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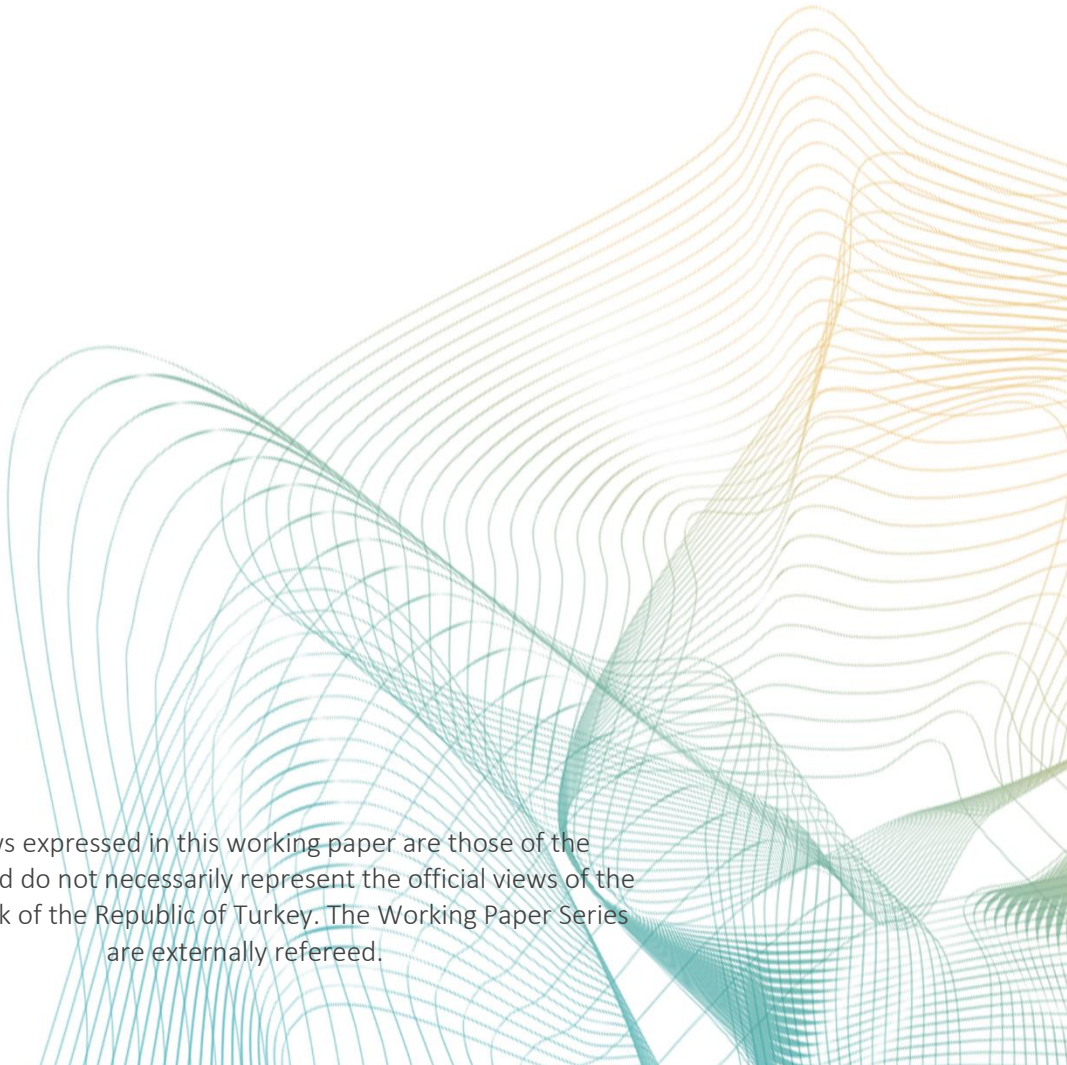

Exports, Imported Inputs, and Domestic Supply Networks[☆]

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Abstract

Exporters have large domestic supply networks. We examine the impact of import reliance within their domestic supply networks on exchange rate pass-through to export prices and volume. For identification, we use administrative firm-to-firm sales and firm-product-destination level customs databases from a large emerging market, Turkey. We find that (i) while exporters' degree of reliance on imported goods is 24%, this number reaches nearly 45% once their suppliers are taken into account; (ii) following a domestic currency depreciation, exporters that use imported inputs more or those working with import-intensive suppliers raise their producer-currency export prices significantly more and increase their export volumes significantly less; (iii) exporters with higher reliance on a single supplier have higher exchange rate pass-through to export prices; and (iv) exporters with higher overall import intensity experience greater disruption in their supply networks, e.g., they establish fewer new supplier linkages and terminate more of their existing linkages, following a domestic currency depreciation.

Keywords: Exchange rate pass-through; Exports; Import reliance; Domestic supply networks.

JEL Codes: D24; F14; F31.

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Non-Technical Executive Summary

The degree to which export volume and price react to exchange rate fluctuations is of considerable interest to monetary policymaking. Standard theory predicts that exports will rise in response to a depreciation in the exchange rate because exporters will be able to offer more competitive prices in international markets. However, recent research has uncovered a high degree of heterogeneity in exchange rate pass-through to export prices. In particular, imported input costs rise in response to exchange rate depreciations which can limit competitive pricing by exporters. An empirical investigation of the actual imported input content of exports is challenging because exporters have large domestic supply networks, which may also rely on imports. We estimate and examine the impact of import reliance within their domestic supply networks on exchange rate pass-through to export prices and volume.

For identification, we use administrative firm-to-firm sales and firm-product-destination level customs databases made available by the Ministry of Industry and Technology. We find that (i) while exporters' degree of reliance on imported goods is 24%, this number reaches nearly 45% once their suppliers are taken into account; (ii) following a domestic currency depreciation, exporters that use imported inputs more or those working with import-intensive suppliers raise their producer-currency export prices significantly more and increase their export volumes significantly less; (iii) exporters with higher reliance on a single supplier have higher exchange rate pass-through to export prices; and (iv) exporters with higher overall import intensity experience greater disruption in their supply networks, e.g., they establish fewer new supplier linkages and terminate more of their existing linkages, following a domestic currency depreciation.

Our results confirm that domestic supply networks explain a large proportion of the import content in Turkish exports and that the import reliance of suppliers has a direct effect on exchange rate pass-through to exports. A key insight of our study is that policymaking needs to take domestic supply network into account in order to accurately predict the impact of exchange rate depreciations on exports. Future research on how import intensity within production networks affect other outcomes like productivity is likely to lead to a more complete understanding of its overall effect on economic performance.

1. Introduction

It is a central puzzle in international macroeconomics that exchange rate pass-through into export prices is high in producer country currencies.[1] A key explanation of this puzzle pertains to the exporters' use of imported goods. Following a depreciation in domestic currency, exporters that rely more on imports face higher marginal costs, and in turn, their export prices in producer country currency moves alongside the exchange rate (Amiti et al., 2014).[2] We show in this paper that the figure is potentially far from complete: Using administrative domestic firm-to-firm sales and firm-product-destination level customs data from a large emerging market, Turkey, we show that the import intensity of exporters is much higher when one considers their suppliers' reliance on imported goods, and that taking into account exporters' supply network unravels a significantly higher degree of influence from import intensity on exchange rate pass-through. That is, exporters set significantly higher prices in producer country currency to the extent their suppliers rely on imports. In line with the effect on the price pass-through, we also find a significantly lower expansion in exports for import-intensive exporters (which rely on imports directly or through their suppliers) following a domestic currency depreciation.

No firm exists in a vacuum. On the contrary, economic outcomes of a firm are very likely to arise from and propagate through its supply network (Acemoglu et al., 2016; Barrot and Sauvagnat, 2016; Tintelnot et al., 2017; Bernard et al., 2017), including price setting behavior (Duprez and Magerman, 2018). In this regard, it is natural to think that import reliance of exporters' suppliers should also matter for the overall sensitivity of export prices or volumes to exchange rate movements. Consider for instance an extreme case where an exporter that does not import relies primarily on its supplier firms for production, and that its suppliers have a significantly high degree of reliance on imports. Following an exchange rate depreciation, suppliers would likely pass the increasing costs to the exporter, which in turn, would leave the exporter to set higher prices. Showing whether such a mechanism is in place is challenging –and not previously explored to

[1] In destination country currencies, the reverse relationship exists. Export prices move only mildly in destination country currency in response to exchange rate movements. Both producer and destination currency pricing has been used in the literature, but this paper estimates pass-through in producer country currencies.

[2] For other explanations, see excellent surveys by Goldberg and Hellerstein (2008) and Burstein and Gopinath (2013). See also Gopinath (2015) who shows that exchange rate pass-through into import prices may be substantially high. For Turkey, she estimates an import price pass-through of 80%.

our knowledge–. We overcome this challenge by using micro-level data on domestic supply network matched with product-level customs and firm-level balance sheet data.[3] This constitutes our key contribution, exploring in a well-identified way whether import behavior of upstream firms to exporters plays a role for the exchange rate pass-through.

The empirical analyses are based on matched administrative firm-destination-product-level customs, firm-to-firm sales and balance sheet databases that cover the universe of firms operating in Turkey for the period of 2006 to 2016. We start with calculating exporters' own reliance on imports, which we label as first-order import intensity in the remainder of the paper, as the ratio of their imported inputs to their cost of sales. We then calculate second- (and later third-) order import intensities of exporters by weighting the import intensity of the supplier firms using the value of the firm-to-firm trade between the supplier and the exporter as a proportion of the total cost of sales for the exporting firm.[4] We then estimate the role of direct or high-order import intensities of exporters in determining the exchange rate pass-through using the variation in import intensity between firms that export the same product category at the Combined Nomenclature (CN) 8-digit level to the same destination country at the same year.[5] This identification strategy, together with our controlling for destination-product market shares, is akin to Amiti et al. (2014), and helps us absorb any demand-side effects or common shocks to marginal costs across these exporters. Given that we introduce exporters' supply network into the picture, we also explore whether exporters' market shares within their supply network matter for the pass-through as well.

The data reveals that almost all Turkish exporters import, once their suppliers' use of imports is accounted for. In particular, while 64% of exporters import themselves, this figure rises as high as 99%, once their suppliers and suppliers' suppliers are taken into account. Similarly, exporters' import intensity doubles from 24% to 45% when we additionally account for the import intensity of their suppliers and their suppliers' suppliers. These findings uncover that focusing on exporters'

[3] Indeed, Amiti et al. (2014) acknowledge for Belgian exporters that some of imports are likely to be made not directly by exporters but through other firms, and they note that they are unable to control for suppliers' imports without more detailed data. Our data on inter-firm trade allows us to fill this gap.

[4] For ease of interpreting the results, we label an exporter's own reliance on imports as the first-order import intensity, the import intensity of an exporter due to its suppliers' imports as the second-order import intensity, and the import intensity of an exporter due to its suppliers' suppliers' imports as the third-order import intensity.

[5] Turkish customs database follow Eurostat and use the Combined Nomenclature (CN) classification for classifying exported or imported goods. The CN coincides with the Harmonized System (HS) classification up to the sixth digit.

own import intensity misses an important ingredient of exporters' 'true' import reliance: the degree of their suppliers' reliance on imports.

