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The International Elasticity Puzzle Is Worse Than You Think

Lionel Fontagné, Philippe Martin & Gianluca Orefice

Highlights

- This paper offers an estimate of the firm level price elasticity of exports using an original instrumental variable strategy. Our results point robustly to an estimate around 5.
- Our results show that the international elasticity puzzle is worse than previously thought. Not only is the elasticity of exports higher for tariffs than for exchange rates, the elasticity of exports to export prices is much larger than those two.
- We show that an estimate of elasticities of exports to exchange rates and tariffs that does not take into account the endogenous reaction of export prices is a mix of two opposite effects: the elasticity of substitution between home and foreign goods and the elasticity of exports to the endogenous reaction of export prices to the exchange rate or tariff shock.

Abstract

We estimate three international price elasticities using exporters data: the elasticity of firm exports to export price, tariff and real exchange rate shocks. In standard trade and international macroeconomics models these three elasticities should be equal. We find that this is far from being the case. We use French firm level electricity costs to instrument for export prices and provide a first estimate of the elasticity of firm-level exports to export prices. The elasticity of exports is highest, around 5, for export prices followed by tariffs, around 2, and is lowest for the real exchange rate, around 0.6. The large discrepancy between these elasticities makes us conclude that the international elasticity puzzle is actually worse than previously thought. Moreover, we show that because exporters absorb part of tariffs and exchange rate movements, estimates of export elasticities that do not take into account export prices are biased.

Keywords

Elasticity, International Trade and Macroeconomics, Export Price, Firm Exports.

JEL

F14, F18, Q56.

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RESEARCH AND EXPERTISE ON THE WORLD ECONOMY

The International Elasticity Puzzle Is Worse Than You Think[1]

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Introduction

In international trade and macroeconomic models, the elasticity of substitution between Home and Foreign varieties, the Armington elasticity, is a crucial parameter. It is one of the fundamental primitives that shape the international transmission of shocks into prices and quantities, and also a key component for analyzing the welfare impacts of trade liberalization (see Arkolakis et al. (2012)).[2] However, no consensus has emerged on its value and a tension between the micro and macro views on this elasticity exists: the evidence suggests that the elasticity of export volumes to changes in tariffs is quite large (typically above 2) whereas the aggregate elasticity to changes in exchange rates is small (typically around one or lower). This is what Ruhl (2008) has dubbed the international elasticity puzzle. As shown by previous studies, the elasticity puzzle is not only observed with macroeconomic or sectoral data but also with firm level data.

Our paper contributes to this literature by stressing the importance of considering export prices in estimating the trade cost elasticity. Previous empirical studies, by omitting changes in export prices, implicitly assume that export prices do not react to exchange rate and tariff shocks. Moreover, the existing literature has not estimated another important international

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[2]Arkolakis et al. (2012) show that for a large class of trade models, the welfare gain from trade (as change in real income) can be expressed as $\hat{W} = \hat{\lambda}^{1/\varepsilon}$ where $\hat{\lambda}$ is the change in the share of domestic expenditure and ε is the trade elasticity to variable trade costs.

elasticity, the elasticity of exports to export prices. The elasticity puzzle literature has focused mainly on the difference in elasticities between tariffs and exchange rates but has not considered the elasticity of export volumes - on the intensive margin - to export prices even though in standard trade models such as Krugman (1979), Eaton and Kortum (2002) and Melitz (2003) these three elasticities are equally important and should be the same.

In this paper, we put firm level export prices explicitly at the center of the analysis of the international elasticity puzzle. An obvious difficulty to estimate the export price elasticity is that export prices and export quantities are endogenous at the firm level. This problem does not occur for exchange rates and tariffs shocks that could be considered exogenous to a single firm. To overcome this difficulty we use a firm level time varying instrumental variable for export prices.[3] To this end, we use an original dataset providing information on a firm specific cost shock, namely *firm level electricity prices*[4]. We argue below that these firm level electricity cost shocks are related to factors exogenous to its export performance (regulation changes, year and length of beginning of contracts, national and local tax changes, location, changes in both market and regulated prices and local weather) and are likely to affect its export performance only through the firm export price. We match this dataset to a data set on French export volumes and values to estimate the firm level export price elasticity. We do this by using French exporters data on the period 1996-2010 and we focus on the intensive margin of trade. To our knowledge, our paper is the first to estimate a firm export price elasticity. One advantage of estimating the international elasticity by using firm level export price shocks in comparison to aggregate shocks (tariffs and exchange rates) is also that the change in a firm level price should have less impact on the price index of the importing country.

Our results confirm that, when estimated at the firm level, the tariff elasticity is higher (around 2) than the exchange rate elasticity (less than 1). This is the standard international elasticity puzzle. We go further by showing that the export price elasticity is even larger (around 5) than both the tariff and the exchange rate elasticities. From this point of view, our results make the international elasticity puzzle worse.

[3] By instrumenting the export price we also improve on measurement errors in trade unit values.

[4] An alternative for marginal cost shocks would be to use exchange rate shocks for intermediate imported inputs such as Piveteau and Smagghue (2015) and Loecker and Biesebroeck (2016). Ganapati et al. (2016) use energy cost shocks as instruments for marginal cost shocks. Their aim, very different from ours, is to estimate the pass-through of those shocks into domestic prices. A major difference with our paper is that they use the interaction between national fuel prices for electricity generation and 5-year lagged electricity generation shares at the state level. We use firm level data for electricity prices.

By introducing firm level export prices among the covariates we also improve on the estimation of the elasticity of exports to exchange rate and tariff shocks. This is because we take explicitly into account the reaction of export prices to exchange rate shocks and tariffs to estimate the elasticity of exports to those shocks. This would not be important if exporters did not react to a tariff or exchange rate change by adjusting their FOB domestic currency export price. We find in the data that exporters do absorb part of those shocks in their export price. In the existing literature, because export prices are not included, the estimated elasticity to tariff and exchange rate movements is a mix of the true elasticity of exports to tariffs or exchange rates and the elasticity of exports to the endogenous reaction of export prices to exchange rates and tariffs movements. This matters because the elasticity of exports is much higher to an export price change than to exchange rate movements. We show this is especially true for tariffs.

Our analysis also uncovers a new stylized fact: exporter prices are countercyclical. Exporters decrease their destination specific prices in years where the GDP of destination is above average. This pricing behavior explains a large share of the increase of exports towards destinations with high demand in addition to the standard direct effect of demand on exports.

Our paper is related to a large literature that has estimated the elasticity of exports to tariffs and exchange rates. Fitzgerald and Haller (2014) and Berman et al. (2012) found that the elasticity of a firm export volumes to an exchange rate movement was below unity and around 0.5 to 0.7. The impact of those shocks on export volumes typically depends on how exporters pass them into export prices, how importers pass them into consumer prices and how final consumers react to change in final goods prices. It also depends on the extent of strategic complementarities between firms in price setting, an issue analyzed by Amiti et al. (2015). Amiti et al. (2015) also estimate the price response to a firm specific cost shock (proxied with changes in the unit values of the imported intermediate inputs) but do not analyze the response of exports to these cost shocks. On the tariff side, Bas et al. (2015) show that aggregate and firm-level elasticities to tariffs are shaped by exporter participation and thus vary across destinations. Berthou and Fontagné (2016) estimate a mean elasticity of the product-destination firm-level exports with respect to applied tariffs at about 2.5. Using product-level information on trade flows and tariffs, Head and Ries (2001), Romalis (2007) and Caliendo and Parro (2015) estimate average elasticities of 6.9, 8.5 and 4.5 respectively. Also using industry-level data, Costinot et al. (2012) find an elasticity of

-6.53.[5] Finally, Anderson and Van Wincoop (2004) survey the evidence on the elasticity of demand for imports at the sectoral level and conclude that this elasticity is likely to be in the range of 5 to 10.

Our paper is also related to Feenstra et al. (2014) who distinguish between the elasticity governing the substitution between home and foreign goods (which they call macro and estimate to be below 1) and the elasticity governing the substitution between varieties of foreign goods (which they call micro and estimate around 4.4). Our approach is different as: (i) we do not make this distinction; (ii) we use exporters level data rather than sectoral data on imports and (iii) we rely on an instrumentation method (firm level electricity cost shocks) rather than a GMM estimator that rests on the assumption that demand and supply costs are unrelated. This assumption may be an issue if higher costs of production are correlated with higher quality.[6] A further advantage of our instrument is that it bypasses the problem of quality that may affect both demand and supply costs. Indeed, an electricity price change in one year is plausibly uncorrelated with a quality change on the exported product in that year.

The remaining of the paper is structured as follows. We present data and our instrumental variable for export prices in Section 1. Our results on the estimate of the elasticity of export volumes to (instrumented) export prices are given in section 2. We then estimate jointly and compare the elasticities of exports to export prices, tariffs and exchange rates in section 3 and presenting the related robustness checks in section 4. The last section concludes.

1. Data and instrumental variable description

1.1. Data

In this paper we use three confidential firm level datasets: (i) *Douanes* database on French firms exports, (ii) *Ficus/Fare* on French firms balance sheet information and (iii) *EACEI* data on energy consumption and purchase of French firms .[7] Then macro level control variables come from standard sources (World Bank, CEPII and Penn World Table).

The *Douanes* database is provided by French customs for the period 1995-2010 and gives us information on import and export flows of French firms by destination country, product

[5] In Costinot et al. (2012) this is the producer price export elasticity.

[6] See Feenstra and Romalis (2014) for how taking into account the issue of endogenous quality alters the estimation of international price elasticities.

[7] All firm level confidential dataset have been used at CEPII.

(HS 6-digit classification) and year. This database contains all trade flows by firm-product-destination that are above 1,000 euros for extra EU trade and 200 euros for intra-EU trade, so it can be considered an exhaustive sample of all French exporting firms. Based on export values and quantity we computed the Trade Unit Values (TUV) for a specific firm-product (HS 6-digit)-destination-year cell (here used as proxy for the export price). The potential amount of observations is thus very large: there are almost 100,000 exporting firms per year and 200 destination markets. For this reason (and also because our main instrumental variable does not vary with product dimension - see section 2), we collapse the French customs data at firm-destination-year level. So the resulting TUV is the weighted average across exported products of a given firm-destination-year cell.[8] Doing so, we lose the HS exported product dimension; but when needed, we still have the information of the main *industry* (NAF700 classification) in which the firm operates (as coded by the INSEE).[9]

Indeed, the weighted average of TUVs can suffer from a composition bias (due to the aggregation of several products exported within a firm-destination-year cell).[10] Hence, in an alternative dataset, we retain the export product dimension of the dataset by restraining the analysis to the core product exported by the firm in a given market. For each firm-destination we keep the HS-6 code that represents the maximum (average across years) exported value for the firm-destination. For the core product of the firm, TUVs do not suffer from a composition bias. Thus, in all the core product estimations we refer to a specific *sector* rather than to a more general industry dimension (as done in the baseline dataset described above).

