EXPORT PRICES ACROSS FIRMS AND DESTINATIONS*

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This article establishes six stylized facts about firms' export prices using detailed customs data on the universe of Chinese trade flows. First, across firms selling a given product, exporters that charge higher prices earn greater revenues in each destination, have bigger worldwide sales, and enter more markets. Second, firms that export more, enter more markets, and charge higher export prices import more expensive inputs. Third, across destinations within a firm-product, firms set higher prices in richer, larger, bilaterally more distant and overall less remote countries. Fourth, across destinations within a firm-product, firms earn bigger revenues in markets where they set higher prices. Fifth, across firms within a product, exporters with more destinations offer a wider range of export prices. Finally, firms that export more, enter more markets, and offer a wider range of export prices pay a wider range of input prices and source inputs from more origin countries. We propose that trade models should incorporate two features to rationalize these patterns in the data: more successful exporters use higher quality inputs to produce higher quality goods (stylized facts 1 and 2), and firms vary the quality of their products across destinations by using inputs of different quality levels (stylized facts 3, 4, 5, and 6). *JEL* Codes: F10, F12, F14, L10.

I. INTRODUCTION

The literature has documented a number of robust facts about the substantial and systematic variation in export performance across firms. More productive firms are more likely to export, have higher export revenues, and enter more markets.[1] Among exporters, larger firms pay higher wages and are more skill- and capital-intensive. Moreover, exporters charge higher prices than nonexporters, and plant size is positively correlated with output and input prices.[2] These patterns are congruent with heterogeneous-firm models that emphasize firms' production

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1. See Clerides, Lach, and Tybout (1998); Aw, Chung, and Roberts (2000); Eaton, Kortum, and Kramarz (2004, 2008); Bernard et al. (2007); and Bernard, Jensen, and Schott (2009) for a survey of the literature.

2. See Bernard and Jensen (1995), Iacovone and Javorcik (2010), Hallak and Sivadasan (2008), Kugler and Verhoogen (2011), and Verhoogen (2008).

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efficiency and product quality as the determinants of export success. In these models, more productive firms enjoy superior export performance because they choose to use more expensive, higher quality inputs to sell higher quality goods at higher prices.[3]

This article establishes six stylized facts about the variation in export prices and imported-input prices across firms, products, and trade partners using detailed customs data on the universe of Chinese trade flows. These stylized facts have two main implications. First, more successful exporters use higher-quality inputs to produce higher-quality goods. Second, firms vary the quality of their products across destinations with different income, market size, bilateral distance, and overall remoteness[4] by using inputs of different quality levels. While the first conclusion confirms recent evidence in the literature, the second is novel. Together, they suggest that international trade models should incorporatequality differentiation not only across firms but also across trade partners within firms in order to account for the patterns in the data. Our findings thus uncover a previously unexplored dimension of firm heterogeneity and adjustments on the quality margin within firms across destinations.

The first two stylized facts we document constitute evidence consistent with quality differentiation across exporters. First, within narrowly defined product categories, firms that charge higher free-on-board (f.o.b.) export prices earn greater revenues in each destination, have bigger worldwide sales, and export to more markets. These patterns are more pronounced in richer destinations and in sectors with greater scope for quality differentiation, as proxied by the Rauch (1999) classification of nonhomogeneous goods, R&D, or advertising intensity. Second, firms that export more, that service more destinations, and that charge higher export prices import more expensive inputs. In the absence of detailed information on domestic input usage or direct measures of product quality, the prices of producers' imported intermediates

3. See Bernard et al. (2003), Melitz (2003), Johnson (2007), Sutton (2007), Hallak and Sivadasan (2008), Kneller and Yu (2008), Kugler and Verhoogen (2011), Melitz and Ottaviano (2008), Verhoogen (2008), Gervais (2009), and Baldwin and Harrigan (2011).

4. Whereas bilateral distance pertains to two countries' geographic proximity, remoteness is a weighted average of a country's bilateral distance to all other countries in the world, using countries' GDP as weights. A country is remote in economic terms if it is physically isolated from most other nations or is close to small countries but far away from big economies. See note 17.

offer an imperfect signal for the quality of all of their inputs.[5] We thus interpret our results as evidence that more successful exporters purchase inputs of higher quality to produce more expensive and more sophisticated products. This interpretation is consistent with productivity being an important factor in firms' export decisions, since it may well determine their optimal choice over input and output quality.

Our findings corroborate the conclusion in the recent literature that quality differentiation across firms matters for export performance. This literature has typically examined country-level export prices or firm-level data on export status, plant size, and input prices instead of detailed information on firms' foreign sales. Our article is thus the first to document these two facts using comprehensive data on firms' matched exports and imports by product and trade partner. Moreover, we are able to identify the inputs that exporters source from abroad specifically for further processing, assembly, and re-exporting. This level of detail is rare in trade data sets, and it also allows us to examine the variation in export activity across destinations within firms.[6]

The remaining stylized facts we establish together suggest that exporters adjust the quality of their products across destinations by varying the quality of their inputs. Our third finding is that firms charge higher f.o.b. prices for a given product in richer, larger, bilaterally more distant and overall less remote economies. The effects of size, distance, and remoteness are concentrated in rich destinations and among firms that vary prices more across countries. Fourth, firms earn more revenues from a specific good in markets where they set higher prices. This pattern is more prominent in richer countries and for goods with bigger potential for quality upgrading. Fifth, within each product, firms with more destinations offer a wider range of export prices, especially for products with greater scope for quality differentiation. Last, firms that export more, that enter more markets, and that offer a wider range of export prices pay a wider range of input prices and source inputs from more origin countries.

5. This is consistent with Kugler and Verhoogen (2009), who find a positive correlation between the prices Colombian plants pay for imported and domestic inputs.

6. As far as we know, comparable data are available only for the United States, France, and Denmark. Publications using these data have examined other questions and rarely exploited the matched data on firms' export and import activity.

Stylized facts three and four are identified purely from the variation across destinations within firm-product pairs. If firms export an identical good to each country, the firm-product fixed effects we include would capture its cost and quality characteristics. Any residual variation in prices across markets would then be due to variable mark-ups. However, current heterogeneous-firm models predict either a constant mark-up above marginal cost (CES demand) or a lower mark-up in big, distant, and less remote countries where competition is tougher (linear demand). Thus, if firms sold an identical product to all trade partners, export prices would counterfactually be either *un*correlated or *negatively* correlated with market size, income, distance, and centrality.

Instead, we propose that firms not only tailor their mark-up to each market but also customize their products' quality. This explanation can also rationalize the last two stylized facts. Although variable mark-ups can generate the positive correlation between a firm's number of destinations and price dispersion across markets, they cannot explain our results for firms' import price dispersion and number of source countries. On the other hand, our findings are consistent with exporters buying multiple quality versions of an input to produce multiple quality versions of an output for sale in different markets.

While the stylized facts we uncover suggest that firms adjust product quality to destination characteristics, we cannot decisively determine what drives firms' quality choice. The finding that firms charge higher prices in richer destinations is strongly indicative of nonhomothetic preferences. With such preferences, firms have a bigger incentive to improve product quality when they face wealthier consumers with lower marginal utility of income and greater willingness to pay for quality.[7] The results for market size, proximity, and remoteness, on the other hand, lend themselves to a number of interpretations. We discuss some of these alternatives but leave it to future work to conclusively establish the underlying mechanism.

In the linear-demand models we consider, destinations' size, bilateral distance, and centrality are positively correlated with market toughness. It is thus possible that firms respond to market competition by both reducing mark-ups and increasing product

7. See Verhoogen (2008); Fajgelbaum, Grossman, and Helpman (2009); and Simonovska (2010).

quality. If quality upgrading requires more expensive, higher-quality inputs, it could raise marginal costs sufficiently quickly to dominate the mark-up correction. This would generate high export prices in big, distant, and less remote countries as we observe. Our results would then capture the net effect of both the quality and mark-up adjustments and provide a lower bound for the response of product quality.

Alternatively, firms might export products of higher quality to more distant trade partners if they incur per unit transportation costs. Specifically, exporters might sell multiple quality versions of a product to each country but vary the quality mix with destinations' proximity. Firms would then optimally shift exports to more distant markets toward better-quality goods because higher unit costs lower the relative price of and increase relative demand for such products.

As for market size, firms might offer products of higher quality to larger destinations if there are economies of scale in the production or delivery of quality goods. On the production side, upgrading quality might entail fixed investments in specialized equipment or hiring skilled workers. On the delivery side, the fixed costs of marketing and distribution might be increasing in product sophistication. As long as firms expect to earn higher revenues in larger markets and the destination-specific fixed costs of exporting rise with product quality, firms will have an incentive to improve the quality of goods shipped to bigger countries.