Our empirical results are threefold:

First, we find that exporters that rely more on imports through their suppliers have higher exchange rate pass-through to producer currency prices. Exporters' own (first-order) import intensity continues to matter for the pass-through. Numerically, an exporter at the 90th percentile of the distribution of first-order import intensity raises its export prices by 6 percentage points more compared to an exporter at the 10th percentile. An exporter at the 90th percentile of second-order import intensity has an additional 3.4 percentage points higher pass-through than an exporter at the 10th percentile. A similar estimation for the third-order import intensity reveals an additional 2.1 percentage points higher pass-through. These effects are economically sizeable, given that when we consider these as a ratio of average pass-through, the first-order effect corresponds to 27%, the second-order to 16% and the third-order to 10%. Moreover, higher price pass-through has a direct impact on the volume exported. Exporters with higher reliance on imports, directly or through their suppliers, raise their exports significantly less following an exchange rate depreciation.

Second, we show that the effects on export price and volume have implications for supply chain disruptions. As a follow-up to our first finding, one may expect a lower input demand by import-intensive exporters following an exchange rate depreciation. Indeed, we find that an import-intensive exporter (directly or through its direct suppliers) experiences a significant reduction in its total number of suppliers, establishes fewer linkages with new suppliers, and loses a larger number of its existing suppliers following an exchange rate depreciation.

Third, exporters' bargaining power within their domestic supply network also matters for the pass-through. Intuitively, an exporter relying on only a few suppliers may have lower bargaining power over its suppliers, and in turn, find it harder to vary its mark-ups and reflect an exchange rate depreciation more onto its product prices. Yet, if the exporter is one of the largest purchaser of a supplier (and hence has higher monopsony power over its supplier), the price pass-through might be lower. In line with this intuition, we find that exporters that rely primarily on its largest supplier raise their export prices significantly more following an exchange rate depreciation (i.e., a higher price pass-through), with weak evidence for export volume and monopsony power. Finally, even after controlling for exporters' bargaining power within their domestic supply network, our

key findings on the effect of first-, second- and third-order import intensities on the pass-through remain strongly intact.

Our results are strongly robust to several additional analyses, including (i) assigning higher weights to higher export values in the estimations (weighted least squares); (ii) limiting the sample to wholesale exporters which are less likely to be able shift increasing marginal costs to other inputs like labor; (iii) focusing on firms' main export products; (iv) high-quality exports (which we proxy by export unit prices); (v) using bilateral exchange rates vis-a-vis all destination countries; (v) using a coarse definition for export goods (CN 4-digit instead of CN 8-digit level); and to some extent, (vi) for exports to the Euro-area countries. Finally, to corroborate the mechanism, we exclude all imports classified as consumption goods (based on Broad Economic Categories (BEC)), and use capital and intermediate goods imports in calculating the import intensities. Our results remain robust: the higher the suppliers rely on imports, the higher the price pass-through of exporters and the lower the expansion in exports following an exchange rate depreciation.

Our study contributes to the recent literature that explores the reasons for pass-through variation by analysing firm-level data and estimating the effects of market structure, productivity, quality of exports, or imported inputs (Berman et al., 2012; Amiti et al., 2014; Auer and Schoenle, 2016; Garetto, 2016; Bernini and Tomasi, 2015; Lewis, 2017). In particular, our approach extends the analysis of Amiti et al. (2014), who develop a theoretical framework on how exporters' pricing of their export goods is linked to their import intensity and destination market shares, and consistent with the model, find robust evidence that exporters that rely on imports raise their export prices significantly more following an exchange rate depreciation.[6] Our data on domestic firm-to-firm sales allows us to further show that exporters' suppliers' reliance on imports is a crucial ingredient of exporters' overall import intensity, and matters significantly for exchange rate pass-through. Furthermore, we extend the previous analyses of market structure and its relation to exchange rate pass-through, and find that exporters' higher concentration on a single supplier increases their exchange rate pass-through to prices.

Another strand of literature that our work relates to is the recently growing production network literature that show that what we observe in sales, productivity, or employment outcomes of a

[6] Amiti et al. (2014) use destination currency pricing and therefore report lower pass-through as a result of higher import intensity. In producer currency pricing, which we use, their results would point to higher pass-through.

firm arises from its production network (Acemoglu et al., 2016; Bernard et al., 2015; Dhyne et al., 2015; Barrot and Sauvagnat, 2016; Lim, 2017; Tintelnot et al., 2017; Duprez and Magerman, 2018; Bernard et al., 2017; Kikkawa et al., 2019; and for an in-depth review, Carvalho and Tahbaz-Salehi, 2018). Using the Belgium inter-firm trade data, Bernard et al. (2017) examine the role of inter-firm linkages for firm size heterogeneity, and Tintelnot et al. (2017) how international trade shocks affect real wages and efficiency of firms, including those that do not directly export or import. A similar mechanism to the present study is analyzed in Duprez and Magerman (2018), who study cost pass-through in supply networks using Belgian data.[7] Finally, Barrot and Sauvagnat (2016) study the propagation of idiosyncratic firm-level shocks, showing that suppliers affected by natural disasters pass substantial output losses on their customers, especially when they produce specific inputs. Our study contributes to this strand of literature by being the first to explore how firm-to-firm trade play a role in determining exchange rate pass-through. Our network encompassing import intensity measure may also have further applications for the wider literature estimating the impact of using imported inputs on firm-level economic outcomes such as productivity and product scope (Goldberg et al., 2010; Halpern et al., 2015).

The remainder of the paper is organized as follows. Section 2 details the empirical methodology used to calculate import intensity and estimate its effects on exchange rate pass-through. Section 3 presents the data sources used and provides descriptive information. Section 4 presents the baseline results and illustrates a large battery of extensions or robustness analyses. Section 5 provides further discussions. Section 6 concludes.

2. Empirical Methodology

2.1. Measuring Import Intensity

In order to estimate the effect of exporters' import intensity on exchange rate pass-through, we first need a measure of degree of reliance on imports. In this regard, we follow the conventional

[7] While the mechanism in our paper operates through import-intensive *domestic* suppliers, similar spillover effects can further be prevalent in an international setting. For instance, a shock to a supplier abroad may affect their downstream across-the-border firms. For instance, di Giovanni et al. (2018b) and Auer et al. (2019) show evidence for how global supply linkages may render comovement of business cycles or prices across countries. Based on French micro-level data, di Giovanni et al. (2018a) show that firms that import intermediate inputs react significantly more to foreign shocks, and lay out the quantitative importance of large 'granular' firms in transmitting foreign shocks to the French economy.

practice in the literature, and use the ratio of total imports (and later, total intermediate goods imports) to the total cost of sales.

We first start with the exporters' own import intensity, $\varphi^1_{f,t}$, calculated by:

$$\varphi^1_{f,t} \equiv \frac{\sum_{c \in C_{f,t}} \sum_{i \in I_{f,t}} \text{Import Value}_{f,i,c,t}}{\text{Cost of Sales}_{f,t}} = \frac{\text{Import Value}_{f,t}}{\text{Cost of Sales}_{f,t}} \tag{1}$$

where the numerator, total imports of an exporter f at year t (Import Value$_{f,t}$), is the sum of the value of all imported goods indexed by $i \in I_{f,t}$ from countries indexed by $c \in C_{f,t}$ by the exporter f at year t. An important virtue of having micro-level data on imports is that we can decompose an exporter's imports into intermediate and final goods, which will prove helpful to shed light on the underlying mechanism. We use total imports for the baseline estimations, and the total intermediate goods imports for robustness. The denominator, Cost of Sales$_{f,t}$, is the sum of total labor costs and material costs of firm f at year t. To distinguish $\varphi^1_{f,t}$ from the import intensity measures of suppliers, we refer to it as first-order import intensity in the remainder of the paper.

To estimate the import intensity of an exporter due to its suppliers' imports, which we call second-order import-intensity for the rest of the paper, we use the formula shown in equation (2). First, we define $w_{f,n,t}$ as the weight of a given supplier firm n among all $N_{f,t}$ firms that supply to the exporter f at year t. The import intensity of supplier firms is calculated similar to equation (1) (by dividing total imports of supplier n to its total cost of sales for each $n \in N_{f,t}$), and then, are weighted according to $w_{f,n,t}$, to construct a variable indicating the weighted average import intensity of the supplier firms for the exporter f. Afterwards, we weight this synthetic import intensity measure with the exporter f's reliance on suppliers (namely, the ratio of purchases from suppliers to the cost of sales of exporter f). Therefore, we reach a second-order import intensity measure, given by equation (2), that takes into account the weight of purchases made from suppliers.

$$\varphi^2_{f,t} \equiv \frac{\text{Supplier Purchases}_{f,t}}{\text{Cost of Sales}_{f,t}} \sum_{n=1}^{N_{f,t}} w_{f,n,t} \frac{\text{Import Value}_{n,f,t}}{\text{Cost of Sales}_{n,f,t}} \tag{2}$$

As a further extension, we construct the third-order import intensity measure shown by equation (3) to measure imported inputs that are used through the suppliers of suppliers for exporter f. The

intuition is similar to equation (2). For each supplier n, we calculate the import intensity of each firm m, i.e., a supplier m of a supplier n to an exporter firm f, and then weight these intensities with the volume of supplied amount (namely, $w_{n,m,t}$, the weight of a firm m among all $M_{n,t}$ firms that supply to the supplier $n \in N_{f,t}$ at year t). We, therefore, obtain a synthetic second-order import intensity of the supplier n. This synthetic import intensity is then weighted by the share of purchases from suppliers in the cost of sales of the supplier firm n and the resulting weighted import intensity measure are summed using the supplier weights $w_{f,n,t}$ and the share of purchases from suppliers in the cost of sales of the main firm f.

$$\varphi^3_{f,t} \equiv \frac{\text{Supplier Purchases}_{f,t}}{\text{Cost of Sales}_{f,t}} \sum_{n=1}^{N_{f,t}} w_{f,n,t} \left[\frac{\text{Supplier Purchases}_{n,t}}{\text{Cost of Sales}_{n,t}} \left(\sum_{m=1}^{M_{n,t}} w_{n,m,t} \frac{\text{Import Value}_{n,m,t}}{\text{Cost of Sales}_{n,m,t}} \right) \right] \tag{3}$$

Since all three import intensity measures are weighted by the exporters' cost of sales, their sum never exceeds 1. In our regressions, we use each of the three import intensity measures, $\varphi^1_{f,t}$, $\varphi^2_{f,t}$, $\varphi^3_{f,t}$, or alternatively, a single aggregate measure of import intensity of exporters, $\varphi^{agg}_{f,t}$, which is defined as

$$\varphi^{agg}_{f,t} \equiv \varphi^1_{f,t} + \varphi^2_{f,t} + \varphi^3_{f,t} < 1 \tag{4}$$

While using the aggregate import intensity in regression specifications loses information, due to potential differences in the impact of imported inputs between own and supplier imports, it is informative as a complete measure of import intensity of inputs in the final product of a given exporter. As we show below, third-order import intensity adds little to aggregate import intensity and we therefore do not calculate further orders of import intensity from higher levels of the supply chain.

