Export prices and markups with a common currency: Empirical evidence from Greek exporting firms and euro adoption

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Abstract: We estimate the effect of euro adoption on prices using data on Greek exporters spanning over the period 1999-2007. The overall impact of the euro on the prices of exports was negligible, but it masks significant heterogeneity across firms with different levels of pre-euro productivity. Our benchmark estimates indicate that the prices set by initially high-productivity firms rose on average by 8.9%. Our evidence further shows that these firms also raised their markups after euro adoption, whereas less efficient firms lowered their markups.

Keywords: common currency; euro; firm exports; prices; markups; productivity.

JEL classification: F1, F4.

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1. Introduction

Adoption of a common currency is at the heart of international macroeconomics. Among other things, a common currency determines the price setting behavior by firms in a globalized environment and the associated welfare gains or losses. This paper studies the effects of adopting the euro on the prices set by Greek exporting firms. To this end, we use data from Greek exporters and estimate the effects of the introduction of the euro in Greece in 2001 on export prices using 11 eurozone and 3 non-eurozone countries as the treatment and control groups, respectively. Our findings suggest that price setting after euro adoption has been asymmetric with a significant productivity-dependent component, as initially more productive firms increased their prices and markups after euro adoption.

The sample of firms that we consider covers exporting firms for which firm-product-destination level data are available from the Intrastat databank via the Greek Statistical Agency. This dataset is merged with firm-level data on balance sheet and financial information, and survey data related to economic activity of manufacturing firms. As we show, this sample is representative of the universe of Greek exporting firms and our overview of the data reveals that they are similar in many respects to those typically used in empirical exercises of micro-exporting. Our empirical analysis then uses the adoption of the euro by Greece on January 1st, 2001 as a natural experiment, which identifies a clear point in time when trade costs fell for Greek exporters.

We anticipate several opposing forces of euro adoption on export pricing. On the one hand, it reduces the costs of exporting firms, e.g. through facilitating transactions and access to larger markets. However, this process may also require quality upgrades, whereas the common currency also implies intensified competition in eurozone markets, which tends to depress the price any given firm can charge on that destination. Importantly, we expect that the response of prices will be different depending on the productivity of exporters. In particular, more efficient exporters will reduce less their prices, or even increase them, relative to less efficient exporters as they are more likely to engage in costly quality upgrades and exploit higher demand for their products in a larger market as it is easier to recover the fixed cost of quality upgrade in a large market, an effect that is consistent with the literature on the nexus between quality and trade at the firm level (see e.g. Fan et al., 2020).

The first main finding is that the overall effect of euro adoption on export prices, defined as the ratio of export values over quantities, is negligible. However, this aggregate effect masks significant heterogeneity across firms with different levels of pre-euro productivity. To gauge the quantitative importance of our findings, in our benchmark specification the

introduction of the euro was followed by a marked increase in the export prices of initially high-productivity firms by 8.9%, whereas the prices of initially less productive firms did not change. This picture remains robust in several sensitivity tests, including the product mix of exporters and the firms' facilitated access to credit after euro adoption.

A notable advantage of our data set is that we can exploit the detailed structure of the firms to infer the impact of the euro on the pricing strategy of heterogeneous exporters based on their markups. To this end, we follow De Loecker and Warzynski (2012) and estimate firm-level markups at the destination level. We find that on average markups fell after the adoption of the euro. However, we also provide strong empirical evidence that markups increased for initially high-productivity exporters and decreased for initially low-productivity firms. These effects contradict the standard intuition that monetary unification intensifies competition and leads to lower prices and markups.

Conceptually, our paper is most closely related to the class of studies that have attempted to assess the effects of currency unions. After the pioneering work of Rose (2000), who found that countries with a common currency trade much more compared to those that do not, a number of studies have provided estimates that have shown non-negligible effects of currency unions.[4] In contrast to these findings, studies that have focused on the effects of the European Monetary Union (EMU), the largest currency union ever formed, were not able to establish impacts of similar magnitudes.[5] However, there are few empirical investigations on the heterogeneous trade effects of the euro adoption using detailed exporter-level data. Berthou and Fontagné (2013) have investigated how French exporters react to a change in trade costs and found that the positive impact of a reduction in trade costs on export sales was concentrated among the most productive exporters. Pappalardo and Vicarelli (2017) confirm that product heterogeneity has been important for the impact of euro adoption on Italian exporters, as only the more productive firms increased their export flows towards both core and peripheral countries, while the less productive ones reduced their trade flows. Despite the evidence that euro adoption is related to firm heterogeneity and variable margins, no study has so far analyzed the introduction of the euro on export pricing and markups with firm-level data. Our work highlights a new dimension in firm exporting with a common currency,

[4] See also Frankel and Rose (2002) and Glick and Rose (2002). Rose and Stanley (2005) summarize these findings and conclude that a currency union increases bilateral trade by 30% to 90%.

[5] See Micco et al. (2003), Bun and Klaassen (2007), Baldwin et al. (2008), Berger and Nitsch (2008), Frankel (2008), Santos Silva and Tenreyro (2010), Kelejian et al. (2012), Badinger and Türkcan (2014), Mika and Zymek (2018). Polák (2019) shows in a meta-analysis that the differences among estimates are systematically driven by data sources, data structure, control variables, and estimation techniques, and reports a mean estimate of the euro's trade effect in the vicinity of 3%, which however is statistically insignificant.

namely that initially more efficient exporters tend to adjust upwards their prices following euro adoption. This finding extends the evidence reported by Fan et al. (2015), who show that Chinese exporting firms raised their prices at the product-destination level following China's trade reform with lower tariffs, to the case of trade liberalization through a common currency.

In a broader sense, our findings corroborate those reported in an important strand of trade literature that has shown that trade liberalization reduces markups (see Levinsohn 1993; Harrison 1994; Krishna and Mitra 1998; Kim 2000; Bottasso and Sembenelli 2001; Badinger 2007). A common feature of these studies with our approach is that they rely on natural experiments to identify the change in markups, rather than specifying functional forms for demand. Based on the existing empirical evidence on the fall of markups following trade liberalization, we should expect euro adoption to exert downward pressure on firm prices through lower average markups. Yet there is little direct evidence on how prices respond after currency unions because they are rarely observed during these episodes. We fill this gap by showing that euro adoption led to asymmetric changes in prices and markups of Greek exporters conditional on their initial productivity.

Thus, the evidence in this study contributes to the growing literature on trade liberalization and variable markups across firms. This literature is based on the theoretical premise that more productive firms set higher markups and, given that these firms can afford to pay higher export entry costs, more efficient exporters will have higher markups (Melitz and Ottaviano, 2008). De Loecker and Warzynski (2012) establish empirically that markups increase when firms enter export markets. Bellone et al. (2016) find that markups of French exporters are positively related to firm productivity. Edmond et al. (2015) show that opening to trade reduces markups only if within-sector productivities are similar and thus lead to increased competition, which in turn does not allow producers from one country to substantially increase their market share and markups in the other country. Arkolakis et al. (2019) point out that a decrease in trade costs reduces the markups of domestic producers, but foreign producers may also increase their markups depending on the degree of cross-country sectoral differences in productivity. In contrast to the Melitz and Ottaviano (2008) model in which firms operating in larger and more integrated markets exhibit higher productivity and lower prices and markups, our findings imply that, initially more productive, and typically larger, firms increase their prices and markups after the adoption of a common currency. Our findings that accounting for efficiency is key when analyzing markups trajectories therefore extend to the case of currency unions recent evidence by Autor et al. (2017) and De Loecker and Eeckhout (2020), who assess empirically that highly profitable "superstar" firms with

high markups have become more important for the aggregate economy.

The evidence on the heterogeneity of the responses of markups after euro adoption presented here is also related to the literature on the pass through of trade costs to international prices. In general, the exchange rate literature has shown that prices do not respond fully to cost at both the firm and product level, a finding that is consistent with variable markups. Melitz (2018) shows that better performing producers absorb a greater proportion of a cost shock into their markups (more incomplete pass-through), a finding that has been confirmed empirically.[6] De Loecker et al. (2016) show that the large decline in marginal costs after trade liberalization in India did not translate to equally large price declines for larger firms because markups increased. Our findings confirm this picture for the case of a currency union and indicate that the direct pro-competitive effect of the euro might be mitigated, or even outweighed, by the increase in prices and markups by initially more productive exporters, which are typically larger firms that account for the lion's share of total exports.

