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Exporter Price Premia?

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This paper provides new evidence on manufacturing firms' output prices: in Denmark, on average, exported varieties are sold at a lower price (i.e. a *negative* exporter price premium) relative to only domestically sold varieties. This finding stands in sharp contrast to previous studies, which have found positive exporter price premia. We also document that the exporter price premium varies substantially across products (both in terms of sign and magnitude). We show that in a standard heterogeneous firms model with heterogeneity in quality as well as production efficiency there is indeed no clear-cut prediction on the sign of the exporter price premium. However, the model unambiguously predicts a negative exporter price premium in terms of quality-adjusted prices, i.e. prices per unit of quality. This prediction is broadly borne out in the Danish data: while the magnitude of the premium varies across products, its sign is (nearly) always negative.

JEL codes: F12, F14, L15.

Key words: Exporters, Pricing, Exporter price premia, Firm-level data.

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1 Introduction

Exporters are superior to non-exporters in many dimensions: they are larger, more productive, pay higher wages and are more likely to import. These results are by now stylized facts, confirmed to hold both across space and time.[1] Much less is however known about how prices correlate with export status. Kugler & Verhoogen (2012), Hallak & Sivadasan (2013) and Gervais (2015) find that exporters charge higher output prices than non-exporters (for the same narrowly defined product).[2] In this paper, we show that the finding of a positive exporter price premium does not hold across space: in Denmark, on average, exported varieties sell at a *negative* price premium compared to varieties that are only sold domestically. Moreover, we document substantial variation in the sign and size of the exporter price premium across products/sectors.

To rationalize these findings, we present a standard version of the heterogeneous-firms framework in Melitz (2003) that includes quality heterogeneity on top of the conventional heterogeneity in production efficiency, where quality increases both demand and marginal costs.[3] In this framework, firms become exporters if they have a favorable quality and/or efficiency draw. Since the two sources of heterogeneity have opposite implications for prices, the price distributions of exported and non-exported varieties overlap. Thus, the model is consistent with positive as well as negative exporter price premia.

The theoretical framework also predicts that exporter premia are *unambiguously* negative when looking at quality-adjusted prices (defined as the price per unit of quality). Intuitively, holding quality constant, we expect exported varieties to have higher efficiency, and thus lower prices. To test this prediction, we follow Khandelwal et al. (2013) in inferring product quality as the residual of a demand equation.[4] Pooled regressions confirm that the exporter premium for quality-adjusted prices is negative. Moreover, while the magnitude of the exporter premium for quality-adjusted prices also varies across products, its sign is (nearly) always negative.

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[1] See Wagner (2007, 2012) for a review of the empirical evidence.

[2] In particular, Kugler & Verhoogen (2012) provide evidence of higher output prices of exporters compared to non-exporters in Colombia; Hallak & Sivadasan (2013) use data from Chile, Colombia, India, and the United States and similarly find a positive exporter price premium (conditional on sales). Gervais (2015) confirms these results for the United States.

[3] Our theoretical framework is closely related to the one in Gervais (2015). See also Hallak & Sivadasan (2013), Johnson (2012), Kugler & Verhoogen (2012), Baldwin & Harrigan (2011), and Verhoogen (2008) for other models on the link between exporting and pricing.

[4] Studies that estimate demand equations for different products in order to infer product quality include Khandelwal (2010) and Hallak & Schott (2011). The methodology in Khandelwal et al. (2013) is somewhat simpler since it employs external information on demand parameters rather than necessitating the researcher to estimate these parameters.

Our results have important implications for the literature that employs the output price as a proxy for product quality. Interpreted in a setting with quality heterogeneity only, one would deduct from the negative exporter price premium that exported varieties are of lower quality. With heterogeneity in both quality and efficiency, there is no direct mapping from output prices to output quality. Hence, our finding do not allow us to make inferences about quality differences across firms/varieties. Our empirical analysis reveals that the negative exporter price premium is larger (in absolute value) in terms of quality-adjusted prices compared to unadjusted prices. This result is suggestive of an (overall) positive exporter quality premium; though the sign of the quality premium may also differ across products and industries.

Our theoretical and empirical analysis thus shows that using output prices as a proxy for quality may lead to erroneous conclusions. This complements the finding in Hallak & Schott (2011) and Khandelwal (2010) that observed differences across countries in unit values can be a poor approximation for relative quality differences. In a similar vein, Gervais (2015) shows that the variation in price understates the variation in product quality across plants. In this paper, we furthermore highlight that researchers should be careful in drawing conclusions from pooled regressions: for example, industries may differ with respect to the relative importance of quality and efficiency heterogeneity in a way that is not easily discernible in the data.

The paper is structured as follows. Section 2 describes the Danish data and presents evidence of a negative exporter price premium. Section 3 introduces the theoretical framework. Section 4 tests the prediction of a negative exporter premium in quality-adjusted prices. Section 5 concludes.

2 Exporter Price Premia in the Danish Data

In this section, we introduce the Danish data and describe how we measure output prices (unit values). We next provide evidence that in Denmark the exporter price premium is negative. Subsequently, we show that the premium varies considerably across industries and products.

2.1 Data

We use production data from the Industrial Commodity Statistics provided by Statistics Denmark. The data are based on a survey in which manufacturing firms report sales of own produced products measured in both physical quantities and values. The survey comprises all firms with at least 10 employees, covering 93 percent of Danish manufacturing turnover. Products are defined at the eight-digit level of the Combined Nomenclature (CN). In the following, we refer to a product produced by a firm as a variety of that product. We complement these data with information on export values and quantities by firm, product and destination from the external trade statistics. Finally, information on key firm variables such as size, wages, industry affiliation etc. is obtained from the firm register.

All data sources can be linked using a unique firm identifier and the product code (where applicable). After data cleaning, we are left with a panel of 4,194 manufacturing firms, covering the period 2000 to 2013. The data cleaning is described in more detail in Appendix A.

The data allow us to construct export indicators at both the firm level and the firm-product level. We also combine the information on production and exports in order to retrieve the volume and value of *domestic* sales. Looking at domestic sales allows us to abstract from the within-firm-product variation in prices across markets, but also has its drawbacks: firms may export not only own-produced goods but also traded goods, implying some measurement error in domestic sales.[5] In fact, in some instances exports even exceed production. For these cases, we set domestic sales to missing.

Panels A and B of Table 1 report summary statistics for firm-level and firm-product-level variables, respectively. In Denmark, exporting is widespread: 84 percent of firms in our sample are exporters. Thus, the share of exporting firms is substantially higher than in e.g. the United States, but comparable to other small open economies, such as Sweden; see Greenaway et al. (2005). In line with the literature, exporting firms are larger in terms of both sales and the number of products they produce. Panel B shows that export participation is slightly lower once we consider the firm-product level: here, 65 percent of varieties are exported. Hence, even exporting firms only export a subset of their products. Moreover, exported varieties are larger than non-exported varieties not only in terms of overall sales, but also in terms of domestic sales.

In Appendix A, we show that our sample replicates all of the results on positive (conditional) exporter premia related to in the introduction: even after controlling for industry fixed effects, Danish manufacturing exporters are larger, more productive, more capital intensive and pay higher wages than non-exporters. Thus, exporting firms are in many ways superior to non-exporters.

Following Kugler & Verhoogen (2012) and Hallak & Sivadasan (2013), our main variable of

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[5] Bernard et al. (2012) document that such carry-along trade is common in the Belgian data, and we similarly find this to be an issue in the Danish data.

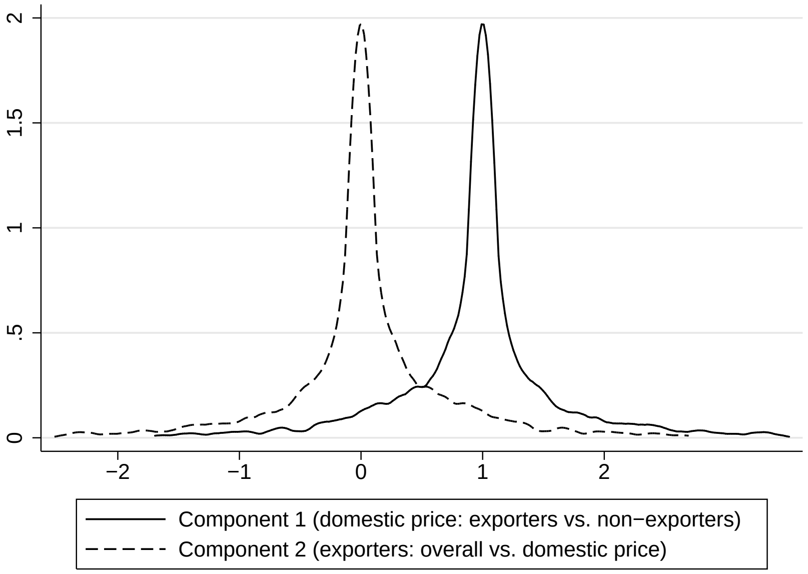
Table 1: Summary Statistics

Panel A: Firm-level variables	All firms			Exporters			Non-exporters		
	mean	sd	N	mean	sd	N	mean	sd	N
Exporter (firm level)	0.84	0.37	25,914	1.00	0.00	21,819	0.00	0.00	4,095
Total sales (by firm, million DKK)	148.70	788.30	25,914	167.30	832.50	21,819	49.75	477.20	4,095
Number of products	3.77	7.06	25,914	4.05	7.53	21,819	2.28	3.22	4,095

Panel B: Firm-product-level variables	All varieties			Exported varieties			Non-exported varieties		
	mean	sd	N	mean	sd	N	mean	sd	N
Exporter (variety level)	0.65	0.48	82,931	1.00	0.00	53,659	0.00	0.00	29,272
Sales (million DKK)	42.16	242.58	82,931	52.86	280.75	53,659	22.53	147.08	29,272
Domestic sales (million DKK)	30.74	177.50	50,479	36.05	189.56	30,240	22.80	157.46	20,239
Export sales (million DKK)	18.78	136.03	60,874	28.14	165.70	40,635	0.00	0.00	20,239

Note: The table reports summary statistics for selected firm-level and firm-product-level variables, separately for exporters and non-exporters. In Panel B, information on domestic sales and export sales is only included for products for which the unit of measurement is the same in the production data and the trade data. In addition, domestic sales are not reported for varieties for which export sales exceed total sales.

Figure 1: Price Difference Decomposition



interest is the producer's output price (unit value), defined as value over quantity. Production values are measured exclusive of transport costs, and prices are therefore measured in free on board terms. We trim the data by dropping outliers and unreasonable values; see Appendix A for details.[6]

2.2 Output Prices vs. Domestic Prices

Similar to previous studies, we construct prices based on the total sales of a variety. The measured output price p_{ijt} thus corresponds to the quantity-weighted average price across domestic and export markets. In particular, we have: $p_{ijt} = \frac{\sum_{c=1}^{C} v_{ijct}}{\sum_{c=1}^{C} q_{ijct}} = \left(\sum_{c=1}^{C} p_{ijct} \frac{q_{ijct}}{\sum_{c=1}^{C} q_{ijct}}\right)$ where v_{ijct}, q_{ijct} and p_{ijct} denote, respectively, the value, quantity and price of variety i for product j in country c at time t. Notably, the set of countries C includes the domestic market.