2.2. Empirical Framework

Our empirical framework extends that of Amiti et al. (2014) by incorporating import intensity of exporters' suppliers or their suppliers' suppliers into the picture. Our main regression specification is given by equation (5) below:

$$\Delta p_{f,i,k,t} = \delta_{s,k,t} + \left(\beta_1 \varphi^1_{f,t-1} + \beta_2 \varphi^2_{f,t-1} + \beta_3 \varphi^3_{f,t-1} + \alpha S_{f,s,k,t-1}\right) \Delta e_{k,t} + \dots$$
$$\dots + b_1 \varphi^1_{f,t-1} + b_2 \varphi^2_{f,t-1} + b_3 \varphi^3_{f,t-1} + a S_{f,s,k,t-1} + u_{f,i,k,t} \quad (5)$$

The dependent variable, $\Delta p_{f,i,k,t}$, is the (log) change in the producer currency (Turkish lira) price of the exported good i of firm f to destination country k from year $t-1$ to t. Goods (is) are defined at the CN 8-digit level. The price is proxied by its unit value, namely, the ratio of export values to export volume, given by $\Delta p_{f,i,k,t} \equiv \Delta log\left(\frac{\text{Export value}_{f,i,k,t}}{\text{Export volume}_{f,i,k,t}}\right)$, where volume corresponds to volume, amount, quantity, or weight.[8]

The independent variables of interest are the interactions of $\Delta e_{k,t}$, i.e., the (log) change in the nominal exchange rate of domestic currency vis-a-vis the destination country k's currency, with $\varphi^1_{f,t-1}$, $\varphi^2_{f,t-1}$, and $\varphi^3_{f,t-1}$ (i.e., the first, second and third order import intensities, respectively).[9] Positive estimated values for β_1, β_2, or β_3, imply a higher estimated price pass-through (or, a lower estimated pass-through in destination country currency terms).

We take firm-level averages of import intensities across the sample period, denoted by φ^1_f, φ^2_f, φ^3_f or φ^{agg}_f, as our primary import intensity indicators. While this assumption is not as restrictive as it may seem, since using lagged values of import intensities in the regression does not significantly alter the results as we show below, our aim is to avoid noise in the import intensity measure caused by temporary shifts or responses to the exchange rate. Indeed, our auxiliary regressions of $\varphi^1_{f,t}$ or $\varphi^{agg}_{f,t}$ on firm fixed effects yield an R^2 of 0.91 and 0.90, respectively, implying that the dependence on imports is an underlying characteristic of an exporting firm –at least for the horizons we consider–, and in this regard, justifies our choice of using firm-level year-averages of import intensities.[10]

We additionally include a control for the destination-sector specific export market share of each

[8] We later use $\Delta V_{f,i,k,t}$, the (log) change in the export volume of good i of firm f to destination country k from year $t-1$ to t, and $\Delta X_{f,i,k,t}$, the (log) change in the export value (price times volume) of good i of firm f to destination country k from year $t-1$ to t, as alternative dependent variables.

[9] An increase in the exchange rate thus defined implies a depreciation in the domestic currency.

[10] A potential reason for why exporters have their import intensities largely unchanged following changes in the exchange rate might be due to costly adjustment of buyer-supplier linkages (e.g., exporters cannot easily switch to suppliers with low import use after a domestic currency depreciation). For evidence that inter-firm linkages within production networks are in general costly to adjust, see Huneeus (2018).

firm, $S_{f,s,k,t-1}$, to proxy for the mark-up channel in pricing. $S_{f,s,k,t-1}$ is defined as export share of firm f in total exports of Turkish firms to a given destination-sector market in year $t-1$, where we define sector s at the 4-digit good category level. Following Amiti et al. (2014), we use the contemporaneous value of export market share, $S_{f,s,k,t}$, though the results are largely unchanged if we use its lagged value. Moreover, defining sectors at the 8-digit level yields very similar results. The mark-up channel, under certain conditions, suggests that the larger the market share, the lower the elasticity of demand facing the firm (see, e.g., Goldberg and Hellerstein, 2008), which in our setting, corresponds to testing for whether α attains a positive value.[11]

For identification purposes, equation (5) also includes destination×sector×year fixed effects denoted by $\delta_{s,k,t}$, which implies that the identification is based on the variation in the overall import intensity of firms that export the same 4-digit good to the same destination country at the same year.[12] The fixed effects further absorb any effects from the level of change in the exchange rate. All standard errors throughout the paper are clustered at the destination-year level, which appear to provide more conservative standard errors than simple heteroskedasticity robust or firm-level clustered standard errors.[13]

Our hypothesis is then whether exporters with a higher degree of import intensity, directly through their own reliance on imports or indirectly through their suppliers' use of imports, raise their export prices more following an exchange rate depreciation, compared to firms that export the same 4-digit category good to the same destination country at the same year but with a lower degree of overall import intensity. This hypothesis corresponds to positive estimated values for β_1, β_2 or β_3. The use of $\delta_{s,k,t}$ controls for any demand-side effects for or common shocks to marginal costs across these exporters.

As a natural extension, we also study the effect of market shares of exporters *within their domestic supply network* on the exchange rate pass-through. In order to proxy the domestic network market shares, we measure the share of the largest supplier L in the total purchases of each exporter f, as shown by equation (6). Similar to other concentration measures, higher values of $C_{f,t}$ proxy

[11] Note also that exporters' import intensities might be correlated with their destination-sector market shares. In particular, exporters with a higher degree of reliance on imports may systematically have higher market shares for their export goods at their destinations. We later show that this is indeed the case in our data set (see Table 2). Hence, the exclusion of export share may cause omitted variable bias unless controlled for.

[12] We found similar results when we included fixed effects at the 8-digit good level.

[13] Our results are robust to using alternative clustering levels such as country or CN-4 digit product group.

for lower market power for the exporting firm.

$$\mathcal{C}_{f,L,t} = \frac{\text{Purchased Value}_{L,f,t}}{\text{Supplier Purchases}_{f,t}} \tag{6}$$

To control for the monopsony power of firm f over its largest supplier and how interplays with the pass-through, we further introduce a variable $\mathcal{M}_{f,t}$ which is defined as the share of sales made by the largest supplier L to the exporter f in the total inter-firm sales made by L, and is given below:

$$\mathcal{M}_{f,L,t} = \frac{\text{Inter-firm Sales}_{L,f,t}}{\sum_{f' \in F} \text{Inter-firm Sales}_{L,f',t}} \tag{7}$$

where F denotes the set of firms that firm L sells at year t. A higher $\mathcal{M}_{f,t}$ implies a higher monopsony power of an exporting firm f over L. Similar to import intensities, we use firm-level averages over the sample period of both concentration and monopsony in the regression specifications.[14]

Our final empirical specification then further incorporates market shares of exporting firms within their domestic supply network, and is given by:

$$\begin{aligned}\Delta p_{f,i,k,t} =& \delta_{s,k,t} + \left(\beta_1 \varphi_f^1 + \beta_2 \varphi_f^2 + \beta_3 \varphi_f^3 + \alpha S_{f,s,k,t} + \gamma_1 \mathcal{C}_{f,L} + \gamma_2 \mathcal{M}_{f,L}\right) \Delta e_{kt} + \dots \\ & \cdots + b_1 \varphi_f^1 + b_2 \varphi_f^2 + b_3 \varphi_f^3 + a S_{f,s,k,t} + g_1 \mathcal{C}_{f,L} + g_2 \mathcal{M}_{f,L} + u_{f,i,k,t}\end{aligned} \tag{8}$$

3. Data

We combine three administrative datasets for the analyses. The datasets are a part of the Entrepreneurship Information System (EIS) provided by the Turkish Ministry of Industry and Technology. First dataset is customs data of all Turkish firms, and includes information about the value, amount, destination country and product code at the CN 12-digit level for each transaction.[15] The

[14] When we regress $\mathcal{C}_{f,L,t}$ on exporter (firm f) fixed effects, we obtain an R^2 of 0.91, implying that exporters' concentration on its largest supplier is largely unchanged over our sample period and an underlying characteristic of exporters. When we regress $\mathcal{M}_{f,L,t}$ on exporter fixed effects, we obtain a lower but still sizeable R^2 (0.71). The result are largely unchanged if we use time-varying market shares of exporters within their domestic supply network (contemporanous, i.e., $\mathcal{C}_{f,L,t}$ and $\mathcal{M}_{f,L,t}$, or lagged values, i.e., $\mathcal{C}_{f,L,t-1}$ and $\mathcal{M}_{f,L,t-1}$) (available upon request).

[15] Classification of goods at a CN 8-digit level follows an international standard, and we use this level of disaggregation in our estimations. More disaggregated classifications, e.g., CN 12-digit level as reported by the Turkish Ministry

second dataset is made up of balance sheets and income statements of all Turkish firms.[16] The final dataset includes details on firm-to-firm trade transactions and is based on the invoices reported to the Ministry of Finance for value added tax purposes. It provides all firm-to-firm transactions above a relatively small threshold, 5,000 TL (which on average corresponds to about 2,500 US dollars based on average exchange rate over our sample period) together with buying and selling firm identifiers. All three datasets are available for the years between 2006 and 2016.

Besides the administrative datasets, we use bilateral exchange rates provided by the Central Bank of Turkey. Turkish Statistics reports that 47% of Turkish exports are invoiced in Euros, and 46% in US dollars.[17] We therefore use the Turkish lira against Euro exchange rate for exports to European Monetary Union (EMU) countries and the Turkish lira against the US dollar exchange rate for all other countries. We later use bilateral exchange rates for all available countries as a robustness test.

Since our dependent variable is in terms of changes, an exporter-good-destination level transaction is included in our sample if it is observed consecutively for two years. We further limit the sample to exports where the absolute value of the change in price does not exceed 100%, which help reduce the possibility that changes in the prices of goods defined at a CN 8-digit level, however highly disaggregate it is, may still reflect compositional changes within the CN 8-digit level or measurement errors.[18] In order to rule out outliers or potential measurement errors, we exclude firms above the 99th percentile in import intensities, exporters that have a final aggregate import intensity exceeding 1. In cases where the total purchases from suppliers we observe in the firm-to-firm sales data exceeds the total cost of sales reported by firms in the balance sheets, we set the exposure to suppliers to 1. We also exclude very small exports which we define as below 100 US dollars.

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of Customs, may be used, but would be too restrictive since our dependent variable is in terms of changes (i.e., we would then include only those that export the same CN 12-digit level good for two consecutive years). The results are strongly robust, though, to using CN 12-digit classification (available upon request). Later, we also use CN 4-digit level customs data for robustness.

[16] Firms with annual gross sales above a relatively modest threshold of around 200,000 Turkish liras (c.a. 100,000 US dollars) report their balance sheets. Since exporters are larger than average firms, almost all exporters appear in the dataset.

[17] See https://www.ticaret.gov.tr/istatistikler/dis-ticaret-istatistikleri for details.

[18] While our main sample includes all product categories, we also ran alternative regressions that exclude agricultural products since agricultural products may behave differently if increases in the marginal costs of agricultural products are compensated by government policy. We found no qualitative difference though in the results (available upon request).

Our final sample consists 72,610 exporting firms, which export to 215 countries (including special administrative units, e.g., Gibraltar (UK), Marshall Islands (US), French Guiana (France), Dutch Antilles (Netherlands)), and cover a total of 67% of Turkish exports.[19] Moreover, we have 813,261 firms that (directly) supply to exporters.