Identifying the determinants of firms' export success is instrumental in understanding the patterns of international trade across countries, the welfare and distributional consequences of globalization, and the design of export-promoting policies in developing economies.

Firm heterogeneity has significant implications for countries' trade and growth. Reallocations across sectors and across firms within a sector are both important in the adjustment to trade liberalization and its impact on aggregate productivity (Pavcnik 2002; Bernard, Jensen and Schott 2006; Chaney 2008). While Arkolakis, Costinot, and Rodríguez-Clare (2010) find that under certain conditions, the effects on aggregate welfare are unaltered by firm heterogeneity, Burstein and Melitz (2011) suggest that heterogeneity matters under endogenous firm productivity growth. Our results raise the possibility that in addition to adjusting trade volumes, product scope, and export destinations, firms might also vary product quality within and across markets in response to trade reforms. This could potentially generate different welfare gains than a world in which firms exported the same product quality to all markets. This is a fruitful area for future research because the models we consider, as well as Arkolakis, Costinot, and Rodríguez-Clare (2010), assume that firm efficiency and product quality are fixed over time.

Even if the effects of globalization on aggregate welfare do not depend on the nature of firm heterogeneity, its distributional consequences do. For example, U.S. output and employment appear less vulnerable to import competition from low-wage countries in sectors characterized by longer quality ladders (Khandelwal 2010).[8] Evidence also suggests that bigger, more productive firms benefit more from trade reforms (Pavcnik 2002; Bustos 2011). A natural extension of our work would be to test whether firms producing higher-quality goods are more resilient to import competition and more likely to expand if given export opportunities. A related question for future research is whether input quality and labor skill are complementary in the production of high-quality goods, and if so, whether trade liberalization affects employment and wages differentially across the skill distribution.

Finally, a deeper understanding of the factors that drive firms' export success will facilitate the design of policies that promote trade and ultimately growth in developing countries. The cross-sectional patterns we document say little about firms' capacity to upgrade product quality. Nevertheless, they indirectly imply that improving quality can boost firms' export potential. It might therefore be beneficial for governments to encourage investment in R&D and technologies that allow firms to produce and export more sophisticated goods. In addition, firms in developing countries might find it difficult to source high-quality inputs domestically and instead rely on imported inputs from more advanced economies.[9] This would explain why more successful Chinese exporters are able to offer higher-quality goods despite the widespread belief that product quality and quality control are weak in China. This argument provides one reason why developing countries might want to liberalize imports if they seek to improve their export performance.

The remainder of the article is organized as follows. The next section describes how our work relates to the previous literature.

8. See also Fernandes and Paunov (2009) for related evidence from Chile.

9. Kugler and Verhoogen (2009) find that Colombian firms' imported inputs are of higher quality than local inputs.

Section III introduces the data, while Section IV documents the six stylized facts and Section V discusses their robustness. Section VI summarizes the implications of different heterogeneous-firm models for the behavior of export prices, which we use to interpret the empirical results in Section VII. The last section concludes.

II. Related Literature

Our work builds on recent publications that study aggregate export prices to determine the relative importance of production efficiency and product quality for firms' export success. Baldwin and Harrigan (2011) and Johnson (2007), for instance, explore the variation in product-level export prices with destination size, income, distance, and remoteness and find evidence in support of quality sorting. Because different models can deliver similar predictions for the behavior of aggregate prices, however, the latter can be inconclusive in principle. It can, in fact, be misleading if unit values at the product level exhibit patterns consistent with a given model, but the underlying firm prices do not. The detailed nature of our data set allows us to address this challenge and directly analyze firms' export prices, while also providing evidence on firms' imported inputs.

Our results also contribute to recent firm-level evidence indicative of quality differentiation across firms. Verhoogen (2008), Kugler and Verhoogen (2011), Hallak and Sivadasan (2008), and Iacovone and Javorcik (2008) document that exporters charge higher prices than nonexporters, plant size is positively correlated with output and input prices, and more productive firms pay higher wages to produce better-quality goods. In concurrent work, Crozet, Head, and Mayer (2009) show that highly ranked French wine producers export more to more markets at a higher average price. Also in concurrent work, Bastos and Silva (2010) find that firms set higher prices in bigger, richer, and more distant countries in a sample of Portuguese exporters.[10] They do not, however, offer an explanation for these findings, explore the relationship between firms' export prices and revenues, or study firm inputs to make inferences about product quality. Finally, Brambilla, Lederman, and Porto (2009) show that Argentine firms that export to richer countries pay higher wages and suggest that these firms sell products of higher quality.

10. See Görg, Halpern, and Muraközy (2010) for related evidence for Hungary.

This article is the first to examine matched data on firm-level export and import prices by product and destination/source country and to do so for the universe of trade flows. We uncover new stylized facts and offer a novel explanation based on firms varying product quality across countries in response to market characteristics. Our results suggest that international trade models should incorporate quality differentiation both across firms and across destinations within firms to explain the stylized facts in the data. Verhoogen (2008) constitutes an important step in this direction by modeling firms that produce two quality levels in the presence of nonhomothetic preferences: one for home, and a higher one for a richer export market. Incorporating unit transportation costs in this framework could also rationalize our results for bilateral distance. Future theoretical work should seek to provide a unified explanation for the patterns we document for market size, income, bilateral distance, and remoteness.

Our findings are also related to the work of Schott (2004), Hummels and Klenow (2005), Hallak (2006), and Mandel (2008). They show that aggregate export prices systematically increase with both trade partners' GDP per capita and with the capital and skill intensity of the exporting country. They propose that cross-country quality differences in production capabilities and consumption preferences can generate these outcomes.[11]

Finally, our results indirectly speak to the large literature on exchange-rate pass-through. This literature has found evidence of pricing to market, that is, that firms vary mark-ups across markets segmented by variable exchange rates.[12] Combined with the stylized facts we establish, this suggests that models with constant mark-ups or product quality across destinations are unlikely to explain either the trade or exchange-rate pass-through patterns in the data.

III. Data

We use recently released proprietary data on the universe of Chinese firms that participated in international trade over the

11. See also Hallak and Schott (2011) who decompose countries' export prices into quality and quality-adjusted prices.

12. See Gopinath, Itskhoki, and Rigobon (2010); Burstein and Jaimovich (2009); and Fitzgerald and Haller (2010).

2003–2005 period.[13] These data have been collected and made available by the Chinese Customs Office. They report the f.o.b. value of firm exports and imports in U.S. dollars by product and trade partner for 243 destination/source countries and 7,526 different products in the eight-digit Harmonized System.[14] The data set also provides information about the quantities traded in 1 of 12 different units of measurement (such as kilograms, square meters, etc.), which makes it possible to construct unit values. We have confirmed that each product is recorded in a single unit of measurement, and we include product fixed effects in all regressions to account for the different units used across goods.

In principle, unit values should precisely reflect producer prices. Since trade data sets at both the aggregate and firm level rarely contain direct information on producer prices, the prior literature has typically relied on unit values, as we do. The level of detail in our data is an important advantage in the construction of unit prices because they are not polluted by aggregation across firms or across markets within firms. Nevertheless, we perform a number of specification checks in Section V.A to ensure that measurement error in unit values does not drive our results.

Although the Chinese customs data are available at a monthly frequency, we focus on annual exports in the most recent year in the panel, 2005. This decision is motivated by a number of considerations. First, we aim to establish stylized facts that obtain in the cross-section of firms and are not interested in export dynamics. Second, there is a lot of seasonality and lumpiness in the monthly data, and most firms do not export a given product to a given market in every month. By focusing on the annual data, we can abstract from these issues and related concerns with sticky prices. Third, when we explore how firms' export prices vary with characteristics of the destination market, we use annual data on GDP, GDP per capita, distance, and remoteness. If the outcome variable were at the monthly frequency, the standard errors could be misleadingly low because we would effectively multiply the number of observations without necessarily introducing new information. Finally, outliers are likely to be of greater concern in

13. Manova and Zhang (2008) describe the data and stylized facts about firm heterogeneity in Chinese trade.

14. Product classification is consistent across countries at the six-digit HS level. The number of distinct product codes in the Chinese eight-digit HS classification is comparable to that in the 10-digit HS trade data for the United States.

the monthly data. Section V.A confirms that all results hold at the monthly frequency and in fact become more significant.