Importantly, for a given product differences in output prices across exported and non-exported varieties are potentially influenced by both price differences across varieties but also price differences within varieties across (export and domestic) markets. Based on the inferred values and quantities of domestic sales (see above), we calculate the price on the domestic market, which we denote by $p_{ijt}^{d} = \frac{v_{ijt}^{d}}{q_{ijt}^{d}}$. Looking at the domestic price allows us to abstract from the within-firm variation in prices across markets; i.e. pricing-to-market.

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[6] We also only keep observations where the reporting unit (e.g. kg) is the same as the most prevalent reporting unit of each product. Hence, we never compare the price of a variety measured in liters with a price for another variety of the same product measured in kilograms.

We now take a first look at price differences across exported and non-exported varieties. For each product, we decompose the difference in average prices as follows:

$$\frac{\sum_{i \in X_j} p_{ijt}}{N_j^X} - \frac{\sum_{i \in D_j} p_{ijt}}{N_j^D} = \underbrace{\frac{\sum_{i \in X_j} p_{ijt}^d}{N_j^X} - \frac{\sum_{i \in D_j} p_{ijt}}{N_j^D}}_{\text{Component 1}} + \underbrace{\frac{\sum_{i \in X_j} (p_{ijt} - p_{ijt}^d)}{N_j^X}}_{\text{Component 2}}, \tag{1}$$

where X_j denotes the set of exported varieties of product j, D_j denotes the set of non-exported varieties, N_j^X denotes the number of exported varieties, and N_j^D denotes the number of non-exported varieties.

Equation (1) shows that the average output price difference between exported and non-exported varieties can be decomposed into (*i*) the average price difference between exported and non-exported varieties on the domestic market (Component 1) and (*ii*) the average price difference between output prices and domestic prices for exported varieties (Component 2). The decomposition in Equation (1) is, however, not comparable across products. To ease interpretation, we therefore divide both sides of the equation by the term on the left hand side, such that the two components of the price difference sum to one. In particular, the value of each component summarizes its contribution to average price differences.

We can now compute these scaled versions of Component 1 and Component 2 for all products in our sample. Figure 1 summarizes the results by plotting the distributions of the two components across products. If price differences were mainly driven by pricing-to-market, i.e. firms charging different prices on international and domestic markets, we would expect Component 2 to dominate. However, we find that Component 2 is tightly centered around zero, implying that it contributes little to observed price differences between exported and non-exported varieties. Component 1, on the other hand, is close to one for a large share of products in the sample. In sum, price differences across exported and non-exported varieties are mainly driven by differences across varieties rather than within-variety price differences across markets.[7]

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[7] This finding is in line with a different type of decomposition put forward by Harrigan et al. (2015), who decompose the average price difference across export markets into a price discrimination effect (capturing *within-firm* price differences across markets), a market share effect (capturing differences in export sales *across firms* and markets), and an interaction effect. They show that the price discrimination effect contributes little to the average price difference across markets.

2.3 Exporter Price Premia

In the following empirical analysis, we relate output prices to export participation. Our basic estimation equation for the exporter price premium reads as follows:

$$\ln p_{ijt} = \beta_0 + \beta EXP_{ijt} + \delta_{jt} + \epsilon_{ijt}, \tag{2}$$

where the price (unit value) of variety i is modeled as a function of a measure of export participation (EXP_{ijt}); δ_{jt} is a product-year fixed effect and ϵ_{ijt} is a mean-zero disturbance. Product-year fixed effects control for differences in prices across products (e.g. pencils vs. cars) and differences in the unit of measurement of the quantities of different products (e.g. kg versus liter). In addition, they also account for product-specific inflation rates.

The explanatory variable of interest EXP_{ijt} is specific to the variety, and we therefore cluster standard errors at the firm-product level. As will become apparent in our theoretical exposition in Section 3, this is indeed the level at which export status should be defined in order to ensure a tight match between the empirical analysis and the theory. Following previous studies, however, we also estimate specifications where export participation is defined at the firm level. Where this is the case, standard errors are clustered accordingly at the firm level.

It should be noted that estimates of β reflect correlations between export participation and output prices, and should not be interpreted causally. In fact, our illustrative model below suggests that both export participation and output prices are driven by unobserved measures of firm efficiency and product quality.

2.3.1 Pooled Regressions

We first estimate Equation (2) by pooling observations across all products; see Table 2. The estimated exporter price premium, $\widehat{\beta}$, is thus informative about the overall relationship between export participation and output prices in our sample.

Column (1) of Table 2 shows results from our preferred specification, where the output price ($\ln p_{ijt}$) is regressed on an indicator variable for export status, which is equal to one if variety i is exported to at least one export destination. The estimated exporter price premium is negative and highly statistically significant: on average, exported varieties are sold at a 8.2 percent *lower* price, compared to only domestically sold varieties of the same product.[8]

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[8] We find similar results to those in column (1) when we standardize output prices, as suggested by Hallak & Sivadasan (2013); see the Online Appendix for regression results.

Table 2: Exporter Price Premia: Pooled Regressions

Dependent variable:	Output price (1)	Domestic price (2)	Output price (3)	Output price (4)	Output price (5)
Exporter (variety)	-0.0815*** (0.028)	-0.0860*** (0.028)			
Export share (variety)			-0.0978** (0.045)		
Exporter (firm)				-0.0434 (0.043)	
Export share (firm)					-0.1592 (0.106)
Observations	82,931	50,171	73,748	82,931	71,282
R-squared	0.918	0.919	0.924	0.918	0.922
Product-year fixed effects	Yes	Yes	Yes	Yes	Yes

Note: In columns (1) to (3), standard errors are clustered at the firm-product level. In columns (4) and (5), standard errors are clustered at the firm level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

In the remainder of the table, we first show that this result is qualitatively and quantitatively robust to a different definition of the dependent variable; see column (2). Secondly, we confirm that the exporter price premium is again negative if we employ the export share of the variety as an alternative measure of export participation; see column (3). Finally, we show that the premium becomes statistically insignificant if export participation is measured at the firm level instead of at the variety level; see columns (4) and (5).

Importantly, the large difference in output prices between exported and non-exported varieties found in column (1) could theoretically be driven by pricing-to-market, i.e. firms charging different prices on different markets. In particular, the literature shows that prices vary across countries depending on destination characteristics, such as income per capita, market size and distance; see *inter alia* Bastos & Silva (2010), Martin (2012) and Harrigan et al. (2015). Denmark has a relatively high domestic income per capita coupled with a small size of the domestic market. Both of these market characteristics tend to be associated with on average higher prices. Thus, if exporting firms charge lower prices to their foreign customers, this pricing behavior could potentially explain the negative exporter price premium that we find in the Danish data (recall that output prices are averaged across markets).

In order to show that pricing-to-market does not drive the negative exporter price premium, we analyze differences across exported and non-exported varieties in *domestic* prices rather than output prices. In terms of our notation above, we look at Component 1 of Equation (1). By definition, exported and non-exported varieties face the same market characteristics when selling domestically. The estimated exporter premium for domestic prices, reported in column (2) of Table 2, is negative and statistically significant. Moreover, it is remarkably similar to the premium in column (1) also in quantitative terms.[9]

So far, we have measured export participation by an indicator variable for export status. In column (3), we consider the share of exports in the total sales of a variety as an explanatory variable.[10] We again find a negative and significant exporter price premium: varieties with a higher share of exports in total sales are on average sold at a lower price.

Finally, we show results where export participation is measured at the firm level.[11] Independent of whether we employ an exporter indicator or the export share as explanatory variable, exporter premia are now statistically insignificant; see columns (4) and (5). However, pricing differences across firms (rather than varieties) may be hard to identify in our sample, since the majority of firms is involved in exporting for at least some of their varieties; see Table 1.

Overall, across specifications, we find robust evidence for a non-positive exporter price premium in the case of Denmark. Moreover, our preferred specifications which use variety-specific export information show a consistently negative exporter premium. These findings stand in sharp contrast to existing evidence on a positive exporter price premium in Hallak & Sivadasan (2013), Kugler & Verhoogen (2012) and Gervais (2015). Moreover, the fact that negative exporter premia are present also when looking at domestic prices suggests that pricing-to-market does not explain our findings. This motivates our modeling framework below (see Section 3), in which heterogeneity in efficiency and product quality drives price differences across firms.

2.3.2 Variation across Industries and Products

We next document another important feature of the data: the exporter price premium varies considerably across industries and products, in terms of both magnitude and sign.

We estimate the specification in column (1) of Table 2 separately by industry or product. We consider various levels of aggregation, using both the product classification as well as the NACE industry classification. Using a correspondence table, we link each eight-digit CN product to a

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[9] As a second piece of evidence in support of the notion that pricing-to-market does not explain the negative exporter price premium, we directly control for differences in destination characteristics across exported and non-exported varieties. Results are reported in the Online Appendix.

[10] The number of observations in column (3) is slightly lower than in column (1) because we only calculate export shares for products for which quantities are measured in the same unit in both the export and the production statistics. Moreover, in cases where export sales exceed total production (e.g. due to carry-along trade), we set the export share to missing.

[11] This is the specification which comes closest to Kugler & Verhoogen (2012), Hallak & Sivadasan (2013) and Gervais (2015), who all define export status at the plant level (in part due to lack of export information at the plant-product level).