The second firm level database is $Ficus/Fare$ which contains balance sheet information for all French firms. From this database we retain the turnover and the employment level of each French manufacturing firm. We use these as control variables in our main regressions. From $Ficus/Fare$ we also keep the labor cost and the purchase of intermediate inputs and raw materials used to compute the share of electricity over the total cost reported below.

The information on firm level electricity price (used as instrumental variable for the export price, see section 2) is provided by the $EACEI$ survey on energy purchase and consumption

[8] We used the exported quantities as weights.
[9] Notice that each firm is assigned to a unique industry of activity by the INSEE. In the NAF700 classification there are 615 industries.
[10] This is not a big problem in our case since the majority of firm-destination cells (the 60%) involve export shipments within a unique HS 4-digit heading. Since products within a HS 4-digit heading are mostly homogeneous, the composition bias concern here is reduced.

by around 11.000 French firms in the period 1996-2010.[11] For each plant-year combination we have information about the use of different types of energy such as electricity, steam, coke and gas. For consistency with the French custom data, the *EACEI* database has been aggregated at firm level by summing electricity bill and consumption across plants within the same firm.[12] The price of electricity has been computed as the ratio between electricity bill (in euro) and purchased quantity of electricity (in kWh). The final electricity price for the firm is thus expressed in euro/kWh. When we merge the three firm level databases we are left with around 8,500 exporters per year.

Finally we merge firm level data with other macro datasets: (i) OECD.stat for the GDP of destination countries, (ii) CEPII MacMap HS-6 data for tariffs and (iii) Penn World Table for nominal exchange rates and consumer price indexes (used to calculate the real exchange rate). The MacMap database on tariffs records ad-valorem *applied* tariff for each country pair-sector (HS-6 digit) observed in four years: 2001, 2004, 2007 and 2010 (see Bouet et al. (2008) and Guimbard et al. (2012) for more details on MacMap).[13] Since French exporters do not face tariff in EU, we simply set to zero intra-EU tariffs. As described above, for our baseline regressions we use a firm-destination-year specific dataset. So we follow Fitzgerald and Haller (2014) and use the weighted average tariff faced by a firm into a given destination-year (average across exported products).[14] In the core product estimations, since we keep the core exported product of each firm, we can use the (core) product level tariff.

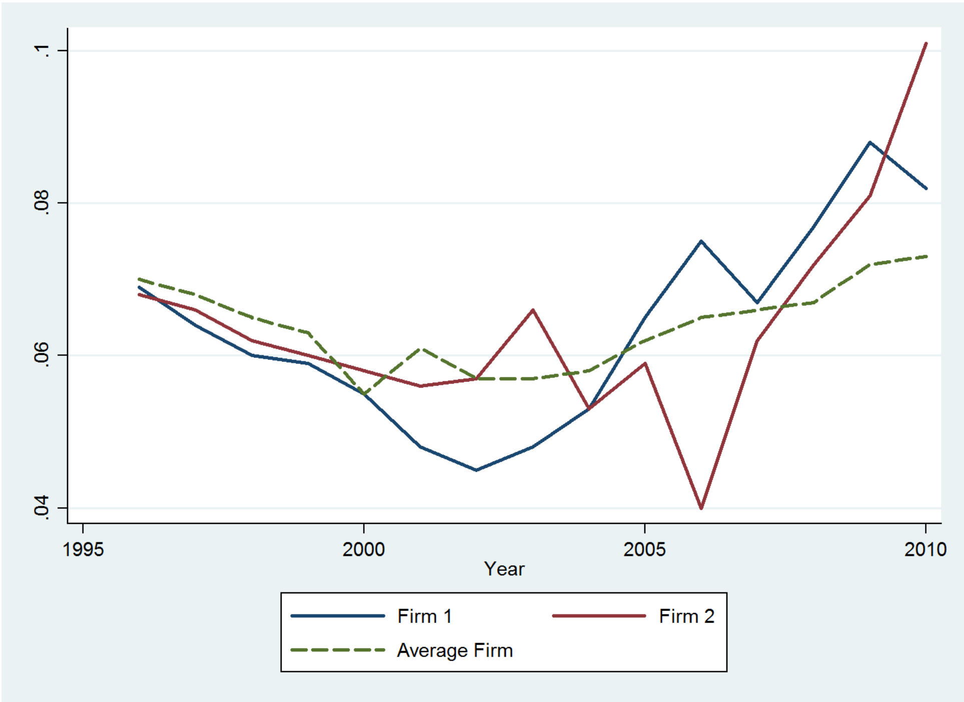
1.2. Firm level electricity prices as instruments for export prices

In our empirical strategy, we use the firm specific electricity price as an instrumental variable for the export price. The average electricity price in our dataset (reported in table 1) is in line with the publicly available average prices for the manufacturing sector. Importantly, our dataset exhibits variance across firms and within a firm over time. We also observe annual variations in prices that are not synchronized across firms. In figure 1 the dotted line is the average price of electricity paid by French firms between 1996 and 2010. We also show the price paid by two anonymous firms chosen here to have a mean price and a standard deviation similar to the mean and the standard deviation of the overall sample. Although

[11] The survey has been conducted on firms with more than 20 employees.
[12] We use the French firm identifier *siren* to merge with the Custom database.
[13] We use tariff in 2001 for the years preceding 2001. Tariffs in 2001 were also used for the period 2001-2003. Then tariffs in 2004 have been used for the period 2004-2007. Finally, tariffs in 2007 were used for tariffs in the period 2007-2010.
[14] We follow Berthou and Fontagné (2016) and use the product share over total exports as a weight.

the overall trend is similar (first downward then upward), we see that these firms experience yearly shocks that are very different.

Figure 1 – Electricity Price (euro/kwh) over the period 1996-2010. Average and two specific firms.



Note: The dashed line refers to the average firm, obtained by collapsing the dataset by year. Firm 1 and 2 are specific (anonymous) firms having mean and std dev electricity price similar to sample mean and std dev. Source: Authors based on EACEI dataset.

We now explain what is behind the firm specific component of electricity prices in the French manufacturing sector. In particular we argue how the specificities of the French electricity market enable us to use firm level electricity prices as an instrument for export prices. Note that our regressions will include firm fixed effects so that any time invariant characteristic of the firm electricity price will be controlled for and that the source of variation we will use is across years for a given firm. A characteristic of the French electricity market is that many contracts co-exist with both regulated and market driven prices. Regulated prices are offered only by EDF (the main historical operator) and unregulated prices are offered by all operators to all firms (Alterna, Direct Energie, EDF, Enercoop, GDF Suez, Poweo...). Firms can also have several contracts with several producers and some produce their own electricity.

Another characteristic is that many firms had to renegotiate long-term contracts that ended during the period. These long term contracts allowed firms to have lower prices and their expiration means that firms may experience an increase in price in different years depending on the year the contract was initially signed and its length. Importantly for us there has also been many changes in regulations during the period 2001-2010. Under the pressure of the European Commission the market has been partially deregulated and opened with an increasing role of both imports and exports. Large firms were the first to be able to opt out from regulated prices in 2000 and this possibility was open progressively to all firms in the 2000s. However, in the same period many different electricity tariffs co-existed and were affected by several changes. For example, in 2006 there was a large increase in electricity prices for firms that had opted (in the preceding years) for contracts with deregulated market prices. The government decided in 2007 to allow those firms to go back to a transitory regulated tariff (TarTAM tariff) calculated on the basis of the regulated tariff plus a surcharge depending on the firm of 10%, 20% or 23%. Not all firms chose to do so as it depended on the difference between the firm specific previous contracted price and the (firm specific) TarTAM (transitory regulated tariff). This choice depended itself on the date the previous contract was signed. This possibility was then stopped in particular because it was deemed to be a sectoral subsidy by the European Commission and this meant another change in price for some but not all firms. There are also different regulated tariffs for firms. The Blue tariff (small electricity users) allows a fixed price (for a year) with possibility to have lower prices during the night. Yellow and Green tariffs (intermediate and large electricity users) may also benefit from a fixed price with lower average prices during the year if they accept to pay higher prices possibly on a maximum 22 days in the year (very cold days in winter when household demand is high). Depending on the location of the firm in France these price increases may differ. Also, some firms benefit from low prices because they are close to hydroelectric facilities. Finally, the electricity price also depends on several taxes especially the so-called TURPE (to pay for distribution and transport in particular) since 2000 which was created after the European Commission obliged France to separate the production and the distribution of electricity. The tax is itself quite complex, firm specific (in particular it is reduced if the firm has experienced a power outage of more than 6 hours in the year) and changes every year. It can constitute up to 40% of the final electricity cost. Another tax (CSPE to finance renewables costs) also varies every year. Finally there are additional taxes at the city and department level that can vary both across locations and years.

This description of the electricity market in France shows that electricity prices vary at the firm level for reasons that are both endogenous to the firm activity (in particular its *average* electricity use, which is then captured by firm fixed effects in our empirical strategy) and more importantly exogenous to the firm export activity (regulation changes, year and length of beginning of contract, tax changes both at the national and local levels, location, changes in both market and regulated tariffs, local weather). We will take into account some of the impact of firm characteristics on electricity prices by including a firm fixed effect as well as time varying measures of its activity (employment or turnover). Using firm specific electricity price changes as an instrument for export prices in the regression to estimate the price elasticity of exports is also valid because we believe that electricity price changes at the firm level affect export volumes only through their effect on export prices (the exclusion restriction). This would not be the case for other types of costs (wages or intermediate inputs) that may alter export volumes if an increase in these costs is caused by an increase in the quality of the good (see Piveteau and Smagghue (2015) on this).