Some state-owned enterprises in China are pure export-import companies that do not engage in manufacturing but serve exclusively as intermediaries between domestic producers (buyers) and foreign buyers (suppliers). Following standard practice in the literature, we identify such wholesalers using key words in firms' names and exclude them from our main results.[15] We do so to focus on the operations of firms that both make and trade goods because we are interested in how firms' production efficiency and product quality affect their export activities. Showing direct evidence on firms' imported-input prices is thus an important component of our analysis as they proxy for input quality. We cannot apply this approach to intermediaries because we do not observe their suppliers and cannot interpret their import transactions as input purchases. However, since wholesalers and producers compete in the same markets, their export prices should exhibit similar patterns. We confirm that this is indeed the case in Section V.B.

Because we examine data for one year denominated in U.S. dollars, and given that roughly 85–90% of Chinese trade is invoiced in U.S. dollars (with the remainder split between euro and yen), our analysis has little to say about the effects of currency movements on firms' optimal pricing behavior. In unreported regressions, we have nevertheless confirmed that all of our results are robust to explicitly controlling for countries' bilateral exchange rate with the renminbi or for firms' exchange rate exposure on the import or export side. We proxy the latter with firms' average exchange rate across source (destination) countries, using import (export) values as weights.

Table I illustrates the substantial variation in prices across the 96,522 Chinese exporters, 6,908 products, and 231 importing countries in our data. After removing product fixed effects, the average log price is 0.00, with a standard deviation of 1.24. Prices vary considerably across Chinese producers selling in a given country and good: the standard deviation of firm prices in the average destination-product market is 0.90. This highlights the extent of firm heterogeneity in the sample. There is also a lot of variation in unit values across trade partners within a given

15. We drop 23,073 wholesalers who mediate a quarter of China's trade. Using the same data, Ahn, Khandelwal, and Wei (2011) identify intermediaries in the same way to study wholesale activity.

TABLE I
THE VARIATION IN EXPORT PRICES ACROSS FIRMS, PRODUCTS, AND DESTINATIONS

	# Obs.	Average	St. Dev.	Min	5th Percentile	95th Percentile	Max
Variation in (log) prices across firms and destinations within HS-8 products							
1. firm-product-destination prices (product F.E.)	2,179,923	0.00	1.24	−12.12	−1.93	2.02	13.65
2. St. dev. of prices across firms and destinations within products (product F.E.)	6,591	1.11	0.65	0.00	0.26	2.33	5.92
Variation in (log) prices across destinations within firm-HS-8 product pairs							
3. St. dev. of prices across destinations within firm-product pairs (firm-product pair F.E.)	303,935	0.46	0.49	0.00	0.01	1.39	9.14
Variation in (log) prices across firms within destination-HS-8 product pairs							
4. St. dev. of prices across firms within destination-product pairs (destination-product pair F.E.)	159,778	0.90	0.74	0.00	0.08	2.30	8.36

Notes. This table summarizes the variation in free-on-board export prices across 96,522 Chinese firms, 6,908 products, and 231 importing countries in 2005. Row 1: summary statistics for firm-product-destination log prices, after taking out HS-8 product fixed effects. Row 2: for each HS-8 product, we take the standard deviation of log prices across firms and destinations. Row 2 shows how this standard deviation varies across the 6,591 HS-8 products traded by at least two firm-destination pairs. Row 3: for each firm that exports a given product to multiple countries, we record the standard deviation of log prices across destinations, by product. Row 3 shows how this standard deviation varies across firm-product pairs. Row 4: for each destination-product market with multiple Chinese exporters, we record the standard deviation of log prices across firms. Row 4 shows how this standard deviation varies across destination-product pairs.

exporter. The standard deviation of log prices across destinations for the average firm-product pair is 0.46. This suggests that models in which firms adjust mark-ups, product quality, or both across markets would likely be more successful at matching the data.

We explore four destination-country characteristics in the analysis: market size, income, bilateral distance from China, and overall remoteness. We use data on GDP and GDP per capita from the World Bank's World Development Indicators, and obtain bilateral distances from CEPII.[16] As is standard in the literature, we measure remoteness as a weighted average of a country's bilateral distance to all other countries in the world, using countries' GDP as weights. A destination is remote in economic terms if it is geographically isolated from most other nations or is close to small countries but far away from big economies.[17] The correlation between distance to China and overall remoteness in our sample is 0.09 and is not significant at 10%.

Based on the availability of data for these country indicators, we work with 242,403 observations across 179 countries and 6,879 HS-8 codes at the destination-product level, and 2,098,634 observations across 94,664 firms at the firm-destination-product level. The firm-level regressions that do not require information on the importer's characteristics exploit the universe of trade flows for a total of 2,179,923 observations (96,522 firms, 6,908 products, and 231 countries).

Our analysis makes use of three different proxies for products' scope for quality differentiation. These measures are relatively standard in the literature and meant to capture technological characteristics of a given product or sector that are exogenous from the perspective of an individual firm and innate to the nature of the manufacturing process. The first indicator is the Rauch (1999) dummy for differentiated goods, identified as prod-

16. The data on bilateral and inner distances are available at http://www.cepii.fr/anglaisgraph/bdd/distances.htm. GDP and distance are imperfect, if commonly used proxies for market size and bilateral trade costs. We leave the study of alternative measures to future work.

17. We measure the remoteness of destination d as $remoteness_d = \sum_o GDP_o \cdot distance_{od}$, where GDP_o is the GDP of origin country o, $distance_{od}$ is the distance between o and d, and the summation is over all countries in the world o. See Baldwin and Harrigan (2011) for a discussion of alternative remoteness indices. Practically identical results obtain if we instead proxy remoteness with another common measure, $\left(\sum_o \frac{GDP_o}{distance_{od}}\right)^{-1}$.

ucts not traded on an organized exchange or listed in reference manuals. It is available for SITC four-digit goods, which we concord to the Chinese HS-8 classification. We also employ continuous measures of R&D intensity or combined advertising and R&D intensity from Klingebiel, Kroszner, and Laeven (2007) and Kugler and Verhoogen (2011), respectively. They are based on U.S. data for three-digit ISIC sectors, which we match to the HS-8 products in our sample. The imperfect correlation among these three proxies for quality differentiation makes it less likely that our results are instead driven by some unobserved product characteristic.[18]

IV. Stylized Facts

This section documents stylized facts about the variation in export and import prices across firms, products, and trade-partner countries. We first explore the correlation between export prices and export revenues across firms within a given product- or destination-product market. We then examine the link between firms' export prices and number of export destinations. Next we study the relationship between export prices, revenues, and country characteristics across trade partners within a firm-product pair. Finally, we consider how firms' imported-input prices, import price dispersion, and number of source countries relate to their export performance.

IV.A. Export Prices at the Product Level

For consistency with the prior literature, we first briefly document how aggregate f.o.b. export prices at the product level vary with characteristics of the destination country. We construct these aggregate prices such that they equal the unit value that product-level data would report. In particular, we first sum the export value and quantity across all firms that sell a specific HS-8 good to a given market. We then obtain the average Chinese export price for each destination-product by dividing total revenues by total quantities.

Table II reports results from a gravity-type regression of product-level unit values on destination size, income, bilateral distance to China, and overall remoteness, with all variables in

18. The correlation between R&D and combined advertising and R&D intensity across the 30 sectors is 0.21. At the HS-8 level, the correlation between the Rauch dummy and R&D (advertising and R&D) is 0.16 (0.20).

TABLE II
PRODUCT-LEVEL AVERAGE EXPORT PRICES AND DESTINATION CHARACTERISTICS (DEPENDENT VARIABLE: (LOG) AVERAGE F.O.B. EXPORT PRICE, BY HS-8 PRODUCT AND DESTINATION)

	All destinations	Rich destinations	Poor destinations
	(1)	(2)	(3)
(log) GDP per capita	0.019***	0.053***	−0.006
	(6.60)	(12.07)	(−0.76)
(log) GDP	−0.005**	−0.003	−0.025***
	(−2.02)	(−1.10)	(−6.40)
(log) Distance	−0.027***	0.021***	−0.108***
	(−5.62)	(3.91)	(−11.79)
(log) Remoteness	−0.148***	−0.134***	−0.106***
	(−15.48)	(−13.60)	(−4.39)
Product FE	Y	Y	Y
R-squared	0.854	0.855	0.876
# observations	242,403	161,835	80,568
# product clusters	6,879	6,773	5,860
# destinations	179	89	90

Notes: This table examines the effect of destination income, market size, distance, and remoteness on average export prices. The outcome variable is the (log) average f.o.b. export price across all Chinese exporters in a given destination and HS-8 product. Column (1) presents results for the full sample of 179 countries, while column (2) (column (3)) restricts the sample to countries with GDP per capita above (below) the sample median. All regressions include a constant term and HS-8 product fixed effects, and cluster errors by HS-8 product. t-statistics in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

logs. As column (1) shows, the average f.o.b. export price is higher in smaller, richer, more proximate, and more central markets.[19] When we repeat the analysis separately for destinations above and below the median income level in the sample, however, we find that these patterns differ between rich and poor markets. The average Chinese export price increases with income, distance and centrality for the 89 rich importers without varying systematically with market size. By contrast, it falls with GDP, distance, and remoteness in the poorer half of the sample without responding to GDP per capita.[20] For reference, Baldwin and Harrigan

19. We describe countries that are closer to China as either less distant or more proximate. We refer to countries that are globally more remote as more isolated or less central.