Table 3: Exporter Price Premia: Results by Industry/Product

Level of aggregation	Number of industries/ products[a]	Number of observations[b]	Negative coefficient[c]	Negative + significant coefficient[c]	Positive coefficient[c]	Positive + significant coefficient[c]
NACE 2 digit	23	82,931	15	5	8	2
		3,606	*0.75*	*0.15*	*0.25*	*0.12*
NACE 4 digit	165	81,754	80	22	85	18
		495	*0.5*	*0.18*	*0.5*	*0.07*
CN 2 digit	71	82,679	41	11	30	7
		1,164	*0.69*	*0.23*	*0.31*	*0.10*
CN 4 digit	376	77,125	201	65	175	46
		205	*0.58*	*0.25*	*0.42*	*0.12*
CN 6 digit	665	65,512	341	126	324	98
		99	*0.54*	*0.2*	*0.46*	*0.12*
CN 8 digit	799	53,681	429	138	370	98
		67	*0.52*	*0.17*	*0.48*	*0.12*

Note: The table summarizes the results from industry- or product-specific regressions of output prices on an exporter indicator variable and product-year fixed effects. At each level of aggregation, only industries/products with at least 25 observations are included. [a] This column indicates the number of products/industries for a given level of aggregation. [b] This column reports the total number of observations included across all regressions at a given level of aggregation, and – in italics – the average number of observations per regression. [c] Columns report the number of industries/products with a negative, negative and significant, positive, positive and significant coefficient on the exporter indicator. The numbers in italics below indicate the corresponding share of the sample. The significance level is 10%.

four-digit NACE industry. Formally, the empirical model generalizes Equation (2) and reads

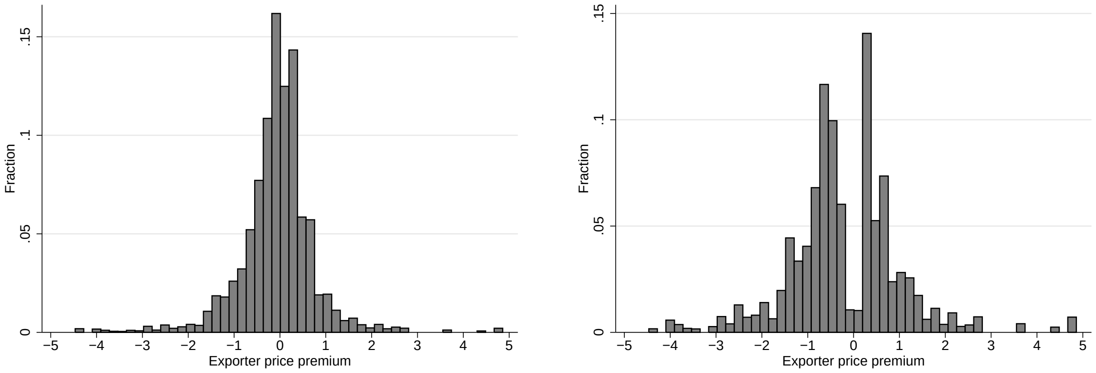
$$\ln p_{ijt} = \beta_0 + \beta_k EXP_{ijt} + \delta_{jt} + \epsilon_{ijt},$$

where k is either a product, i.e. $k = j$, or an aggregate of products, e.g. a two-digit NACE industry. At any level of aggregation, we only include products/industries with at least 25 observations. Higher levels of aggregation have the advantage that a larger fraction of the sample is included in the analysis, but the disadvantage that we pool over products that might differ in the exporter price premium.

Table 3 summarizes the results. At the most aggregate level, we find a negative exporter price premium in 15 out of 23 NACE two-digit industries, accounting for 75 percent of observations in our sample. However, the effect is negative and statistically significant only in 5 industries. As a general rule, the sample is more evenly split between industries/products with negative and positive exporter price premia at lower levels of aggregation. For example, at the eight-digit level of the CN code, the sample is almost evenly split between products with a negative premium (429 out of 799 products, or 52 percent of observations in the sample) and those with a positive premium. Moreover, price premia (whether positive or negative) are statistically significant for only approximately a third of observations, independent on the level of aggregation considered.

The *magnitude* of the exporter price premium also varies significantly across products. Figure 2 shows the distribution of the estimated coefficient on EXP_{ijt} based on regressions at the

Figure 2: Variation in the Exporter Price Premium across Eight-Digit Products



(a) All products

(b) Products with statistically significant premia

Note: The figure is based on results from regressions at the eight-digit level of the CN code and shows the distribution of exporter price premia. Product-specific premia are weighted by the number of observations in a given product category.

eight-digit level of the CN code. Figure 2(a) includes all products (independent of whether the coefficient is statistically significant), while Figure 2(b) includes only products for which coefficient estimates are statistically significant. In both cases, the distribution for the exporter price premium is almost symmetrically distributed around zero. Moreover, a significant share of products has exporter premia well exceeding 50 percent (in absolute value), especially if we only consider products with a statistically significant exporter price premium.[12]

In sum, the negative exporter price premium found in the pooled regressions of Table 2 hides significant heterogeneity across industries and products. Based on these empirical findings, in the following section we propose a variant of the standard model of firm heterogeneity and export behavior which is capable of explaining the existence of both positive and negative exporter price premia.

3 Theoretical Framework

We present a standard extension of the heterogeneous-firms trade framework in Melitz (2003) which includes heterogeneity in quality as well as efficiency, and multiple sectors. The two-dimensional heterogeneity implies that pricing and sorting into exporting depend on efficiency *and* quality. A very similar model has been considered by Gervais (2015). Here, we employ this

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[12] Kugler & Verhoogen (2012) suggest an elegant theoretical model which explains variation in the size of the exporter price premium across products by differences in the scope for quality differentiation. Based on Colombian data, they find that the exporter price premium is larger for products with a higher scope for quality differentiation. We find a similar pattern in our Danish data, but – in contrast to Kugler & Verhoogen (2012) – predict non-positive exporter price premia even for products with a high scope for quality differentiation.

framework to discuss implications for price differences across firms.

Export sales (or latent export sales) predict export status perfectly in heterogeneous-firms models with CES preferences (constant mark-ups), constant marginal costs, and fixed costs of exporting (common across varieties). Models with heterogeneity in efficiency only, e.g. Melitz (2003), unambiguously predict negative exporter price premia. The mechanism is that sales increase in efficiency, and exported varieties are therefore those with high efficiency and accordingly lower marginal costs and prices. In a model where quality heterogeneity is the only source of heterogeneity, selection into exporting is based on quality. If costs are independent of quality, all varieties have identical prices and there is no exporter price premium. However, if high quality varieties are more expensive to produce and high quality varieties have higher sales due to strong preferences for quality among consumers, the models predict a positive exporter price premium.[13] With both sources of heterogeneity present, the sign of the exporter price premium is ambiguous and highly dependent on the distribution of the two sources of heterogeneity and preferences for vs. costs of producing quality.

Our model is kept transparent by letting quality and efficiency be exogenous, i.e. we do not include endogenous quality or efficiency upgrading as in e.g. Hallak & Sivadasan (2013) and Bustos (2011). However, as we do not impose any restrictions on the bivariate distribution of quality and efficiency our model is both general and flexible. In this sense, our model nests models in the literature which either endogenously or exogenously include dependence between quality and efficiency; see e.g. Kugler & Verhoogen (2012) and Baldwin & Harrigan (2011).

In the empirical analysis, we have multi-product firms. However, to simplify exposition, in the theoretical model we assume single-product firms and we therefore use the notions firm and variety interchangeably.[14] Under the following additional assumptions our findings apply at the firm-product level in a multi-product firm extension: *(i)* costs of developing, producing and selling different products within a firm are independent of each other and *(ii)* quality and efficiency across products within a firm are (drawn) independent from each other.

Foreign variables are denoted with an asterisk (*) and preferences are assumed to be homo-

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[13] In contrast, if high quality varieties are more expensive to produce but high quality varieties have lower sales due to weak preferences for quality among consumers, models with quality heterogeneity may even predict a negative exporter price premium.

[14] Note that in the data we can not distinguish varieties of the same product within firms (recall that products are defined at the eight-digit level). Our units of analysis in the theoretical model are therefore representative varieties at the firm-product level.

thetic and identical in the two countries.[15]

3.1 Households

There is a continuum of identical households with measure L. Each household supplies one unit of labor inelastically. The preferences are two-tier. The upper tier across products is Cobb-Douglas whereas the lower tiers across varieties within products are CES. The utility function of the representative household reads

$$U = \exp\left(\log \int_0^1 C_j dj\right) = \exp\left(\log \int_0^1 \left(\int_{i\in\Omega_j} \left(\gamma_{ij}^{\theta_j} c_{ij}\right)^{\frac{\sigma_j-1}{\sigma_j}} di\right)^{\frac{\sigma_j}{\sigma_j-1}} dj\right), \tag{3}$$

where $j \in [0,1]$ captures the product, $i \in \Omega_j$ captures variety i of product j available to the household, c_{ij} is the consumed units of variety i of product j, and γ_{ij} is the quality of variety i of product j. The parameter θ_j captures how much households appreciate quality. The implied demand functions read

$$c_{ij} = \frac{E}{P_j} P_j^{\sigma_j} \left(\gamma_{ij}^{\theta_j}\right)^{\sigma_j-1} p_{ij}^{-\sigma_j} \qquad \forall i,j, \tag{4}$$

where E denotes aggregate expenditures, p_{ij} denotes the price of variety i of product j, and $P_j = \left(\int_{i\in\Omega_j} \left(\gamma_{ij}^{\theta_j}\right)^{\sigma_j-1} p_{ij}^{1-\sigma_j} di\right)^{\frac{1}{1-\sigma_j}}$ is the price index for product j.

3.2 Firms

Firms produce a firm-specific variety of a single product and compete under monopolistic competition with free entry. There are sunk costs of F_{ej} to develop a blue-print for a new variety of product j. These costs as well as all other costs are paid in terms of labor units – the only factor of production being priced W per unit. A blue-print comes with marginal production efficiency (henceforth efficiency) φ_{ij} and quality γ_{ij}. These are drawn from a known bivariate distribution with cumulative distribution function $H_j(\varphi_{ij}, \gamma_{ij})$. Production is subject to fixed costs of production, $F_j > 0$. After obtaining knowledge about efficiency and quality firms decide which markets (if any) to serve. Exporting is subject to a fixed costs of F_{xj} and iceberg trade costs, τ_j. Marginal costs of production are constant but depend on efficiency and quality such

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[15] We consider a two-country economy as we do not take the number of export markets into account in the empirical analysis.

that[16]

$$mc_{ij} = \frac{W}{\varphi_{ij}} \gamma_{ij}^{\kappa_j}, \tag{5}$$

where $\kappa_j > 0$ captures that high-quality varieties are more expensive to produce than low-quality varieties. Due to the constant elasticity of demand, cf. Equation (4), prices are set as constant mark-ups on marginal costs, i.e. the f.o.b. price reads

$$p_{ij}^{fob} = p_{ij}^{d} = \frac{\sigma_j}{\sigma_j - 1} mc_{ij} = \frac{\sigma_j}{\sigma_j - 1} \frac{W}{\varphi_{ij}} \gamma_{ij}^{\kappa_j}. \tag{6}$$

Hence, higher efficiency reduces the price and higher quality increases the price. Profits read

$$\pi_{ij} = a_{ij} \left(B_j + B_j^* I_{xij} \tau_j^{1-\sigma_j} \right) - I_{xij} W F_{xj} - W F_j, \tag{7}$$

where

$$a_{ij} \equiv \left(\gamma_{ij}^{\theta_j - \kappa_j} \varphi_{ij} \right)^{(\sigma_j - 1)} \tag{8}$$

is an aggregate mapping of the two-dimensional heterogeneity into a single-dimensional heterogeneity variable determining sales, profits and export status, I_{xij} is an indicator variable taking the value 1 if the variety is exported and zero otherwise, and $B_j = W^{1-\sigma_j} \frac{E}{P_j} P_j^{\sigma_j} \frac{1}{\sigma_j - 1} \left(\frac{\sigma_j}{\sigma_j - 1} \right)^{-\sigma_j}$ and $B_j^* = W^{1-\sigma_j} \frac{E^*}{P_j^*} \left(P_j^* \right)^{\sigma_j} \frac{1}{\sigma_j - 1} \left(\frac{\sigma_j}{\sigma_j - 1} \right)^{-\sigma_j}$ are endogenous country-product specific demand components which are common across varieties and exogenous to the individual firms.