We close the introductory section by pointing out that a particular characteristic, and potential caveat, of our analysis could be that we do not observe trade flows of Greek exporters prior to 1999. Hence, our analysis does not capture the impact of EMU, but only assesses adoption of the euro after 2001. Bergin and Lin (2012) argue that new goods entered the export market prior to the actual union effect, which indicates forward-looking behavior in anticipation of positive future policy changes and increased trade opportunities. Although we can only conjecture the anticipation of this event, it is likely that our findings underestimate the corresponding overall impact of the formation of the eurozone on export pricing.

The paper proceeds as follows. Section 2 describes the data sources and presents the properties of the dataset along various margins and firm dimensions. Sections 3 and 4 present our approach to disentangle and evaluate the euro effects to the observed changes in export prices. Section 5 discusses the estimates of markups and presents evidence on how they changed after the adoption of the euro. Section 6 concludes the paper.

2. Data

We use a dataset on Greek exporters that merges data from three main sources for the period 1999-2007. Trade data at the firm-product-destination level are obtained from the Intrastat databank, available via the Greek Statistical Agency (ELSTAT), which includes data on the

[6] See Berman et al. (2012) for France, Amiti et al. (2014) for Belgium, and Li et al. (2015) for China.

export revenues and quantities of individual Greek firms starting in 1999. The classification of all reported exported goods (approximately 2500 products) follows the Standard International Trade Classification (SITC) system. We merge export data with firm-level information. Financial variables are obtained from the ICAP database, which collects balance sheet and financial information on Greek firms. Additional information at the firm level is obtained from the Annual Manufacturing Survey (AMS), which contains survey data related to economic activity of medium- and large-scale manufacturing firms. The AMS survey includes data for manufacturing firms, such as the number of employees and total assets.[7]

A set of aggregate controls is used in the regression analysis to disentangle the effects of the introduction of the euro on the export prices of Greek firms from other macroeconomic shocks. These include the destination's real gross domestic product (GDP), the real exchange rate and a proxy of world demand. In some regressions with markups we also control for the percentage of a firm's differentiated products, the total number of other firms that export the same product as firm *f* in year *t*, and other firm characteristics.

Our empirical analysis uses the adoption of the euro by Greece on January 1st, 2001 as a natural experiment, which identifies a clear point in time when trade costs fell for all Greek exporters.[8] Table 1 reports the mean, standard deviation, and percentile statistics for a number of variables capturing the profiles of Greek firms that export goods to eleven eurozone countries (Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxembourg, Germany, Portugal and Spain) and three non-eurozone member states of the EU-15 countries that are not part of the euro area (United Kingdom, Sweden, and Denmark).

Table 1 reports aggregated summary statistics on the full set of Greek exporters in the exporting database and for our estimation samples (which are restricted by the availability of control variables for the census of manufacturing firms). We stress that the 'full' sample in the first column of Table 1 covers the eleven e and three non-eurozone destinations listed above. In terms of annual exports, firms in our estimation samples tend to have on average larger export revenues, serve more destinations, and export more products. Also, firms in our estimation samples are larger and older than the typical Greek exporting firm.

A potential concern in our analysis is whether our control group of three non-eurozone

[7] We note that the firm survey is collected at the plant level, but export and financial information is recorded at the firm level. Following Feenstra et al. (2014), we clean the sample for mismeasurement and for very small firms by checking that key financial variables, such as total assets and sales are not missing. We also confirm that total assets exceed liquid assets and fixed assets and that exports do not exceed total sales.

[8] The parities of the 11 original eurozone currencies with respect to the Euro were fixed on January, 1st, 1999. The physical units of euro notes and coins were introduced on January, 1st 2002. National currencies, following a two-month dual circulation period, were irrevocably withdrawn on February, 28th 2002.

countries is comparable to our treatment group of eleven eurozone countries. To investigate whether trade patterns between eurozone and non-eurozone destinations in our sample is comparable and also if it has markedly changed after the adoption of the euro compared, we take a more detailed look at the firm-destination-year level data (i.e. at observations aggregated across products) for the periods before and after the adoption of the euro. In particular, we compute the average export revenues per destination and products per destination for the 11 eurozone and 3 non-eurozone countries for the full set of Greek exporters and for our estimation samples, as well as their decomposition for the pre-euro (1999-2000) and post-euro (2001-2007) periods. Table 2 displays these statistics and we observe that revenues are, as expected, larger for the firms in our sample, whereas the number of products per destination is virtually identical with the full set of exporters and similar across eurozone and non-eurozone countries (we notice that most firms export to both eurozone and non-eurozone destinations). Our empirical analysis should therefore be interpreted as shedding light on export pricing of large manufacturing firms, which typically account for the bulk of exports in each country (see also Bastos et al. 2018). In general, our overview of the data reveals that our dataset is similar in many respects to those typically used in empirical exercises of micro-exporting (see e.g. Arkolakis and Muendler 2013).

3. The effects of euro adoption on the prices of Greek exporters

In this section we estimate the effect of euro adoption on the prices of exporters. We first outline the main empirical framework and then we present the empirical findings.

3.1. Empirical models and predictions

We exploit the full dimensionality of our data and examine the variation in prices across exporting firms at the destination-product level. Specifically, the price (or unit value), P_{fpdt}, is calculated by dividing the value of firm's f exports of product p to destination d in period t, X_{fpdt}, with the quantity exported, Q_{fpdt}, and is given by $P_{fpdt} = X_{fpdt}/Q_{fpdt}$. Observations of export prices are then trimmed using the following rule for quantities. If the number of non-available observations for each product is smaller (exceeds) 5% of the total number of the product's observations, then the primary product quantities (labeled "other quantities") are used. Unit values that exceed 10 times the median or are lower than 10% of the median prices are trimmed from the dataset.

The baseline specifications are:

$$\ln(P_{fpdt}) = \alpha_1 EZ + \bar{\beta}_1 \bar{\mathbf{Z}} + \kappa_{fpd} + \kappa_t + \mu_{fpdt} \quad (1)$$

$$\ln(P_{fpdt}) = \alpha_1 EZ + \alpha_2 (EZ \times tfp) + \bar{\beta}_1 \bar{\mathbf{Z}} + \kappa_{fpd} + \kappa_t + \nu_{fpdt} \quad (2)$$

$$\ln(P_{fpdt}) = \alpha_3 (EZ \times tfp_{low}) + \alpha_4 (EZ \times tfp_{medium}) + \alpha_5 (EZ \times tfp_{high}) + \bar{\beta}_1 \bar{\mathbf{Z}} + \kappa_{fpd} + \kappa_t + \xi_{fpdt} \quad (3)$$

where *EZ* is a euro dummy variable that is equal to 1 during the period 2001-2007 if the destination country was a member of the eurozone area and 0 otherwise, *tfp* denotes initial (pre-euro) firm productivity, $\bar{\mathbf{Z}}$ is a vector of controls, and μ_{fpdt}, ν_{fpdt} and ξ_{fpdt} are the error terms. The effect of the euro is captured by the dummy variable and the three non-eurozone destinations compose the control group. The vector $\bar{\mathbf{Z}}$ includes the real exchange rate vis-à-vis the destination country to control for competitiveness, real GDP to control for market size, which may have affected differentially Greek exports before and after euro adoption, and a firm-specific indicator of world demand to take into consideration the effects of world movements in the prices set by Greek exporters. The world demand indicator is calculated the ratio of exports by all Greek exporters of product *p* (SITC2 classification) to the destinations in our sample to which firm *f* is exporting this product over the total imports of product *p* in these destination countries.[9]

All specifications include firm-product-destination fixed effects, denoted by κ_{fpd}. The identifying time variation in euro adoption therefore arises from comparing export prices in the post-euro years with export prices in pre-euro years for the firm-product-destination triad. The specifications also include time fixed effects, denoted by κ_t, that control for symmetric developments common to all destinations. To account for the potential correlation in the error term of observations within a destination-year pair, we cluster standard errors at the destination-year level.

Given the structure of our specifications, coefficient α_1 in equations (1) and (2) captures the average effect of euro adoption on export pricing. We expect that this effect will vary depending on the initial firm productivity level, an effect that is captured by coefficient α_2 on the interaction term of the *EZ* dummy and the firm's productivity in equation (2). In turn, parameters α_3, α_4, α_5, capture the decomposed effect of euro adoption on export prices within the groups of firms with low, medium and high initial productivity respectively.