20. We cluster errors by product in Table II, but obtain similar results with robust standard errors. When we instead cluster errors by destination, only income and remoteness (only market size and distance) enter significantly in columns (1) and (2) (column (3)). The inconclusiveness of these results further motivates our analysis at the firm level.

(2011) find that average U.S. export prices fall with the importer's GDP, proximity, and remoteness, and vary either positively or negatively with income depending on the specification. Since they focus on the top 100 export destinations of the United States, which largely overlap with the countries in the richer half of our sample, our results are consistent with theirs at the product level.

As we explain in Section VI, the behavior of aggregate prices might not conclusively distinguish between efficiency and quality heterogeneity across firms as both can exhibit the same patterns at the product level. More important, aggregate prices could be misleading if they are consistent with a given model, but the underlying firm prices are not. In the rest of the article we therefore exploit the richness of our data and directly examine firm-level prices.

IV.B. Export Prices across Firms

Consider first the correlation between f.o.b. export prices and worldwide export revenues across firms selling a given HS-8 product. To explore this variation, we aggregate the data to the firm-product level by summing sales and quantities across markets. We then take their ratio and construct firm *f*'s average export price for product p across all destinations d it serves, $price_{fp} = \frac{\sum_d revenue_{fpd}}{\sum_d quantity_{fpd}}$. Using this measure, we estimate the following specification:

$$\log price_{fp} = \alpha + \beta \cdot \log revenue_{fp} + \delta_p + \varepsilon_{fp}, \quad (1)$$

where product fixed effects δ_p control for systematic differences across goods in consumer appeal, comparative advantage, transportation costs, units of measure, and other product characteristics that affect all manufacturers equally. At this level of aggregation, the sample comprises 898,247 observations spanning 96,522 firms and 6,908 products. We cluster errors ε_{fp} by firm.

We are primarily interested in the sign of β, which reflects the sign of the conditional correlation between export price and revenues across firms within a product.[21] The sign of this correlation later allows us to evaluate the importance of production efficiency and product quality for firms' export performance. We

21. More precisely, β is the ratio of the covariance of price and revenue to the variance of revenue. β thus has the same sign as the correlation between price and revenue.

emphasize that we cannot and do not want to give β a causal interpretation becaise firms' unit values and sales are both affected by unobserved firm characteristics and are the joint outcome of firms' profit maximization.

As column (1) in Table III shows, within a given product, firms that charge a higher average export price earn bigger worldwide revenues.[22] The point estimates suggest that a one-standard-deviation increase in log export sales is associated with a 27% higher export price, which represents 20% of the standard deviation in log average export prices.[23] The strength of this correlation, however, varies systematically across products with different scope for quality upgrading. In column (3), we regress unit values on firm sales and their interaction with the dummy for differentiated goods. The positive correlation between price and revenues across firms is two and a half times stronger among nonhomogeneous products. Similar results obtain in columns (4), (5), and (6) when we instead proxy the potential for quality differentiation with sectors' R&D intensity or combined advertising and R&D intensity.[24] All of these patterns are significant at 1%.

In the last column of Table III, we distinguish between firms' exports to rich and poor destinations. In particular, we compute average prices and total revenues at the firm-product level separately for countries above and below the median income in the sample, using the same cut-off as in Table II. When we expand (1) to include a dummy for rich destinations and its interaction with revenues, we find that the correlation between export prices and sales is positive for both poor and rich markets, but a significant 50% higher for the latter.

This analysis abstracts away from the substantial variation across exporters in the number of countries they sell to. It also

22. Column (2) in this table, as well as in Tables IV and VI, documents the negative correlation between f.o.b. export prices and quantities. This is consistent with both efficiency and quality sorting and does not help differentiate between them. Moreover, this result may be driven by measurement error in quantities because we obtain prices as unit values. For these reasons, we report these results only for completeness and do not discuss them further.

23. These comparative statics use the standard deviation of export values and prices after demeaning them with their product-specific average. Very similar results obtain if we use the raw data without demeaning instead.

24. The coefficient on the interaction with R&D intensity is negative, though only significant at 10%. R&D intensity is very unevenly distributed in the data, however, with many values between 0.00 and 0.03 and a few above 0.07. When we group sectors into high and low R&D intensity, the interaction with a dummy for high R&D intensity is positive and significant at 1%.

TABLE III

FIRMS' EXPORT PRICES AND WORLDWIDE EXPORT REVENUES
(DEPENDENT VARIABLE: (LOG) AVERAGE F.O.B. EXPORT PRICE, BY FIRM AND HS-8 PRODUCT)

	Variation across firms within products						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(log) Revenue	0.094***		0.040***	0.097***	0.091***	0.085***	0.067***
	(49.25)		(14.15)	(48.26)	(47.14)	(41.31)	(24.07)
(log) Quantity		−0.165***					
		(− 103.75)					
(log) Revenue x different. good			0.065***				
			(22.83)				
(log) Revenue x R&D intensity				−0.079*			
				(− 1.73)			
(log) Revenue x high R&D intensity					0.008***		
					(4.67)		
(log) Revenue x adv. + R&D intensity						0.362***	
						(8.23)	
(log) Revenue x rich destinations							0.031***
							(11.37)
Product FE	Y	Y	Y	Y	Y	Y	Y
R-squared	0.644	0.671	0.642	0.637	0.637	0.637	0.649
# observations	898,247	898,247	619,357	871,596	871,596	875,097	974,033
# products	6,908	6,908	4,276	6,182	6,182	6,252	6,879
# firm clusters	96,522	96,522	84,464	93,514	93,514	94,005	94,664

Notes. This table examines the relationship between firms' worldwide export prices and revenues. It exploits the variation across firms within products, by including HS-8 product fixed effects. The outcome variable is the (log) average f.o.b. export price by firm and HS-8 product, constructed as the ratio of worldwide revenues and quantities exported by firm and product. Products' scope for quality differentiation is proxied by (1) a dummy variable equal to 1 for differentiated products as classified by Rauch (1999), column (3); (2) R&D intensity by three-digit ISIC sector from Klingebiel, Kroszner, and Laeven (2007), column (4); a dummy variable equal to 1 for R&D intensity above the median, column (5); or (3) the combined advertising and R&D intensity by three-digit ISIC sector from Kugler and Verhoogen (2011), column (6). In column (7), the average price and worldwide revenues are computed separately for countries above and below the median income in the sample, and the regression includes a dummy for rich destinations and its interaction with revenues. All regressions include a constant term and cluster errors by firm. t-statistics in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

ignores potentially large differences in the market environment across destinations that may influence firms' export participation and pricing decisions. We therefore next exploit the full dimensionality in the data and examine the variation in export prices across Chinese firms selling in a given market, where a market is defined as a destination-product pair. This could be, for example, all Chinese shoe manufacturers exporting to Germany.

We adopt the following estimating equation:[25]

$$\log price_{fpd} = \alpha + \beta \cdot \log revenue_{fpd} + \delta_{pd} + \varepsilon_{fpd}. \quad (2)$$

Here $price_{fpd}$ and $revenue_{fpd}$ are the f.o.b. bilateral export price and revenue of firm f selling product p in destination d, and δ_{pd} are destination-product pair fixed effects. Once again, we interpret the sign of β as the sign of a conditional correlation that does not reflect causality. We conservatively cluster errors ε_{fpd} by destination-product, but note that all of our results are robust to alternative levels of clustering, such as by firm, product, destination, firm-destination, or firm-product. Since the unit of observation is now at the firm-product-country level, the sample size in these regressions grows to 2,179,923 data points.