3.3 Sorting and the Exporter Price Premium

From Equation (7) it follows that profits (in a given market) increase in the heterogeneity aggregate, a_{ij}. In fact, a_{ij} is a sufficient statistic for variety-heterogeneity in determining sales and thus profits on a given market.[17] The heterogeneity aggregate increases in efficiency. Hence, varieties with higher efficiency are *ceteris paribus* more likely to be supplied to a given market. The effect of quality is however ambiguous. If $\theta_j > \kappa_j$ the heterogeneity aggregate increases in quality as the positive impact on demand outweighs the negative impact from higher costs and thus higher price. The opposite is the case for $\theta_j < \kappa_j$. Thus, higher quality varieties are *ceteris paribus* more likely to be supplied in given market only if $\theta_j > \kappa_j$.

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[16] The present framework is similar to the quality heterogeneous firms model of Baldwin & Harrigan (2011) and the model from section 2.4 in Johnson (2012) in the special case where $\theta = 1, \kappa = 0$, and where $\log \gamma$ and $\log \varphi$ are perfectly negatively correlated such that $\gamma \propto \varphi^{-1-\beta}$ for $\beta > -1$.

[17] Hence, in contrast to the framework of Hallak & Sivadasan (2013), an exporter premium conditional on sales is not well-defined as the sales distribution of exported varieties does not overlap with the sales distribution of non-exported varieties.

Accordingly, varieties self-select into various modes of operation based on a_{ij}, such that varieties with $a_{ij} < a_j^d$ exit, varieties with $a_j^d \leq a_{ij} \leq a_j^x$ are sold on the domestic market only, and varieties with $a_{ij} > a_j^x$ are sold on the export market as well as on the domestic market.[18] We now turn to the determination of these threshold values of the heterogeneity aggregate.

The least profitable varieties produced, i.e. varieties with zero flow profits on the domestic market, have a heterogeneity aggregate a_j^d satisfying

$$a_j^d B_j - WF_j = 0 \Rightarrow a_j^d = \frac{WF_j}{B_j}. \tag{9}$$

Combining the threshold value in Equation (9) with the definition of the heterogeneity aggregate in (8), we can derive the iso-profit locus containing all combinations of γ and φ which imply zero profits on the domestic market:

$$\gamma_j^d = \left(\frac{F_j}{B_j}\right)^{\frac{1}{(\sigma_j-1)(\theta_j-\kappa_j)}} W^{\frac{\sigma_j}{(\sigma_j-1)(\theta_j-\kappa_j)}} \left(\varphi_j^d\right)^{-\frac{1}{\theta_j-\kappa_j}}. \tag{10}$$

Similarly, the least profitable varieties exported generate flow profits of zero on the export market and have a heterogeneity aggregate a_j^x satisfying[19]

$$a_j^x B_j^* \tau_j^{1-\sigma_j} - WF_{xj} = 0 \Rightarrow a_j^x = \frac{WF_{xj}}{B_j^* \tau_j^{1-\sigma_j}}. \tag{11}$$

This export threshold value for the heterogeneity aggregate yields an iso-profit locus given by

$$\gamma_j^x = \left(\frac{F_{xj}}{B_j^* \tau_j^{1-\sigma_j}}\right)^{\frac{1}{(\sigma_j-1)(\theta_j-\kappa_j)}} W^{\frac{\sigma_j}{(\sigma_j-1)(\theta_j-\kappa_j)}} \left(\varphi_j^x\right)^{-\frac{1}{\theta_j-\kappa_j}}, \tag{12}$$

which contains all combinations of γ and φ which imply zero profits on the export market.

The slopes of the iso-profit loci in (φ,γ) are determined by

$$\frac{d\gamma_j^x}{d\varphi_j^x}\frac{\varphi_j^x}{\gamma_j^x} = \frac{d\gamma_j^d}{d\varphi_j^d}\frac{\varphi_j^d}{\gamma_j^d} = -\frac{1}{\theta_j - \kappa_j}, \tag{13}$$

and depend on how quality affects demand (θ_j) and costs (κ_j). The thresholds and loci in Equations (9) to (12) divide varieties into exported and non-exported varieties.

Next, we analyze how prices vary across exported and non-exported varieties. While the heterogeneity aggregate, a_{ij}, is a sufficient statistic for variety-heterogeneity regarding export

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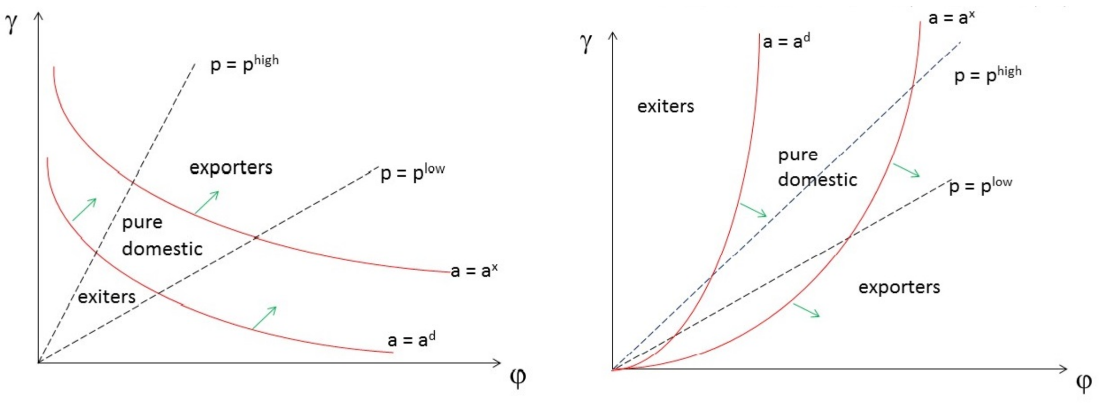
[18] In line with empirical evidence we do not consider equilibria where some varieties are exported without being sold on the domestic market.

[19] To obtain the assumed sorting it must be the case that

$$\frac{WF_{xj}}{B_j^* \tau_j^{1-\sigma_j}} > \frac{WF_j}{B_j} \Leftrightarrow \frac{F_{xj}\tau_j^{\sigma_j-1}}{F_j}\frac{B_j}{B_j^*} > 1.$$

Figure 3: Selection and Pricing



(a) Case A: $\theta_j > \kappa_j = 1$ (quality pays)

(b) Case B: $\theta_j < \kappa_j = 1$ (quality does not pay)

status the same is not true for price. Hence, there is not a one-to-one mapping between sales and price, and this explains the ambiguity of the sign of the exporter price premium. From Equation (6) we obtain iso-price[20] loci defined by

$$\gamma_j^p = \left(\frac{p}{W}\frac{\sigma_j - 1}{\sigma_j}\right)^{\frac{1}{\kappa_j}} \left(\varphi_j^p\right)^{\frac{1}{\kappa_j}}, \tag{14}$$

which are positively sloped. Due to the constant mark-up, the iso-price loci are also iso-marginal-costs loci, which explains the slope: higher efficiency allows production of higher quality at given marginal costs. Formally, $\frac{d\gamma_{ij}^p}{d\varphi_{ij}^p}\frac{\varphi_{ij}^p}{\gamma_{ij}^p} = \frac{1}{\kappa_j} > 0$.

Figure 3 illustrates selection and pricing in two cases. In Case A, depicted in the left-hand figure, parameters are such that $\theta_j > \kappa_j = 1$ and profits therefore increase in quality, i.e. iso-profit loci are downward sloping cf. Equation (13). In Case B, depicted in the right-hand figure, $\theta_j < \kappa_j = 1$ and profits therefore decrease in quality, i.e. iso-profit loci are upward sloping cf. Equation (13). Both figures include two dashed iso-price loci (see Equation (14)), one for a high price and one for a low price.[21] Profits increase in the direction of the arrows, i.e. profits increase in both quality and efficiency in Case A, whereas profits increase in efficiency and decrease in quality in Case B.

Figure 3 contains several important messages. First, the price distributions of exported and non-exported varieties overlap in both cases, as both exported and non-exported varieties are

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[20] The prices are fob prices.

[21] $\kappa = 1$ ensures that iso-price loci are linear. Iso-price loci are concave (convex) for $\kappa > 1$ ($\kappa < 1$). For $\kappa = 0$ iso-price loci are vertical as only efficiency matters for costs and thus prices. It is easy to show for Case B that the iso-profit loci are steeper than the iso-price loci at their intersection point and that the two loci intersect once and only once for $\varphi > 0$ as illustrated in Figure 3.

sold at the low price as well as the high price (we have depicted only two iso-price loci but this applies for all price levels). Hence, the sign of the exporter price premium is in both cases ambiguous, and it is determined by the joint distribution of quality and efficiency. In particular, even if ‘quality pays’ in the sense that higher quality yields *ceteris paribus* higher profits (as in Case A, the case commonly assumed in the literature), the model can still rationalize a negative exporter price premium.

Second, among varieties of equal quality exported varieties have higher efficiency and thus lower costs and prices than the non-exported varieties; i.e. conditional on quality there is a negative exporter price premium. Third, among varieties with equal efficiency exported varieties have higher quality in Case A with $\theta_j > \kappa_j > 0$ and lower quality in Case B with $\kappa_j > \theta_j \geq 0$. Hence, even conditional on efficiency the sign of the exporter price premium is ambiguous as it is positive in Case A but negative in Case B.

Finally, even if exported varieties have a quality premium as documented in Crozet et al. (2012) and Gervais (2015)[22] and if profits increase in quality, i.e. Case A, the sign of the exporter price premium is ambiguous. The exporter price premium is positive if efficiency is identical across varieties, cf. above. However, a negative exporter price premium and a positive exporter quality premium may coexist in Case A if the correlation of quality and efficiency is sufficiently high, i.e. exported varieties are of higher quality (higher price) but also produced with higher efficiency (lower price).

In sum, the sign of the exporter price premium is generally ambiguous and is highly dependent not only on the parameters of the model but also on the joint distribution of quality and efficiency. Hence, the model can perfectly rationalize the vast variation in the magnitude and sign of the exporter price premium uncovered in Table 3 and Figure 2. However, in contrast to previous models such as Kugler & Verhoogen (2012), it does not yield easily testable predictions on how the exporter price premium is expected to vary across products. Below, we instead derive a novel, testable prediction regarding exporter premia in terms of quality-adjusted prices.