We anticipate several opposing forces on α_1. On the one hand, euro adoption reduces the direct marginal costs of exporting firms through facilitating transactions but may also require quality upgrades. On the flip side, the common currency also implies intensified competition

[9] We drop observations with import values of less than 10000 euro.

in eurozone markets, which tends to depress the price any given firm can charge on that destination. The expected sign of parameter α_1 is therefore ambiguous. We expect however that the response of prices will be different depending on the productivity of exporters. In particular, more productive exporters will reduce less their prices, or even increase them, relative to less productive exporters as they are more likely to engage in costly quality upgrades and exploit higher demand for their products in a larger market as it is easier to recover the fixed cost of quality upgrade on a large market. Overall, we expect that $\alpha_2 > 0$ and that $\alpha_5 > \alpha_4 > \alpha_3$.

3.2. Results

Table 3 documents the effect of euro adoption on export prices across firms. The dependent variable is the export price (unit value calculated as value over quantity) at the firm level. At this level of data disaggregation, the sample comprises 22,351 observations spanning 1,169 products exported by 539 firms.

Column (1) shows that on average there is no significant negative effect of the euro on export prices. Although this average coefficient does not show any impact, it does not fully capture any underlying conditional euro effect on pricing. Based on the ample evidence on the heterogeneity of exporter behavior, in column (2) we investigate whether euro adoption affected export pricing differently based on the exporters' productivity. On this basis, we retain the variables of the previous specifications and augment specification (1) by introducing an interaction variable of the euro dummy with *initial tfp* (productivity in year 2000). Column (2) shows that there is a strong negative effect of the euro that is accompanied by a significant positive coefficient on the interaction term with *initial tfp*. This result indicates that the introduction of the euro lowered export prices on average, but this effect is diminished for initially more productive firms. To further explore the pattern of these impacts, in columns (3) we split the interaction term into firms with high, medium, and low *initial tfp* (where high refers to the top third of the initial productivity distribution and low refers to the bottom third), and therefore omit the euro dummy from the regression model. The interaction of the euro dummy with high *initial tfp* firms is positive and significant at the 1% level, indicating a 8.9% (=exp(0.085)-1) rise in export prices for these firms, whereas the corresponding interactions for firms with medium and high *initial tfp* are insignificant.

To assess the robustness of these results to the sample utilized, we perform two exercises. First, there is a potential composition problem, as the previous regressions are based on all observations, including those for products exported by firms solely to non-eurozone

destinations. This could interfere with the assessment of the effects of the euro adoption on export prices, as firms exporting to the eurozone destinations might have shifted after euro adoption their product mix towards products not exported by firms exporting to non-eurozone destinations in order to avoid competition in the eurozone and attain higher prices. This caveat can be partially addressed by excluding from our sample exporters to non-eurozone destinations that do not sell common products with exporters to eurozone destinations. Hence, any observation from exporters to non-eurozone destinations will be included in the sample, as long as these firms have at least one common product with eurozone firms.

Although this strategy addresses the composition issue, in practice only 34 firms are excluded from the sample, thus yielding virtually identical results with those reported earlier on. Moreover, there is an additional representativeness problem, as the sample contains country-product observations to which exporters to eurozone destinations may not sell. To address this issue, we construct a narrower sample with only product-destination pairs that are common between firms exporting to eurozone and non-eurozone destinations. For example, if firms exporting to eurozone destinations export 1000 products in total to these countries, we include in the sample the observations of firms exporting to non-eurozone destinations only for their exports of these products to any destination. In other words, the sample covers both types of firms (eurozone and non-eurozone sellers) to any destination in which exporters to eurozone destinations sell.

In columns (4)-(6) of Table 3 we run the same regressions as in columns (1)-(3) using this narrower sample, which comprises 12,458 observations spanning 444 products exported by 456 firms. In column (4) the interaction terms are suppressed and we find a positive, yet marginally significant, effect of the euro on prices. Columns (5) and (6) confirms the previous finding on the heterogeneous effects on euro adoption on export prices based on initial firm productivity. When the interaction is split for firms with high, medium, and low *initial tfp* in column (6), we see that the positive effect of the euro stems from firms with high *initial tfp*. The estimated coefficient indicates that after the introduction of the euro firms with high pre-euro productivity raised their prices by 12.9% (=exp(0.121)-1), compared to other firms exporting the same product to the same destination market after excluding observations from exporters to non-eurozone destinations that refer to products that are not exported by exporters to eurozone destinations.

An alternative concern related to sample selection might be that the heterogeneous effect of euro adoption on export prices based in initial firm productivity might be driven by the extensive product margin. That is, firms with higher initial productivity might turn after euro

adoption into new, more expensive, products of higher quality. In such a case, we would wrongly attribute the ability of firms with higher efficiency to engage in the production of more expensive products with higher marginal costs when overall costs fall to the establishment of the common currency.

In columns (7)-(9) of Table 3 we perform the same regression analysis after reducing the sample to the products that were only sold before and after euro adoption. The sample now comprises now slightly fewer observations compared to the original one (20,355 versus 22,351 observations) and spans 1013 products (156 fewer than the full sample) exported by 516 firms. The overall picture remains robust compared to columns (1)-(3): firms with higher *initial tfp* exhibit a relatively stronger rise in their export prices after euro adoption when only existing products are considered compared to the benchmark (amounting to 10.7%), whereas no significant effects are found for the rest of the firms. We therefore conclude that, although more efficient firms are more likely to engage in costly quality upgrades, the estimated positive euro effect in export prices by these firms cannot be attributed to their turn into new, more expensive products of higher quality.

The results so far, taken together, imply that on average there was a negative effect of euro adoption on Greek exporters. Once we account for firm heterogeneity, we find that initially more efficient firms increased their prices. As in Berthou and Fontagné (2013), who found that more productive French exporters gained from euro adoption in terms of revenues, we also find that firm heterogeneity in the form of initial productivity plays an important role for assessing the effect of the euro on exports.

4. Sensitivity analysis for export prices

Although the previous section shows that firms with high initial productivity have increased their prices after the adoption of the euro, when making inference on this effect several factors must be considered. This section reports a battery of robustness exercises conducted to test the sensitivity of this result to the use of alternative measures of firm performance. We also investigate the role of financial conditions in the post-euro period for these findings.

4.1. Best sellers

An open question on the effects of euro adoption on export pricing is the composition of products within the firm. It is known that more productive exporters export more products (see Bernard et al. 2014). Mayer et al. (2014) analyze the implications of export market competition for export pricing and the product mix of exporters. They report that increased

export competition induces French exporters to concentrate ('skew') their product mix toward their best-performing products in bigger and more centrally-located destinations where competition from other exporters and domestic producers is tougher. Iacovone and Javorcik (2010) provide empirical evidence that the skewness of export sales by Mexican firms to the United State increased after NAFTA through an expansion of their better performing products with higher market shares.

It is therefore possible that the rise in the export prices of high-productivity exporters after euro adoption is driven by a shift towards their best-performing products because of more intensive market competition, rather than by euro adoption itself. To address this concern, we construct two measures of best-performing products at the firm level. The first measure ("*bestseller1*") distinguishes the product that had the highest share of overall sales at the firm level before euro adoption. This measure intends to identify changes in the price of the best-performing product of the firm versus the corresponding price changes in the rest of its products in separate regressions. However, this approach that the firm has a single best-performing product, whereas it may be the case that a firm has different best-performing products across markets, only one of which would be classified as "best-performing" under the previous classification. Our second measure ("*bestseller2*") therefore denotes the product that had the highest share of sales at the firm-destination level before euro adoption. This distinction allows us to capture price changes of multiple best-performing products across markets within each firm.

Table 4 presents the results for the two measures of best-performing products and also for the rest of the products. Specifically, columns (1)-(6) present the results for the best-performing products. There is no direct statistically significant effect of euro adoption on the prices of these products. However, when we interact with initial productivity, we see that there is a statistically significant negative effect of euro adoption on their prices, which is less strong in firms with higher *initial tfp*. As shown in columns (3) and (6), the prices of the best-performing products have increased after euro adoption in firms with high initial productivity, whereas there is no effect in the rest of the firms. When we look at the corresponding specifications for the rest of the products in columns (7)-(12), we find that the overall picture is similar. Regarding the magnitude of the interaction coefficient for firms with high initial productivity, it is approximately twice as high compared to the corresponding one for best-performing products. This indicates that product performance was not the driving force of the rise in exports prices in firms with high productivity after euro adoption.