Similarly to (1), the extensive set of fixed effects in this specification implicitly control for product characteristics that are invariant across manufacturers and trade partners. However, they also condition on features of the importing country that affect all products and firms selling there, such as consumer income, regulatory restrictions, legal institutions, inflation, and exchange rates. Finally and most importantly, the δ_{pd}'s take account of transportation costs, bilateral tariffs, demand conditions, market toughness, and other economic factors that influence exporters in any given destination-product market. The coefficient on revenues is thus identified purely from the variation across firms within very fine segments of the world economy.

Table IV presents robust evidence that firms setting a higher export price earn greater revenues even within such narrowly defined destination-product markets. This relationship is highly statistically significant. It is also markedly stronger for goods with greater scope for quality upgrading, as proxied by product differentiation and sectors' R&D or advertising intensity. Finally, it is

25. In all specifications, we use the same symbols for the intercept, coefficients, fixed effects, and error terms as in equation (1). This is only for expositional convenience; these objects will of course differ across specifications.

TABLE IV

VARIATION IN EXPORT PRICES ACROSS FIRMS IN A DESTINATION
(DEPENDENT VARIABLE: (LOG) F.O.B. EXPORT PRICE, BY FIRM, DESTINATION, AND HS-8 PRODUCT)

	Variation across firms Within destination-product pairs					
	(1)	(2)	(3)	(4)	(5)	(6)
(log) Revenue	0.081***		0.036***	0.077***	0.065***	0.061***
	(70.07)		(9.36)	(54.61)	(35.32)	(9.72)
(log) Quantity		−0.183***				
		(− 144.72)				
(log) Revenue x different. good			0.054***			
			(12.97)			
(log) Revenue x R&D intensity				0.200***		
				(3.17)		
(log) Revenue x adv. + R&D intensity					0.616***	
					(10.63)	
(log) Revenue x (log) GDP per capita						0.002***
						(3.17)
Destination-product FE	Y	Y	Y	Y	Y	Y
R-squared	0.744	0.773	0.729	0.741	0.741	0.743
# observations	2,179,923	2,179,923	1,494,839	2,130,413	2,139,735	2,098,634
# dest-product pairs	258,056	258,056	163,873	247,867	249,874	242,403

Notes. This table examines the relationship between firms' bilateral export prices and revenues. It exploits the variation across firms within a destination-product market by including country–HS-8 product pair fixed effects. The outcome variable is the (log) f.o.b. export price by firm, destination, and HS-8 product. Products' scope for quality differentiation is proxied as in Table III. Column (6) includes the interaction of revenues with the destination's GDP per capita. All regressions include a constant term and cluster errors by destination-product. t-statistics in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

systematically more positive in richer destinations, as indicated by the interaction of revenues with the importer's GDP per capita.

In terms of economic magnitudes, these estimates have similar implications to those in Table III. The elasticity of export prices with respect to revenues is 0.08. A doubling in firm sales in a given market is thus associated with 6% higher bilateral unit prices for the average product. This number is, however, 7 percentage points bigger for sectors at the upper end of the distribution in advertising and R&D intensity relative to sectors at the lower end of the distribution. Similarly, the magnitudes are 150% higher for differentiated goods relative to homogeneous products. Finally, the elasticity of price with respect to sales is twice as large in a rich destination (75th percentile of the distribution of GDP per capita) compared to a poor export market (25th percentile).[26]

When evaluating these results, it is important to note that constructing unit prices as the ratio of export revenues to export quantities does not restrict the sign of the correlation between price and revenue. Appendix Table A.I illustrates this with six examples, in which five observations always have the same price profile but very different revenue and quantity patterns. Prices may be perfectly positively correlated with revenue and uncorrelated with quantity (Case 1), or negatively correlated with quantity and uncorrelated with revenue (Case 2). Prices may also be positively (negatively) correlated with both revenue and quantity (Cases 3 and 4), or positively correlated with revenue and negatively correlated with quantity (Case 5). Finally, prices may be only weekly correlated with revenue and/or quantity (Case 6). The only pattern ruled out by construction is the combination of a positive correlation between price and quantity and a negative correlation between price and revenue. A positive correlation between price and revenue in the data can thus be informative and does not arise mechanically by construction.

IV.C. Export Prices and Number of Destinations

We next examine the relationship between firms' export prices and number of export destinations. Of interest are both firms' average unit value and the extent to which they vary

26. All comparative statics in the article are based on regressions that include product, firm-product, or destination-product fixed effects. These fixed effects naturally absorb a lot of the variation in the data, but are necessary for the clean interpretation of the estimated coefficients.

prices across markets. The following regressions explore how these variables co-move with the number of trade partners at the firm-product level:

$$\log price_{fp} = \alpha + \beta \cdot \log \#destinations_{fp} + \delta_p + \varepsilon_{fp}, \tag{3}$$

$$sd_{fp}(\log price_{fpd}) = \alpha + \beta \cdot \log \#destinations_{fp} + \delta_p + \varepsilon_{fp}. \tag{4}$$

As before, $price_{fp}$ refers to firm f's average export price for product p, while $\#destinations_{fp}$ gives the number of countries that buy p from f. We measure price dispersion with $sd_{fp}(\log price_{fpd})$, the standard deviation of log f.o.b. export prices across destinations within each firm-product pair. The estimation controls for good-specific characteristics with product fixed effects δ_p, and clusters errors ε_{fp} by firm. In both equations, β is identified purely from the variation across firms within a given HS-8 code. It is thus not affected by any systematic differences across products in average price or in typical price variability across importers. Since firms' market entry decisions are made jointly with their pricing strategies, we will later interpret the results from these specifications in terms of correlations and not causality.

As reported in Table V, exporters that supply more countries systematically charge a higher average price (Panel A). Firms selling to more destinations also exhibit greater price dispersion across importers (Panel B).[27] These results are both largely driven by products with substantial potential for quality differentiation. As columns (2)–(6) show, the patterns hold only for differentiated varieties (but not for homogeneous goods) and are more pronounced in R&D- and advertising-intensive sectors. Note also that the correlations in Panel B do not arise mechanically because firms can choose to offer the same price in every market or a narrower range of prices if they transact with more trade partners.

To gauge the economic significance of these correlations, consider a one-standard-deviation increase in a firm's trade-partner intensity, or 2.11 more destinations. Such an increase would be accompanied by a 1% rise in the firm's average export price and 0.5% more dispersion in export prices across markets. These calculations are for the average product. Though these magnitudes would be negligible for sectors at the low end of the

27. Price dispersion is only defined for firm-product pairs with at least two destinations, hence the smaller sample size.

TABLE V

FIRMS' EXPORT PRICES AND NUMBER OF EXPORT DESTINATIONS

			Hom. goods	Diff. goods		
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. Dep. variable: (log) average f.o.b. export price, by firm and HS-8 product						
(log) # Destinations	0.014***	0.010	0.010	0.022***	0.004	−0.003
	(2.79)	(1.41)	(1.40)	(4.12)	(0.70)	(− 0.46)
(log) # Dest x different. good		0.012				
		(1.50)				
(log) # Dest x R&D intensity					0.428**	
					(2.43)	
(log) # Dest x adv. + R&D intensity						0.577***
						(3.77)
Product FE	Y	Y	Y	Y	Y	Y
R-squared	0.632	0.628	0.647	0.622	0.624	0.624
# observations	898,247	619,357	61,843	557,514	871,596	875,097
# products	6,908	4,276	1,321	2,955	6,182	6,252
# firm clusters	96,522	84,464	23,390	76,793	93,514	94,005

TABLE V
(CONTINUED)

			Hom. goods	Diff. goods		
	(1)	(2)	(3)	(4)	(5)	(6)
Panel B. Dep. variable: st. dev. of (log) f.o.b. export prices across destinations within a firm-HS-8 product pair						
(log) # Destinations	0.004**	0.004	0.004	0.006***	−0.002	0.007**
	(2.12)	(0.90)	(0.88)	(2.65)	(− 0.77)	(2.33)
(log) # Dest x different. good		0.002				
		(0.53)				
(log) # Dest x R&D intensity					0.248***	
					(3.21)	
(log) # Dest x adv. + R&D intensity						−0.112
						(− 1.36)
Product FE	Y	Y	Y	Y	Y	Y
R-squared	0.139	0.137	0.200	0.126	0.135	0.136
# observations	303,935	210,419	18,741	191,678	296,777	298,032
# products	5,852	3,666	1,026	2,640	5,365	5,426
# firm clusters	66,360	54,545	10,560	48,845	64,223	64,616

Notes. This table examines the relationship between firms' export prices and number of destinations, by firm and HS-8 product. The outcome variable in Panel A is the (log) average f.o.b. export price, constructed as the ratio of worldwide revenues and quantities exported by firm and product. The outcome variable in Panel B is the standard deviation of the (log) export price across destinations within firm-product pairs with more than one destination. Products' scope for quality differentiation is proxied as in Table III. All regressions include a constant term and cluster errors by firm. t-statistics in parenthesis. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

distribution by R&D intensity, however, they would reach 3% and 2%, respectively, for a sector at the top of the distribution.