In what follows we provide a detailed discussion on how electricity prices affect the export prices of French firms (by commenting our first stage estimation results); while in the appendix section, we illustrate the underlying mechanism using a very simple theoretical framework where firms use several inputs (energy among others) which are imperfect substitutes. We show that in a standard framework where a firm i minimizes costs, the path-through of a firm level electricity cost shock p_{ei} to export prices p_i is given by:

$$\frac{dp_i}{dp_{ei}}\frac{p_{ei}}{p_i} = \frac{p_{ei}e_i}{p_{ei}e_i + \sum_{m=1}^{M} p_m x_{mi}} \tag{1}$$

where M is the number of inputs (other than electricity) and $p_m x_{mi}$ the expenditures on those inputs. Hence, the passthrough of electricity cost shocks to export prices is simply the share of electricity costs in the total costs of the firm. For each firm we have labor costs, energy costs and intermediate goods costs but not capital costs. In our data set which is restricted to the manufacturing sector this ratio is around 2.7% (see table 1) so we should expect that in our first stage regressions the pass-through of a firm level electricity price shock to export prices is around the same number. An alternative instrument for the firm specific export price, consistent with equation 1, would be the interaction between the firm-year specific price of electricity and the firm specific share of electricity over total costs. For this cost share we tried either the average share for the firm on the whole period or the share for the sector to reduce endogeneity. The advantage of this instrument is that it uses an information specific to the firm or the sector which describes its electricity intensity. The disadvantage is that total costs (including labor costs and intermediates) may be endogenous to exports of the firm and may affect exports in particular its mix of produced (and then exported) goods. We use this alternative instrument in robustness checks in section 4 and find similar results.

Table 1 – In-sample descriptive statistics on firm-year level dataset.

	Mean	Std Dev	Min	Max	Std Dev Between	Std Dev Within
Electricity Price (euro/kwh)	0.064	0.016	0.033	0.139	0.016	0.009
Electricity cost share	0.027	0.059	0.000	0.999	0.059	0.043
Trade Unit Value (ln)	2.256	1.673	-1.660	7.982	1.667	0.479

Source: Author's calculation on Ficus/Fare sample and Douane data.

The share of electricity over the total cost (as reported in table 1) is computed as the ratio between the electricity bill and the total production costs of the firms available in the Ficus/Fare dataset (i.e. labor cost, purchase of intermediate inputs, raw materials and electricity). Table 2 reports the summary statistics for the sample of firms we use in our baseline regressions, so the number of firms and the other statistics reported in the table refer to a sample of exporting firms for which we also have balance sheet and electricity bill data. The average size of the firm over the period 1996-2010 is large but this is not surprising since these are exporting firms only.[15] There is also some variation in the electricity cost share over time: from 1.9% in 2005 up to 3.6% in 2002 and back to 2.5 % in 2010 (the average over the period is 2.7%).

Table 2 – In-sample summary statistics

Year	N. Firms	Employees	Elec. Price	Elec. Share
1996	9,000	227	0.070	0.029
1997	9,492	217	0.068	0.029
1998	9,746	215	0.065	0.028
1999	9,702	213	0.063	0.028
2000	5,561	289	0.055	0.020
2001	8,744	223	0.061	0.025
2002	5,895	344	0.057	0.036
2003	5,715	353	0.058	0.036
2004	6,054	316	0.059	0.035
2005	4,613	241	0.062	0.019
2006	6,198	205	0.065	0.020
2007	6,464	201	0.067	0.022
2008	5,413	223	0.068	0.021
2009	5,437	194	0.073	0.033
2010	5,721	183	0.075	0.025

Notes: statistics on the sample of firms used in the baseline estimations.
Source: Authors' calculations on EACEI and Douane dataset.

Our empirical strategy proceeds in two steps. First, we estimate the elasticity of export

[15]Moreover, remember that EACEI survey is conducted on firms with more than 20 employees.

volumes to prices by using an instrumental variable approach to solve the endogeneity problem of prices i.e. Trade Unit Values. Then, we analyze the international elasticity puzzle in our data set by including in the same regression export price (instrumented), real exchange rate and firm specific tariffs.

2. Export Volumes Elasticity to Export Prices

To estimate the elasticity of export volumes to export prices we use the instrumental strategy described in the previous section. To highlight the robustness of our price elasticity estimation, we show results with several combinations of fixed effects and controls. The second stage regression has the following econometric specification depending on the set of fixed effects included:

$$ln(exp_{i,j,t}) = \theta_i + \theta_{jt} + \sigma ln\left(TUV_{i,j,t}\right) + \beta_1\left(X_{i,t}\right) + \varepsilon_{i,j,t} \quad (2)$$

$$ln(exp_{i,j,t}) = \theta_i + \theta_{jst} + \sigma ln\left(TUV_{i,j,t}\right) + \beta_1\left(X_{i,t}\right) + \varepsilon_{i,j,t} \quad (3)$$

$$ln(exp_{i,j,t}) = \theta_{ij} + \theta_t + \sigma ln\left(TUV_{i,j,t}\right) + \beta_1\left(X_{i,t}\right) + \beta_2\left(Z_{j,t}\right) + \varepsilon_{i,j,t} \quad (4)$$

while the first stage regression is the following:

$$ln(TUV_{i,j,t}) = \theta_i + \theta_{jt} + \gamma_1 ln\left(ElectricityPrice_{i,t}\right) + \gamma_2\left(X_{i,t}\right) + \eta_{i,j,t} \quad (5)$$

$$ln(TUV_{i,j,t}) = \theta_i + \theta_{jst} + \gamma_1 ln\left(ElectricityPrice_{i,t}\right) + \gamma_2\left(X_{i,t}\right) + \eta_{i,j,t} \quad (6)$$

$$ln(TUV_{i,j,t}) = \theta_{ij} + \theta_t + \gamma_1 ln\left(ElectricityPrice_{i,t}\right) + \gamma_2\left(X_{i,t}\right) + \gamma_3\left(Z_{j,t}\right) + \eta_{i,j,t} \quad (7)$$

where subscripts i,j, s and t stand respectively for firm, destination market, sector and year. The dependent variable is the log of the exported volume by firm i in a specific country j and year t. The main explanatory variable here is the log of the export price (i.e. trade unit value) - $ln(TUV_{i,j,t})$ - instrumented as in equation (4), (5) and (6), so we expect a negative coefficient for σ. As explained in the data section we use two main regression samples: (i) exported volumes and average TUV across products within firm-destination-year (*baseline full dataset*), (ii) exported volumes and TUV of the HS-6 specific core product of the firm for a given destination (*core product dataset*). The subscript s refers to industry (NAF700 classification) and sector (HS classification) respectively for baseline and core product dataset (see section 1 for further details).

We want to compare our estimates of the price elasticity with various fixed effect combinations. In the first regression we include firm fixed effects (θ_i) and destination-year fixed effects (θ_{jt}) - in both first and second stage regressions. This enables to control for any time invariant characteristic of the firm and for any destination specific time varying impact on the firm demand. The latter includes the effect of the macroeconomic cycle in the destination country as well as the multilateral resistance term (Anderson and van Wincoop (2003) and Head and Mayer (2014)). This set of fixed effects is standard in the trade literature. Specification (3) goes further and is more demanding than specification (2) as it replaces destination-year fixed effects (θ_{jt}) by destination-sector (or industry)-year fixed effects (θ_{jst}). In the core product estimations, when s represents the sector of firm's export, the θ_{jst} fixed effects should better identify the resistance term as it takes into account differences across sectors in a same destination-year cell. Moreover, θ_{jst} fixed effects control for sector specific shock in each destination.[16] Then we compare results based on previous sets of fixed effects with those including firm-by-destination (θ_{ij}) and year (θ_t) fixed effects.[17] These fixed effects properly control for any time shock (common to all destinations) and for any firm-destination specific characteristics affecting the export volumes of French firms (average size and productivity of the firm, quality of exported products, managerial capability, relative comparative advantage between France and the destination country j, the preference of a given firm for a specific destination). Because the specification in (4) does not control for the multilateral price resistance term in destination countries, we add a set of country-year specific variables Z_{jt} including GDP (in ln) and effective real exchange rate as a proxy for the multilateral price resistance term (the real exchange rate has been computed as in Berman et al. (2012)). The set of control variables X_{it} includes turnover (in ln) or employment (in ln) with the aim of controlling for the time varying performance of the firm which may affect its export performances and electricity price (this reduces the omitted variable problem in our estimations).

Table 3 shows the results of the simplest IV regression where the first stage results are shown at the bottom of the table. The coefficient on electricity prices is always positive and significant, showing the relevance of the electricity price in explaining the within variation of

[16] Destination-industry-year fixed effects in the baseline sample estimations use the NAF700 classification of each firm, i.e. the industry to which the firm belongs to, so they are poorer proxy for the resistance term.

[17] We use high-dimensional instrumental variable estimations procedure developed in Bahar (2014) - **ivreg2hdfe** in Stata.

export price. The F-stat is always above 10. Note in particular that the first stage estimates of the impact of electricity cost shocks on export prices are very stable as they vary between 0.040 and 0.049[18]. As discussed before, a simple model predicts that this elasticity should be close to the share of electricity costs in total costs. The average observed share in our sample is around 3% so not very different.

Table 3 provides a first estimate of the export price elasticity that varies (in absolute value) between 2.9 and 5.7[19]. In the specification reported in column 1 of table 3, firm fixed effects and destination year fixed effects are included but there are no controls for the time varying activity of the firm. These are added in specifications 2 and 3. Then, in specifications 4, 5 and 6, the destination-year fixed effect is replaced by a more demanding destination-industry-year fixed effect. Industries are defined using the NAF700 4-digit classification of the French statistical institute INSEE for each firm. There are 615 NAF700 industries in the French economy. Finally specifications 7,8 and 9 have a firm-destination fixed effect and a year fixed effect.

All in all, we can conclude that the export price elasticity is strongly robust across different specifications (i.e. fixed effects) and always around 5 in our preferred specifications (columns 4-9).

[18] The full first stage regression results are shown in the appendix in table A3.

[19] We report the OLS estimation in the appendix in table A2. Not surprisingly the demand elasticity is lower in absolute value when we do not instrument the export price. An obvious reason is that in this case price movements are affected by demand shocks to the firm.