4.2. Firm controls

In trade models with heterogeneous firms higher productivity translates into a larger company. A standard measure of firm size is total (export) sales, which represent quantities times prices; therefore, any measurement error in prices might appear on both sides in regressions with prices as the dependent variable. To address this concern, Kugler and Verhoogen (2012) proxy plant size by employment, which has the advantage that measurement error is likely to be less severe and, importantly, uncorrelated with measurement error in output values and quantities. Given the importance of time-varying firm attributes for the determination of prices, we also experiment with an empirical specification that augments the set of controls with a number of firm attributes.

Specifically, following the specifications for price regressions in Bastos and Silva (2010), Kugler and Verhoogen (2012) and Secchi et al. (2016), we include the number of persons employed and total assets to account for size effects (lagged one year). The results from this analysis are presented in Table 5. For comparison purposes, we use the same samples as in Table 3. In all three samples we find that the effect of euro adoption is affected by the initial productivity of the firm. When we split the samples in low, medium and high productivity firms we find that the latter raised their prices with a magnitude that is very similar to the one obtained in the corresponding regressions of Table 3. We therefore conclude that the rise of export prices after euro adoption in firms with high *initial tfp* remains after controlling for firm size.

4.3. Financial factors

To what extent do changes in financial conditions following euro adoption drive our results? Financial constraints can play a central role in export pricing decisions. Secchi et al. (2016) report that Italian firms facing tighter credit conditions charge higher prices than unconstrained firms exporting the same product to the same destination. Dinopoulos et al. (2020) document that less financially constrained Greek exporters charge higher prices and propose a model in which less credit-constrained exporters face less elastic demand and export higher-quality products.

In our context, a prominent implication of euro adoption was the reduction in interest rates in peripheral countries, which facilitated access to credit mainly in the form of lower interest rates, which was not uniform across firms. Looking at the differential impact of financial conditions on firm export behavior in the context of pre-euro productivity and euro adoption is therefore important for the following reason. If, for instance, higher productivity

firms were those that faced less tight financial constraints in the post-euro period, nothing could be learned from the simple fact that their export prices increased after the adoption of the euro. This rise could simply be due to the partial relaxation of constraints that benefited high-productivity firms more than low-productivity firms. However, by partialling out the positive effect of high productivity on export pricing for firms with differential financial conditions before and after the adoption of the euro, we can infer whether credit access was a crucial determinant of export pricing in the post-euro era, rather than the euro adoption itself.

To test this hypothesis, we use a proxy for access to credit to infer their impact on export margins. The literature on micro-exporting and financial conditions has used a variety of measures to identify their effects on export margins. Greenaway et al. (2007), Bellone et al. (2010), Berman and Héricourt (2010) used liquidity and leverage as balance sheet measures of financially binding constraints. Muûls (2015), and Secchi et al. (2016) used credit scores to explore empirically the effects of credit access on export margins. We proxy here credit access by the firm's lagged credit rating, which expresses a multivariate estimate of credit quality with respect to the probability of default and/or bankruptcy. The classification of firm credit rating includes 10 categories from 1 (low rating) to 10 (high rating). The average credit rating for a firm in our estimation sample is 6.6, which is slightly higher than the average rating for all Greek exporters (6.3).

In Table 6 we summarize our main finding from running regressions with similar samples to those reported in the previous subsections. To investigate whether the driving force of the export margins is captured by the financial conditions of the firm or productivity, we introduce triple interaction terms of the EZ dummy with low, medium and high *initial tfp*, and low and high initial rating, respectively.[10] The results show that firms with high *initial tfp* and high financial rating raised their export prices. There is also some evidence for a -smaller- rise in export prices by firms with high *initial tfp* and weak financial conditions in our sample with constant number of products. We conclude that the overall picture remains robust, with the rise in export prices after euro adoption coming from firms with high initial productivity along with some additional evidence that the rise was mostly driven by firms with less tight financial constraints.

[10] Similar results (available upon request) are obtained using as measures of financial conditions at the firm level the pre-euro values of the liquidity ratio (current assets less current liabilities over total assets) and the leverage ratio (total liabilities over equity).

5. The effects of euro adoption on the markups of Greek exporters

Our results so far indicate that initially high-productivity firms significantly increased their prices after euro adoption. To further explore this dimension of export pricing using our dataset, in this section we first estimate time-varying firm-destination markups. To this end, we follow De Loecker and Warzynski (2012) who use a methodology of broad appeal that accommodates a wide range of price-setting models. We then correlate markups across exporters with the introduction of the euro to grasp the driving forces in the heterogeneity in the responses of prices across firms with different levels of pre-euro productivity.

5.1. Estimation of markups, baseline specification and empirical predictions

De Loecker and Warzynski (2012) estimate markups relying on optimal input demand conditions obtained from standard cost minimization to identify the output elasticity of a variable input, free of adjustment costs, which equals its expenditure share when price equals marginal cost. The methodology does not rely on the assumption of constant returns to scale and measuring the user cost of capital. The data required to implement the procedure include production data in which output, total expenditures on variable inputs, and revenue are observed. We use this procedure to recover a markup estimate for each firm-destination pair in our sample. In particular, output production function coefficients are estimated by industry and are used to obtain a firm's output elasticity of labor. The markup is computed as the ratio of the output elasticity of labor divided by the expenditure share for labor. Since we do not observe the level of inputs used to serve different destinations in which exported goods are sold at the firm level, we decompose markups across destinations within a firm by making the extra assumption that input shares are proportional to the shares of exports destined to a country.[11]

In our sample, the mean (standard deviation) markup for all exporters is 3.44 (3.12) and 3.68 (2.22) for the pre-euro and post-euro periods respectively. There are no marked differences when we look across eurozone and non-eurozone destinations. The average markups for eurozone destinations are 3.51 (3.17) and 3.72 (2.22) for the pre- and post-euro periods, whereas they amount to 3.17 (2.88) and 3.55 (2.19) for non-eurozone destinations. When we split our sample of markups to firms with low, medium and high *initial tfp*, we observe that less efficient firms had on average higher markups, amounting on average to

[11] The benefit of this approach is that it assumes that the physical relationship between inputs and outputs is the same across destinations and does not require additional assumptions on how firms allocate inputs, something we do not observe in our data. See Brambilla et al. (2012) for a similar assumption to estimate the level of skilled labor used to serve different destinations at the firm level.

3.88, with the corresponding figures for firms with medium and high *initial tfp* amounting to 3.71 and 3.43 respectively.[12]

An advantage of our method to calculate markups is that we obtain one for each firm-destination pair, so we have the evolution of the entire distribution of markups. In panel A of Figure 1, we plot the kernel density of the unweighted log markups for 2000 and 2005. We find that the variance has decreased without any significant changes in the upper and lower tails. In panel B of Figure 1, we rank the firms by markup (updating the ranking each year, so the firms at higher percentiles may not be the same each year) and plot the distribution over time. The median (P50) and the percentiles above the median are invariant over time and there is no particular change in markups.

Following the rationale for export prices, the baseline specification for the estimation of the effect of euro adoption on markups is:

$$\ln(m_{fdt}) = \gamma_1 EZ + \kappa_{fd} + \kappa_t + \mu_{fdt} \quad (4)$$

$$\ln(m_{fdt}) = \gamma_1 EZ + \gamma_2(EZ \times tfp) + \kappa_{fd} + \kappa_t + \nu_{fdt} \quad (5)$$

$$\ln(m_{fdt}) = \gamma_3(EZ \times tfp_{low}) + \gamma_4(EZ \times tfp_{medium}) + \gamma_5(EZ \times tfp_{high}) + \kappa_{fd} + \kappa_t + \xi_{fdt} \quad (6)$$

where m_{fdt} is the markup of firm f in destination d and μ_{fdt}, ν_{fdt} and ξ_{fdt} are the error terms. The effect of the euro is captured by the dummy variable, EZ, and the three non-eurozone destinations compose the control group.

All specifications include firm-destination fixed effects, denoted by κ_{fd}. The identifying time variation in euro adoption arises from comparing firm markups in the post-euro years with firm markups in pre-euro years for the firm-destination dyad. The specifications also include time fixed effects, κ_t. Standard errors of the parameters are clustered at the destination-year level. In analogy to our empirical strategy for export prices, coefficient γ_1 in equations (4) and (5) captures the average effect of euro adoption of firm markups. We expect that this effect will vary depending on the initial firm productivity level, an effect that is captured by coefficient γ_2 on the interaction term of the EZ dummy and the firm's productivity in equation (5). Parameters γ_3, γ_4, γ_5, capture the decomposed effect of euro adoption on firm markups within the groups of firms with low, medium and high initial productivity respectively. In our robustness analysis we include in this regression alternative definitions of productivity and control for various samples and covariates.