Table 1 shows that almost all exporters import. In particular, an exporter's probability of being also an importer is 64%, and once their suppliers are taken into account, this figure raises as high as 99%. Moreover, exporting firms are on average larger (they have about three times as many employees as supplier firms or other firms in the inter-firm trade), have higher sales and are more productive (based on sales per employee). The observation that exporting firms are on average larger and more productive than the rest of the firms accords well with the literature and holds for a wide range of countries (see, e.g., Melitz, 2003; Mayer and Ottaviano, 2007; Amiti et al., 2014). We further observe that exporters' suppliers are larger and more productive than non-exporters. Moreover, few firms directly export. But in fact, due to exporters working with many suppliers (each exporter has an average of 11 suppliers), a significant number of firms in the economy eventually contributes to the exporting activity.[20]

Figure 1 further shows that how incorporating suppliers into the picture adds up to the overall import intensity of an exporter. Predictably, exporters' suppliers matters more for the overall import intensity (second-order import intensity), compared to their suppliers' suppliers (third-order import intensity). Moreover, once exporters' suppliers are taken into account, the import intensity distributions become considerably flatter (Figure 2). The figure, in particular, shows the kernel density estimations for all exporters that also import. While there is a strong concentration close to 0 even among this sample, peak concentration level rises and the distribution becomes flatter once we add second and third-order import intensities. The variation in aggregate import intensity is therefore considerably higher than the variation in first-order import intensity.[21]

Finally, Figure 3 shows how exporters' import intensity has evolved over time. Each of the lines, that shows first-, second-, third-, or aggregate import intensity, represents averages weighted

[19] The primary reason for why our coverage is less than 100% despite our using the universes of firms and customs databases is that we use changes in prices (or volumes) as our dependent variable, and hence, our sample includes consecutive export observations of the same CN 8-digit level goods by the same exporter to the same destination.

[20] For a similar finding for Belgian exporters, see also Dhyne and Rubinova (2016).

[21] An increase in the cross-sectional variation in exporters' import intensity also helps for better identification.

by export values. Aggregate import intensity is around 45% with only mild changes over the sample period. Importantly, adding up second- and third-order import intensities nearly doubles exporters' import intensity.

In sum, the key message is that focusing on exporters' own import intensity misses an important ingredient of their 'true' import reliance: the degree of their suppliers' reliance on imports. Once suppliers are taken into account, exporters' reliance on imports almost doubles, and the cross-sectional variation in the degree of exporters' reliance on imports increases strongly.

Similar to market shares in export destination markets, exporters' market shares or monopsony power within their supply network may also matter for the pass-through ($\mathcal{C}$ and $\mathcal{M}$, as presented above). Figure 4 shows the kernel density estimate of reliance on a single supplier for exporters. For a large majority of exporters, the largest supplier constitutes about 20% to 40% of the total upstream supply. Moreover, about 10% of exporters work with a single supplier. Figure 5 further shows the monopsony power of exporters over their largest suppliers. A large majority of exporters have a low monopsony power (that is, their largest suppliers work with many other firms). For only a few exporters, we find a very strong monopsony power (for which the monopsony variable approaches a value of one).

Moreover, Table 2 shows that exporters with a higher degree of aggregate import intensity have a lower concentration on their largest supplier and have lower monopsony power. Therefore, not including exporters' market power within their domestic supply markets may cause an omitted variable bias in our analyses. Later, we also control for these effects and show that our results are strongly robust.

Finally, Table 3 presents the summary statistics of the variables used in the regression analyses. In evaluating economic impacts, we will refer to the 10th and the 90th percentiles of the variable of interest.

4. Empirical Results

4.1. Does exporters' higher-order import intensity matter for the pass-through of exchange rates on export prices?

Table 4 presents our main results. In order to estimate the overall exchange rate pass-through, we start with a relatively modest specification in column (1) that includes destination×sector and year

fixed effects. Destination×sector fixed effects absorb time-invariant destination country demand for a given product, and year fixed effects any demand or marginal cost shocks common to all exporters. The pass-through estimate, evaluated at the means of first-order import intensity and export market share, is 22%. That is, following a 10% domestic currency depreciation, firms raise their export prices by 2.2% (in domestic currency terms). This seems in line with the estimate of Bussière et al. (2014), who find a long-run exchange rate pass-through of 28% for Turkish exports. Moreover, as given by the estimated coefficient for the interaction between first-order import intensity and the exchange rate, exporters that rely more on imports raise their export prices significantly more following an exchange rate depreciation. Lastly, in line with the literature, having a larger share at a destination×sector market has an increasing effect on the exchange rate pass-through.

Our preferred specification given in equation (5) controls for any time-varying demand-side effects or common marginal costs by including destination×sector×time fixed effects. This is the specification employed for columns (2) to (5). The coefficient on first-order import intensity rises from 0.05 to 0.10 once yearly shocks at the destination×sector level are accounted for. Using the percentile values reported in Table 1, we estimate that moving a firm from the 10th to 90th percentile in first-order import intensity would raise the estimated pass-through by 6 percentage points which is equivalent to 27% of the estimated pass-through of 22% in column (1).[22] In columns (3) and (4), we include second and third-order import intensities in interaction with the change in the exchange rate. Both effects are statistically significant. The economic significance of import intensity from suppliers is smaller than that of first-order intensity, but is still sizeable. Numerically, an exporter at the 90th percentile of second-order import intensity has 3.4 percentage points higher pass-through than an exporter at the 10th percentile. A similar estimation for third-order import intensity reveals a 2.1 percentage points higher exchange rate pass-through. Given the pass-through estimate of 22% in column (1), these increases in pass-through for second and third-order import intensity correspond to 16% and 10% rises in average pass-through respectively.

The fifth and final column of Table 4 uses aggregate import intensity of exporters, obtained by adding up all three import intensity measures. As we move an exporter from the 10th to 90th per-

[22] The difference in import intensity given by Table 1 is 0.46, which we multiply with the first-order import intensity coefficient of 0.10 in column 2 and divide with the exchange rate pass-through estimate of 0.22 to arrive at the 27% increase estimate.

centile of the aggregate import intensity measure, the exchange rate pass-through rises by almost 35%. The drawback of aggregating all import intensity measures into a single variable is that it ignores the possibility of differential effects from first, second and third-order import intensity and is therefore less precise. Nevertheless, comparing the 6% increase in moving from 10th to 90th percentile in first-order import intensity estimated in column (2) with the 7.7% increase estimated for aggregate import intensity in column (5) demonstrates that the role of import intensity on exchange rate pass-through is underestimated if the indirect imported input usage is not accounted for.

We conduct a battery of robustness tests, mostly based on using alternative sampling and variable definitions in our baseline estimates. Table 5 presents the results. Column (0) reports the baseline estimates for ease of comparison.

Weighted Estimates.

So far, we treated each observation as equally important for the pass-through estimates. Consider, however, a potential concern that import intensive firms may be exporting disproportionately more varieties to various destination countries but constituting only a small fraction of overall exports. In this case, our previous estimates would imply an upper bound for the effect of import intensities on the pass-through. We therefore re-estimate our baseline specification by assigning higher weights to higher export values.[23] The estimates, reported in column (1), are strongly similar in magnitude to the baseline results (column (0)).

Time-Varying Import Intensity.

In column (2), we swap the average import intensities of an exporter over the sample period with its import intensity in the previous year. The results are qualitatively strongly robust, with a moderate decrease in the estimated coefficients. On average, this result is inline with Figure 3 showing that exporters' import intensities move mildly over the sample period, or at a micro level, that the exporter fixed effects can explain a significant share of variation in import intensities across exporters (as discussed in Section 2.2).

[23] In particular, we use the log of export value at $t-1$ as the weight for each observation. We employ weighted least squares.

Wholesale Traders.

We expect the effect of import intensity on the pass-through to hold particularly for wholesale exporters, since they are less likely to be able to shift increasing marginal costs to other inputs like labor following a cost shock. In column 3, we therefore limit the sample to wholesale exporters.[24] Column (3) shows that the results are strongly robust and the estimated effects are twice as strong for the first-, second- and third-order import intensities.

Main Export Products.

Firms generally produce not only a single product but many, and the production technology for each good may differ (Eckel and Neary, 2010; Chatterjee et al., 2013). Exporters are no exception. In our sample, a firm exports an average of 3 unique CN-2 level varieties.[25] Since there is no data on the use of imported goods or cost of production for each variety within a firm, it is practically not feasible to differentiate the role of import intensity for each variety produced an exporter. As a remedy, however, we make a plausible assumption that import use may be relevant particularly for the main products of an exporter. Along these lines, we define main products of an exporter as those product categories (defined at the CN 2-digit level) that make-up more than 10% of its total exports during the sample period.[26] We then re-estimate our baseline specification for only the main products.

Column (4) shows that the baseline results are robust. Higher first- and second-order import intensities are estimated to increase the pass-through significantly. While higher third-order import intensity too raises the pass-through, the effect is not significant.

Moreover, following Eckel and Neary (2010) and Chatterjee et al. (2013), we may hypothesize that the pricing behavior of exporters would be more dependent on import intensity and its effect on the marginal cost of a product if they are less competitive outside of their main products. Indeed, we find smaller estimated effects than the baseline estimates, implying that import intensity has a greater impact on pass-through for products outside of an exporter's main product categories.

[24] We define wholesale exporters as those firms in NACE-2 category 46 ("Wholesale trade, except of motor vehicles and motorcycles ").

[25] The precise average number of unique CN-2 level varieties per exporter is 3.089.

[26] When we construct a distribution of export shares by product category for each firm, the 10% cut-off coincides with the 25th percentile of the product share in exports distribution. That is, by focusing on main products, we loose about 25% of observations.

High Quality Products.

High quality exports may command a different degree of pass-through. Using Italian data, for instance, Bernini and Tomasi (2015) find that higher quality exporters tend to use higher quality imports, which in turn reduces the impact of import intensity on exchange rate pass-through of exports. This finding depends on the premise that higher quality importers tend to have larger mark-ups and therefore ability to insulate their prices from exchange rate shocks. We test the plausibility of a similar finding for Turkish exports by limiting our sample to "high quality" exports (which we proxy by defining exports that were priced above the median at the product-year level as high quality). Results reported in column (5) appear quite similar to baseline estimates, indicating that export quality does not play a large role for Turkish exporters in determining the impact of import intensity on exchange rate pass-through.

Bilateral Exchange Rates.

The customs database do not report the invoice currency. On aggregate, we know from Turkish Statistics that more than 90% of exports are invoiced using US dollars or Euros. In this regard, our previous stand that the value of Turkish lira against Euro matters for exports to the Euro-area countries, and that against US dollar matters for exports to other countries, appears plausible.

We now assume that it is the bilateral exchange rates that matter for the pass-through (that corresponds to assuming, e.g., that the value of Turkish lira against the Brazilian real (rather than US dollar) matter for Turkish exports to Brazil). The estimated coefficients are similar in magnitude to the baseline estimates (column (6)).[27]

Estimates at the CN 4-digit good level

So far we have been using export goods defined at a CN 8-digit level (the highest level of disaggregation that complies with the international standards). An alternative would be to use a coarse definition for goods, which on the one hand, provides more observations per goods per destination country, and thus, may help us reach better inferences, but on the other, entails the risk

[27] The Central Bank of Turkey provides bilateral exchange rates for 57 countries. In column (6) of Table 5, we continue to use the US dollars for missing bilateral exchange rates. Limiting the sample to 57 destinations for which we have bilateral exchange rates gives similar results where first- and second-order import intensity are statistically significant at the 1% level. Third-order import intensity remains positive, but turns statistically insignificant.

of having weakly comparable goods. To address the concern that this trade-off is resolved in favor of the former, we now use customs data at the CN 4-digit (column (7)).[28]

Column (7) presents the results. The first-, second-, and third-order import intensities remain highly significant, and are numerically similar to the baseline estimates with the exception that the estimated effect of third-order import intensity on the pass-through appears larger.