Table 3 – Baseline 2SLS regressions on full dataset.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Dep Var: Export Volumes (ln)			Dep Var: Export Volumes (ln)			Dep Var: Export Volumes (ln)		
TUV (ln)	-4.203***	-2.918***	-3.916***	-5.692***	-4.342***	-5.366***	-5.544***	-3.944***	-5.131***
	(0.729)	(0.514)	(0.671)	(1.197)	(0.918)	(1.125)	(0.982)	(0.699)	(0.900)
Turnover (ln)		0.299***			0.264***			0.361***	
		(0.010)			(0.015)			(0.014)	
Employment (ln)			0.159***			0.132***			0.205***
			(0.012)			(0.017)			(0.015)
GDP (ln)							0.784***	1.029***	0.831***
							(0.167)	(0.119)	(0.153)
Effective RER (ln)							-0.067***	-0.073***	-0.067***
							(0.017)	(0.012)	(0.016)
Firm FE	yes	yes	yes	yes	yes	yes	no	no	no
Destination-Year FE	yes	yes	yes	no	no	no	no	no	no
Firm-Destination FE	no	no	no	no	no	no	yes	yes	yes
Year FE	no	no	no	no	no	no	yes	yes	yes
Destination-Industry-Year FE	no	no	no	yes	yes	yes	no	no	no
First Stage									
Electricity Price	0.049***	0.049***	0.050***	0.040***	0.040***	0.040***	0.046***	0.046***	0.046***
Turnover (ln)		0.001			-0.005			-0.002	
Employment (ln)			0.002			-0.002			-0.001
GDP (ln)							-0.158***	-0.158***	-0.158***
Effective RER (ln)							0.003	0.003	0.003
F-stat	23.25	22.94	23.47	15.83	14.79	15.60	22.83	21.88	22.67
Observations	1630856	1626667	1630856	1630856	1626667	1630856	1488954	1485547	1488954

Standard errors are clustered within firm-year in all estimations.
More details on the first stage results are reported in table A3
*** $p < 0,01; **p < 0,05; *p < 0,1$.

2.1. Robustness checks using core product dataset.

In table 4, we perform several robustness checks on the sample. First, we restrict the sample to the core product of the firm (for each firm we keep the product line having the maximum average exports over the period 1996-2010). This solves the potential aggregation bias concern when firms export more than one product to a given destination. In this case, changes in unit values and quantities may reflect changes in the product mix instead of real price changes. One may also be concerned that an electricity price increase may push firms to concentrate on the high quality exported goods and therefore to change its mix of exported products. To eliminate these problems, we restrict the sample to a set of observations for which the firm exports only one product over our time frame which we take as the core product. Second, we restrict the sample to firms exporting to a given destination over the entire period. This is the simplest way to deal with the selection bias (entry/exit dynamics of the firm) - see Fitzgerald and Haller (2014). Results reported in columns 1-3 in table 4 show an estimated elasticity a bit higher (in absolute value) than that obtained on the full sample (when we do not restrict to the core product). This may indeed suggest that firms faced with a cost shock tilt a bit their product mix towards higher quality, lower elasticity products. The F-stat of the first stage regressions decrease and are slightly lower than 10. This suggests a moderate weak instrument issue that might be due to the reduced number of observations in presence of clustered standard errors with demanding sets of fixed effects. In the appendix table A4 we report the same regressions with destination-sector-year fixed effects and obtain similar results. In those regressions, because we use the core product of the firm we can use the HS classification for the sector fixed effect. We use the 4 digit level of HS because defining the sector fixed effect at the 6 digit level is too demanding for the regressions. Then, in columns 4-6 in table 4, we report a further robustness check by using the core product of the firm for a sub-sample of firms exporting at least five years over the period 1996-2010. This robustness check aims at reducing the problem of churning without sticking on pure continuous exporting firms. The estimated elasticities are a bit higher in the range of 4.6 to 6.5 with a reassuring joint F-stat above 10.

We also run the regressions for the entire sample in first difference estimations in columns 7-9 in table 4. In this case, our estimation of the export price elasticity is not over a change in price relative to its average over the period for a given destination but relative to the previous year for a given destination. It is reassuring that the (instrumented) export price elasticity remains very similar (between 5 and 6). In this case however, the F-stat is lower suggesting a weak instrument problem in the first difference dimension.

2.2. Robustness checks controlling for strategic complementarity.

A final issue we want to address is strategic complementarity that has been emphasized recently by Amiti et al. (2015) in international pricing. The concern is that in the first stage regression, the electricity cost shock that generates the export price increase could also lead close competitors to increase their own price. In turn, this may alter the estimate of the impact of the export price increase on its export sales. If such a strategic complementarity exists, for example of the kind analyzed by Atkeson and Burstein (2008), the perceived elasticity of demand is different (smaller) from the elasticity of substitution across products. A complete analysis of this issue is beyond the scope of our paper but we can take advantage of our dataset to check whether our estimates are robust to a crude measure of these strategic complementarities. Note that they should be already taken into account when we include destination-industry-year fixed effects as in columns 4 to 6 of table 3, and/or destination-sector-year fixed effects as in table A4. The reason is that in a model such as Atkeson and Burstein (2008), the firms are large enough to affect the sectoral price index. A destination-sector-year fixed effect should control for the sector price index and therefore for the strategic complementarity effects. One interpretation of the larger (in absolute term) coefficient that we obtain in columns 4 to 6 compared to columns 1 to 3 in table 3 is therefore that when we do not include destination-sector year fixed effects, the estimated elasticity is the perceived elasticity of demand (around 3 to 4) whereas when do, the estimated elasticity is the elasticity of substitution between home and foreign products within a sector (around 4 to 6). However, one could argue that the NAF4 digit sectors that we use for these fixed effects are not necessarily the valid ones to capture these strategic complementarities. However, destination-HS4-year fixed effects as in table A4 are a more compelling way of controlling for strategic complementarity and results hold. Moreover, as a further robustness test, we use the core product dataset and control for the prices of other French exporters to the same destination and in the same HS6 sector.

We follow a similar empirical strategy as in Amiti et al. (2015) although we depart from them because we use a different instrumental variable and we analyze the strategic complementarity on export prices while they analyze it on domestic prices. We proceed in two steps. First we control for strategic complementarity of French exporters only and then we control for strategic complementarity of non French exporters to the destination. In order to define the relevant set of competitors, we need the specific HS 6-digit in which the firm operates. So, for this estimations we rely on the core product based sample of firms (as in table 4). For firm *i* exporting to a given HS6-Destination combination, we define the French competitors trade unit value (TUV) as the average TUV of French firms exporting to that HS6-Destination combination. We exclude from this average the TUV of firm *i*. We also exclude from the sample HS6-destination combinations with less than two competitors. Finally, we define foreign competitors TUV as the average import price (TUV) of non-French exporters to a given HS6-destination where the French firm *i* is exporting (using BACI dataset). In table 5 we show results based on core product dataset (firms exporting more than 5 years) controlling for the average price of French competitors - columns 1 to 3 - and for both domestic and foreign competitors TUV - columns 5 to 7.[20] The results are intuitive as firm export prices increase with both domestic and foreign competitors prices (in the first stage) suggesting the presence of strategic complementarity. The price of competitors also have a positive impact on export volumes. However, the main result is that the estimated elasticity is not much affected.

As a robustness check in columns 4 of table 5 we replace the French competitors prices by an exogenous shock to these prices, i.e. the average electricity cost for these French competitors. Its effect on export volumes is positive and significant in column 4 but again the estimate of the export price elasticity is not much affected. All in all, from this first set of evidence we conclude that our estimate of the firm level export price elasticity is precisely estimated and relatively high at around 5.

[20] In appendix table A6 we show the same type of estimations on the balanced core product dataset.

Table 4 – Baseline 2SLS regressions. Robustness checks.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Dep Var: Export Volumes (ln)			Dep Var: Export Volumes (ln)			Dep Var: Export Volumes (ln)		
TUV (ln)	-5.231***	-4.062***	-5.296***	-6.504***	-4.576***	-5.991***	-6.066**	-5.175**	-5.306**
	(1.678)	(1.244)	(1.667)	(1.537)	(1.028)	(1.426)	(2.885)	(2.471)	(2.391)
Turnover (ln)		0.428***			0.428***			0.179***	
		(0.037)			(0.021)			(0.016)	
Employment (ln)			0.201***			0.196***			0.111***
			(0.027)			(0.023)			(0.021)
GDP (ln)							1.388***	1.456***	1.454***
							(0.305)	(0.262)	(0.256)
Effective RER (ln)							-0.197***	-0.189***	-0.189***
							(0.040)	(0.034)	(0.034)
Sample	Core product and balanced database			Core product. exporting more than 5 year			First difference estimations		
Firm FE	yes	yes	yes	yes	yes	yes	no	no	no
Destination-Year FE	yes	yes	yes	yes	yes	yes	no	no	no
Year FE	no	no	no	no	no	no	yes	yes	yes
First Stage									
Electricity Price	0.043***	0.045***	0.043***	0.042***	0.044***	0.042***	0.015*	0.014*	0.015*
Turnover (ln)		0.023***			0.010***			0.002	
Employment (ln)			-0.002			-0.004			0.006*
GDP (ln)							-0.092***	-0.093***	-0.092***
Effective RER (ln)							-0.008	-0.009	-0.008
F-stat	8.75	9.71	8.75	14.67	15.81	14.26	3.28	3.18	3.60
Observations	173827	173524	173827	643564	642477	643567	1003361	1000403	1003361

Standard errors are clustered within firm-year in all estimations.

*** $p < 0,01; ** p < 0,05; *p < 0,1$.

Table 5 – Controlling for strategic complementarity from both domestic and foreign competitors. Robustness checks using core product database.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Dep Var: Export Volumes (ln)				Dep Var: Export Volumes (ln)		
TUV (ln)	-6.563***	-5.012***	-6.232***	-6.381***	-6.094***	-4.633***	-5.770***
	(1.725)	(1.295)	(1.699)	(1.758)	(1.552)	(1.172)	(1.527)
Turnover (ln)		0.416***				0.412***	
		(0.023)				(0.022)	
Employment (ln)			0.160***	0.153***			0.162***
			(0.043)	(0.045)			(0.041)
TUV competitors (ln)	0.664***	0.465***	0.622***		0.555***	0.381***	0.517***
	(0.219)	(0.164)	(0.216)		(0.184)	(0.138)	(0.181)
TUV importing country (ln)					0.221***	0.164***	0.208***
					(0.059)	(0.045)	(0.059)
Electricity Price competitors (ln)				0.216**			
				(0.036)			
Sample	Core product exporting more than 5 years						
Firm FE	yes	yes	yes	yes	yes	yes	yes
Destination-Year FE	yes	yes	yes	yes	yes	yes	yes
Electricity Price	0.047***	0.048***	0.046***	0.045***	0.049***	0.050***	0.048***
Turnover (ln)		0.004				0.004	
Employment (ln)			-0.017***	-0.017***			-0.018***
TUV competitors (ln)	0.127***	0.127***	0.127***		0.118***	0.118***	0.118***
TUV importing country (ln)					0.038***	0.038***	0.038***
Electricity Price competitors (ln)				0.002			
F-stat	12.54	12.83	11.62	11.33	13.42	13.60	12.41
Observations	301795	301154	301795	301795	298431	297796	298431

Standard errors are clustered within firm-year in all estimations.
*** $p < 0,01; **p < 0,05; *p < 0,1$.