IV.D. Export Prices across Destinations within Firms

The analysis so far has focused on the variation in export prices across firms within narrowly defined product categories or destination-product markets. This subsection instead documents systematic patterns in the variation of export prices across trade partners within firm-product pairs.

We first study the correlation between f.o.b. export prices and revenues across importing countries within an exporter with the following specification:

$$\log price_{fpd} = \alpha + \beta \cdot \log revenue_{fpd} + \delta_{fp} + \varepsilon_{fpd}. \quad (5)$$

We now include firm-product pair fixed effects δ_{fp}. In addition to subsuming the role of product characteristics common to all firms, these fixed effects also control for firm attributes such as overall production efficiency, managerial talent, labor force composition, general input quality, and so on, that affect the firm's export performance equally across products. Crucially, the δ_{fp}'s account for firm-product specific characteristics that are invariant across export markets.[28] The coefficient of interest, β, is thus identified purely from the variation in prices across destinations within a given manufacturer and product line. We cluster errors at the destination-product level, but our findings are robust to alternative clustering, such as by firm, product, or destination.

In Table VI, we consistently find that firms earn bigger revenues from a given HS-8 product in markets where they set higher f.o.b. prices. This result cannot simply be attributed to firms' market power, as they are robust to controlling for firms' market share in each country and product (column (3)).[29] The remainder of the table further shows that the positive correlation

28. In the models in Section VI, all products enter the utility function symmetrically. The models' predictions are thus for prices per utility-adjusted unit of output. Firm-product pair fixed effects help address the concern that consumers get different utils from the products of different firms.

29. We measure firm f's market share with the share of f's exports of product p to destination d in total Chinese exports of p to d. f's true market share is our measure, multiplied by the share of Chinese exports in total consumption of p in d, which is invariant across Chinese exporters. Although imperfect, this is the best proxy for market power in these data.

TABLE VI

VARIATION IN EXPORT PRICES ACROSS DESTINATIONS WITHIN A FIRM
(DEPENDENT VARIABLE: (LOG) F.O.B. EXPORT PRICE, BY FIRM, DESTINATION, AND HS-8 PRODUCT)

	Variation across destinations Within firm-product pairs						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(log) Revenue	0.021***		0.020***	0.015***	0.018***	0.017***	0.004***
	(36.34)		(35.77)	(6.52)	(23.79)	(13.92)	(4.29)
(log) Quantity		−0.080***					
		(− 117.98)					
Market share			0.015***				
			(4.53)				
(log) Revenue x different. good				0.008***			
				(3.27)			
(log) Revenue x R&D intensity					0.093***		
					(3.90)		
(log) Revenue x adv. + R&D intensity						0.145***	
						(3.81)	
(log) Revenue x (log) GDP per capita							0.002***
							(21.60)
Firm-product FE	Y	Y	Y	Y	Y	Y	Y
R-squared	0.954	0.957	0.954	0.950	0.953	0.953	0.954
# observations	2,179,923	2,179,923	2,179,923	1,494,839	2,130,413	2,139,735	2,098,634
# dest-product clusters	258,056	258,056	258,056	163,873	247,867	249,874	242,403
# firm-product pairs	898,247	898,247	898,247	619,357	871,596	875,097	869,203

Notes. This table examines the relationship between firms' bilateral export prices and revenues. It exploits the variation across destinations within a firm by including firm–HS-8 product pair fixed effects. The outcome variable is the (log) f.o.b. export price by firm, destination, and HS-8 product. Column (3) controls for the share of each firm's exports in total Chinese exports, by destination and product. Products' scope for quality differentiation is proxied as in Table III. Column (7) includes the interaction of revenues with the destination's GDP per capita. All regressions include a constant term and cluster errors by destination-product pair. t-statistics in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

between export price and sales across destinations within a firm is stronger among richer destinations and for goods with greater scope for quality differentiation.

So far we have largely treated destinations anonymously and symmetrically. Chinese trade partners, however, vary considerably along a number of dimensions. We focus on four country characteristics in particular: size (GDP_d), income ($GDPpc_d$, or GDP per capita), distance to China ($distance_d$), and overall economic remoteness ($remote_d$). To explore how these market features affect Chinese exporters' bilateral prices, we estimate the following specification:

$$\log price_{fpd} = \alpha + \beta \cdot \log GDPpc_d + \gamma \cdot \log GDP_d + \lambda \cdot \log distance_d + \mu \cdot \log remote_d + \delta_{fp} + \varepsilon_{fpd} \quad (6)$$

As in (5), we include firm-product pair fixed effects δ_{fp} such that β, γ, λ, and μ are identified purely from the variation in unit values across destinations for a given producer and good. To account for the potential correlation in the error term across firms within a destination-product market, we cluster errors by destination-product.

Table VII establishes that firms charge higher f.o.b. prices for the same product in bigger, richer, more distant, and less remote markets. These results are not driven by firms' country-product-specific market share (column (6)).[30] They are also highly statistically and economically significant. For example, raising market size from the first quartile to the third quartile of the distribution is associated with 2.3% higher export prices. The corresponding numbers for income, distance and remoteness are 4.3%, 0.9%, and –1.1%, respectively.

Table VIII explores how the sensitivity of export prices to a market's GDP, proximity, and centrality depends on the income level in that market, by including the interactions of the former three variables with GDP per capita. We find that market size, distance, and remoteness increase firm prices relatively more in richer countries. All three interaction terms enter positively and significantly at the 1% level. Splitting the sample into homogeneous and differentiated goods, we further observe that this result holds only for products with scope for quality upgrading but not for standardized items (columns (2) and (3)).

30. We may be over-controlling in this context since firms' market share likely rises with product quality.

TABLE VII

FIRMS' EXPORT PRICES AND DESTINATION CHARACTERISTICS
(DEPENDENT VARIABLE: (LOG) F.O.B. EXPORT PRICE, BY FIRM, DESTINATION, AND HS-8 PRODUCT)

	Variation across destinations Within firm-product pairs					
	(1)	(2)	(3)	(4)	(5)	(6)
(log) GDP per capita	0.021***				0.015***	0.015***
	(27.24)				(14.84)	(15.42)
(log) GDP		0.012***			0.005***	0.008***
		(23.30)			(8.25)	(11.75)
(log) Distance			0.016***		0.012***	0.009***
			(8.40)		(6.01)	(4.52)
(log) Remoteness				−0.062***	−0.027***	−0.021***
				(− 18.75)	(− 8.26)	(−6.60)
Market share						0.067***
						(18.03)
Firm-product FE	Y	Y	Y	Y	Y	Y
R-squared	0.954	0.954	0.954	0.954	0.954	0.954
# observations	2,098,634	2,098,957	2,177,935	2,177,935	2,098,634	2,098,634
# dest-product clusters	242,403	242,649	256,772	256,772	242,403	242,403
# firm-product pairs	869,203	869,297	898,035	898,035	869,203	869,203
# destinations	179	180	210	210	179	179

Notes. This table examines the effect of destination income, market size, distance, and remoteness on firms' export prices. It exploits the variation across destinations within a firm, by including firm–HS-8 product pair fixed effects. The outcome variable is the (log) f.o.b. export price by firm, destination, and HS-8 product. Column (6) controls for the share of each firm's exports in total Chinese exports, by destination and product. All regressions include a constant term and cluster errors by destination-product pair. t-statistics in parenthesis. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

TABLE VIII

DESTINATIONS'S WILLINGNESS TO PAY FOR QUALITY AND FIRMS' EXPORT PRICE DISPERSION
(DEPENDENT VARIABLE: (LOG) F.O.B. EXPORT PRICE, BY FIRM, DESTINATION, AND HS-8 PRODUCT)