Exports to the Euro-area countries

Column (8) focuses on the subsample of exports to the Euro-area countries. This analysis, on the one hand, offers an even finer identification since the exchange rate is uniform across countries, but on the other, goods exported to the Euro-area countries or these countries themselves may be fundamentally different than the rest (e.g., EU countries are more likely have higher technology levels than Turkey, or in this regard, they may be fundamentally different than other destination countries).

De Blas and Russ (2015) suggests that when a lower technology country exports to a higher technology country, prices tend to be more rigid. Another argument for lower pass-through effects from import intensity to Europe may be derived from the study of Gust et al. (2010), who find that increased trade integration has meant that exporters base their prices on that of their competitors and vary their mark-ups rather than prices to absorb changes in exchange rates. If prices are dependent on competitors, exporters are unlikely to be able to change their prices based on changes in their marginal costs from imports caused by exchange rate movements. Turkish exporters to Euro-area countries may therefore have less room to pass their import related costs onto prices.

The results suggest that such a mechanism is indeed at work for Turkish exports to Europe. The interaction between exchange rates and first-order import intensity is no longer significant. Second-order import intensity remains large and statistically significant. Exporters therefore still appear to pass-through changes in the import costs of their suppliers. Third-order import intensity also turns statistically insignificant though the coefficient remains large.

Intermediate Import Goods

Note the key mechanism behind our results: an exchange rate depreciation leading to a higher

[28] Another virtue of using a coarse definition is that our export coverage increases (from 67% to 70%), since now we restrict the sample to firms that export coarsely-defined goods (CN 4-digit) for two consecutive years.

cost of production for exporters with a higher degree of reliance on imports (directly or indirectly), and in turn, such exporters raising their export prices more. To provide supportive evidence that such a mechanism is at work, we now exclude imports classified as a final good (using Broad Economic Categories, BEC, Rev.4), and use only the intermediate import goods when calculating the import intensities of exporters or their suppliers (or their suppliers' suppliers). We report the results in the Appendix (Table A.1). Similar as above, column (0) reports the baseline estimates, and the rest of the columns presents the robustness analyses.

The results are strongly robust to using intermediate good imports. Exporters that rely more on imported intermediate goods, directly or through the firms in their production network, raise their prices significantly more following an exchange rate depreciation. The results are robust to weighting observations by export volumes, using lagged import intensities, using the sample of wholesale traders, focusing on main products of exporters or high quality exports, using bilateral exchange rates, using a coarse definition (CN 4-digit) for export goods, or for exports to the Euro-area countries. Moreover, similar as above, we find that exporters with a higher market share of a good at the destination country at a given year raise their prices more.

4.2. Does exporters' higher-order import intensity matter for the pass-through of exchange rates on export volumes?

So far, we have established that exporters with high import intensity, directly or through their suppliers' reliance on imports, raise their export prices more following a domestic currency depreciation. This finding is likely to have direct implications for the volume/quantity exported.[29]

Table 6 tests this prediction. In particular, we extend the previous analyses by replacing the dependent variable in our baseline specification (equation (5)) with the log change in the export volume, based on the same level of disaggregation as before (firm-destination country-product-year).

Our preferred specifications are similar as above, and control for any demand-side effects or common marginal costs by including destination×sector×year fixed effects (columns (2) to (4)), with each column adding an additional order of import intensity. The remaining columns (column

[29] For ease of discussion, we use the term "volume" to stand for volume, quantity, amount, or weight.

(1) and (5)) include destination×sector and year fixed effects, which allows us to estimate the effect of exchange rate changes separately.

We start with a simple specification that includes first-order import intensity, export market share and exchange rate changes (column (1)). Consistent with the effect of export market share on prices, we find that an exporter with a higher market share at a destination market at a given year raises its export volume less following an exchange rate depreciation. We find no significant effect of first-order import intensity or the change in the exchange rate on export volume. Column (2) extends this specification by including destination×sector×year fixed effects. We continue to find that first-order import intensity does not matter for export volumes.

Columns (3) to (5) additionally include higher order import intensities. We find robust evidence that exporters working with import-intensive suppliers raise their export volumes significantly less following an exchange rate depreciation. Moreover, the first-order import intensity appears statistically significant once second and third-order import intensities are controlled for. Numerically, compared to an exporter at the 10th percentile of first-order import intensity, an exporter at the 90th percentile raises its export volume by 0.7 percentage points less following a 10% domestic currency depreciation.

Moreover, suppliers' import intensities appear to have large effects. Following a 10% domestic currency depreciation, an exporter with a high degree of second-order import intensity (the 90th percentile vs. the 10th percentile of the distribution of second-order import intensity) lowers its exports by 1.5 percentage points. We calculate the economic impact of third-order import intensity similarly. An exporter with a high degree of third-order import intensity raises its export volume by 2.4 percentage points less.

Finally, column (5) shows the direct effect a change in the exchange rate on exports. It attains a positive value, meaning that after controlling for import intensities and export market shares, a domestic currency depreciation leads to a rise in exports. Putting it differently, we observe an increase in export volumes following a domestic currency depreciation only for exporters with sufficiently low degree of reliance on imports.

Similar as above, we conduct several robustness checks (Table 7). The key results are by and large robust to estimating the model with weighted least squares (where observations are weighted by the respective (log) export value), using lagged values of import intensities, focusing on whole-

sale traders, main products of exporting firms or high quality exports, using bilateral exchange rates, or CN 4-digit definition for export products. One difference is that import intensities seem not to matter for export volumes to Euro-area countries. Moreover, these results are also strongly robust to using intermediate goods imports (Appendix Table A.3). Finally, the negative impact on volume appears to dominate the positive impact on price when it comes to total value (price$\times$volume) of exports as shown by Appendix Table A.2. That is, exporters that rely on import-intensive suppliers raise their value of exports significantly less following a domestic currency depreciation.

5. Further Discussions

5.1. Exporters' Market Shares within Their Domestic Supply Network

Previously, we showed that export market share, which captures the destination-sector-year specific demand elasticity that exporters face, has a significant and consistent impact on the exchange rate pass through. Along a similar line of reasoning, one could expect exporters' market share within their domestic supply network to matter as well for exchange rate pass-through. Moreover, if the mechanism, suppliers' passing on increasing costs to their downstream exporters, is in place, we would expect exporters with lower bargaining power within their supply network to set higher prices after a depreciation in the exchange rate. For instance, an exporter that relies only on a few suppliers may have a lower bargaining power over its suppliers, and thus, the supplier may find it easier to pass on increasing production costs to the exporter or price according to the exporter's expected earnings. Alternatively, consider for instance a case where an exporter's monopsony power is close to one. Having a large bargaining power, the exporter would likely have the supplier passing increasing production costs mildly.[30] We assess whether these hypotheses hold.

While the effect of exporters' market shares within their domestic supply network on the pass-through is important per se, controlling for which would also be relevant for our estimations if it is correlated with import intensity measures. Indeed, as we presented in Section 3, import-intensive exporters work with a greater number of suppliers (i.e., have a lower concentration on a single supplier) and lower monopsony power.

[30] In line with this intuition, Kikkawa et al. (2019) documents based on Belgian firm-to-firm trade data that firms that have higher input shares among their buyers charge higher mark-ups.

Tables 8 and 9 present the results, the former on export prices and the latter on export volumes. In Table 8, we start augmenting the baseline specification by adding the interaction between the exchange rate and the supplier concentration (columns (1) and (2)). The coefficient on the interaction term is positive and statistically significant, implying that the higher the reliance on a single supplier, the higher the exchange rate price pass-through. Next, in column (3) and (4) we further interact the exchange rate with the monopsony variable. The estimated coefficient is negative (in line with our intuition above) but not statistically significant. Moreover, even after controlling for domestic market shares, import intensity measures preserve their intended effect on price pass-through, remain strongly statistically significant, and become larger in magnitude (confirming the negative correlation between import intensity and reliance on a single supplier).

In Table 9, we then explore a similar question for export volumes. We do not find a statistically significant effect of market shares within the domestic network. Higher-order import intensities continue to be a significant and robust factor, and have the expected signs: an exporter working more with import-intensive suppliers raise their exports significantly less following an exchange rate depreciation.

5.2. Disruption in Exporters' Domestic Supply Network

Changes in the exchange rate and exporters' reliance on imported goods may also consequences for the buyer-supplier linkages. Our robust findings that exporters that rely on imports (directly or through their suppliers) raise their prices more and export volumes less may concurrently imply a lower demand for domestic inputs.

Table 10 explores this hypothesis. It presents the results of three firm-level estimations, where we explore whether exporters' first- and second-order import intensities (used in levels and in interaction with change in the exchange rate) play a role for the supply chain disruption. In column order, the dependent variables are defined as the log change in the number of (direct) suppliers, the log of (1+number of new suppliers) and the log of (1+lost suppliers).[31]

We find that exporters with higher import intensities experience greater supply chain disruptions. Following an exchange rate depreciation, an exporter with a higher degree of reliance on

[31] To avoid missing observations, we add 1 to the number of new suppliers and to the number of lost suppliers. The results are robust if we do not add 1 to these measures. 2016 is excluded in all regressions since the number of lost suppliers cannot be calculated for the final sample year.

imports (directly or through its direct suppliers) experiences a greater reduction in total number of suppliers, works less with new suppliers, and loses a greater number of existing suppliers. This finding in part indicates lower demand by high import-intensity exporters for inputs compared to low import-intensity exporters following a depreciation, as well as the resulting higher, potentially abrupt, increase in marginal costs for more import-intensive suppliers.

Evaluating each of these impacts at their respective interquartile ranges shows that the estimated disruption is economically sizeable. An exporter at the 90th percentile of first-order import intensity works with 1.4% lower number of suppliers, establish 3.3% fewer linkages with new suppliers, and loses 3.1% of its existing suppliers, following a 10% depreciation (compared to an exporter at the 10th percentile). For exporters with a higher degree of second-order import intensity, the respective figures are 1.1%, 2.6%, and 0.8%, respectively.[32]

6. Conclusion

There is growing acknowledgment that behaviour of individual firms is closely related to the supply chains they are a part of. With increasing data availability, we are able to better map out how supply chains affect final pricing behaviour of firms. In this paper, we apply this idea to exchange rate pass through to export prices (and later volume), by studying administrative databases from an emerging market economy, Turkey, on the universe of domestic firm-to-firm sales, product-level exports and imports, and firm-level balance sheets. We explore whether –and if so, to what extent– exporters' import use through their domestic supply network matters for the exchange rate pass-through to export prices or volumes.

We show that exporters' direct use of imports is half of the picture. Once exporters' suppliers are taken into account, almost all exporters import and exporters' import intensities almost double. We then provide robust evidence that exporters that rely more on import-intensive suppliers raise their export prices significantly more and expand their export volumes significantly less following a domestic currency depreciation. The effect of exporters' higher-order import intensities on the pass-through is quantitatively sizable. Moreover, exporters' market shares within their domestic

[32] Similar as above, we calculate these economic impacts by multiplying the difference between the 90th and 10th percentile of the distribution of variable of interest with the respective coefficient estimate and with 0.1 (the 10% depreciation rate).

supply network matter for the pass-through. We find that exporters with higher reliance on a single supplier have higher price pass-through.