3. Export Elasticity to Prices, Tariffs and Real Exchange Rates

In this section we compare the elasticity to the firm specific export price with two other trade elasticities often estimated in the existing literature: the elasticity (i) to tariff and (iii) to real exchange rate. The previous literature highlighted the presence of the so called international elasticity puzzle as trade volumes react more elastically to tariffs than to real exchange rate movements. As a preliminary step to our micro-level estimations of export volume elasticities, we provide aggregate OLS estimations in order to reproduce in our data the presence of the international elasticity puzzle. We follow the same logic as in Fitzgerald and Haller (2014) and aggregate our dataset at industry-destination-year to estimate the effect of tariff and real exchange rate on both export volumes and revenues.[21] All variables are taken in log and we include destination and industry-year fixed effects in all the estimations. Results, reported in table 6 strongly confirm the presence of the international elasticity puzzle. The estimated coefficients on tariff range between 1 and 1.23, while coefficients on real exchange rate are between 0.57 and 0.72. French exporters react more to tariffs than to real exchange movements. Then in a last specification (see columns 3 and 6), with a pure illustrative purpose, we include the (log of) export price. Coefficients on TUV have the expected sign with an elasticity of 0.48 on export volumes but are clearly biased due to endogeneity.

Our main interest is however on firm-level (rather than aggregated) elasticity puzzle estimations. So, we now come back to firm-level estimations with the same instrumental strategy as in the previous section. Namely, our estimation strategy is the same as in equation (4) but we include firm-destination-year specific tariffs ($ln(tariff_{ijt}+1)$) and bilateral real exchange rate (RER_{jt}) as follows:[22]

$$\begin{aligned} ln(exp_{i,j,t}) \quad = \quad & \theta_{ij} + \theta_t + \alpha_1 ln\left(TUV_{i,j,t}\right) + \alpha_2 \left(RER_{j,t}\right) + \alpha_3 ln\left(tariff_{i,j,t}+1\right) + \\ & \alpha_4 \left(X_{i,t}\right) + \alpha_5 \left(Z_{j,t}\right) + \varepsilon_{i,j,t} \qquad (8) \end{aligned}$$

[21] Our approach differs from Fitzgerald and Haller (2014) in the sectorial aggregation. While Fitzgerald and Haller (2014) aggregate at HS 6-digit level, we do it at industry NAF700 level to be coherent with the classification used in the baseline dataset described above. For these estimations, tariff corresponds to the average tariff faced by French firms in a given NAF700 when exporting into a given destination. Interestingly, we confirm the elasticity puzzle highlighted by Fitzgerald and Haller (2014) also by using different sectorial aggregation.

[22] $ln(tariff_{ijt}+1)$ is the weighted average tariff faced by a given firm into a given destination across exported products. We use the product share of firm's exports as a weight.

Table 6 – Aggregated regressions.

	Dep Var: Export Volumes (ln)			Dep Var: Export Revenues (ln)		
	(1)	(2)	(3)	(4)	(5)	(6)
RER (ln)	0.649***	0.725***	0.786***	0.574***	0.639***	0.634***
	(0.063)	(0.070)	(0.067)	(0.051)	(0.056)	(0.056)
Ln(tariff+1)	-1.132***	-1.040***	-1.185***	-1.233***	-1.112***	-1.098***
	(0.169)	(0.168)	(0.162)	(0.137)	(0.136)	(0.136)
GDP (ln)		1.034***	1.168***		1.119***	1.106***
		(0.077)	(0.075)		(0.068)	(0.063)
Effective RER (ln)		0.107***	0.111***		0.107***	0.107***
		(0.028)	(0.028)		(0.023)	(0.023)
TUV			-0.486***			0.046***
			(0.009)			(0.007)
Destination FE	yes	yes	yes	yes	yes	yes
Industry-Year FE	yes	yes	yes	yes	yes	yes
Observations	40557	39974	39974	40557	39974	39974
R-squared	0.796	0.798	0.812	0.810	0.813	0.813

These specifications are based on a sample obtained by aggregating at NAF700-destination-year the. baseline full sample used in table 3. Robust standard errors. *** $p < 0,01; **p < 0,05; *p < 0,1$.

All variables have the same meaning as before. In contrast to the specifications we tested in the previous section, we can only include firm-destination (θ_{ij}) and year (θ_t) fixed effect since destination-year fixed effects would be perfectly collinear with real exchange rates.[23] As before we include a set of destination-year specific control variables Z_{jt} containing the GDP (in log) of destination countries to control for import demand and the real *effective* exchange rate to control for the degree of competition in the destination country and the price index of the importing country.

The results are shown in table 7. In the first stage regression, we find that tariffs and real exchange rates shocks are partly absorbed by exporters in their markups. French exporters price to market. Only a small part of the exchange rate change is absorbed (less than 3 percent). The pricing to market behavior is more relevant for core product sample estimations reported in table A7 in appendix), where around 10 percent of the exchange rate shock is absorbed in the export price. This result is consistent with the evidence in Berman et al. (2012). Note that most of the evidence on pricing to market following exchange rate movements is on import prices and not export goods prices so this result may suggest that importers and retailers at destination do absorb exchange rate movements. However, for tariffs, exporters react differently as they lower export prices by 0.35 percent following a 1 percent increase in tariff. Table 7 also shows that the inclusion of tariffs and real exchange rates does not alter

[23] In a robustness check reported in table 8 we exclude RER from the sample of covariates and run a specification including destination-tear fixed effects.

the estimates of the instrumented export price elasticity that remains between 5.2 and 5.6 depending on the specification. The export price elasticities are systematically much larger than the elasticity for the tariff which itself is larger that the elasticity for the real exchange rate. The tariff elasticity is around 1.9 and the exchange rate elasticity is around 0.6.

We also analyze the difference between OECD and non OECD countries in regressions (6) and (7) and notice that in the first stage, French exporters do more pricing to market (absorb more of exchange rate movements) towards OECD destinations than towards non OECD countries. In the latter case, there is basically no pricing to market. We also note that the coefficients in the second stage are relatively similar in OECD and non OECD countries. The trade elasticities are all larger in the OECD countries but the difference is only significant for the exchange rate. This may suggest that French goods are more substitutable with OECD produced goods than with non OECD ones.

One important advantage of including the (instrumented) price in the export volume equation is that it enables to take into account that exporters absorb part of a change in tariff and exchange rate in their FOB export price in exporter's currency. In the existing literature based on firm level data (see Fitzgerald and Haller (2014) and Berman et al. (2012)) where TUVs are absent, the estimates of the international elasticity of tariffs and exchange rates are actually a mix of two elasticities: the elasticity through the change in export prices and the "true" elasticity of exports to tariffs or exchange rates. To see this in our data we can run the standard OLS equation that does not include the instrumented export price. This is done in columns 8 in table 7 that can be compared to regression 5. In this case, the exchange rate elasticity is reduced from 0.66 to 0.52 and the tariff elasticity is reduced (in absolute value) from 1.77 to 0.03 (and not significant). The difference is much larger for tariffs because we saw that in the first stage exporters absorb a large part of the tariff in their export price but a smaller part of an exchange rate change. An increase in tariffs for example affects export volumes via the elasticity of substitution effect (measured here as -1.77) and via the impact it has on export price which themselves affect export volumes (-0.35*-5.17=1.81). The two effects in our data approximately cancel each other which we see in the OLS regression (6) in the coefficient on tariffs (0.03). But it would be clearly wrong to conclude from the OLS regression that tariffs have no impact on firm level exports.

Another way to see the importance of taking into account export prices in the estimation of international elasticities is to compare the estimation for export values and export volumes in the OLS regression. If the inclusion of export prices in the estimation is not an important issue, then the elasticity to tariff and exchange rate shocks should be identical for export values or volumes. We see in regressions (8) and (9) that, especially for tariffs, this is clearly not the case. Note that neither regression (8) or (9) provides an estimate close to ours in the case of tariff shocks.

Another interesting result of table 7 is the impact of cyclical demand in the destination country. French exporters *decrease* their export prices towards destinations where GDP is higher than average. Because we have country and year fixed effects, this does not mean that exporters have lower prices in richer countries but that they lower prices in a specific country in years where GDP is higher than average.[24] The impact is substantial: a 1% above average growth rate in destination leads French exporters to decrease their price to that destination by 0.18% (regression 5). This pricing behavior is also at work for core-products (see table A7 in appendix) but to a lower extent (0.07%). This also means that the elasticity of exports to destination demand is the sum of two components: the direct and standard effect of final demand on exports (0.62 in the full sample) on the one hand and the effect of the fall in export prices (-0.18*-5.2=0.94). The OLS coefficient on GDP in regression (8) is the sum of these two effects (1.56). Hence more than half (0.94/1.56) of the increase in exports following an increase in GDP in the destination country is due to the pricing strategy of firms rather than the standard direct effect.[25] To our knowledge, our paper is the first to document this pricing behavior which cannot be directly reconciled with existing models. Although Atkeson and Burstein (2008) may be a good candidate, we leave to future research the aim to rationalize this stylized fact.[26]

4. Robustness checks

In table 8, we replace firm year fixed effects by destination-year fixed effects. In this case, the exchange rate variable is absorbed by the fixed effect but the impact of the tariff which is firm-destination specific can still be estimated. The destination-year fixed effect enables

[24]This is also true in the specification in first difference (see table A11 in appendix).

[25]For core products (see table A7 in appendix), the standard effect is dominant but the impact of the pricing strategy is still substantial (around 30%).