The framework does not allow clear-cut analytical comparative statics for the exporter price premium. However, our numerical analysis (available in the Online Appendix) shows consistently with Figure 3: *(i)* the sign of the exporter price premium is ambiguous, *(ii)* the exporter price premium decreases in the (relative) importance of efficiency heterogeneity in the sales

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[22] Note that in this framework with two sources of heterogeneity exporters do not necessarily have a quality premium. Even in Case A where quality ‘pays’, exporters might have higher or lower quality than non-exporters, depending on the joint distribution of quality and efficiency and the slopes of the iso-profit loci.

distribution[23] and *(iii)* the exporter price premium is systematically related to the correlation between quality and efficiency.

Turning to the quality-adjusted price, $\hat{p}_{ij}^{fob}$, i.e. the price of buying one quality-adjusted consumption unit, $\gamma_{ij}^{\theta_j} c_{ij}$, we have that

$$\hat{p}_{ij}^{fob} = \frac{p_{ij}^{fob}}{\gamma_{ij}^{\theta_j}} = \frac{\sigma_j}{\sigma_j - 1} \frac{W}{\varphi_{ij}} \gamma_{ij}^{\kappa_j - \theta_j} = \frac{\sigma_j}{\sigma_j - 1} W \left(a_{ij}\right)^{-\frac{1}{\sigma_j - 1}} . \tag{15}$$

It follows directly from Equation (15) that there is a negative and monotone one-to-one mapping between the quality-adjusted price and the heterogeneity aggregate. Since the heterogeneity aggregate is positively related to export status it follows that the present framework unambiguously predicts a negative exporter price premium in terms of quality-adjusted prices. We take this prediction to the data below.

4 Exporter Premia in Quality-Adjusted Prices

Our model unambiguously predicts a negative exporter price premium in terms of quality-adjusted prices. To test this prediction, we construct quality-adjusted prices as follows. Consider the domestic demand for variety i of product j. Log-linearizing the demand equation in (4) and re-arranging, we have:

$$\ln c_{ij}^{d} + \sigma_j \ln p_{ij}^{d} = \ln(EP_j^{\sigma_j - 1}) + (\sigma_j - 1) \ln \gamma_{ij}^{\theta_j} \qquad \forall\, i, j, \tag{16}$$

where the superscript d signals that consumption and prices refer to domestic variables. We can follow Khandelwal et al. (2013) and use information on quantities and prices to infer $\ln \gamma_{ij}^{\theta_j}$. In particular, we take estimates of the elasticity of substitution σ from Broda & Weinstein (2006) to compute the left hand side of Equation (16). The term $\ln(EP_j^{\sigma_j - 1})$, on the other hand, varies only across products and years (not across varieties), and can thus be captured by product-year fixed effects δ_{jt}. In sum, we run the following regression:

$$\ln c_{ij,t}^{d} + \sigma_j \ln p_{ij,t}^{d} = \delta_{jt} + \epsilon_{ij,t}. \tag{17}$$

Based on the regression residual $\widehat{\epsilon}_{ij,t}$ from this estimation, quality can be inferred as $\ln \gamma_{ij}^{\theta_j} = \widehat{\epsilon}_{ij,t}/(\sigma_j - 1)$. Quality-adjusted prices are then given by $\ln p_{ij,t}^{d} - \ln \gamma_{ij}^{\theta_j}$.

We first pool observations across all products as in Table 2. Running the regression in

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[23] Recall that there is a positive one-to-one mapping between sales and export status.

Table 4: Exporter Premia for Quality-Adjusted Prices: Results by Industry/Product

Level of aggregation	Number of industries/ products[a]	Number of observations[b]	Negative coefficient[c]	Negative + significant coefficient[c]	Positive coefficient[c]	Positive + significant coefficient[c]
NACE 2 digit	21	32,897	19	10	2	0
		1,567	*0.99*	*0.86*	*0.01*	*0*
NACE 4 digit	108	32,489	88	44	17	3
		301	*0.92*	*0.57*	*0.08*	*0.01*
CN 2 digit	58	32,835	53	30	5	2
		566	*0.99*	*0.77*	*0.01*	*0*
CN 4 digit	193	30,972	152	80	41	9
		160	*0.88*	*0.5*	*0.12*	*0.01*
CN 6 digit	293	27,975	236	114	57	11
		95	*0.85*	*0.49*	*0.15*	*0.02*
CN 8 digit	360	24,289	284	121	76	17
		67	*0.84*	*0.38*	*0.16*	*0.03*

Note: The table summarizes the results from industry- or product-specific regressions of quality-adjusted prices prices on an exporter indicator variable and product-year fixed effects. At each level of aggregation, only industries/products with at least 25 observations are included. [a] This column indicates the number of products/industries for a given level of aggregation. [b] This column reports the total number of observations included across all regressions at a given level of aggregation, and – in italics – the average number of observations per regression. [c] Columns report the number of industries/products with a negative, negative and significant, positive, positive and significant coefficient on the exporter indicator. The numbers in italics below indicate the corresponding share of the sample. The significance level is 10%.

Equation (2) with quality-adjusted price as the dependent variable yields – in line with the theoretical prediction – a negative coefficient on the exporter indicator. Moreover, the exporter price premium in quality-adjusted prices is significantly larger (in absolute value) than in output prices: on average, exported varieties have 33 percent lower quality-adjusted prices than non-exported varieties.[24] This difference in the exporter premium in terms of prices vs. quality-adjusted prices is suggestive of an (overall) positive exporter quality premium.[25]

Importantly, the model further predicts that the premium should be negative for all products. In the following, we therefore report results from industry- or product-specific regressions, analogously to Table 3 and Figure 2 above. Table 4 and Figure 4 show results for the exporter premium in terms of quality-adjusted prices. Independent on the level of disaggregation, exporter premia are negative for the overwhelming majority of the sample. Consider first the highest level of disaggregation. We find a negative premium in 284 out of 360 eight-digit products, corresponding to 84 percent of observations in the sample. Moreover, for products for

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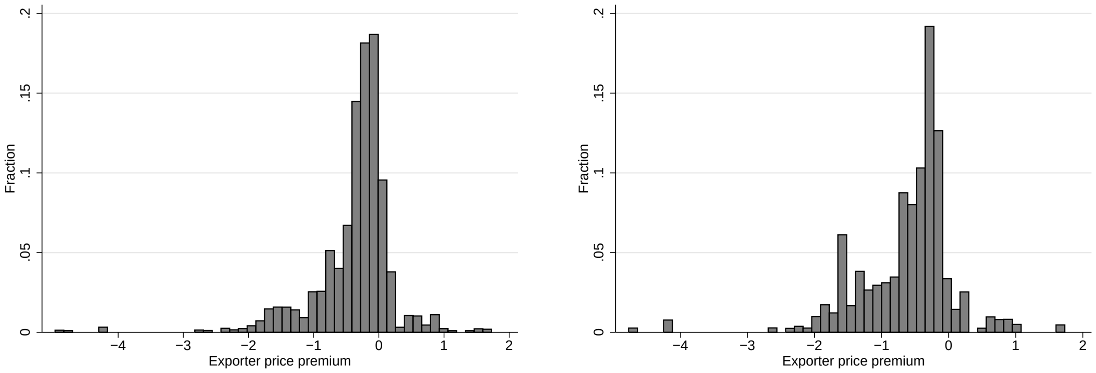
[24] Gervais (2015) estimates the exporter price premium *conditional* on quality and finds that this premium is positive or negative, depending on the specification used. Our approach is conceptually different because it does not hinge on the estimation of the quality-elasticity of prices, which – given the simultaneity of firms' pricing and quality choices – is challenging to identify empirically.

[25] Recall that the model does not yield any clear-cut prediction on the sign of the exporter *quality* premium; see Figure 3 and footnote 22 above. At the eight-digit product level, we find that roughly two thirds observations exhibit a positive quality premium. However, the premium is statistically significant only for 26 percent of observations. In contrast, 32 percent of observations have a negative quality premium, though this is only statistically significant for 7 percent of observations.

Figure 4: Variation in the Exporter Premium for Quality-Adjusted Prices across Eight-Digit Products



(a) All products

(b) Products with statistically significant premia

Note: The figure is based on results from regressions at the eight-digit level of the CN code and shows the distribution of exporter price premia. Product-specific premia are weighted by the number of observations in a given product category.

which the premium is positive, it is usually not statistically significant: only 17 out of 362 eight-digit products (accounting for a mere 3 percent of observations) have a positive and significant exporter premium for quality-adjusted prices. Even stronger results are obtained at higher levels of aggregation: for example, 53 out of 58 two-digit products of the CN code (accounting for 99 percent of observations) have a negative exporter premium, and there are no two-digit products with a positive and statistically significant premium. Thus, the prediction that the exporter premium is unambiguously negative for quality-adjusted prices is broadly borne out by the data.

5 Conclusion

We show that the finding in the literature of a positive exporter price premium does not hold across space: in Denmark, on average, exported varieties sell at a *lower* price compared to varieties that are only sold domestically. The negative sign of the exporter price premium does not seem to be driven by pricing-to-market. Moreover, we document substantial variation in the sign and size of the exporter price premium across products. Turning to quality-adjusted prices we find that the exporter premium is negative (or at least non-positive) for the overwhelming majority of products in the sample. We show that these empirical patterns are consistent with a standard heterogeneous-firms trade model including heterogeneity in quality and efficiency. We will at this point emphasize that the finding of a negative exporter price premium is perfectly consistent with exporters being superior to non-exporters in many dimensions. Indeed, in our sample we do find that exporters are superior in terms of size, productivity, sales, wages, and capital per worker.

As most studies on exporter price premia are conducted for large (US) or developing economies (e.g. Chile) it interesting to investigate in future research whether the finding of a negative exporter price premium in the present paper is specific to Danish manufacturing. It is likely that country characteristics influence the exporter price premium as selection into exporting is less tough in more open economies (lower trade barriers). Furthermore, our model suggests that a country's industry composition plays a crucial role in determining the sign of the exporter price premium (as premia vary across sectors) and countries at different stages of development are likely specialized in different sets of industries. Hence, other high-income small-open-economies may share the property of a negative exporter price premium.

A negative exporter price premium driven by selection suggests that price/cost competitiveness is important for selection into exporting in Danish manufacturing. This may come as a surprise as Denmark is a high cost economy where firms are expected to compete in other parameters than price. However, the present analysis is insufficient to make the conclusion that Danish firms primarily compete in prices/costs for several reasons. First, there are both positive and negative premia at disaggregated levels. Second, varieties actually produced in Denmark may all be high-quality types in an international comparison. In particular, in the data we only observe the varieties that actually make it on the market. Third, there may be substantial variation across exported and non-exported varieties where high quality (and thus high cost) products could on average be the most profitable within each group. Finally, each variety has the same weight when computing exporter price premia and among exported varieties high price varieties may have larger market shares.