[12] We note that, although less productive firms theoretically will tend to have lower markups, depending on their market fundamentals (demand, market structure, firm behavior), their markups can be high or low compared to more productive firms.

Regarding the expected sign of the coefficients, we expect that markups fall after euro adoption due to the standard pro-competitive effect of liberalization. In addition, in line with the empirical literature mentioned in the introductory section, we also expect that better performing producers absorb a greater proportion of a cost shock into their markups compared to less efficient exporters (more incomplete pass-through). Thus, we expect that $\gamma_1 < 0$, $\gamma_2 > 0$ and $\gamma_5 > \gamma_4 > \gamma_3$.

5.2. Results on the effects of euro adoption on markups

Table 7 reports results of regressing markups on the euro dummy and its interactions with productivity for our full sample and the narrow sample with constant product range. In column (1) we report a baseline regression on the post-euro dummy, which shows that on average markups fell after the introduction of the euro in our full sample (574 firms).[13] In column (2) we add an interaction term of the euro dummy with *initial tfp* and find that markups fell, but the drop is smaller for initially high-productivity exporters with both effects being statistically significant. In column (3) we split the interaction with *initial tfp* for firms with high, medium, and low *initial tfp* and find that markups fell for firms with low and medium *initial tfp*, but this effect is mitigated or reversed for firms with high *initial tfp*. These effects are statistically significant effect in all subgroups. Similar results are obtained when we use the narrow sample (constant product range) with the corresponding findings reported in columns (4)-(6).[14]

To assess the validity of these empirical findings, we perform a battery of sensitivity tests. First, when faced with easier exporting conditions through the introduction of the euro, a firm operating in the domestic market will have a tendency to enter into the export market and raise its markups (De Loecker and Warzynski, 2012). To identify the impact of the euro on firm markups, uncontaminated by entry and exit decisions, we want to hold as constant as possible the range of firms in our sample. We therefore restrict the sample to firms that have always been exporters in our sample period. This eliminates the entry/exit issue but reduces

[13] Notice that the sample sizes in the markup regressions is slightly larger compared to the corresponding ones for price regressions because the latter are constrained by the availability of the world demand variable.

[14] We explored the sensitivity of our findings to the definition of productivity using as a proxy the number of export destinations served by the firm (see Berman et al., 2012). To classify firms based on this measure we split the sample into firms that export to one destination, which is the median in our sample (and also the median in the full sample of Greek exporters), and to the rest of the firms, labeled as low- and high-productivity firms respectively. Alternatively, we split the firms into those that export to three or less destinations (low-productivity firms) and to the rest (high-productivity firms). Of the 574 firms, 355 have more than one Destination and 274 have more than three. The results from the regressions on prices and markups are presented in the online Appendix and confirm the overall picture for both specifications.

the sample size, which now covers approximately 27% of our initial observations coming from 86, mainly very large, firms. The results are displayed in columns (1)-(3) of Table 8. On average, markups did not change, but there is substantial heterogeneity among exporters. Initially low-productivity firms lowered their markups, whereas initially high productivity firms with high *initial tfp* exhibited a rise in their markup.

Another concern is that the heterogeneity in markups at the firm-destination level can generally be attributed to variations in product quality. Harrigan et al. (2015) point out that consumers choose goods on the basis of "quality-adjusted" prices and are willing to pay a higher price for an expensive, high-quality good. However, this nexus is not sufficient to argue that firms charge larger markups for higher quality exports, since the latter also require more expensive inputs and, thus, imply higher marginal costs. Gervais (2015) uses US Census firm-level data and shows that prices are increasing in quality after controlling for productivity (which affects prices negatively). Eckel et al. (2015) examine the implications of cost-based versus quality-based competence for multi-product Mexican exporting (and non-exporting) firms and find that firms in (non-)differentiated sectors exhibit (cost) quality competence. Fan et al. (2020) consider non-homothetic preferences and a market structure that features variable markups across firms with vertically differentiated products and quality upgrading, which allows for much of the variation across destinations and firms to be attributed to quality variations of output.

A valid point might therefore be that, following a liberalization episode (like the currency union and the widening of the market), Greek exporting firms with, for instance, higher productivity may have aimed at quality upgrading and switched to more differentiated products, that in turn raised their markups. In a related vein, Fan et al. (2015) show that in industries in which products are highly differentiated (homogeneous), firms raise (reduce) their export prices in response to a fall in the tariffs they pay on imported inputs. In such a case, the interaction term of euro adoption and *initial tfp* would confound the euro effect based on productivity with shifts in quality triggered by lower input costs. To address this issue, we use the Rauch index and control for the percentage of products at the firm level that are classified as differentiated in every year. This is less restrictive in terms of sample size, as 91% of the observations are retained for estimation. Columns (4)-(6) in Table 8 show the estimates from these regressions. The coefficient on the Rauch index is positive, albeit marginally significant, indicating that more differentiated products are -as expected- associated with higher markups. The signs and magnitudes of the direct and interaction terms of the post-euro dummy being almost identical to the benchmark specification, which

indicated that our findings are not affected by the inclusion of product differentiation.

Finally, markups are naturally related with market size and structure of the destination country. In a review of the literature, Tybout (2003) reports that "*in every country studied, relatively high sector-wide exposure to foreign competition is associated with lower price-cost margins, and the effect is concentrated in larger plants*". This feature is also present in subsequent trade models such as the Melitz and Ottaviano (2008) model, in which the competition faced by exporters in the destination market is an important determinant of markups. In their setup, a larger market hosts more productive firms and implies more product variety and lower markups. In a similar vein, Melitz (2018) shows that the gains of better performing firms increase proportionally more with market size integration and competition. This is particularly relevant for large eurozone markets in which Greek exports have relatively high shares (e.g., Germany). In these firm-destination pairs higher markups of more productive firms might be driven by the relatively large volume of exports, rather than the degree of competition.

To introduce time-varying competition from local firms in a destination market, we compute the number of Greek firms for which have data on markups, which export in that destination at a given year. We stress that this is not a measure of toughness of competition that a domestic firm faces on the different markets where it sells, as it does not take into account the overall imports of that destination. The measure rather serves as a proxy of local presence in each destination. In columns (7)-(9) of Table 8 we estimate the corresponding set of regressions, in which we include the number of other firms that export in the same destination as a control variable. Interestingly, we find that the coefficient on this variable has a positive sign and is statistically significant in two out of three regressions. The coefficients of interest on the *EZ* dummy and its interactions with *initial tfp* have the expected sign and are very similar in magnitude to those derived in the rest of the specifications.

We conclude that our predictions on the impact of euro adoption on markups and its relationship with initial firm productivity are broadly supported for our sample of Greek exporters. In line with findings in related literature on the behavior of firm markups following trade liberalization, we find that markups of Greek exporting firms decreased on average after euro adoption. Yet, we also establish that initially more efficient exporters, which are typically larger firms, increased their markups.

6. Conclusions

Over the last two decades, a substantial literature has argued that firm productivity matters for

exporting decisions. In parallel, a large number of empirical papers have sought to pin down the trade impact of adopting a common currency, with special emphasis given to the introduction of the euro. Despite the optimistic expectations when the euro was formed, an overwhelming number of studies have failed to identify an unambiguous positive effect of euro adoption on trade. To the best of our knowledge, no study has so far analyzed the introduction of the euro with firm-level data on export pricing and markups, though there is ample recent evidence that a currency union is related to firm heterogeneity. Our paper fills this gap by examining how exporting firms in Greece responded to the introduction of the euro. We document an asymmetric reaction across exporters, as more productive firms raised their prices and markups whereas less productive exporters lowered their markups without any significant changes in their prices.

Our results pin down some—up to now—unidentified channels of the impact of a common currency on trade, and in particular firm exporting, which are found to depend largely on the heterogeneous nature and market power of exporters. Yet, we stress that our analysis remains agnostic about the origins of these shift, i.e. whether they are driven by the need for quality upgrading, more expensive inputs, terms of trade appreciation, or product market distortions, as well as their overall welfare implications. Hence, our analysis has both advantages and limitations: it allows us to assess the partial effects of the euro on exporters when estimating ad hoc specifications, but does not rely on a full-fledged general equilibrium setup and, hence, cannot identify the structural mechanism behind these results. In addition, we do not know to what extent any hidden price-markup effect generalizes to other eurozone countries and whether it was aggravated by the subsequent 2008-9 crisis. Exploring this channel with micro-data seems therefore warranted in order to assess and understand any masked effects of currency unions.