[26]Atkeson and Burstein (2008) indeed show in their model of imperfect competition and variable markups that because firms market shares determine the price elasticity of demand, firms decrease their markups and prices when they loose market share. If a destination GDP boom attracts new firms and products (domestic and foreign) and therefore reduces the French exporters market share, this would increase the elasticity of demand and provide an incentive to reduce their export price. A related but different mechanism is introduced by Jaravel (2016) who shows that increasing market size causes the introduction of more products and, through increased competitive pressure and decreasing markups, lower prices. This is also coherent with a Melitz and Ottaviano (2008) type of model where, departing from CES assumptions, competition is tougher (markups lower) in larger markets accommodating more firms.

to better control for the impact of changes in tariffs on the destination price index. The estimated elasticity for the TUV is not affected. The elasticity on the tariff increases a bit, relative to the estimate in table Table 7, but the difference is not statistically different.

Our results are robust to using the core-product on a balanced panel as shown in table A7 in appendix as well as using data only up to 2007 (see table A8) therefore excluding crisis years which may be important for the exchange rate elasticity. The results are also robust when we use the core product sample with firms exporting more than 5 years (see table A10) and when we run regressions in first difference as shown in table A11 in appendix. The estimated coefficients are very similar and robust across specifications and robustness check. However, the relatively low F-stat suggests a weak instrument concern in the balanced core-product estimations reported in table A7.

Another empirical concern is the selection bias in the export status if firms select endogenously in different destinations (firm-level zeros). In heterogeneous firm trade models, only high-productive firms are able to serve far and more costly (complicated) markets. In our framework, higher tariff observations will be associated with high-productive firms. To partially address this problem, we follow Fitzgerald and Haller (2014) and Mulligan and Rubinstein (2008) and run a last set of robustness checks using a subsample of firms with sufficiently high number of destinations (more than 11 destinations, corresponding to the 25th percentile of the distribution). Results, reported in table A9 confirm our main results.

Table 7 – 2SLS regressions on full baseline dataset.

	Dep Var: Export Volumes (ln)							Export Volumes (ln)	Export Values (ln)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
TUV (ln)	-5.498***	-5.556***	-5.588***	-5.586***	-5.171***	-5.434***	-4.681***	-	-
	(0.0983)	(0.982)	(0.992)	(0.994)	(0.911)	(1.000)	(1.200)		
RER (ln)			0.552***	0.673***	0.659***	0.831***	0.566***	0.524***	0.550***
			(0.035)	(0.044)	(0.040)	(0.089)	(0.037)	(0.019)	(0.014)
Ln(tariff+1)			-1.927***	-1.908***	-1.771***	-2.508***	-1.534***	0.028	-0.320***
			(0.367)	(0.365)	(0.335)	(0.628)	(0.405)	(0.057)	(0.047)
Effective RER (ln)				0.125***	0.121***	0.026***	0.117***	0.074***	0.083***
				(0.021)	(0.019)	(0.051)	(0.019)	(0.010)	(0.008)
Employment (ln)					0.205***	0.248***	0.144***	0.217***	0.215***
					(0.015)	(0.017)	(0.021)	(0.009)	(0.008)
GDP (ln)		0.772***	0.594***	0.568***	0.624***	0.530***	0.817***	1.556***	1.376***
		(0.167)	(0.189)	(0.191)	(0.175)	(0.260)	(0.168)	(0.051)	(0.026)
Estimator			2SLS			2SLS		OLS	
Sample			All countries			OECD	non-OECD	All countries	
Firm-Destination FE	yes	yes	yes	yes	yes	yes	yes	yes	yes
Year FE	yes	yes	yes	yes	yes	yes	yes	yes	yes
First Stage									
Electricity Price	0.046***	0.046***	0.046***	0.046***	0.046***	0.049***	0.042***	-	-
RER (in log)			0.017***	0.026***	0.026***	0.061***	0.006	-	-
Ln(tariff+1)			-0.350***	-0.348***	-0.348***	-0.498***	-0.327	-	-
Effective RER (ln)				0.009*	0.009*	-0.009	0.007	-	-
Employment (ln)					-0.001	0.002	-0.008	-	-
GDP (ln)		-0.157***	-0.179***	-0.181***	-0.181***	-0.235***	-0.131***	-	-
F-stat	22.40	22.94	22.75	22.63	22.47	23.08	9.10	-	-
Observations	1496270	1496270	1496270	1488954	1488954	863035	625919	1488954	1488954

Standard errors are clustered within firm-year in all estimations.

More details on the first stage results for specifications in columns 1-5 are reported in table A12.

*** $p < 0,01; **p < 0,05; *p < 0,1$.

Table 8 – 2SLS regressions with destination-by-year fixed effects.

	Dep Var: Export Volumes (ln)	
TUV	-5.482***	-5.065***
	(0.945)	(0.864)
Ln(tariff+1)	-2.324***	-2.116***
	(0.513)	(0.475)
Employment (ln)		0.207***
		(0.014)
Firm-Destination FE	yes	yes
Destination-Year FE	yes	yes
Sample	Full	
First Stage		
Electricity Price	0.052***	0.052***
Ln(tariff+1)	-0.228***	-0.228***
Employment (ln)		0.001
F-stat	24.18	24.04
Observations	1496270	1496270

Standard errors are clustered within firm-year in all estimations.
*** $p < 0,01; **p < 0,05; *p < 0,1$.

Finally, we test the robustness of our results to the use of an alternative instrument for the firm specific export price. Consistent with equation 1, we use the interaction between the firm-year specific electricity price and the electricity costs share over total firm's costs. For this cost share we use either the average share for the firm on the whole period or the share for the sector to reduce endogeneity. The advantage of this instrument is that it uses a specific information about the firm or sector specific electricity intensity (as in equation 1). The drawback of this approach is the likely endogeneity bias. Indeed, the total cost of the firms (in particular labor costs and intermediates) may be endogenous to the export performance of the firm and may affect exports through other channels than the export price. In particular, the mix of exported goods might be affected by labor and/or intermediates cost if such products are labor or intermediate goods intensive. Hence, we think this instrument may be more reliable when used in the core product sample. The results are shown in table A13. The instrument works well in the sense that in the first stage the elasticity of export price to the instrument is between 0.8 and 0.9 (regressions 1 to 4) in the full sample. This elasticity should be around unity if there was full pass-through of costs to prices but we do not expect full pass-through given that this is not the case for exchange rates or tariffs. In addition, we do not have information on capital costs so we should also expect the elasticity to be below unity. The international elasticities are similar to those estimated with our main instrument except that they are smaller especially for tariffs and export prices. As explained above however, we believe that this instrument is more reliable for the core product sample which is shown in regressions 5 and 6. In this case the first stage is weaker, but the estimated elasticities are very similar to those estimated with our main instrument (see table 7).

5. Concluding remarks

The main contribution of this paper is to offer an estimate of the firm level price elasticity of exports using an original instrumental variable strategy. Our results point robustly to an estimate around 5. The second contribution is to show that this elasticity is much higher in absolute value than both the exchange rate (around 0.6) and the tariff (around 2) elasticities. We also show the importance of the absorption of exchange rate and tariff changes by exporters in their export prices. This implies that an estimate of elasticities of exports to exchange rates and tariffs that does not take into account the endogenous reaction of export prices is a mix of two opposite effects: the elasticity of substitution between home and foreign goods and the elasticity of exports to the endogenous reaction of export prices to the exchange rate or tariff shock. These two effects have opposite signs: an increase in tariff generates a substitution away from French exports but the endogenous fall in French exporters prices counteracts this. Because the elasticity of exports to exporters prices is much larger than to exchange rates and tariffs, this mechanism is quantitatively important.

Our results show that the international elasticity puzzle is well alive and actually worse than previously thought. Not only is the elasticity of exports higher for tariffs than for exchange rates, the elasticity of exports to export prices is much larger than those two. The issue is not the horizon as the differences are estimated across the same horizon.

We also uncover a new stylized fact: exporter prices are countercyclical. Exporters decrease prices towards destinations that experience changes in GDP. This is an important empirical regularity since such pricing behavior explains a large share of the increase of exports towards destinations with high demand. This mechanism works on top of the standard direct demand effect of GDP shocks.

Our results can be viewed as stylized facts in search of theory. One interpretation of our results, which we cannot test in our data, is that importers and wholesalers in the destination country absorb differently in their prices these three shocks or that they switch to alternative producers differently depending on the source of the shock. If these intermediaries pass export price shocks to retail prices more than tariff and exchange rate shocks this could explain the ranking we observe. This could in turn be due to differences in the perceived persistence and volatility of those shocks. Consistent with the model of Drozd and Nosal (2012), importers and retailers absorb more volatile shocks because they need to explicitly build market shares by matching with their customers. If this process is costly and time consuming, it may be that they will do it only when shocks are persistent enough. We calculated in our sample the coefficients of variation for the three shocks. To be consistent with the dimension of our estimation we calculated the coefficient of variation of the three shocks for a given firm-destination and them computed the average. For the export prices we choose the predicted value from the first stage. The largest variability is for the real exchange rate (7.8%) followed by the export price (1.6%) and the tariff (0.9%). Hence, real exchange rate shocks appear indeed more volatile than tariffs and firm export prices. However, tariff movements seem less volatile than export prices so this may not be enough to explain the higher elasticity of exports to export prices than to tariffs. Another interpretation could also be linked to the literature on rational inattention. One result of this literature (see Maćkowiak and Wiederholt (2009)) is that firms pay more attention to idiosyncratic conditions than to aggregate conditions which would be consistent with retailers and importers reacting more to exporters changing the price of their goods, than to tariff changes or exchange rate movements. We leave for future research to test for these alternative explanations.