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A Data Appendix

A.1 Data Sources

All firm- and firm-product level data is obtained from Statistics Denmark, and can be linked via a unique firm identification number (and the product code, where applicable).

Commodity Statistics. In the commodity statistics, the reporting unit is the Kind of Activity Unit (KAU), which is the sum of a firm's workplaces engaged in the same economic activity (industry). The survey comprises all manufacturing KAUs with at least 10 employees. In the survey, firms are asked to report their sales volume of own produced goods in terms of quantities and values, and for each product they produce. Products are reported according to the eight-digit level of the CN code. Sales are reported independent of in which market the product is sold and therefore include both domestic and export sales. After dropping observations with missing quantity or value information, we aggregate the production data up to the firm-product level.

External Trade Statistics. In the external trade statistics, firms report the quantities and value of their exports by product and destination. Products are again reported according to the eight-digit level of the CN code, and can therefore be directly matched to the commodity statistics. The data is derived from two different sources: Intrastat and Extrastat. Intrastat covers trade with other EU countries and is based on data reported by Danish enterprises with total annual imports of goods and/or exports of goods over respectively, DKK 3.9 million and DKK 5.0 million in 2013. The reporting threshold is fixed each year to cover 95% of total imports and 97% of total exports. Extrastat covers trade with non-EU member countries and is based on data reports concerning customs and supplies collected from the Danish tax authorities. If the value of a transaction is not over DKK 7,500 and the weight is not over 1,000 kg, these goods can be recorded under a special commodity item (other goods).

A.2 Data Cleaning

We only keep manufactured goods in the sample and drop observations with missing revenue or quantity information. Quantities are recorded in different units (e.g. kg, pieces, liter, ...) depending on the product. In very few cases, quantity information for a given product code (and year) is given in different units of measurement (e.g. kg and pieces). In these cases, we only keep information for the main unit of measurement. In practice, however, this only removes few observations (around 0.1 percent of the sample).

In order to mitigate the influence of outliers and measurement error, we follow previous empirical work and trim the price information as follows: Since measurement error might be large at small volumes, we drop observations where the quantity sold is one (e.g. 1 kg or 1 piece) or the value of the transaction is $\leq$7500 DKK (approx. 1,000 EUR). To avoid the influence of outliers, for each product we trim both output prices and domestic prices by 1% on both tails of the distribution. In few cases, there are still some large outliers remaining, so we drop observations where the price is more than five standard deviations above or below the mean for the product.

Constructing domestic prices. We construct domestic prices in two alternative ways. First, we compute domestic quantities and values by subtracting exports from the production statistics. In the main text, results for this first measure of domestic prices are reported. Secondly, we further add imports (of the same eight-digit product) to the production statistics before subtracting exports. Recall that domestic quantities and values (and, therefore, domestic prices) might be miscalculated if firms are involved in carry-along trade. The second measure of domestic prices partly adjusts for carry-along trade in the form of firms importing and re-exporting the same product. Regression results for this second measure of domestic prices are remarkably similar to those reported in the text, and the negative exporter price premium here even increases in quantitative terms.

In a few cases, quantities are recorded in different units in the commodity and external trade statistics. In these cases, we cannot compute domestic sales and therefore record domestic prices as missing.

A.3 Exporter Premia in the Danish Data

In Table A.1, we confirm that our sample replicates many of the stylized facts on exporting firms mentioned in the introduction: first, controlling for industry affiliation, exporters are almost twice as large as non-exporters in terms of employment. Second, conditional on industry and firm size, exporters are also more productive, larger in terms of sales, pay higher wages, and are more capital intensive. Finally, differences in sales are also apparent at the firm-product level: exported varieties have almost double as high overall sales, and 75 percent higher domestic sales than non-exported varieties, even after controlling for product-year fixed effects. Thus, the sales differences highlighted in Table 1 persist.

Table A.1: Exporter Premia in our Sample

	Firm-level exporter premia					Firm-product-level exporter premia	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependent variable:	Log size	Log productivity	Log sales	Log wages	Log capital per worker	Log sales	Log domestic sales
Exporter (firm-level)	0.977***	0.049***	0.263***	0.031***	0.104**		
	(0.039)	(0.015)	(0.039)	(0.007)	(0.045)		
Exporter (variety-level)						0.954***	0.703***
						(0.049)	(0.063)
Observations	23,845	22,536	23,845	22,642	23,648	76,149	46,160
R-squared	0.157	0.143	0.735	0.276	0.205	0.617	0.659
Year fixed effects	Yes	Yes	Yes	Yes	Yes	No	No
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	No	No
Firm size control	No	Yes	Yes	Yes	Yes	Yes	Yes
Product-year fixed effects	No	No	No	No	No	Yes	Yes

Note: Columns (1) to (5) report regressions at the firm level. Firm size is measured in terms of employment. Productivity refers to labor productivity. Standard errors are clustered at the firm level. Columns (6) to (7) report regressions at the firm-product level and standard errors are clustered accordingly at the firm-product level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

B Online Appendix

This Online Appendix contains supplementary information for the paper "Exporter Price Premia?". Section B.1 reports robustness analysis for our finding of a negative exporter price premium. Section B.2 shows that the estimated exporter price premium in our Danish data is non-positive even in sectors with a high scope for quality differentiation. Section B.3 provides numerical analysis to further explore the relative role of quality and efficiency in determining the sign and size of the exporter price premium.

B.1 Robustness Analysis for the Exporter Price Premium

B.1.1 Standardizing Output Prices and Controlling for Firm Size

In this section, we relate our empirical analysis to the estimates in Hallak & Sivadasan (2013). In particular, we follow their strategy of standardizing output prices and/or controlling for firm size. Results are reported in columns (1) to (3) of Table B.1.

Hallak & Sivadasan (2013) note that product-year fixed effects only control for differences in the average level of prices across products, but these fixed effects do not account for differences in the variability of prices across products. Hallak & Sivadasan (2013) therefore suggest standardizing prices (i.e. subtracting the average and dividing by the standard deviation) for each product. Column (1) of Table B.1 shows that we still find a negative and significant exporter price premium when using standardized output prices as dependent variable. These estimates imply that exported varieties are on average sold at 7.8 percent lower prices than purely domestic varieties.

The theoretical model in Hallak & Sivadasan (2013) explains why exporters should charge higher prices than non-exporters *conditional* on firm size. In contrast, in our theoretical analysis, the exporter price premium conditional on firm size is not well defined, and we thus estimate unconditional premia throughout the paper.[1] Nevertheless, in columns (2) and (3) of Table B.1, we follow Hallak & Sivadasan (2013) in controlling for product-specific firm size effects by including interactions of product indicators with firm size, measured as log total sales. Indepen-

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[1] Hallak & Sivadasan (2013) assume that iceberg costs decrease in quality (Alchian and Allen effect). This assumption implies a relative advantage of high-quality firms on the export market, and it thus generates a positive exporter price premium conditional on sales/size. However, as we show in Table B.1, we find a non-positive exporter price premium even conditional on firm size. Our theoretical model therefore reverts to a simpler formulation of trade costs.

Table B.1: Exporter Price Premia: Robustness Analysis

Dependent variable:	Standardized output price	Output price	Standardized output price	Output price	Output price
	(1)	(2)	(3)	(4)	(5)
Exporter (variety)	-0.0780***	-0.0003	0.0141		-0.2213***
	(0.024)	(0.013)	(0.011)		(0.029)
Average GDP per capita				0.1808***	0.1937***
				(0.044)	(0.044)
Average GDP				-0.0293	-0.0243
				(0.020)	(0.020)
Average distance				0.1663***	0.2184***
				(0.022)	(0.023)
Observations	82,931	67,273	67,273	56,231	56,231
R-squared	0.287	0.915	0.305	0.926	0.927
Product-specific size effects[a]	No	Yes	Yes	No	No
Product-year fixed effects	Yes	Yes	Yes	Yes	Yes

Note: Standard errors are clustered at the firm-product level. The variable *Average GDP per capita* (*Average GDP*, *Average distance*) is calculated as the weighted average of GDP (GDP per capita, geographical distance) of the markets to which a variety is sold (including the domestic market). *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

[a] 'Product-specific size effects' are interactions of firm size (measured by total sales) with product indicators.

dent of whether we standardize output prices or not, we now find an insignificant exporter price premium.[2] Remarkably, though, we do not find a positive premium even in these conditional regressions. Moreover, in unreported regressions where size is defined at the firm-product level, we – once more – find a negative exporter price premium.[3]

B.1.2 Differences in Market Characteristics

In the main text, we argue that our finding of a negative exporter price premium in the pooled regressions of Section 2 is unlikely driven by pricing-to-market, as we find a negative price premium even when looking at domestic prices. In this section, we suggest a different strategy in order to account for pricing-to-market and, in particular, differences in destination characteristics across markets. We then show that such differences can not explain our negative estimate of the exporter price premium.

As a starting point, we briefly review the basic arguments for how pricing differs across markets. First, higher prices are expected in markets with a higher income per capita, as customers in these markets may be less price responsive (thus leading to higher mark-ups) and/or demand higher quality (at potentially higher prices); see *inter alia* Alessandria & Kaboski (2011) and Simonovska (2015). In the Danish case, these mechanisms could drive the negative exporter

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[2] Because of the large number of fixed effects, these regressions are estimated in Stata with the command `reghdfe`. The number of observations is lower in columns (2) and (3) compared to column (1) due to singleton observations, which are automatically excluded by `reghdfe`.

[3] Results are available on request from the authors. In Table B.1, we choose to report results from regressions which mirror the specification in Hallak & Sivadasan (2013) as closely as possible.

price premium, as foreign consumers often have a lower income than domestic consumers. Second, if larger markets are more competitive, mark-ups (and thus prices) should be lower in these markets. In the Danish case, exporters might lower their output prices when selling on larger, more competitive, foreign markets. Finally, according to the Alchian-Allen hypothesis (Alchian & Allen, 1964) prices are expected to be higher in more distant destinations. This last argument would suggest higher prices for exported varieties (and thus can not explain a negative exporter price premium).

We construct measures of average destination characteristics in a similar fashion to average prices, i.e. using quantity weights:[4]

$$\overline{Z}_{ijt} = \left(\sum_c Z_{ct} \frac{q_{ijct}}{\sum_c q_{ijct}} \right) \qquad \text{where} \qquad Z_{ct} = \{\text{distance, GDP, GDP per capita}\}.$$

Note that we sum over all markets, including the domestic market. Hence, for a non-exported variety, the average destination GDP is equal to Danish GDP. Exported and non-exported varieties do indeed differ significantly in the characteristics of the markets to which they are supplied: exported varieties tend to be sold to markets that, on average, have a lower income per capita, are more distant, and are larger than the domestic market.