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TABLE 1. Summary statistics of Greek exporters: firm data (1999-2007)

	All exporters	Estimation sample (1)	Estimation sample (2)
export revenues	1.3	2.6	3.5
number of destinations	2.8	4.1	4.5
number of products	3.2	3.0	4.1
employment	105.7	125.2	135.1
age	15.5	24.2	24.3
number of firms	960 - 6968	555 - 575	515 - 539

Notes: Table reports annual firm averages for the 1999-2007 period. Export revenues in millions of euros. Number of firms depends on the availability of the corresponding variable. Estimation samples (1) and (2) are those used in Tables 3-6 and Tables 7-8 respectively. See section 2 for details on the data sources.

TABLE 2. Summary statistics of Greek exporters: firm-destination-year data

	All exporters	Estimation sample (1)	Estimation sample (2)
A. *exports per destination (in mn euros)*			
all	0.5	0.6	0.8
NEZ, pre-euro	0.4	0.7	0.5
NEZ, post-euro	0.5	0.7	0.7
EZ, pre-euro	0.4	0.8	0.5
EZ, post-euro	0.5	0.8	0.6
B. *number of products per destination*			
all	2.1	2.0	2.2
NEZ, pre-euro	1.8	2.0	1.8
NEZ, post-euro	1.9	2.0	2.0
EZ, pre-euro	2.0	2.3	2.0
EZ, post-euro	2.2	2.3	2.1

Notes: *NEZ* and *EZ* denote non-eurozone and eurozone destinations, *pre-euro* and *post-euro* denote years 1999-2000 and 2001-2007 respectively. A pair (*NEZ, pre-euro*) includes observations with exports to *NEZ* destinations in years 1999-2000. See also Table 1 for details on the data.

Table 3. Export prices, productivity and euro adoption

Dependent variable:	*all destinations*			*narrow sample*			*products sold before and after*		
log(export price)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
EZ	0.026	-0.714***		0.056*	-0.865**		0.041	-0.789***	
	(0.020)	(0.251)		(0.033)	(0.362)		(0.025)	(0.258)	
EZ x tfp initial		0.347***			0.431**			0.387***	
		(0.120)			(0.174)			(0.122)	
EZ x tfp initial low			-0.025			-0.028			-0.018
			(0.031)			(0.046)			(0.034)
EZ x tfp initial med			-0.030			0.004			-0.034
			(0.024)			(0.038)			(0.028)
EZ x tfp initial high			0.085***			0.121**			0.102***
			(0.032)			(0.050)			(0.035)
real exchange rate	0.207	0.195	0.202	0.118	0.103	0.102	0.235	0.221	0.222
	(0.189)	(0.187)	(0.188)	(0.304)	(0.300)	(0.299)	(0.201)	(0.197)	(0.196)
gdp	-0.360	-0.376	-0.385	-0.774*	-0.781*	-0.779*	-0.476*	-0.488	-0.492
	(0.246)	(0.248)	(0.252)	(0.459)	(0.459)	(0.457)	(0.304)	(0.304)	(0.303)
world demand	0.008	0.007	0.007	0.019	0.018	0.018	0.011	0.010	0.010
	(0.008)	(0.008)	(0.008)	(0.015)	(0.015)	(0.015)	(0.009)	(0.008)	(0.008)
obs.	22,351	22,351	22,351	12,458	12,458	12,458	20355	20355	20355
# of firms	539	539	539	456	456	456	516	516	516
adj R-Squared	0.934	0.934	0.934	0.932	0.932	0.932	0.933	0.933	0.933
# of fixed effects	8,291	8,291	8,291	4,621	4,621	4,621	7403	7403	7403

Notes: The dependent variable is the export price (value over quantity) at the firm-product-destination level. All regressions include a constant, firm-product-destination fixed effects and year fixed effects. Standards errors are clustered at the destination-year level and three, two and one star denote significance at the 0.01, 0.05, 0.1 level respectively.

Table 4. Export prices, productivity and euro adoption: best-performing products

Dependent variable:	*bestsellers1*			*bestsellers2*			*others1*			*others2*		
log(export price)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
EZ	0.010	-0.476**		-0.004	-0.636**		0.042	-0.846**		0.058	-0.588	
	(0.017)	(0.195)		(0.018)	(0.253)		(0.040)	(0.419)		(0.043)	(0.421)	
EZ x tfp initial		0.230**			0.299**			0.412**			0.300	
		(0.093)			(0.121)			(0.197)			(0.197)	
EZ x tfp initial low			0.006			-0.022			-0.074			-0.023
			(0.029)			(0.035)			(0.071)			(0.076)
EZ x tfp initial med			-0.042			-0.048*			-0.017			-0.012
			(0.026)			(0.029)			(0.052)			(0.054)
EZ x tfp initial high			0.056***			0.043*			0.103*			0.116**
			(0.021)			(0.024)			(0.056)			(0.057)
real exchange rate	0.078	0.071	0.080	-0.086	-0.091	-0.086	0.303	0.291	0.293	0.535	0.520	0.526
	(0.153)	(0.152)	(0.151)	(0.162)	(0.160)	(0.160)	(0.348)	(0.345)	(0.347)	(0.383)	(0.379)	(0.382)
gdp	-0.020	-0.032	-0.034	0.029	0.018	0.015	-0.641	-0.667	-0.679	-0.736	-0.761	-0.782
	(0.140)	(0.142)	(0.141)	(0.153)	(0.155)	(0.154)	(0.436)	(0.442)	(0.451)	(0.488)	(0.496)	(0.506)
world demand	-0.002	-0.002	-0.002	0.002	0.002	0.002	0.018	0.017	0.017	0.016	0.016	0.015
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.015)	(0.015)	(0.015)	(0.017)	(0.017)	(0.017)
obs.	9,067	9,067	9,067	11,434	11,434	11,434	13,284	13,284	13,284	10,917	10,917	10,917
# of firms	480	480	480	533	533	533	449	449	449	400	400	400
adj R-Squared	0.951	0.951	0.951	0.952	0.952	0.952	0.918	0.918	0.918	0.911	0.911	0.912
# of fixed effects	2356	2356	2356	3766	3766	3766	5935	5935	5935	4525	4525	4525

Notes. See Table 3. *bestseller1* denotes the product that had the highest share of sales at the firm level before euro adoption. *bestseller2* denotes the product that had the highest share of sales at the firm-destination level before euro adoption.

Table 5. Export prices, productivity and euro adoption: firm controls

Dependent variable:	*all destinations*			*narrow sample*			*products only sold before and after*		
export price	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
EZ	0.031	-0.690***		0.060*	-0.833**		0.043*	-0.786***	
	(0.021)	(0.258)		(0.034)	(0.381)		(0.026)	(0.264)	
EZ x tfp initial		0.338***			0.418**			0.386***	
		(0.123)			(0.182)			(0.125)	
EZ x tfp initial low			-0.012			-0.010			-0.010
			(0.031)			(0.046)			(0.035)
EZ x tfp initial med			-0.026			0.001			-0.034
			(0.024)			(0.038)			(0.028)
EZ x tfp initial high			0.088***			0.122**			0.102***
			(0.033)			(0.053)			(0.036)
real exchange rate	0.208	0.197	0.204	0.132	0.116	0.115	0.234	0.220	0.222
	(0.193)	(0.190)	(0.191)	(0.307)	(0.301)	(0.300)	(0.206)	(0.201)	(0.201)
gdp	-0.321	-0.337	-0.345	-0.769	-0.774*	-0.773*	-0.464	-0.475	-0.479
	(0.250)	(0.253)	(0.257)	(0.465)	(0.464)	(0.461)	(0.309)	(0.309)	(0.308)
world demand	0.008	0.008	0.008	0.019	0.019	0.019	0.010	0.010	0.010
	(0.008)	(0.008)	(0.008)	(0.015)	(0.015)	(0.015)	(0.009)	(0.009)	(0.008)
employment	-0.006	-0.005	-0.004	0.002	0.006	0.007	-0.010	-0.006	-0.004
	(0.018)	(0.018)	(0.018)	(0.015)	(0.016)	(0.016)	(0.019)	(0.019)	(0.019)
total assets	0.029	0.025	0.025	-0.008	-0.014	-0.013	0.028	0.022	0.022
	(0.019)	(0.019)	(0.019)	(0.029)	(0.029)	(0.029)	(0.024)	(0.024)	(0.024)
obs.	21,602	21,602	21,602	12,044	12,044	12,044	19,780	19,780	19,780
# of firms	515	515	515	439	439	439	497	497	497
adj R-Squared	0.933	0.933	0.933	0.929	0.929	0.929	0.932	0.932	0.932
# of fixed effects	7933	7933	7933	4426	4426	4426	7123	7123	7123

Notes. See Table 3.