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A Appendix

A1 Theory

This appendix shows that in a standard model the elasticity of producer prices to electricity cost shocks is the share of electricity costs in total costs. Firms have several inputs, among them electricity, labor, capital and intermediates in the production function of the different varieties of final goods they produce. These inputs are imperfect substitutes and we will assume that this elasticity is low: $\rho < 1$. There are M inputs other than electricity in the production function. The production function of firm i with productivity φ is given by:

$$y_i(\varphi) = \varphi \left[\alpha_{ei} e_i^{(\rho-1)/\rho} + \sum_{m=1}^{M} \alpha_{mi} x_{mi}^{(\rho-1)/\rho} \right]^{\rho/(\rho-1)} \quad (9)$$

with α_{ei} a parameter that describes how electricity dependent the firm is, e_i the quantity of electricity employed and x_{mi} the use of other inputs by the firm. $\alpha_{ei} + \sum_{m=1}^{M} \alpha_{mi} = 1$. The relative demand for electricity and any other input is given by: $\frac{e_i}{x_{mi}} = \left(\frac{\alpha_{ei} p_m}{\alpha_{mi} p_{ei}} \right)^{\rho}$ with p_m the price of input m and p_{ei} the firm-specific energy price. So total costs of firm i are:

$$C_i(\varphi) = \frac{p_{ei}}{\varphi} \alpha_{ei}^{-\rho/(\rho-1)} y_i(\varphi) \left[1 + \sum_{m=1}^{M} \frac{p_m x_{mi}}{p_{ei} e_i} \right]^{1/(1-\rho)} \quad (10)$$

With monopolistic competition on the demand side with σ the elasticity of substitution between varieties, the producer price $p_i(\varphi)$ expressed in Home currency (euros in our case)of firm/variety φ exporting to country i is the usual mark-up over marginal cost. It is given by:

$$p_i(\varphi) = \frac{\sigma}{\sigma - 1} \frac{p_{ei}}{\varphi} \alpha_{ei}^{-\rho/(\rho-1)} \left[1 + \sum_{m=1}^{M} \frac{p_m x_{mi}}{p_{ei} e_i} \right]^{1/(1-\rho)} \quad (11)$$

In the data, we do not observe the parameter α_{ei}. However we will observe total costs of the firm and its electricity expenditures: $p_{ei} e_i$. Hence, the elasticity of the producer price to the electricity price is given by:

$$\frac{dp_i}{dp_{ei}} \frac{p_{ei}}{p_i} = \frac{p_{ei} e_i}{p_{ei} e_i + \sum_{m=1}^{M} p_m x_{mi}} \quad (12)$$

which is the observed ratio of electricity expenditures to total costs.

A2 Tables

Table A1 – In-sample descriptive statistics before the firm-year aggregation.

	Observations	Mean	Std Dev	Min	Max
Electricity Price (euro/kwh)	1630856	0.062	0.015	0.033	0.139
Exported Quantity (ln)	1630856	8.378	3.187	-0.693	20.702
TUV (ln)	1630856	2.608	1.813	-1.66	8.005
Employment (ln)	1630856	5.372	1.068	0.693	8.869
Turnover (ln)	1630856	10.407	1.471	-1.881	17.23
Ln (tariff+1)	1630856	0.042	0.084	0	2.397
RER (ln)	1630856	0.106	0.191	-2.005	1.162
GDP (ln)	1630856	26.05	1.925	18.3	30.24
Effective RER (ln)	1630856	1.179	1.967	-2.09	9.499

Table A2 – OLS regressions on full baseline dataset.

	Dep Var: Export Volumes (ln)			Dep Var: Export Volumes (ln)		
	(1)	(2)	(3)	(4)	(5)	(6)
TUV (ln)	-1.268***	-1.268***	-1.268***	-1.143***	-1.143***	-1.143***
	(0.003)	(0.003)	(0.003)	(0.004)	(0.002)	(0.002)
Turnover (ln)		0.298***			0.371***	
		(0.009)			(0.012)	
Employment (ln)			0.153***			0.215***
			(0.007)			(0.008)
GDP (ln)				1.477***	1.472***	1.457***
				(0.037)	(0.026)	(0.027)
Effective RER (ln)				-0.081***	-0.082***	-0.080***
				(0.008)	(0.008)	(0.008)
Firm FE	yes	yes	yes	no	no	no
Destination-Year FE	yes	yes	yes	no	no	no
Firm-Destination FE	no	no	no	yes	yes	yes
Year FE	no	no	no	yes	yes	yes
Observations	1633037	1628826	1366037	1624300	1620118	1624300
R-squared	0.650	0.652	0.621	0.879	0.880	0.873

Standard errors are clustered within firm-year in all estimations.
*** $p < 0,01; **p < 0,05; *p < 0,1$.

Table A3 – First stage regression results on full baseline dataset.

	Dep Var: TUV (ln)			Dep Var: TUV (ln)			Dep Var: TUV (ln)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Electricity Price (ln)	0.046***	0.049***	0.050***	0.040***	0.040***	0.040***	0.046***	0.046***	0.046***
	(0.011)	(0.010)	(0.010)	-0.01	-0.01	-0.01	(0.010)	(0.011)	(0.011)
Turnover (ln)		0.001			-0.005			-0.002	
		(0.003)			-0.003			(0.003)	
Employment (ln)			0.002			-0.002			-0.001
			(0.004)			-0.004			(0.004)
GDP (ln)							-0.157***	-0.158***	-0.157***
							(0.013)	(0.013)	(0.013)
Effective RER (ln)							0.003	0.003	0.003
							(0.004)	(0.004)	(0.004)
Firm FE	yes	yes	yes	yes	yes	yes	no	no	no
Destination-Year FE	yes	yes	yes	no	no	no	no	no	no
Firm-Destination FE	no	no	no	no	no	no	yes	yes	yes
Year FE	no	no	no	no	no	no	yes	yes	yes
Destination-Industry-Year FE	no	no	no	yes	yes	yes	no	no	no
Observations	1630856	1626667	1630856	1630856	1626667	1630856	1488954	1485547	1488954
R-squared	0.770	0.770	0.770	0.779	0.779	0.779	0.883	0.883	0.883
F-stat	23.25	22.94	23.47	15.83	14.79	15.60	22.83	21.88	22.67

Standard errors are clustered within firm-year in all estimations.
*** $p < 0,01; **p < 0,05; *p < 0,1$.

Table A4 – Robustness check with Destination-Sector-Year fixed effects using core product database

	Dep Var: Export Volumes (ln)		
	(1)	(2)	(3)
TUV (ln)	-3.287***	-2.511***	-3.325***
	(0.819)	(0.632)	(0.818)
Turnover (ln)		0.323***	
		(0.019)	
Employment (ln)			0.172***
			(0.020)
Sample	Core product and balanced database		
Firm FE	yes	yes	yes
Destination-Sector-Year FE	yes	yes	yes
First Stage			
Electricity Price	0.062***	0.065***	0.063***
Turnover (ln)		0.099	
Employment (ln)			-0.006
F-stat	7.68	8.35	7.71
Observations	173827	173524	173827

Standard errors are clustered within firm-year in all estimations.
*** $p < 0,01; **p < 0,05; *p < 0,1$.

Table A5 – Controlling for strategic complementarity. Robustness checks using core product database.

	(1)	(2)	(3)	(4)	(5)	(6)
	Dep Var: Export Volumes (ln)			Dep Var: Export Volumes (ln)		
TUV (ln)	-6,121***	-4,342***	-5,644***	-5,839***	-4,476***	-5,495***
	(1,389)	(0,951)	(1,292)	(1,246)	(0,955)	(1,216)
Turnover (ln)		0,419***			0,356***	
		(0,021)			(0,017)	
Employment (ln)			0,194***			0,150***
			(0,022)			(0,028)
TUV competitors (ln)						
TUV importing country	0,426***	0,278***	0,386***			
	(0,115)	(0,078)	(0,107)			
Sample	Core product, exporting more than 5 years					
Firm FE	yes	yes	yes	yes	yes	yes
Destination-Year FE	yes	yes	yes	no	no	no
Destination-Sector-Year FE	no	no	no	yes	yes	yes
First Stage						
Electricity Price	0,044***	0,045***	0,043***	0,046***	0,046***	0,044***
Turnover (ln)		0,009***			-0,003	
Employment (ln)			-0,005			-0,001***
TUV competitors (ln)						
TUV importing country	0,083***	0,083***	0,083***			
F-stat	15,88	16,81	15,40	10,96	10,99	10,19
Observations	634475	633389	634475	643564	642477	643564

Standard errors are clustered within firm-year in all estimations.
*** $p < 0,01; **p < 0,05; *p < 0,1$.

Table A6 – Controlling for strategic complementarity from both domestic and foreign competitors. Robustness checks using core product balanced database.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Dep Var: Export Volumes (ln)				Dep Var: Export Volumes (ln)		
TUV (ln)	-4.547**	-3.606**	-4.642**	-4.706**	-4.280**	-3.336**	-4.382**
	(1.824)	(1.426)	(1.830)	(1.858)	(1.773)	(1.372)	(1.779)
Turnover (ln)		0.408***				0.402***	
		(0.035)				(0.034)	
Employment (ln)			0.176***	0.175***			0.179***
			(0.034)	(0.034)			(0.032)
TUV competitors (ln)	0.3008*	0.213	0.317*		0.267	0.176	0.276*
	(0.177)	(0.137)	(0.178)		(0.165)	(0.126)	(0.166)
TUV importing country (ln)					0.099**	0.074**	0.101**
					(0.041)	(0.032)	(0.041)
Electricity Price competitors (ln)				-0.036			
				(0.128)			
Sample	Core product and balanced database						
Firm FE	yes	yes	yes	yes	yes	yes	yes
Destination-Year FE	yes	yes	yes	yes	yes	yes	yes
Electricity Price	0.043**	0.043**	0.045**	0.044**	0.043**	0.044**	0.043**
Turnover (ln)		0.017***				0.018***	
Employment (ln)			-0.008	-0.008			-0.008
TUV competitors (ln)	0.097***	0.097***	0.097***		0.094***	0.093***	0.094***
					0.023***	0.023***	0.023***
Electricity Price competitors (ln)				-0.045*			
F-stat	6.06	6.23	6.11	6.03	5.82	6.01	5.87
Observations	96177	95971	96177	96177	95520	95314	95520

Standard errors are clustered within firm-year in all estimations.

*** $p < 0,01; **p < 0,05; *p < 0,1$.

Table A7 – 2SLS regressions on core-product balanced panel.