Interaction Variable:	Variation across destination within firm-product pairs GDP per capita					Firm price dispersion	
	All (1)	Hom. goods (2)	Diff. goods (3)	Rich dest. (4)	Poor dest. (5)	All (6)	All (7)
(log) GDP per capita	−0.505***	0.038	−0.626***	0.021***	0.015***	0.015***	
	(− 4.45)	(0.10)	(− 4.25)	(13.49)	(4.37)	(8.64)	
(log) GDP per capita interaction						−0.002	−0.002
						(− 0.43)	(− 0.35)
(log) GDP	−0.015***	0.007	−0.013***	0.005***	−0.002	−0.005***	
	(− 4.41)	(0.67)	(− 2.87)	(6.34)	(− 1.00)	(− 4.55)	
(log) GDP interaction	0.002***	0.000	0.002***			0.023***	0.024***
	(5.51)	(0.21)	(3.65)			(7.36)	(7.69)
(log) Distance	−0.097***	−0.024	−0.117***	0.014***	−0.007	−0.022***	
	(− 7.92)	(− 0.70)	(− 6.85)	(6.32)	(− 1.43)	(− 8.08)	
(log) Distance interaction	0.011***	0.003	0.014***			0.072***	0.073***
	(8.37)	(0.94)	(7.16)			(8.85)	(9.21)
(log) Remoteness	−0.107***	−0.008	−0.134***	−0.021***	−0.020	0.026***	
	(− 4.11)	(− 0.09)	(− 3.95)	(− 6.04)	(− 1.64)	(4.31)	
(log) Remoteness interaction	0.009***	−0.001	0.012***			−0.112***	−0.109***
	(3.42)	(− 0.15)	(3.38)			(− 6.84)	(− 6.68)

TABLE VIII
(CONTINUED)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Firm-product FE	Y	Y	Y	Y	Y	Y	Y
Destination FE	N	N	N	N	N	N	Y
R-squared	0.954	0.958	0.949	0.953	0.978	0.935	0.935
# observations	2,098,634	125,495	1,315,615	1,767,397	331,237	1,533,339	1,533,339
# dest-product clusters	242,403	24,541	129,181	161,835	80,568	209,259	209,259
# firm-product pairs	869,203	58,732	541,348	792,906	181,127	303,908	303,908
# destinations	179	175	179	89	90	179	179

Notes. This table examines the differential effect of market income, size, distance, and remoteness on firms' export prices across destinations at different income levels and across firms with different export price dispersion. It exploits the variation across destinations within a firm, by including firm–HS-8 product pair fixed effects. Column (7) also includes destination fixed effects. The outcome variable is the (log) f.o.b. export price by firm, destination, and HS-8 product. Columns (1), (6), and (7) examine the full sample; column (2) (column (3)) restricts the sample to homogeneous (differentiated) goods only, according to the Rauch (1999) classification; and column (4) (column (5)) restricts the sample to destinations with GDP per capita above (below) the sample median. Firms' export price dispersion in columns (6) and (7) is measured by the standard deviation of the (log) export price across destinations within firm-product pairs with more than one destination. All regressions include a constant term and cluster errors by destination-product pair. t-statistics in parenthesis. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

The coefficients on the main effects of GDP and distance change sign when we include their interactions with GDP per capita. The overall impact of size and distance on firms' export prices is therefore positive whenever income is above a certain cut-off level, and negative otherwise. In the cross-section of 179 countries in the sample, the total effect of GDP (distance) is positive for the richest 107 (72) markets. However, in the full sample of firm-product-destination triplets, it is positive for fully 88% (82%) of all observations.[31]

The sign of these effects, though, says little about their economic or statistical significance. In columns (4) and (5) we therefore estimate specification (6) separately in two subsamples of rich and poor destinations, with GDP per capita above and below the median, respectively. We find significant results for all four country characteristics in the rich group, but only for GDP per capita in the poor set.[32] This highlights the robustness of our results for income and suggests that the effects of the other market features on firms' prices are concentrated in richer destinations.

The last two columns of Table VIII further document that while all firms set higher export prices in richer countries, market size, distance, and remoteness have differential effects across firms. In particular, the more firms vary prices across trade partners, the likelier they are to charge more in bigger, more distant, and less remote destinations. These results are based on expanding specification (6) to include the interactions of all four country characteristics with the measure of firms' export price dispersion from Table V (i.e., the standard deviation of prices across destinations within a firm-product pair). Note that the main effect of market size, distance, and remoteness in these regressions is opposite to that of the interaction. We have confirmed that the total effect of these variables goes in the direction of the interaction term for two thirds of all firms and observations and is not significantly different from 0 for the observations at the bottom third of the distribution by export price dispersion.

Distinguishing among firms in this way also allows us to control for systematic differences across economies with country fixed effects (column (7)). While these fixed effects subsume

31. This is because firms are substantially more likely to enter richer countries, and there are many fewer observations for poorer destinations.

32. Similar results obtain if we instead distinguish between countries with income above or below the cut-off above which the overall effects of GDP and distance turn positive in column (1).

the main impact of each market characteristic, the coefficients on the interaction terms can still be identified from the variation in price dispersion across firms within a given destination. Even in this stringent specification, we continue to observe that exporters that vary prices more across importers set higher prices in bigger, more distant, and less remote markets. Because the effect of income is very strong for all firms and the income elasticity of price does not vary across sellers, that interaction term is not significant as in column (6).

Finally, we have confirmed that our results are qualitatively similar when we allow for different sources of heteroskedasticity in the unobserved error term. There might be multiple dimensions along which the error is correlated across observations in our sample. ε_{fpd} is likely correlated across firms in a given destination-product market because of unobserved demand or cost shocks common to suppliers serving that market. That is why we cluster errors by destination-product in the main specifications we report. However, ε_{fpd} might also be correlated across countries within a firm-product if the cost or demand shock operates at that level, or across countries and products within firms. As Bertrand, Duflo, and Mullainathan (2004) argue, including fixed effects at the level at which the error term is correlated addresses this problem in part, but not fully. Separately, our regressions of firm-product-destination level prices on destination characteristics may be subject to the Moulton (1990) problem if the variance of ε_{fpd} differs across countries, because multiple observations share the same values for the right-hand-side variables.

Because the econometrician cannot be certain about the source of heteroskedasticity in the data, an agnostic approach is to use Huber-White heteroskedasticity-robust standard errors. This allows for a flexible structure of clusters in the data, where errors are correlated within each cluster. Reassuringly, all of our results obtain at similar or higher levels of significance when we estimate them with robust standard errors. Our results also hold when we alternatively cluster by firm, product, firm-product, or firm-destination. When we cluster by country, we continue to observe statistically significant coefficients on GDP, GDP per capita, and remoteness if we estimate the effect of each characteristic separately in Table VII. When we group economies in three bins according to their proximity to China, we also recover a positive and significant coefficient on distance for markets at intermediate distances (see also Section V.C). When we instead jointly estimate the effect of all four country measures, we find that only destination income and size are significant, and remoteness has a significant impact if it enters nonlinearly. However, all of our results for the differential effects of country characteristics across firms with different export price dispersion in Table VIII are robust to clustering by destination.

IV.E. Imported-Input Prices and Export Performance

The last set of stylized facts we uncover concern the relationship between firms' input purchases and export performance. In the absence of detailed figures on domestic input orders, we use data on producers' imported intermediates as an imperfect but informative signal for all of their inputs. We examine three aspects of exporters' import activity: input prices, number of suppliers, and input price dispersion across source countries.

The detailed nature of our data allows us to distinguish between imported inputs used in the production of goods for the home and foreign markets. In particular, the Chinese customs records discriminate between "ordinary" trade and trade under the "processing-and-assembly" regime. We exploit information only on firms' imports in the latter category to ensure that we can correctly interpret them as inputs to the goods firms sell abroad.[33] Of the 96,522 exporting firms in our sample, 37,647 also import under processing and assembly. We observe all of their import values, quantities, and hence unit prices by HS-8 product and country of origin. We examine the correlation between import prices and export performance for this subset of firms.

Many firms import and export multiple products, and we cannot match specific inputs to output categories. For this reason, we use four different firm-level measures of export performance that have been aggregated across export goods and destinations: total exports worldwide; number of countries to which the firm ships at least one product; the average export price across products and destinations; and the standard deviation of export prices across products and markets. For each firm, the average export price is the weighted average of all (log) firm-product-destination prices which have been demeaned by their product-specific average, with export revenue shares as weights. The standard deviation of the

33. All of our results hold if we instead use data on all imported inputs and not only those under the processing-and-assembly regime. We can then study 58,337 firms.

(log) export price within a firm across goods and markets is also based on demeaned unit values.