Table 6. Export prices, productivity and euro adoption: financial conditions

Dependent variable:	*all destinations*			*narrow sample*			*products only sold before and after*		
log(export price)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
EZ_BF	0.014			0.111			0.087		
	(0.056)			(0.078)			(0.069)		
lntfp_initial_EZ	0.003			-0.007			-0.005		
	(0.006)			(0.008)			(0.007)		
EZ_BF x rating_low		0.040			0.096*			0.075	
		(0.035)			(0.055)			(0.047)	
EZ_BF x rating_high		0.029			0.031			0.032	
		(0.021)			(0.033)			(0.024)	
EZ x tfp initial low x			-0.064			-0.066			-0.040
rating initial low			(0.039)			(0.050)			(0.042)
EZ x tfp initial low x			0.024			0.010			0.004
rating initial high			(0.039)			(0.056)			(0.043)
EZ x tfp initial med x			-0.037			-0.010			-0.026
rating initial low			(0.029)			(0.039)			(0.031)
EZ x tfp initial med x			0.024			0.060			0.007
rating initial high			(0.032)			(0.059)			(0.041)
EZ x tfp initial high x			0.241**			0.304**			0.277**
rating initial low			(0.105)			(0.133)			(0.117)
EZ x tfp initial high x			0.032			0.027			0.046**
rating initial high			(0.022)			(0.033)			(0.023)
real exchange rate	0.227	0.226	0.221	0.158	0.150	0.142	0.271	0.268	0.249
	(0.198)	(0.197)	(0.195)	(0.323)	(0.318)	(0.310)	(0.212)	(0.211)	(0.203)
gdp	-0.361	-0.358	-0.365	-0.826*	-0.821*	-0.792*	-0.451	-0.450	-0.454
	(0.255)	(0.252)	(0.253)	(0.472)	(0.467)	(0.445)	(0.315)	(0.315)	(0.307)
world demand	0.008	0.008	0.008	0.019	0.019	0.018	0.009	0.009	0.009
	(0.008)	(0.009)	(0.008)	(0.015)	(0.015)	(0.015)	(0.009)	(0.009)	(0.008)
obs.	21,330	21,330	21,330	11,996	11,996	11,996	19,422	19,422	19,422
# of firms	492	492	492	419	419	419	471	471	471
adj R-Squared	0.937	0.937	0.937	0.932	0.932	0.932	0.936	0.936	0.936
# of fixed effects	7861	7861	7861	4412	4412	4412	7020	7020	7020

Notes. See Table 3.

Table 7. Markups, productivity and euro adoption

Dependent variable:	*full sample*			*narrow sample*		
log(markup)	(1)	(2)	(3)	(4)	(5)	(6)
EZ	-0.035**	-5.398***		-0.061***	-5.662***	
	(0.014)	(0.077)		(0.015)	(0.085)	
EZ x tfp initial		2.527***			2.646***	
		(0.037)			(0.041)	
EZ x tfp initial low			-0.483***			-0.530***
			(0.015)			(0.016)
EZ x tfp initial med			-0.113***			-0.099***
			(0.019)			(0.021)
EZ x tfp initial high			0.252***			0.231***
			(0.015)			(0.014)
obs.	14,585	14,585	14,585	10,808	10,808	10,808
# of firms	574	574	574	542	542	542
adj R-Squared	0.826	0.872	0.862	0.818	0.872	0.858
# of fixed effects	3610	3610	3610	2899	2899	2899

Notes: The dependent variable is the markup at the firm-destination level. All regressions include a constant, firm-destination fixed effects and year fixed effects. Standards errors are clustered at the destination-year level and three, two and one star denote significance at the 0.01, 0.05, 0.1 level respectively.

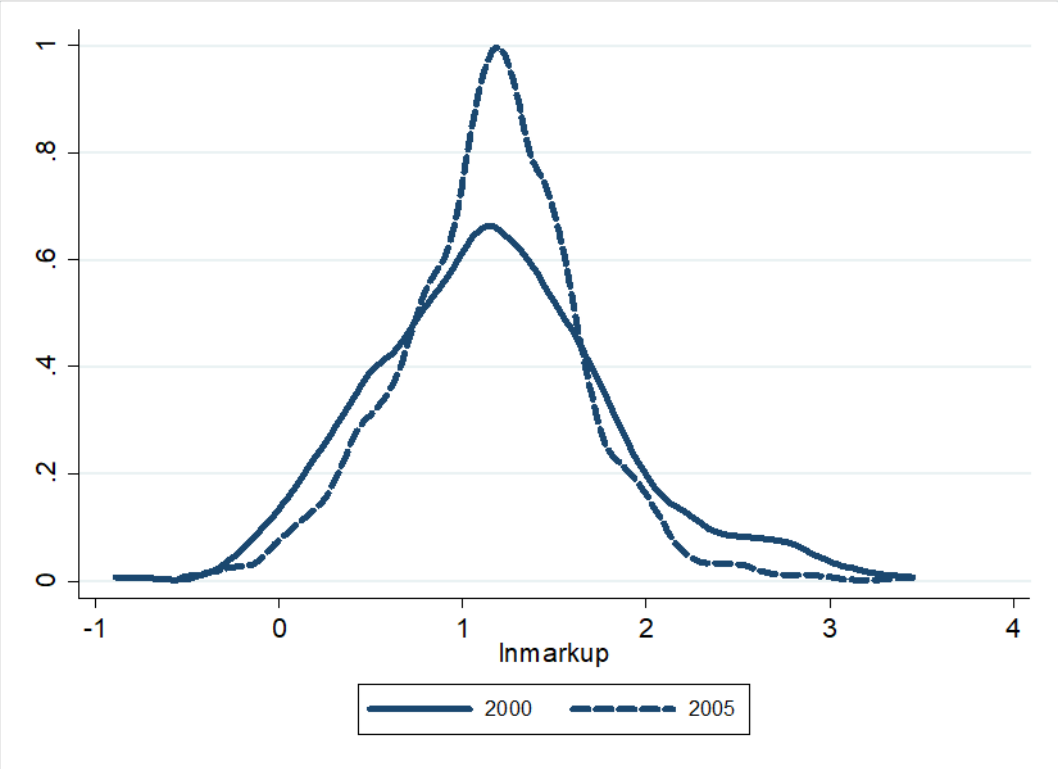
Table 8. Markups, productivity and euro adoption: robustness regressions

Dependent variable:	Exporters in all years			Rauch differentiated products			Competition		
log(markup)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
EZ	-0.018	-3.328***		-0.030**	-5.708***		-0.026**	-5.390***	
	(0.016)	(0.216)		(0.014)	(0.079)		(0.013)	(0.077)	
EZ x tfp initial		1.555***			2.680***			2.524***	
		(0.103)			(0.038)			(0.037)	
EZ x tfp initial low			-0.380***			-0.482***			-0.477***
			(0.019)			(0.015)			(0.014)
EZ x tfp initial med			0.000			-0.111***			-0.108***
			(0.025)			(0.018)			(0.019)
EZ x tfp initial high			0.138***			0.277***			0.257***
			(0.020)			(0.014)			(0.014)
lib				0.027*	0.023*	0.021			
				(0.016)	(0.013)	(0.013)			
comp							0.130***	0.034	0.070**
							(0.036)	(0.027)	(0.032)
obs.	3,949	3,949	3,949	13,245	13,245	13,245	14,585	14,585	14,585
# of firms	86	86	86	559	559	559	574	574	574
adj R-Squared	0.852	0.870	0.871	0.822	0.874	0.861	0.826	0.872	0.862
# of fixed effects	724	724	724	3356	3356	3356	3610	3610	3610