	Dep Var: Export Volumes (ln)				
	(1)	(2)	(3)	(4)	(5)
TUV	-5.081***	-5.490***	-5.419***	-5.418***	-5.498***
	(1.774)	(1.856)	(1.813)	(1.810)	(1.803)
RER (ln)			0.953***	1.055***	1.060***
			(0.206)	(0.205)	(0.205)
Ln(tariff+1)			-0.724***	-0.707***	-0.715***
			(0.175)	(0.175)	(0.177)
Effective RER (ln)				0.132***	0.130***
				(0.049)	(0.050)
Employment (ln)					0.194***
					(0.028)
GDP (ln)		1.310***	1.197***	1.157***	1.120***
		(0.167)	(0.176)	(0.174)	(0.173)
Firm-Destination FE	yes	yes	yes	yes	yes
Year FE	yes	yes	yes	yes	yes
First Stage					
Electricity Price	0.040***	0.041***	0.041***	0.041***	0.041***
RER (in log)			0.106***	0.105***	0.106***
Ln(tariff+1)			0.006	0.006	0.006
Effective RER (ln)				-0.000	-0.000
Employment (ln)					-0.000
GDP (ln)		-0.0662***	-0.069***	-0.070***	-0.069***
F-stat	7.6	7.9	8.13	8.13	8.13
Observations	172947	172947	172947	172918	172918

Standard errors are clustered within firm-year in all estimations.
*** $p < 0,01; ** p < 0,05; *p < 0,1$.

Table A8 – 2SLS regressions using full baseline data up to 2007.

	Dep Var: Export Volumes (ln)				
	(1)	(2)	(3)	(4)	(5)
TUV	-5.444***	-5.526***	-5.524***	-5.555***	-5.260***
	(1.127)	(1.130)	(1.130)	(1.144)	(1.070)
RER (in log)			0.645***	0.803***	0.790***
			(0.043)	(0.058)	(0.054)
Ln(tariff+1)			-2.119***	-2.117***	-2.000***
			(0.485)	(0.488)	(0.457)
Effective RER (log)				0.154***	0.151***
				(0.026)	(0.024)
Ln employment					0.175***
					(0.016)
GDP (log)		1.056***	0.905***	0.862***	0.897***
		(0.151)	(0.171)	(0.176)	(0.165)
Firm-Destination FE	yes	yes	yes	yes	yes
Year FE	yes	yes	yes	yes	yes
First Stage					
Electricity Price	0.044***	0.044**	0.044**	0.044***	0.044***
RER (in log)			0.022***	0.035***	0.035***
Ln(tariff+1)			-0.411***	-0.409***	-0.409***
Effective RER (log)				0.013**	0.013**
Ln employment					-0.000
GDP (log)		-0.116***	-0.136***	-0.139***	-0.139***
F-stat	16.87	17.19	17.16	16.55	16.87
Observations	1221409	1221409	1221409	1218470	1218470

Standard errors are clustered within firm-year in all estimations.

*** $p < 0,01$; $** p < 0,05$; $*p < 0,1$.

Table A9 – 2SLS regressions using firms exporting to a large number of destinations

	Dep Var: Export Volumes (ln)				
	(1)	(2)	(3)	(4)	(5)
TUV	-7.461***	-7.511***	-7.573***	-7.330***	-6.989***
	(2.396)	(2.394)	(2.420)	(2.268)	(2.173)
RER (ln)			1.039***	1.115***	1.085***
			(0.189)	(0.189)	(0.181)
Ln(tariff+1)			-0,277	-0,276	-0.292*
			(0.183)	(0.175)	(0.169)
Effective RER (ln)				0.095***	0.092***
				(0.031)	(0.029)
Employment (ln)					0.161***
					(0.025)
GDP (ln)		0.761***	0.591*	0.606**	0.637***
		(0.288)	(0.312)	(0.294)	(0.281)
Firm-Destination FE	yes	yes	yes	yes	yes
Year FE	yes	yes	yes	yes	yes
First Stage					
Electricity Price	0.029***	0.029***	0.029***	0.030***	0.029***
RER (in log)			0.076***	0.080***	0.080***
Ln(tariff+1)			0.037	0.037	0.037
Effective RER (ln)				0.004	0.004
Employment (ln)					-0.004
GDP (ln)		-0.114***	-0.123***	-0.123***	-0.123***
F-stat	8.18	8.29	8.25	8.79	8.60
Observations	768292	768292	768292	764623	764623

Number of destination above 11 corresponding to the 25_{th} percentile of the distribution.
Standard errors are clustered within firm-year in all estimations.
*** $p < 0,01; ** p < 0,05; *p < 0,1$.

Table A10 – 2SLS regressions on core-product. Firms exporting more than 5 years into a given country

	Dep Var: Export Volumes (ln)				
	(1)	(2)	(3)	(4)	(5)
TUV	-7.285***	-7.406***	-7.412***	-7.302***	-6.751***
	(1.888)	(1.888)	(1.886)	(1.821)	(1.710)
RER (in log)			1.065***	1.151***	1.100***
			(0.158)	(0.159)	(0.149)
Ln(tariff+1)			-0.235	-0.231	-0.256
			(0.186)	(0.183)	(0.169)
Effective RER (log)				0.101***	0.099***
				(0.034)	(0.031)
Ln employment					0.206***
					(0.025)
GDP (log)		0.814***	0.663**	0.654**	0.709***
		(0.248)	(0.263)	(0.256)	(0.238)
Firm-Destination FE	yes	yes	yes	yes	yes
Year FE	yes	yes	yes	yes	yes
First Stage					
Electricity Price	0.036***	0.037***	0.037***	0.037***	0.037***
RER (in log)			0.079***	0.082***	0.082***
Ln(tariff+1)			0.038	0.038	0.038
Effective RER (log)				0.000	0.000
Ln employment					-0.006
GDP (log)		-0.122***	-0.130***	-0.130***	-0.130***
F-stat	12.42	12.86	12.88	13.24	12.77
Observations	642839	642839	642839	640447	640447

Standard errors are clustered within firm-year in all estimations.
*** $p < 0,01; **p < 0,05; *p < 0,1$.

Table A11 – 2SLS regressions in first differences.

	Dep Var: Export Volumes (ln)				
	(1)	(2)	(3)	(4)	(5)
TUV (ln)	-5.905**	-5.981**	-5.974**	-6.063**	-5.306**
	(2.735)	(2.759)	(2.753)	(2.882)	(2.380)
RER (ln)			0.600***	0.587***	0.552***
			(0.125)	(0.144)	(0.306)
Ln(tariff+1)			-2.374*	-2.413*	-2.070*
			(1.269)	(1.325)	(1.100)
Effective RER (ln)				-0.023	-0.026
				(0.038)	(0.032)
Employment (ln)					0.111***
					(0.021)
GDP (ln)		1.538***	1.168***	1.155***	1.239***
		(0.275)	(0.351)	(0.365)	(0.306)
Year FE	yes	yes	yes	yes	yes
First Stage					
Electricity Price	0.015*	0.015*	0.015*	0.015*	0.015*
RER (in log)			0.041***	0.045***	0.045***
Ln(tariff+1)			-0.453***	-0.452***	-0.452***
Effective RER (ln)				0.004	0.004
Employment (ln)					0.006*
GDP (ln)		-0.085***	-0.116***	-0.115***	-0.116***
F-stat	3.45	3.47	3.5	3.3	3.6
Observations	1007989	1007989	1007989	1003361	1003361

Standard errors are clustered within firm-year in all estimations.
*** $p < 0,01; **p < 0,05; *p < 0,1$.

Table A12 – First stage regression results on full dataset.

	Dep Var: TUV (ln)				
	(1)	(2)	(3)	(4)	(5)
Electricity Price (ln)	0.046***	0.046***	0.046***	0.046***	0.046***
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
RER (ln)			0.170**	0.026***	0.026***
			(0.007)	(0.008)	(0.008)
Ln(tariff+1)			-0.350***	-0.348***	-0.348***
			(0.029)	(0.029)	(0.029)
Effective RER (ln)				0.009*	0.009*
				(0.004)	(0.004)
Employment (ln)					-0.002
					(0.004)
GDP (ln)		-0.157***	-0.179***	-0.187***	-0.181***
		(0.013)	(0.013)	(0.013)	(0.004)
Firm-Destination FE	yes	yes	yes	yes	yes
Year FE	yes	yes	yes	yes	yes
Observations	1496270	1496270	1496270	1488954	1488954
R-squared	0.883	0.883	0.883	0.883	0.883
F-stat	22.40	22.94	22.75	22.63	22.47

Standard errors are clustered within firm-year in all estimations.
*** $p < 0,01; **p < 0,05; *p < 0,1$.

Table A13 – Robustness Check using alternative Instrumental Variables.

	Dep Var: TUV (ln)					
	(1)	(2)	(3)	(4)	(5)	(6)
TUV (ln)	-2.365***	-1.286***	-2.378***	-1.297***	-7.262*	-5.656***
	(0.469)	(0.440)	(0.473)	(0.441)	(3.984)	(1.688)
RER (ln)			0.586***	0.557***	1.246***	1.077***
			(0.021)	(0.018)	(0.431)	(0.195)
Ln(tariff+1)			-0.799***	-0.423***	-0.708***	-0.715***
			(0.172)	(0.159)	(0.232)	(0.182)
Effective RER (ln)	-0.076***	-0.079***	0.095***	0.086***	0.129*	0.130***
	(0.008)	(0.007)	(0.011)	(0.008)	(0.067)	(0.052)
Employment (ln)	0.211***	0.214***	0.211***	0.214***	0.190***	0.194***
	(0.008)	(0.007)	(0.008)	(0.007)	(0.038)	(0.028)
GDP (ln)	1.265***	1.434***	1.127***	1.322***	0.999***	1.108***
	(0.078)	(0.073)	(0.089)	(0.082)	(0.312)	(0.166)
Sample	Full Sample				Balanced Core Products	
Firm-Destination FE	yes	yes	yes	yes	yes	yes
Year FE	yes	yes	yes	yes	yes	yes
First Stage						
Electricity Price*Avg. Elec Dependency	0.873***		0.868***		0.631**	
Electricity Price*Sector Elec Dependency		0.805***		0.806***		0.924***
RER (in log)			0.026***	0.026***	0.105***	0.105***
Ln(tariff+1)			-0.348***	-0.348***	0.004	0.007
Effective RER (ln)	0.003	0.003	0.009*	0.009*	-0.000	-0.000
Employment (ln)	-0.002	-0.002	0.002	0.002	-0.002	-0.002
GDP (ln)	-0.156***	-0.156***	-0.179***	-0.179***	-0.067***	-0.067***
F-stat	19.20	21.14	18.99	21.20	3.13	10.43
Observations	1488954	1488954	1488954	1488954	172918	172918

Standard errors are clustered within firm-year in all estimations.
*** $p < 0,01$; $** p < 0,05$; $*p < 0,1$.