta_k \ln e_{ij,t-k} + \sum_{k=0}^{2} \beta_k^{\$} \ln e_{i\$,t-k} + Controls + FE_{ijp} + FE_{pt} + \varepsilon_{ijp,t} \quad (7)$$

The results from the dynamic lag specification suggests that total export volumes do not increase until after the first year (by 0.27 percent) following a one percent depreciation of the US-dollar exchange rate. The sum of lagged coefficients (long-term effect) is not significant. The increase in the number of exporters appear in the first year, with additional increases after two (reaching a total effect of 0.18 percent after two years). Average exports per firm is significant after one year

(0.17 percent) at the 5 percent level, but is negatively associated with exports after two years at the 10 percent level (see Table C.1).

Gopinath et al. (2020) specify their regressions in log-changes. As a robustness check and to ensure that the results are not driven by different specification, all variables in the baseline regressions are transformed into log-changes as in (8). The results are in Table C.2 and are broadly similar to the baseline findings: export growth increases following a depreciation of the exporters currency against the US-dollar and is driven primarily by the extensive margin (number of exporters).

$$\Delta \ln X_{ijp,t} = \sum_{k=0}^{2} \beta_k \Delta \ln e_{ij,t-k} + \sum_{k=0}^{2} \beta_k^{\$} \Delta \ln e_{i\$,t-k} + Controls + FE_{ijp} + FE_{pt} + \varepsilon_{ijp,t} \quad (8)$$

Table C.1: Dynamic lag specification

	$\ln X_{ijp}$	$\ln N_{ijp}$	$\ln x_{ijp}$
$\ln e_{ij,t}$	0.049***	0.027***	0.021
	(0.017)	(0.009)	(0.014)
$\ln e_{ij,t-1}$	0.016	0.000	0.016*
	(0.011)	(0.004)	(0.009)
$\ln e_{ij,t-2}$	-0.011	-0.001	-0.010
	(0.011)	(0.005)	(0.010)
$\ln e_{i\$,t}$	-0.035	0.034	-0.069
	(0.065)	(0.027)	(0.058)
$\ln e_{i\$,t-1}$	0.267***	0.100***	0.167**
	(0.072)	(0.026)	(0.067)
$\ln e_{i\$,t-2}$	-0.151**	0.047*	-0.198***
	(0.064)	(0.028)	(0.057)
Long-term $\ln e_{ij}$ effect	0.054**	0.027**	0.027*
Long-term $\ln e_{i\$}$ effect	0.081	0.181***	-0.101*

Note: *, **, and *** denote $p < 0.10$, $p < 0.05$, and $p < 0.01$, respectively. Robust standard errors are clustered at the exporter × importer level (3,534) and are reported in parenthesis. All regressions include 349,388 and exporter × HS2-product × importer and HS2-product × year fixed-effects, as well as controls for real GDP of the exporting and importing country as well as total imports of HS2-products in the importing country. The last row presents the linear combination of the contemporaneous and lagged parameters.

Table C.2: Δ dynamic lag specification

	$\Delta \ln X_{ijp}$	$\Delta \ln N_{ijp}$	$\Delta \ln x_{ijp}$
$\Delta \ln e_{ij,t}$	0.068**	0.011	0.057*
	(0.031)	(0.009)	(0.033)
$\Delta \ln e_{ij,t-1}$	0.020	0.008	0.012
	(0.033)	(0.012)	(0.031)
$\Delta \ln e_{ij,t-2}$	-0.008	0.010	-0.018
	(0.036)	(0.011)	(0.037)
$\Delta \ln e_{i\$,t}$	0.331*	0.509***	-0.178
	(0.182)	(0.110)	(0.202)
$\Delta \ln e_{i\$,t-1}$	-0.078	0.029	-0.107
	(0.174)	(0.064)	(0.171)
$\Delta \ln e_{i\$,t-2}$	0.514**	0.310***	0.205
	(0.201)	(0.086)	(0.216)
Long-term $\Delta \ln e_{ij}$ effect	0.080	0.028	0.052
Long-term $\Delta \ln e_{i\$}$ effect	0.767**	0.848***	-0.081

Note: *, **, and *** denote $p < 0.10$, $p < 0.05$, and $p < 0.01$, respectively. Robust standard errors are clustered at the exporter $\times$ importer level (3,534) and are reported in parenthesis. All regressions include 128, 428 and exporter $\times$ HS2-product $\times$ importer and HS2-product $\times$ year fixed-effects, as well as controls for real GDP of the exporting and importing country as well as total imports of HS2-products in the importing country. The last row presents the linear combination of the contemporaneous and lagged parameters.

D. Construction of the instrument

The US monetary policy shocks used in this paper are obtained from a three-variable sign-restricted VAR as outlined in IMF (2014b) and Matheson and Stavrev (2014). The VAR is estimated on daily data for yields (the 10-year US treasury yield at constant maturity), the (log of) the SP 500 index and exchange rate the US-dollar index (the nominal effective exchange rate):

$$R_t = \alpha_0 + \alpha_1 R_{t-1} + \alpha_2 S_{t-1} + \alpha_3 E_{t-1} + \varepsilon_t^R;$$

$$S_t = \delta_0 + \delta_1 R_{t-1} + \delta_2 S_{t-1} + \delta_3 E_{t-1} + \varepsilon_t^S;$$

$$E_t = \beta_0 + \beta_1 R_{t-1} + \beta_2 S_{t-1} + \beta_3 E_{t-1} + \varepsilon_t^E;$$

The reduced form shocks ($\varepsilon^{R,S,E}$) are linear combinations of three structural shocks: demand shocks which increases US stock prices, yields and appreciates the US-dollar exchange rate, (contractionary) monetary policy shocks that decreases US stock prices, increases yields and appreciates the exchange rate and (lower) risk aversion shocks that increase US stock prices and yields and depreciates the nominal effective exchange rate. The daily shocks are accumulated to an annual frequency to match the data in the EDD. The contemporaneous sign restrictions used are outlined in Table D.1.

Table D.1: VAR sign-restrictions

	US 10Y bond yields	US stock prices	US NEER
Monetary tightening	+	-	+
Increase in demand	+	+	+
Lower risk aversion	+	+	-

Source: IMF (2014b) and Matheson and Stavrev (2014).

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