Column (4) in Table B.1 shows how output prices depend on these measures of destination characteristics: prices are positively correlated with the average destination GDP per capita and distance, but unrelated to average destination GDP.[5] Notably, the lower average destination income per capita for exporters would suggest a negative exporter price premium, but the higher destination distance would push prices in the opposite direction. From column (4), it is hence not clear whether differences in destination characteristics can explain the negative exporter premium of Table 2 in the main text.

In order to address this question, we estimate the exporter premium while directly controlling for differences in the characteristics of markets served by exported and non-exported varieties. Importantly, the coefficient on the exporter indicator is still negative, highly statistically significant, and even larger in size than in previous regressions; see column (5) of Table B.1. In sum,

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[4] Data on GDP and GDP per capita comes from the World Development Indicators (WDI). Information on bilateral as well as internal distances is taken from the GeoDist database of the CEPII; see Mayer & Zignago (2011).

[5] These results are in line with findings in Bastos & Silva (2010), Martin (2012) and Harrigan et al. (2015), though our specification differs from theirs in that we are using output price information rather than export prices, which allows us to include non-exporting firms in the estimation.

results in columns (4) and (5) of Table B.1 suggest that the negative exporter price premium found in our pooled regressions in the main text is not driven by differences across exporters and non-exported in the characteristics of markets to which they are selling their products.

B.2 Exporter Price Premia and the Scope for Quality Differentiation

Previous modeling frameworks relate heterogeneity in exporter price premia across products to differences in the scope for (vertical) product differentiation. In particular, the model in Kugler & Verhoogen (2012) predicts that (*i*) exporter premia are increasing in the scope for quality differentiation; and that (*ii*) the premium should be positive if the scope for quality differentiation is sufficiently large. In this section, we show that our data only partly replicate their empirical results: while the exporter price premium indeed varies across products depending on measures of quality differentiation, the data predict negative or insignificant exporter price premia even where these measures are high.

We consider two different measures of the scope for quality differentiation. First, we employ data from an innovation survey available from Statistics Denmark to measure variation in R&D intensity across industries. The variable *R&D propensity* reflects the share of firms within an industry which performed R&D (averaged across years).[6] We expect more firms to perform R&D in sectors where the scope for quality differentiation is higher. Secondly, Khandelwal (2010) provides estimates of 'quality ladders', measuring the extent of quality differentiation across products within an industry.[7] Products with a larger value of the variable *Quality ladder* have a higher scope for quality differentiation.

As noted by Kugler & Verhoogen (2012), industries with a high extent of vertical differentiation may also be characterized by a high extent of horizontal differentiation. In order to control for the latter, we construct an indicator variable *Horizontal diff.* equal to one for differentiated

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[6] We obtain information on firm-level R&D from an innovation survey, which is available for the years 2000 to 2013. This survey contains information on approximately 3,500–4,800 firms in each year. Due to an insufficient match with the production data, we do not use the information at the firm level directly. Rather, we calculate a measure of the propensity to do R&D for each industry as the percentage of firms which report positive R&D expenditure. From the register database, each firm can be linked to an industry of the 127 Grouping of the Danish Industry Classification.

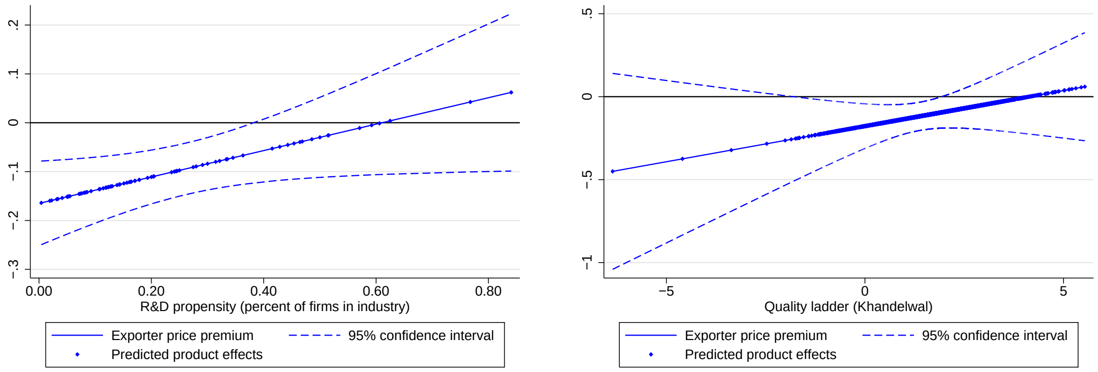
[7] The data in Khandelwal (2010) is coded according to the ten-digit HS classification. The first six digits of this classification are internationally harmonized, and thus correspond to the six-digit CN code. Averaging quality ladders across ten-digit HS codes that pertain to the same six-digit CN code therefore allows us to match these data to our sample of Danish varieties.

Table B.2: Exporter Price Premia and the Scope for Quality Differentiation

Dependent variable:	Output price (1)	Output price (2)	Output price (3)	Output price (4)
Exporter	-0.1650***	-0.1715***	-0.1775***	-0.3874**
	(0.044)	(0.055)	(0.069)	(0.171)
Exporter × *R&D propensity*	0.2703**	0.2453*		
	(0.134)	(0.138)		
Exporter × *Quality ladder*			0.0429	0.0542
			(0.039)	(0.040)
Exporter × *Horizontal diff.*		0.0077		0.2017
		(0.052)		(0.151)
Observations	82,931	79,906	49,928	48,774
R-squared	0.918	0.917	0.900	0.899
Product-year fixed effects	Yes	Yes	Yes	Yes
Predicted pos. EPP[a]	0.000	0.000	0.000	0.000
Predicted neg. EPP[b]	0.664	0.661	0.617	0.513

Note: Standard errors are clustered at the firm-product level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$
[a] Gives the share of the sample with a predicted positive and significant exporter price premium.
[b] Gives the share of the sample with a predicted negative and significant exporter price premium.

Figure B.1: Exporter Price Premia and the Scope for Quality Differentiation



products according to the classification of Rauch (1999).[8]

We run regressions where our export indicator is interacted with these different measures of vertical (and horizontal) product differentiation. Results are given in Table B.2, where columns (1) and (3) include interactions of export status with vertical product differentiation measures, and columns (2) and (4) additionally control for differences across products in horizontal differentiation. In line with expectations, exporter price premia are larger in industries with a higher R&D propensity; see column (1). However, we do not find any significant differences across products according to the quality ladders of Khandelwal (2010); see column (3). Moreover, these results are not driven by differences across products in the extent of horizontal differentiation; see columns (2) and (4).

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[8] Rauch (1999) provides a classification of products into homogeneous, referenced-priced, and differentiated products at the four-digit level of the SITC product code. We employ Rauch's 'conservative' classification and use a correspondence table to match SITC products to the six-digit CN code.

Based on regression results in columns (1) and (3) of Table B.2, Figure B.1 visualizes the exporter price premium as a function of the product differentiation variables. It shows that the predicted exporter price premium is positive but statistically insignificant for high values of the R&D propensity, but it turns negative and statistically significant for low values. A similar pattern holds for the other measure of product differentiation, which shows negative premia for short quality ladders and zero premia for longer quality ladders. Thus, none of these estimates predict positive and significant exporter price premia even at higher levels of quality differentiation. In fact, the predicted price premium is negative and significant for around 51 to 66 percent of observations but positive and significant for 0 percent of observations.

B.3 Numerical Analysis

We conduct numerical analysis to back up the intuition from Figure 3 in the main text. The strategy is to explore numerically how the exporter price premium varies with the underlying distribution of quality and efficiency. We change the distribution such that the distribution of the heterogeneity aggregate and therefore the thresholds of the heterogeneity aggregate remain unchanged. In particular, we consider variation in *(i)* the relative importance of efficiency as a source of heterogeneity and *(ii)* the correlation between the two sources of heterogeneity.

B.3.1 Non-Correlated Sources of Heterogeneity: Relative Importance of Efficiency and Quality

Here we explore the impact of the relative importance of the two sources of heterogeneity under the assumption that the two sources are drawn independently of each other.

Let Z and Y be two independent log-normals with mean $\hat{\mu}$ and variance $\hat{V}$ (we suppress the j subscript in the following) such that $\log Z$ and $\log Y$ are both normal with mean 0 and variance 1. We construct the heterogeneity in the following way

$$\gamma = e^{b_\gamma} Z^{g_\gamma} \Rightarrow \log\gamma = b_\gamma + g_\gamma \log Z$$

$$\varphi = e^{b_\varphi} Y^{g_\varphi} \Rightarrow \log\varphi = b_\varphi + g_\varphi \log Y,$$

implying γ and φ are independent and that the log of the heterogeneity aggregate

$$\begin{aligned} \log a &= (\sigma-1)\left[(\theta-\kappa)\log\gamma + \log\varphi\right] \\ &= (\sigma-1)\left[(\theta-\kappa)b_\gamma + b_\varphi + (\theta-\kappa)g_\gamma \log Z + g_\varphi \log Y\right] \end{aligned}$$

is normal with mean and variance given by

$$\begin{aligned} E\log a &= (\sigma-1)\left[(\theta-\kappa)b_{\gamma}+b_{\varphi}\right] \\ Var\log a &= \left[(\theta-\kappa)^{2}g_{\gamma}^{2}+g_{\varphi}^{2}\right](\sigma-1)^{2}. \end{aligned}$$

In the following we consider different values of g_{γ} and g_{φ} keeping the mean and variance of the log of the heterogeneity aggregate unchanged. As g_{γ} (the variance of log quality) and g_{φ} (the variance of log efficiency) change, so does the relative variance of quality and efficiency and thus their relative importance in determining sales and export status. Because the heterogeneity aggregate is log-normal and because we consider values of g_{γ} and g_{φ} that keep the mean and variance fixed, the entire distribution remains fixed (a normal distribution is fully characterized by its mean and variance). The exit and export threshold depend on cost parameters, the elasticity of substitution within the sector, and the distribution of the composite only. Thus, the distribution of the heterogeneity aggregate conditional on being an exported (pure domestic) variety remains unchanged as we change g_{γ} and g_{φ}. To keep the distribution of the heterogeneity aggregate unchanged we must have that g_{γ}, b_{φ} and g_{φ} satisfy [9]

$$c_1=(\theta-\kappa)^{2}g_{\gamma}^{2}+g_{\varphi}^{2}$$

for some constant c_1.