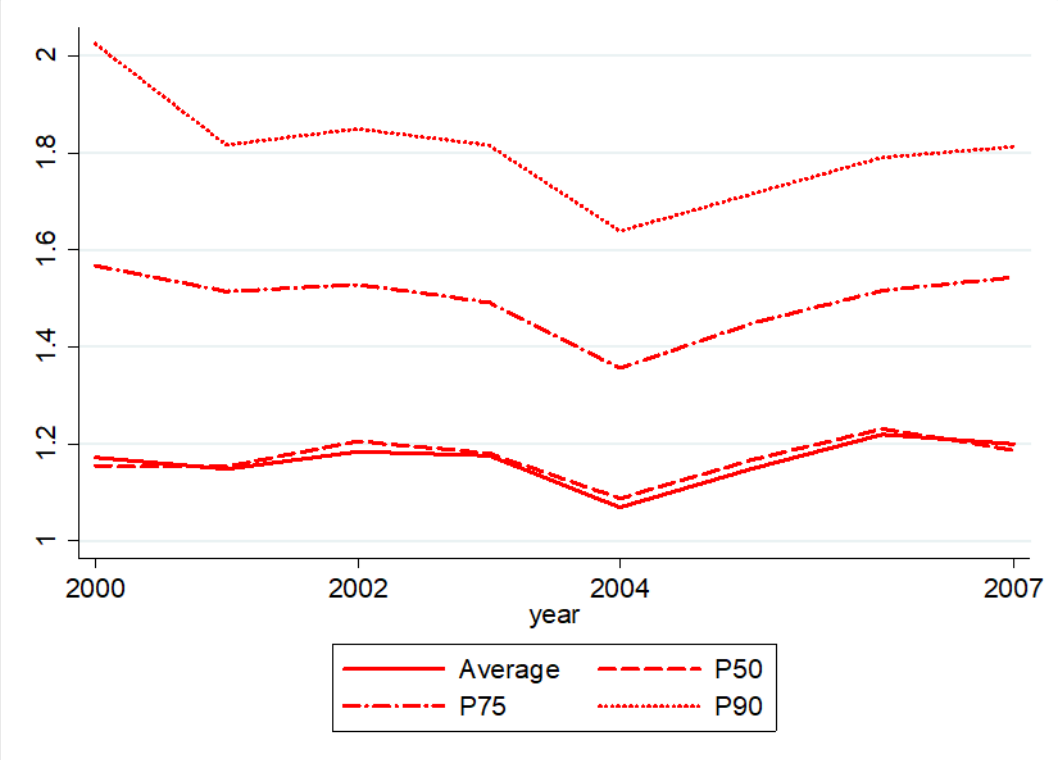
Notes: See Table 3 and Table 7. *lib* denotes the liberal classification in the Rauch index of product differentiation and *comp* denotes the (log of the) total number of other firms exporting in the same country as firm *f* in each year.

Figure 1. The distribution of pre- and post-euro markups of Greek exporters

A. Kernel density



B. Percentiles markup distribution



Export prices and markups with a common currency: Empirical evidence from Greek exporting firms and euro adoption

Online Appendix

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TABLE A1. Export prices, productivity and euro adoption (destinations with available markups)

Dependent variable: export prices	(1)	(2)	(3)
EZ	0.042*	-0.789***	
	(0.025)	(0.259)	
EZ x tfp initial		0.387***	
		(0.122)	
EZ x tfp initial low			-0.017
			(0.035)
EZ x tfp initial med			-0.033
			(0.029)
EZ x tfp initial high			0.102***
			(0.035)
real exchange rate	0.215	0.202	0.203
	(0.204)	(0.200)	(0.199)
gdp	-0.466	-0.478	-0.482
	(0.306)	(0.306)	(0.305)
world demand	0.010	0.009	0.009
	(0.008)	(0.008)	(0.008)
obs.	20,611	20,611	20,611
# of firms	574	574	574
adj R-Squared	0.933	0.933	0.934
# of fixed effects	108	108	108

Notes: The dependent variable is the export price (value over quantity) at the firm-product-destination level. All regressions include a constant, firm-product-destination fixed effects and year fixed effects. Standards errors are clustered at the destination-year level and three, two and one star denote significance at the 0.01, 0.05, 0.1 level respectively.

Table A2. Using # of destinations as tfp proxy: export prices

Dependent variable:	*all destinations*			*narrow sample*			*products sold before and after*		
log(export price)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
EZ	0.026	-0.102*	-0.067	0.056*	-0.111	-0.080	0.041	-0.096	-0.083
	(0.020)	(0.060)	(0.048)	(0.033)	(0.089)	(0.066)	(0.025)	(0.080)	(0.059)
EZ x high_dest1		0.134**			0.177*			0.144*	
		(0.066)			(0.096)			(0.085)	
EZ x high_dest3			0.105*			0.155*			0.138*
			(0.058)			(0.082)			(0.072)
real exchange rate	0.207	0.210	0.204	0.118	0.116	0.112	0.235	0.234	0.229
	(0.189)	(0.191)	(0.191)	(0.304)	(0.305)	(0.306)	(0.201)	(0.201)	(0.202)
gdp	-0.360	-0.371	-0.378	-0.774*	-0.780*	-0.791*	-0.476	-0.480	-0.487
	(0.246)	(0.251)	(0.254)	(0.459)	(0.462)	(0.467)	(0.304)	(0.306)	(0.308)
world demand	0.008	0.008	0.008	0.019	0.019	0.018	0.010	0.010	0.010
	(0.008)	(0.008)	(0.008)	(0.015)	(0.015)	(0.015)	(0.009)	(0.008)	(0.008)
obs.	22,351	22,351	22,351	12,458	12,458	12,458	20,355	20,355	20,355
# of firms	539	539	539	456	456	456	516	516	516
adj R-Squared	0.934	0.934	0.934	0.932	0.932	0.932	0.933	0.933	0.933
# fixed effects	8,291	8291	8291	4621	4621	4621	7403	7403	7403

Notes: See Table A1. *high_dest1 is a dummy that takes the value of 1 if the firm has sold in more than one destination during 1999 and 0 otherwise. high_dest3 is a dummy that takes the value of 1 if the firm has sold in more than three destinations during 1999 and 0 otherwise*.

Table A3. Using # of destinations as tfp proxy: markups

Dependent variable:	*full sample*			*narrow sample*		
log(markup)	(1)	(2)	(3)	(4)	(5)	(6)
EZ	-0.035**	-0.250***	-0.306***	-0.063***	-0.294***	-0.347***
	(0.014)	(0.021)	(0.019)	(0.016)	(0.023)	(0.017)
EZ x high_dest1		0.245***			0.265***	
		(0.024)			(0.027)	
EZ x high_dest3			0.343***			0.369***
			(0.021)			(0.020)
obs.	14,585	14,585	14,585	10,808	10,808	10,808
# of firms	574	574	574	542	542	542
adj R-Squared	0.826	0.829	0.834	0.818	0.821	0.828
# fixed Effects	3610	3610	3610	2899	2899	2899

Notes: The dependent variable is the markup at the firm-destination-year level. All regressions include a constant, firm-destination fixed effects and year fixed effects. Standards errors are clustered at the destination-year level and three, two and one star denote significance at the 0.01, 0.05, 0.1 level respectively.

Table A4. Markups, productivity and euro adoption: adding controls

Dependent variable:	*full sample*			*narrow sample*		
log(markup)	(1)	(2)	(3)	(4)	(5)	(6)
EZ	-0.019	-5.278***		-0.047**	-5.531***	
	(0.015)	(0.093)		(0.018)	(0.109)	
EZ x tfp initial		2.476***			2.589***	
		(0.043)			(0.050)	
EZ x tfp initial low			-0.470***			-0.512***
			(0.016)			(0.018)
EZ x tfp initial med			-0.095***			-0.080***
			(0.017)			(0.020)
EZ x tfp initial high			0.261***			0.242***
			(0.013)			(0.014)
real exchange rate				0.199	0.025	0.044
				(0.127)	(0.084)	(0.088)
gdp				0.193**	0.102	0.134
				(0.091)	(0.076)	(0.081)
employment	-0.209***	-0.186***	-0.195***	-0.190***	-0.163***	-0.173***
	(0.043)	(0.043)	(0.043)	(0.050)	(0.048)	(0.047)
total assets	0.114***	0.067**	0.088***	0.103***	0.046	0.074**
	(0.028)	(0.033)	(0.030)	(0.026)	(0.032)	(0.029)
obs.	14,146	14,146	14,146	10,494	10,494	10,494
# of firms	555	555	555	542	542	542
adj R-Squared	0.841	0.885	0.876	0.833	0.884	0.872
# of fixed effects	3481	3481	3481	2801	2801	2801

Notes: See Table A3.