Finally, exporters that rely more on imports (directly or through their suppliers) experience greater supply network disruptions. In particular, following an exchange rate depreciation, exporters with higher reliance on imports experience a greater disruption in their supply network, i.e., work with lower number of suppliers, establish fewer linkages with new suppliers, or lose greater number of suppliers.

Our results are likely to be applicable to all exporting countries but may be particularly relevant for countries where there is a large domestic production network and indirect import intensities are prevalent. Along these lines, a key insight is that policies that miss exporters' production network may not be able to accurately predict the impact of an exchange rate depreciation on exports. Future research on how import intensity within production networks affect other outcomes like productivity or product scope is likely to lead to further insights.

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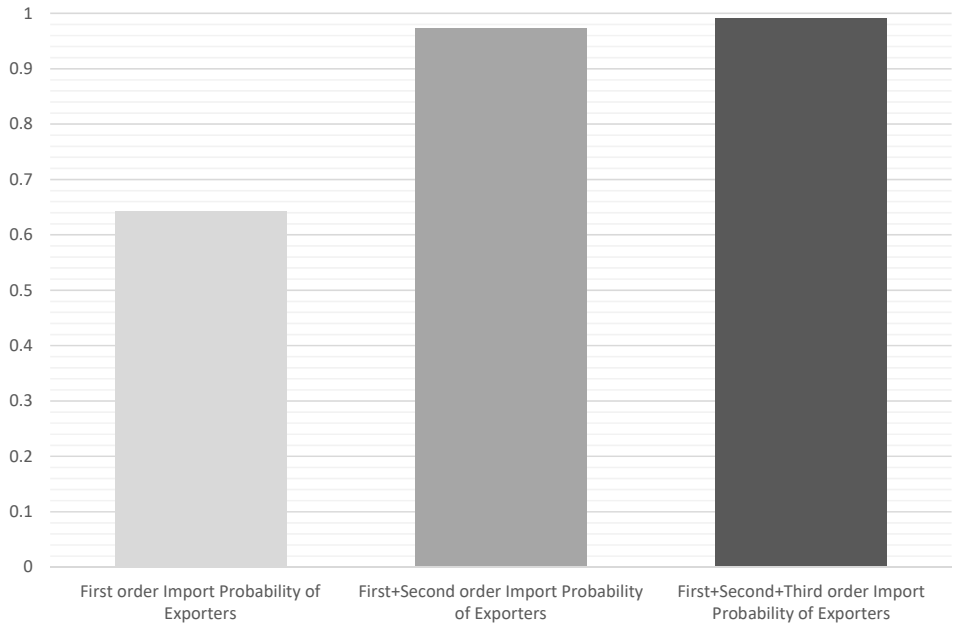
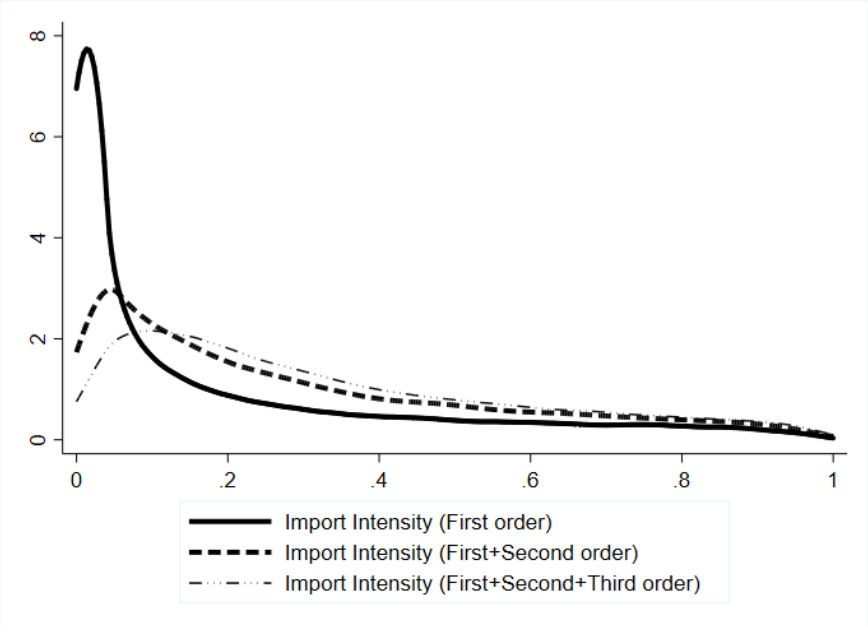
Figures and Tables

FIGURE 1: PROBABILITY OF EXPORTERS' USING IMPORTED GOODS



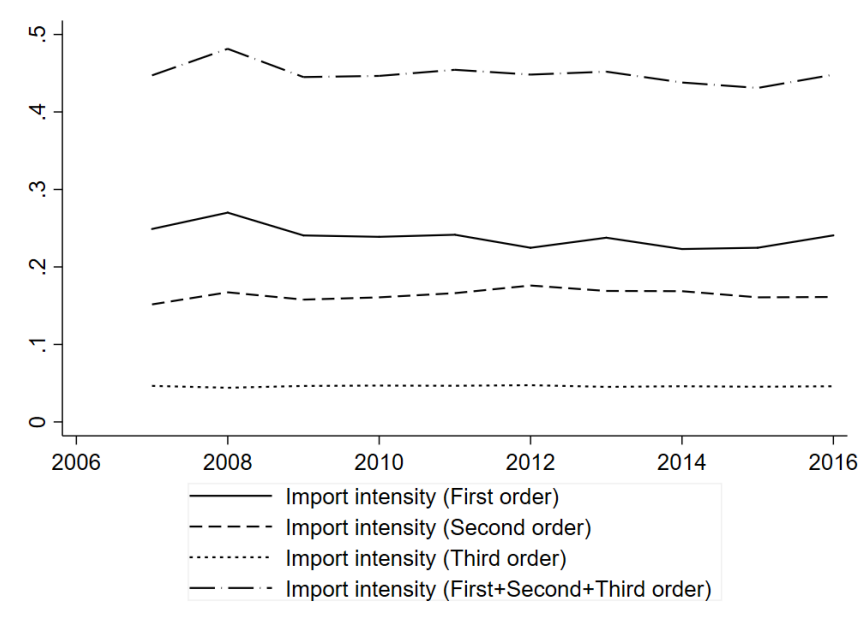
Notes: First-order import probability refers to exporters' own imports. Second-order includes the probability of a direct supplier importing. Third-order includes the probability of a suppliers' supplier importing.

FIGURE 2: IMPORT INTENSITY OF EXPORTERS



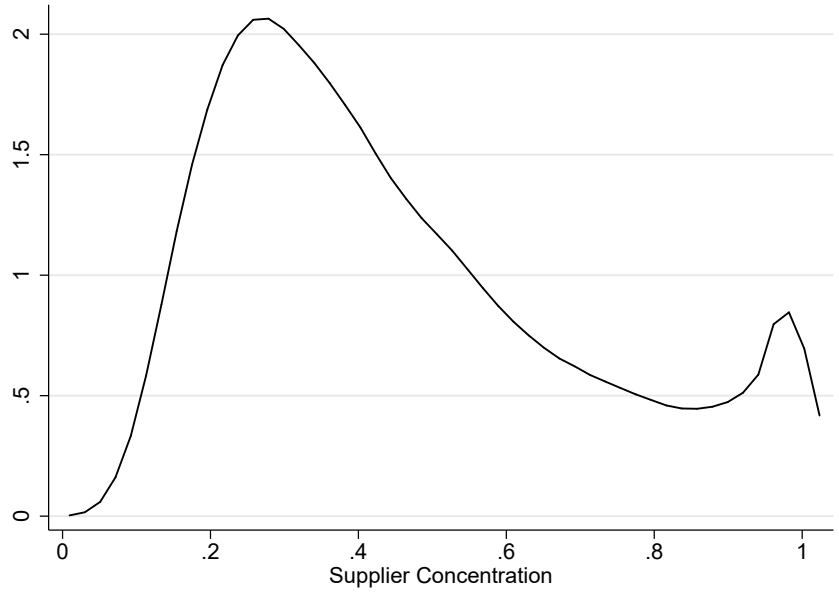
Notes: The figure plots the kernel density estimates of exporters' import intensity. First-order import intensity refers to exporters' own imports to cost of sales ratio. Second-order import intensity reflects exporters' reliance on imports through their suppliers' import reliance. Similarly, third-order import intensity reflects exporters' reliance on imports throught their suppliers' suppliers' reliance on imports.

FIGURE 3: EXPORTERS' IMPORT INTENSITY OVER TIME



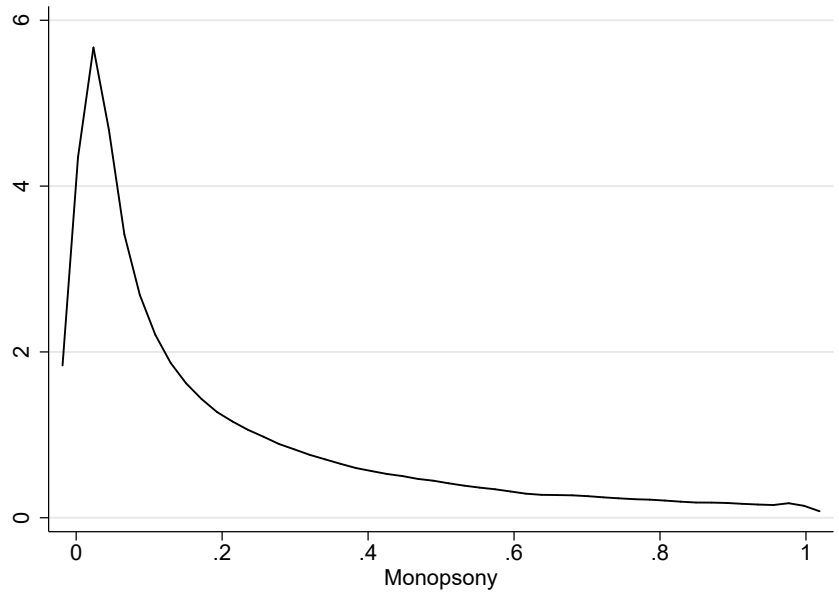
Notes: All import intensity measures are weighted using the value of exports.

FIGURE 4: EXPORTERS' MARKET SHARE WITHIN THEIR DOMESTIC SUPPLY NETWORK: CONCENTRATION



Notes: The figure plots the kernel density estimate of the share of domestic supply purchases made by exporters from their largest supplier. The value for each firm is the average over the observed period.

FIGURE 5: EXPORTERS' MONOPSONY POWER WITHIN THEIR DOMESTIC SUPPLY NETWORK



Notes: The figure plots the kernel density estimate of the share of sales made by the largest supplier of an exporter to that exporter. The value for each firm is the average over the observed period.