Turning to prices we have that

$$\log p=\log\frac{\sigma}{\sigma-1}W+\kappa\log\gamma-\log\varphi$$

is normally distributed with variance and mean given by

$$\begin{aligned} Var\log p &= \kappa^{2}g_{\gamma}^{2}+g_{\varphi}^{2} \\ E\log p &= \log\frac{\sigma}{\sigma-1}W+\kappa b_{\gamma}-b_{\varphi}. \end{aligned}$$

Imposing the constraint on g_{γ} and g_{φ} we get that

$$Var\log p = (2\kappa-\theta)\,\theta g_{\gamma}^{2}+c_1.$$

We now further assume that $2\kappa-\theta=0$, which ensures that the variance of log price remain constant as we vary g_{γ} and g_{φ} subject to the constraint above. The mean of log price does not

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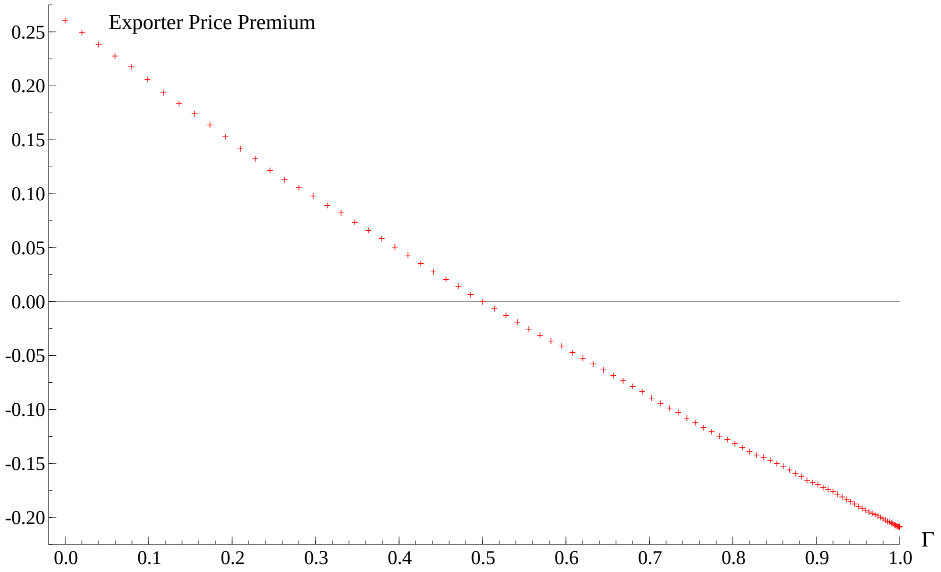
[9] Hence we consider different values of g_{γ} and then let $g_{\varphi}=\sqrt{c_1-(\theta-\kappa)^{2}g_{\gamma}^{2}}$.

Figure B.2: Exporter Price Premium as a Function of Γ



depend on g_γ and g_φ. Hence, we have that the price distribution remains constant. In sum, when changing g_γ and g_φ under these assumptions the relative importance of quality and efficiency in the shaping the sales and price distributions and in determining selection into exporting changes but sales and price distributions remain unchanged. The condition $2\kappa - \theta = 0$ also implies that we are in Case A, where profits increase in quality.

The relative importance of efficiency in shaping the sales distribution is given by

$$\begin{aligned}\Gamma &\equiv \frac{Var \log (\varphi)^{(\sigma-1)}}{Var \log a} \\ &= \frac{g_\varphi^2}{(\theta-\kappa)^2 g_\gamma^2 + g_\varphi^2} = 1 - \frac{(\theta-\kappa)^2 g_\gamma^2}{c_1}.\end{aligned}$$

In the numerical analysis, we consider the range $g_\gamma \in \left[0, \frac{\sqrt{c_1}}{\theta - k}\right]$ such that the relative importance of efficiency Γ runs from 0 to 1. In the simulation, we set $c_1 = 0.025$,$\kappa = 2$, $\theta = 4$, $F = 1$, $F_E = 1$, $F_X = 1.25$, $\tau = 1.25$, $\sigma = 4$, $b_\varphi = log(0.7)$, and $b_\gamma = 0$.

It can be seen from Figure B.2 that the exporter price premium declines in the relative importance of efficiency in shaping the sales distribution, Γ. At the left end – i.e. the case where quality heterogeneity alone determines the sales dispersion – the exporter price premium is positive. The reason is that profits increase in quality (i.e. we are in Case A), and thus high-quality, high-price varieties are the ones exported. At the right end – the case where efficiency heterogeneity alone determines the sales dispersion – the exporter price premium is negative.

In fact, the standard model with efficiency heterogeneity only would predict an unambiguously negative exporter price premium.

In sum, the more important efficiency is in determining the sales dispersion (and thus, the less important is quality), the more likely the exporter price premium is negative.

B.3.2 Correlated Sources of Heterogeneity

We now explore the role of the correlation between the two sources of heterogeneity in the limiting case where quality does not affect costs, i.e. $\kappa = 0$. This parameter constraint implies that quality affects demand and thereby the export decision, but it does not affect prices.

Let Z and Y be two independent log-normals with mean $\hat{\mu}$ and variance $\hat{V}$ (we suppress the j subscript in the following) such that $\log Z$ and $\log Y$ are both normal with mean 0 and variance 1. We construct the heterogeneity in the following way:

$$\begin{aligned}\gamma &= e^{b_\gamma} Z^{g_\gamma} \Rightarrow \log\gamma = b_\gamma + g_\gamma \log Z \\ \varphi &= e^{b_\varphi} Y^{g_{\varphi,Y}} Z^{g_{\varphi,Z}} \Rightarrow \log\varphi = b_\varphi + g_{\varphi,Y}\log Y + g_{\varphi,Z}\log Z,\end{aligned}$$

implying a correlation between log quality and log efficiency given by

$$\begin{aligned}\rho &= Corr\left(\log\gamma,\log\varphi\right) = \frac{Cov\left(\log\gamma,\log\varphi\right)}{\sqrt{Var\log\gamma Var\log\varphi}} = \frac{Cov\left(g_\gamma\log Z, g_{\varphi,Z}\log Z\right)}{\sqrt{Var\log\gamma Var\log\varphi}} \\ &= \frac{g_\gamma g_{\varphi,Z}}{\sqrt{g_\gamma^2\left(g_{\varphi,Y}^2+g_{\varphi,Z}^2\right)}}.\end{aligned}$$

It follows by setting $\kappa = 0$ that

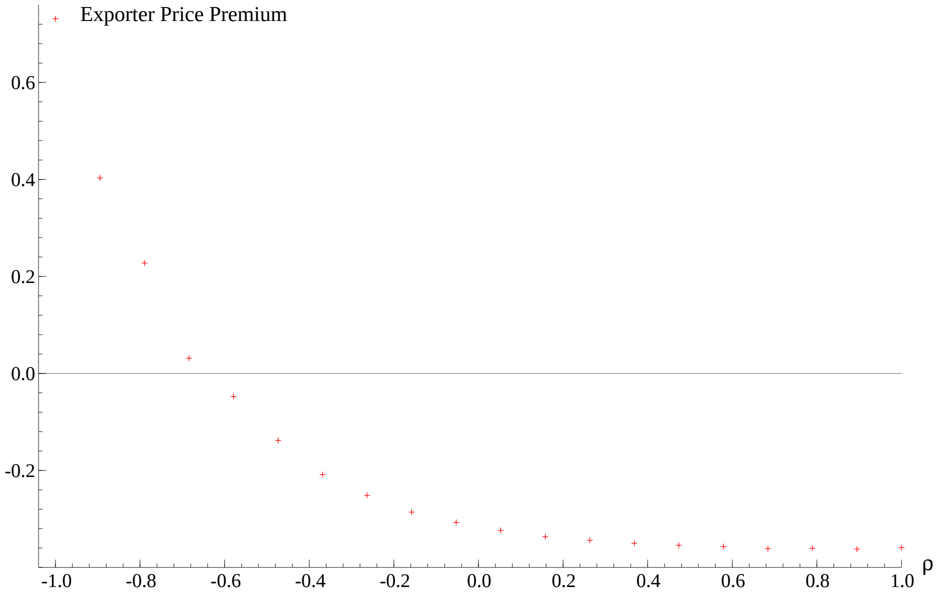
$$\begin{aligned}\log a &= (\sigma-1)\left[\theta\log\gamma+\log\varphi\right] = (\sigma-1)\left[\theta b_\gamma+\theta g_\gamma\log Z+b_\varphi+g_{\varphi,Y}\log Y+g_{\varphi,Z}\log Z\right] \\ \log p &= \log\frac{\sigma}{\sigma-1}W-\log\varphi = \log\frac{\sigma}{\sigma-1}W-b_\varphi-g_{\varphi,Y}\log Y-g_{\varphi,Z}\log Z,\end{aligned}$$

implying that

$$\begin{aligned}E\log a &= (\sigma-1)\left[\theta b_\gamma+b_\varphi\right] \\ Var\log a &= (\sigma-1)^2\left[(\theta g_\gamma)^2+2\theta g_\gamma g_{\varphi,Z}+g_{\varphi,Y}^2+g_{\varphi,Z}^2\right] \\ E\log p &= \log\frac{\sigma}{\sigma-1}W-b_\varphi \\ Var\log p &= g_{\varphi,Y}^2+g_{\varphi,Z}^2,\end{aligned}$$

and to keep these moments fixed we must let $g_{\varphi,Y}^2+g_{\varphi,Z}^2 = c_2$ and $(\theta g_\gamma)^2+2\theta g_\gamma g_{\varphi,Z}+g_{\varphi,Y}^2+g_{\varphi,Z}^2 = (\theta g_\gamma)^2+2\theta g_\gamma g_{\varphi,Z}+c_2 = c_3$ where c_2 and c_3 are positive constants. Hence, we can now change

Figure B.3: Exporter Price Premium (and Exporter Quality Premium as a Function of ρ



$g_{\varphi,Z}$ exogenously to vary ρ where $g_{\varphi,Y}$ adjusts to ensure $g_{\varphi,Y}^2 + g_{\varphi,Z}^2 = c_2$ and g_γ adjusts to keep $(\theta g_\gamma)^2 + 2\theta g_\gamma g_{\varphi,Z} + c_2 = c_3$. In the numerical simulation we let $g_{\varphi,Z}$ run from -1 to 1 and set $c_2 = 1$,$c_3 = 1.5$,$\kappa = 0$, $\theta = 4$, $F = 1$, $F_E = 1$, $F_X = 1.25$, $\tau = 1.25$, $\sigma = 4$, $b_\varphi = log(0.7)$, and $b_\gamma = log(0.7)$.

It can be seen from Figure B.3 that the exporter price premium decreases in the degree of correlation between (logs of) quality and efficiency, ρ. The parameter condition $\theta > \kappa = 0$ implies that we are in Case A where higher quality increases profits. Hence, a positive correlation implies that higher quality (which makes exporting more likely but has no impact on price) comes with higher efficiency, and thus lower prices. Even though quality is assumed to not affect prices, there might still be a positive exporter price premium if the correlation between quality and efficiency is sufficiently small.[10] In that case, high quality (making exporting more likely) comes with low efficiency (implying higher prices, and thus a positive exporter price premium, but also making exporting less likely). If quality is sufficiently important the effect of higher quality/demand dominates the effect from lower efficiency in the export decision and exported varieties will be those of high quality and low efficiency.

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[10] Intuitively, one may think of the case where the correlation between quality and efficiency is small as a situation where quality comes at higher marginal cost.

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