Table 1: Summary Statistics: Exports, Suppliers, and Other Firms in the Supply Network

	Exporters	Suppliers	Non-Exporters
Prob. of being an importer	0.64	0.16	0.06
Prob. of being an importer (agg)	0.99	--	--
Employment	38.68	11.41	5.18
Net sales (log)	14.73	13.43	12.57
Sales per employment (000s, TL)	1117.44	683.09	577.18
Cost of sales (log)	14.52	13.15	12.27
N	72,610	813,261	1,603,575

Table 2: Summary Statistics: Correlation Matrix

	Import Intensity	Export Market Share	Supplier Concentration	Monopsony
Import Intensity	1			
Export Market Share	0.1038***	1		
Supplier Concentration	-0.3163***	-0.0010*	1	
Monopsony	-0.0527***	0.0225***	0.3082***	1

Table 3: Summary Statistics: Regression Variables

Variables	Symbol	Definition	Mean	Median	SD	10%	90%	N
Dependent Variables								
Δ log(Price)	$\Delta P_{f,i,k,t}$	Log change in export price of firm f of product i to country k (TL)	0.0642	0.0781	0.3584	-0.4002	0.5099	3,237,893
Δ log(Volume)	$\Delta V_{f,i,k,t}$	Log change in export volume of firm f of product i to country k	0.0226	0.0000	1.4006	-1.6094	1.6635	3,237,893
Independent Variables								
Import Intensity	ϑ_f^1	Imports / Cost of Sales of firm f	0.1306	0.0205	0.1956	0.0000	0.4602	3,237,893
Import Intensity of Its Suppliers	ϑ_f^2	Weighted average "Imports / Cost of Sales" of firm f's suppliers multiplied by "Supplier Purchases / Cost of Sales"	0.1269	0.0963	0.1174	0.0176	0.2765	3,237,893
Import Intensity of Its Suppliers' Suppliers	ϑ_f^3	Weighted average "Imports / Cost of Sales" of firm f's suppliers' suppliers multiplied by "Supplier Purchases / Cost of Sales" of firm f times "Supplier Purchases / Cost of Sales" of firm f's suppliers	0.0535	0.0495	0.0291	0.0196	0.0898	3,237,893
Overall Weighted Import Intensity	ϑ_f^{agg}	Weighted average "Imports / Cost of Sales" of firm f' taking into account its suppliers and suppliers' suppliers	0.3110	0.2531	0.2239	0.0625	0.6602	3,237,893
Export Market Share	$S_{f,s,k,t}$	Share of exports of sector s by firm f to country k at time t	0.0500	0.0046	0.1288	0.0001	0.1326	3,237,893
Supplier Concentration	$\boldsymbol{C}_{f,t}$	Purchases from the largest supplier divided by total supplier purchases	0.3852	0.2784	0.2852	0.1111	0.7882	3,234,961
Monopsony	$\boldsymbol{M}_{f,t}$	Sales of the largest supplier of firm f to firm f divided by total sales of the largest supplier of firm f	0.3317	0.2489	0.2811	0.0280	0.6612	3,234,961

Table 4: Baseline Results (Price)

Dependent variable: Log-change in export price ($\Delta P_{f,i,k,t}$)	(1)	(2)	(3)	(4)	(5)
$\Delta ER_{k,t}$ * First-order Import Intensity	**0.0463****	**0.1026*****	**0.1206*****	**0.1311*****	
	(0.0233)	(0.0220)	(0.0232)	(0.0240)	
$\Delta ER_{k,t}$ * Export Market Share	**0.1025*****	**0.0825*****	**0.0761*****	**0.0761*****	**0.0758*****
	(0.0207)	(0.0254)	(0.0252)	(0.0252)	(0.0252)
$\Delta ER_{k,t}$ * Second-order Import Intensity			**0.1385*****	**0.1327*****	
			(0.0330)	(0.0324)	
$\Delta ER_{k,t}$ * Third-order Import Intensity				**0.3034****	
				(0.1316)	
$\Delta ER_{k,t}$ * Aggregate Import Intensity					**0.1303*****
					(0.0224)
$\Delta ER_{k,t}$	**0.2187*****				
	(0.0185)				
Destination x Sector *and* Year FE	Yes	--	--	--	--
Destination x Sector x Year FE	No	Yes	Yes	Yes	Yes
Observations	3,237,893	3,237,893	3,237,893	3,237,893	3,237,893
R-squared	0.030	0.106	0.106	0.106	0.106

Notes: Standard errors are clustered at the destination x year level, and given in parantheses. Columns (1) to (2) include the levels of export market share and first-order import intensity. Column (3) additionally includes the level of second-order import intensity, and column (4) additionally includes the level of third-order import intensity. Column (5) includes the levels of export market share and aggregate import intensity. *** significant at 1%, ** significant at 5%, and * significant at 10%.

Table 5: Robustness (Price)

Specification:	Baseline	Weighted LS	Time-varying Import Intensity ($\vartheta_f \equiv \vartheta_{f,t}$)	Wholesale Traders	Main Export Products	High Quality Products	Bilateral Exchange Rate	CN 4-digit	Euro-area Countries
Dependent variable: Log-change in export price ($\Delta P_{f,i,k,t}$)	(0)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Δ $ER_{k,t}$ * First-order Import Intensity	**0.1311*** **	**0.1290*** **	**0.1108*** **	**0.3033*** **	**0.0933*** **	**0.1457*** **	**0.1514*** **	**0.1227*** **	**0.0184**
	(0.0240)	(0.0227)	(0.0207)	(0.0471)	(0.0259)	(0.0323)	(0.0237)	-0.0247	(0.0462)
Δ $ER_{k,t}$ * Export Market Share	**0.0761*** **	**0.0643*** **	**0.0799*** **	**0.0432**	**0.0700*** **	**0.1534*** **	**0.1309*** **	**0.1183*** **	**0.3059*** **
	(0.0252)	(0.0246)	(0.0252)	(0.0466)	(0.0269)	(0.0376)	(0.0256)	(0.0275)	(0.0576)
Δ $ER_{k,t}$ * Second-order Import Intensity	**0.1327*** **	**0.1165*** **	**0.0828*** **	**0.2635*** **	**0.0978*** **	**0.1190** **	**0.1570*** **	**0.1154*** **	**0.1451** **
	(0.0324)	(0.0319)	(0.0281)	(0.0471)	(0.0374)	(0.0467)	(0.0334)	(0.0393)	(0.0671)
Δ $ER_{k,t}$ * Third-order Import Intensity	**0.3034** **	**0.3041** **	**0.2523** **	**0.6240*** **	**0.0776**	**0.1242**	**0.3537** **	**0.4047*** **	**0.1899**
	(0.1316)	(0.1275)	(0.1021)	(0.1988)	(0.1592)	(0.1565)	(0.1382)	(0.1393)	(0.3044)
Destination x Sector x Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3,237,893	3,237,893	3,237,893	1,333,269	2,386,320	1,549,541	3,237,893	2,415,915	785,801
R-squared	0.106	0.110	0.106	0.142	0.120	0.142	0.106	0.124	0.097

Notes: Standard errors are clustered at the destination x year level, and given in parantheses. All columns include the levels of export market share, and first-, second-, and third-order import intensities. *** significant at 1%, ** significant at 5%, and * significant at 10%.

Table 6: Baseline Results (Volume)

Dependent variable: Log-change in export volume ($\Delta V_{f,i,k,t}$)	(1)	(2)	(3)	(4)	(5)
Δ $ER_{k,t}$ * First-order Import Intensity	**-0.0794**	**-0.0548**	**-0.1582**	**-0.2843*** **	**-0.2161** **
	(0.0940)	(0.0942)	(0.0982)	(0.1031)	(0.0990)
Δ $ER_{k,t}$ * Export Market Share	**-0.3409** **	**-0.6384*** **	**-0.6003*** **	**-0.5993*** **	**-0.2931** *
	(0.1495)	(0.1801)	(0.1799)	(0.1799)	(0.1509)
Δ $ER_{k,t}$ * Second-order Import Intensity			**-0.8094*** **	**-0.7258*** **	**-0.7058*** **
			(0.1639)	(0.1582)	(0.1512)
Δ $ER_{k,t}$ * Third-order Import Intensity				**-3.6736*** **	**-4.3251*** **
				(0.7412)	(0.7224)
Δ ER_{kt}	**-0.1484**				**0.1828** *
	(0.0974)				(0.0980)
Destination x Sector *and* Year FE	Yes	--	--	--	Yes
Destination x Sector x Year FE	No	Yes	Yes	Yes	No
Observations	3,237,893	3,237,893	3,237,893	3,237,893	3,237,893
R-squared	0.061	0.138	0.138	0.139	0.062

Notes: Standard errors are clustered at the destination x year level, and given in parantheses. Columns (1) and (2) include the levels of export market share and first-order import intensity, column (3) additionally includes the level of second-order import intensity, and columns (4) and (5) additionally include the level of third-order import intensity. *** significant at 1%, ** significant at 5%, and * significant at 10%.

Table 7: Robustness (Volume)

Specification:	Baseline	Weighted LS	Time-varying Import Intensity ($\vartheta_f \equiv \vartheta_{f,t}$)	Wholesale Traders	Main Export Products	High Quality Products	Bilateral Exchange Rate	CN 4-digit	Euro-area countries
Dependent variable: Log-change in export volume ($\Delta V_{f,i,k,t}$)	(0)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Δ $ER_{k,t}$ * First-order Import Intensity	**-0.2843*** **	**-0.3236*** **	**-0.0376**	**0.0347**	**-0.3966*** **	**-0.4896*** **	**-0.1746**	**-0.3092*** **	**0.1501**
	(0.1031)	(0.1027)	(0.0914)	(0.2678)	(0.1053)	(0.1338)	(0.1117)	(0.1021)	(0.2472)
Δ $ER_{k,t}$ * Export Market Share	**-0.5993*** **	**-0.4808*** **	**-0.6227**	**-0.5894** **	**-0.3976** **	**-0.7657*** **	**-0.3173** *	**-0.5874*** **	**-0.8881*** **
	(0.1799)	(0.1677)	(0.1811)	(0.2882)	(0.1804)	(0.2486)	(0.1780)	(0.1737)	(0.2623)
Δ $ER_{k,t}$ * Second-order Import Intensity	**-0.7258*** **	**-0.6874*** **	**-0.3925*** **	**-0.7785*** **	**-0.6689*** **	**-0.6580*** **	**-0.3130** *	**-0.7834*** **	**0.1403**
	(0.1582)	(0.1558)	(0.1678)	(0.2429)	(0.1715)	(0.2167)	(0.1740)	(0.1620)	(0.2855)
Δ $ER_{k,t}$ * Third-order Import Intensity	**-3.6736*** **	**-4.0968*** **	**-0.3874**	**-4.2663*** **	**-4.0680*** **	**-3.3116*** **	**-2.6204*** **	**-3.9597*** **	**0.0888**
	(0.7412)	(0.7378)	(0.5029)	(1.1344)	(0.8052)	(0.9565)	(0.9348)	(0.7306)	(1.5244)
Destination x Sector x Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3,237,893	3,237,893	3,237,893	1,332,269	2,410,617	1,418,426	3,237,893	2,415,193	785,801
R-squared	0.139	0.142	0.176	0.174	0.147	0.168	0.139	0.134	0.048

Notes: Standard errors are clustered at the destination x year level, and given in parantheses. All columns include the levels of export market share, and first-, second-, and third-order import intensities. *** significant at 1%, ** significant at 5%, and * significant at 10%.

Table 8: Competition in Export Market and within the Supply Network (Price)

Dependent variable: Log-change in export price ($\Delta P_{f,i,k,t}$)	(1)	(2)	(3)	(4)
Δ $ER_{k,t}$ * Supplier Concentration$_f$	**0.1155*** **	**0.1152*** **	**0.1220*** **	**0.1215*** **
	(0.0135)	(0.0136)	(0.0147)	(0.0147)
Δ $ER_{k,t}$ * Monopsony$_f$			**-0.0207**	**-0.0199**
			(0.0143)	(0.0143)
Δ $ER_{k,t}$ * First-order Import Intensity	**0.1777*** **	**0.1885*** **	**0.1796*** **	**0.1900*** **
	(0.0252)	(0.0264)	(0.0252)	(0.0264)
Δ $ER_{k,t}$ * Export Market Share	**0.0732*** **	**0.0732*** **	**0.0749*** **	**0.0748*** **
	(0.0251)	(0.0251)	(0.0249)	(0.0249)
Δ $ER_{k,t}$ * Second-order Import Intensity	**0.1041*** **	**0.0980*** **	**0.1001*** **	**0.0944*** **
	(0.0323)	(0.0318)	(0.0324)	(0.0318)
Δ $ER_{k,t}$ * Third-order Import Intensity		**0.3170** **		**0.3106** **
		(0.1363)		(0.1361)
Destination x Sector x Year FE	Yes	Yes	Yes	Yes
Observations	3,234,860	3,234,860	3,234,860	3,234,860
R-squared	0.106	0.106	0.106	0.106

Notes: Standard errors are clustered at the destination x year level, and given in parantheses. All columns include the levels of supplier concentration, export market share, and first- and second-order import intensities. Column (2) additionally includes the level of third-order import intensity. Columns (3) and (4) additionally includes the level of monopsony, with column (4) additionally including the level of third-order import intensity. *** significant at 1%, ** significant at 5%, and * significant at 10%.

TABLE 9: COMPETITION IN EXPORT MARKET AND WITHIN THE SUPPLY NETWORK (VOLUME)

Dependent variable: Log-change in export volume ($\Delta V_{f,i,k,t}$)	(1)	(2)	(3)	(4)
$\Delta ER_{k,t}$ * Supplier Concentration	**0.0855**	**0.0847**	**0.0811**	**0.0834**
	(0.0608)	(0.0606)	(0.0711)	(0.0707)
$\Delta ER_{k,t}$ * Monopsony			**0.0014**	**-0.0079**
			(0.0858)	(0.0852)
$\Delta ER_{k,t}$ * First-order Import Intensity	**-0.0934**	**-0.2075***	**-0.1007**	**-0.2141***
	(0.1089)	(0.1143)	(0.1091)	(0.1147)
$\Delta ER_{k,t}$ * Export Market Share	**-0.5973*****	**-0.5966*****	**-0.5965*****	**-0.5951*****
	(0.1798)	(0.1799)	(0.1783)	(0.1785)
$\Delta ER_{k,t}$ * Second-order Import Intensity	**-0.7972*****	**-0.7255*****	**-0.7939*****	**-0.7236*****
	(0.1601)	(0.1545)	(0.1600)	(0.1551)
$\Delta ER_{k,t}$ * Third-order Import Intensity		**-3.2967*****		**-3.3072*****
		(0.7425)		(0.7358)
Destination x Sector x Year FE	Yes	Yes	Yes	Yes
Observations	3,234,860	3,234,860	3,234,860	3,234,860
R-squared	0.139	0.139	0.139	0.139

Notes: Standard errors are clustered at the destination x year level, and given in parantheses. All columns include the levels of supplier concentration, export market share, and first- and second-order import intensities. Column (2) additionally includes the level of third-order import intensity. Columns (3) and (4) additionally includes the level of monopsony, with column (4) additionally including the level of third-order import intensity. *** significant at 1%, ** significant at 5%, and * significant at 10%.

Table 10: Disruption in Domestic Supply Network

Dependent variable:	Log(Number of Suppliers)	Log(Number of New Suppliers)	Log(Number of Lost Suppliers)
	(1)	(2)	(3)
Δ ER_t * First-order Import Intensity	**-0.3025*** **	**-0.7336*** **	**0.6679*** **
	(0.0690)	(0.1095)	(0.0867)
Δ ER_t * Second-order Import Intensity	**-0.4212*** **	**-0.9874*** **	**0.2965** **
	(0.1102)	(0.1801)	(0.1408)
Year FE	Yes	Yes	Yes
Observations	171,006	171,006	171,006
R-squared	0.092	0.095	0.164

Notes: Standard errors are clustered at the firm level, and given in parantheses. All columns include the levels of first- and second-order import intensities. *** significant at 1%, ** significant at 5%, and * significant at 10%.

Appendix

Table A.1: Intermediate Imported Goods and Price Pass-through

Specification:	Baseline	Weighted LS	Time-varying Import Intensity ($\vartheta_f \equiv \vartheta_{ft}$)	Wholesale Traders	Main Export Products	High Quality Products	Bilateral Exchange Rate	CN 4-digit	Euro-area countries
Dependent variable: Log-change in export price ($\Delta P_{f,i,k,t}$)	(0)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Δ $ER_{k,t}$ * First-order Import Intensity	**0.1153*** **	**0.1148*** **	**0.1018*** **	**0.2586*** **	**0.0690*** **	**0.1459*** **	**0.1335*** **	**0.1098*** **	**-0.0036**
	(0.0225)	(0.0214)	(0.0193)	(0.0447)	(0.0247)	(0.0330)	(0.0225)	(0.0238)	(0.0448)
Δ $ER_{k,t}$ * Export Market Share	**0.0765*** **	**0.0646*** **	**0.0798*** **	**0.0446**	**0.0695*** **	**0.1369*** **	**0.1307*** **	**0.1181*** **	**0.3046*** **
	(0.0251)	(0.0245)	(0.0252)	(0.4654)	(0.0265)	(0.0386)	(0.0255)	(0.0275)	(0.0576)
Δ $ER_{k,t}$ * Second-order Import Intensity	**0.1276*** **	**0.1116*** **	**0.0792*** **	**0.2498*** **	**0.0732** **	**0.1225** **	**0.1508*** **	**0.1111*** **	**0.1380** **
	(0.0322)	(0.0317)	(0.0279)	(0.0465)	(0.0371)	(0.0512)	(0.0331)	(0.0388)	(0.0673)
Δ $ER_{k,t}$ * Third-order Import Intensity	**0.2988** **	**0.2978** **	**0.2541** **	**0.5826*** **	**0.0529**	**0.0607**	**0.3431** **	**0.4286*** **	**0.1669**
	(0.1296)	(0.1250)	(0.1024)	(0.2001)	(0.1583)	(0.1663)	(0.1354)	(0.1402)	(0.2982)
Destination x Sector x Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3,235,548	3,235,548	3,235,548	1,334,413	2,430,636	1,418,426	3,235,548	2,419,831	785,255
R-squared	0.106	0.110	0.106	0.142	0.118	0.149	0.106	0.124	0.097

Notes: Standard errors are clustered at the destination x year level, and given in parantheses. All columns include the levels of export market share, and first-, second-, and third-order import intensities. *** significant at 1%, ** significant at 5%, and * significant at 10%.

Table A.2: Import Intensity and Export Values

Dependent variable: Log-change in export value ($\Delta X_{f,i,k,t}$)	(1)	(2)	(3)	(4)	(5)
Δ $ER_{k,t}$ * First-order Import Intensity	**-0.0331**	**0.0478**	**-0.0376**	**-0.1532**	**-0.1577**
	(0.0911)	(0.0913)	(0.0955)	(0.1008)	(0.0961)
Δ $ER_{k,t}$ * Export Market Share	**-0.2384**	**-0.5559*****	**-0.5242*****	**-0.5232*****	**-0.1853**
	(0.1494)	(0.1822)	(0.1821)	(0.1821)	(0.1511)
Δ $ER_{k,t}$ * Second-order Import Intensity			**-0.6709*****	**-0.5930*****	**-0.7769*****
			(0.1572)	(0.1516)	(0.1444)
Δ $ER_{k,t}$ * Third-order Import Intensity				**-3.3702*****	**-3.7674*****
				(0.7324)	(0.7176)
Δ ER_{kt}	**0.0703**				**0.3794*****
	(0.1014)				(0.1009)
Destination x Sector *and* Year FE	Yes	--	--	--	Yes
Destination x Sector x Year FE	No	Yes	Yes	Yes	No
Observations	3,237,893	3,237,893	3,237,893	3,237,893	3,237,893
R-squared	0.069	0.147	0.147	0.147	0.069

Notes: Standard errors are clustered at the destination x year level, and given in parantheses. Columns (1) and (2) include the levels of export market share and first-order import intensity, column (3) additionally includes the level of second-order import intensity, and columns (4) and (5) additionally include the level of third-order import intensity. *** significant at 1%, ** significant at 5%, and * significant at 10%.

Table A.3: Intermediate Imported Goods and Export Volume

Specification:	Baseline	Weighted LS	Time-varying Import Intensity ($\vartheta_f \equiv \vartheta_{ft}$)	Wholesale Traders	Main Export Products	High Quality Products	Bilateral Exchange Rate	CN 4-digit	Euro-area countries
Dependent variable: Log-change in export price ($\Delta P_{f,i,k,t}$)	(0)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Δ $ER_{k,t}$ * First-order Import Intensity	**-0.4412*** **	**-0.4579*** **	**-0.1948** **	**-0.1203**	**-0.3966*** **	**-0.4896*** **	**-0.3091*** **	**-0.3866*** **	**0.1296**
	(0.0996)	(0.1012)	(0.0892)	(0.2041)	(0.1053)	(0.1338)	(0.1082)	(0.1020)	(0.2211)
Δ $ER_{k,t}$ * Export Market Share	**-0.5855*** **	**-0.4681*** **	**-0.6096*** **	**-0.6015** **	**-0.3976** **	**-0.7657*** **	**-0.3017** *	**-0.5713*** **	**-0.8681*** **
	(0.1803)	(0.1682)	(0.1816)	(0.2833)	(0.1804)	(0.2486)	(0.1784)	(0.1805)	(0.2619)
Δ $ER_{k,t}$ * Second-order Import Intensity	**-0.7719*** **	**-0.7313*** **	**-0.4379*** **	**-0.7736*** **	**-0.6689*** **	**-0.6580*** **	**-0.3519** **	**-0.7706*** **	**0.1316**
	(0.1583)	(0.1561)	(0.1371)	(0.2461)	(0.1715)	(0.2167)	(0.1761)	(0.1623)	(0.2916)
Δ $ER_{k,t}$ * Third-order Import Intensity	**-3.9459*** **	**-4.3392*** **	**-0.5568**	**-4.3554*** **	**-4.0680*** **	**-3.3116*** **	**-2.8438*** **	**-4.1354*** **	**0.0060**
	(0.7466)	(0.7471)	(0.5078)	(1.1091)	(0.8052)	(0.9565)	(0.9546)	(0.7280)	(1.5952)
Destination x Sector x Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3,235,548	3,235,548	3,235,548	1,334,413	2,410,617	1,418,426	3,235,548	2,419,831	785,255
R-squared	0.138	0.142	0.138	0.174	0.147	0.168	0.139	0.159	0.102

Notes: Standard errors are clustered at the destination x year level, and given in parantheses. All columns include the levels of export market share, and first-, second-, and third-order import intensities. *** significant at 1%, ** significant at 5%, and * significant at 10%.

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