We first study the relationship between imported-input prices and export activity with the following specification:

$$\log price_{fpo} = \alpha + \beta \cdot export\,performance_f + \delta_p + \varepsilon_{fpo}, \quad (7)$$

where $price_{fpo}$ is the price that firm f pays for import product p from origin country o, and $export\,performance_f$ is one of the four firm-level measures just described. At this level of disaggregation, the sample spans 724,790 observations. All regressions in this subsection cluster errors by firm, and are robust to alternative levels of clustering.

The product fixed effects δ_p in (7) control for characteristics of each imported good that are common across firms, such as average value and quality, import restrictions, domestic distribution costs, the measurement unit for quantities, or the need for specialized labor or equipment to process the input. β is thus identified from the variation across exporters that buy a given intermediate product. We are only interested in the sign of β as the sign of a conditional correlation, since we expect that unobserved firm characteristics determine both input choices and export performance.

We find that firms paying more for their imported inputs have consistently higher export prices, larger worldwide export revenues, and a bigger number of export destinations (Panel A of Table IX). Exporters that vary prices more across markets also tend to buy more expensive inputs on average. All of these results are highly statistically and economically significant. For example, a firm that exports twice as much typically uses inputs that are 10% more expensive, whereas a firm whose exports are twice as expensive pays 38% higher prices for its imported inputs.

We next examine the spread (standard deviation) of prices that firms are willing to incur for a given imported input:

$$sd_{fp}(\log price_{fpo}) = \alpha + \beta \cdot export\,performance_f + \delta_p + \varepsilon_{fp}. \quad (8)$$

The unit of observation is now a firm-product pair, for 129,059 data points. The left-hand-side variable is the standard deviation of (log) import unit values across origin countries o within a firm f and import product p.

We systematically observe that firms paying a broader range of import prices for a given good export more to more markets

TABLE IX

FIRMS' IMPORTED-INPUT PRICES AND EXPORT PERFORMANCE

	(1)	(2)	(3)	(4)
Panel A. Dep. variable: (log) import price, by firm, source country, and HS-8 product				
(log) Total firm exports	0.139***			
	(25.45)			
(log) # Export destinations		0.047***		
		(4.58)		
Average (log) export price			0.459***	
			(44.30)	
St. dev. of (log) export price				0.669***
				(33.05)
Product FE	Y	Y	Y	Y
R-squared	0.603	0.589	0.630	0.599
# observations	724,790	724,790	724,790	587,110
# products	5,351	5,351	5,351	5,142
# firm clusters	37,647	37,647	37,647	27,291
Panel B. Dep. variable: st. dev. of (log) import prices across source countries within a firm and HS-8 product				
(log) Total firm exports	0.042***			
	(24.07)			
(log) # Export destinations		0.051***		
		(17.04)		
Average (log) export price			0.076***	
			(21.39)	
St. dev. of (log) export price				0.147***
				(19.48)
Product FE	Y	Y	Y	Y
R-squared	0.193	0.182	0.191	0.185
# observations	129,059	129,059	129,059	125,828
# products	3,760	3,760	3,760	3,738
# firm clusters	21,248	21,248	21,248	20,027
Panel C. Dep. variable: (log) number of source countries within a firm and HS-8 product				
(log) Total firm exports	0.059***			
	(41.37)			
(log) # Export destinations		0.065***		
		(26.77)		
Average (log) export price			0.013***	
			(4.68)	
St. dev. of (log) export price				0.026***
				(4.86)
Product FE	Y	Y	Y	Y
R-squared	0.189	0.159	0.138	0.141
# observations	460,213	460,213	460,213	443,702
# products	5,362	5,362	5,362	5,326
# firm clusters	37,671	37,671	37,671	34,584

TABLE IX
(CONTINUED)

	(1)	(2)	(3)	(4)
Panel D. Dep. variable: st. dev. of (log) import prices within a firm across source countries and HS-8 products				
(log) Total firm exports	0.045***			
	(29.70)			
(log) # Export destinations		0.022***		
		(8.04)		
Average (log) export price			0.074***	
			(25.53)	
St. dev. of (log) export price				0.349***
				(64.73)
R-squared	0.027	0.002	0.074	0.123
# observations (# firms)	32,187	32,187	32,187	29,803

Notes: This table examines the relationship between firms' imported-input prices, export performance, and export prices for the subset of Chinese exporters that import inputs under the processing and assembly regime. The dependent variable in Panel A is the (log) import price by firm, source country and HS-8 product. In Panel B, it is the standard deviation of (log) import prices across source countries within a firm and HS-8 product pair. In Panel C, it is the (log) number of source countries within a firm and HS-8 product pair. All regressions in Panels A, B, and C include HS-8 product fixed effects and cluster errors by firm. The dependent variable in Panel D is the standard deviation of (log) import prices within a firm across source coutries and HS-8 products, after these prices have been demeaned by their HS-8 product average. The right-hand-side variables include (log) worldwide firm exports and the (log) number of export destinations. For each firm, the average (log) export price is the weighted average of (log) (firm, destination, HS-8 product) prices which have been demeaned by their HS-8 product average, with export shares as weights. The standard deviation of (log) export prices within a firm across destinations and HS-8 products is also based on product-demeaned (log) export prices. All regressions include a constant term. t-statistics in parenthesis. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

at a higher average price (Panel B of Table IX). They also offer a broader menu of export prices across destinations. These results obtain even after controlling for product fixed effects, which capture, among other things, the average amount of price dispersion and scope for quality differentiation in each imported input. Similar patterns emerge in Panel D, where we collapse the data to the firm level and study the total variation in import prices across all products and source countries within a firm.[34]

Because $sd_{fp}(\log price_{fpo})$ is only defined for firms that purchase input p from multiple countries of origin, in Panel C we also look directly at the (log) number of countries from which producers source p. Consistently with the foregoing results, firms

34. In particular, we estimate $sd_f\left(\log price_{fpo}\right) = \alpha + \beta \cdot export\,performance_f + \varepsilon_f$ in the cross-section of firms. The left-hand-side variable is now the standard deviation of (log) import unit values across origin countries o and products p within a firm f, after these prices have been demeaned with their product-specific average.

that employ more suppliers offer a wider menu of export prices and ship more to more destinations at a higher average price.

IV.F. Summary of Stylized Facts

We summarize the systematic patterns we have established with six stylized facts.

FACT 1. Across firms selling a given product, exporters that charge higher prices earn greater revenues in each destination, have bigger worldwide sales, and enter more markets. These patterns are more pronounced for products with greater scope for quality differentiation and for richer destinations.

FACT 2. Firms that export more, that enter more markets, and that charge higher export prices use more expensive imported inputs.

FACT 3. Across countries within a firm-product, firms set higher prices in richer, bigger, more distant, and less remote markets. The effects of size, distance, and remoteness are concentrated in rich destinations and among firms that vary prices more across markets.

FACT 4. Across countries within a firm-product, firms earn more revenues in markets where they set higher prices. This pattern is more pronounced for products with greater scope for quality differentiation and for richer destinations.

FACT 5. Across firms within a product, firms with more destinations offer a wider range of export prices. This pattern is more pronounced for products with greater scope for quality differentiation.

FACT 6. Firms that export more, that enter more markets, and that offer a wider range of export prices pay a wider range of input prices and source inputs from more origin countries.

Some of these facts confirm that patterns recently established for a subsample of exporters (in other countries) hold in comprehensive data on the universe of (China's) export transactions. Focusing on the wine industry in France, for example, Crozet, Head, and Mayer (2009) show that highly ranked French wine makers export more to more destinations at a higher average price. In a sample of Portuguese exporters, Bastos and Silva (2010) document that firms set higher prices in bigger, richer, and more distant countries. Aside from these two findings, all other stylized facts are novel.

V. Robustness

V.A. *Measurement Error*

A potential concern with the analysis is that export revenues or quantities may be measured with error. If there is classical measurement error (ME) in revenues, it would generate attenuation bias in the regressions of export prices on export sales (Tables III, IV, and VI). Because unit values are the ratio of revenues to quantities, however, measurement error may also be nonclassical and appear on both sides of these regressions. By contrast, such ME cannot affect any of the other specifications. In particular, it does not pose a challenge for the correlations between export prices and country characteristics (Tables II, VII, and VIII), between export prices and the number of destinations (Table V), or between import and export activity (Table IX).

Nonclassical measurement error in export prices may introduce either positive or negative bias in Tables III, IV, and VI. To understand why the direction of the bias is ex ante ambiguous, consider first ME in export quantities. Recall that the coefficient β from a regression of log prices on log revenues equals the ratio of the covariance of measured price and revenues to the variance of measured revenues. If log actual quantities were q^* but one observed $q = q^* + \eta$, measured log unit prices would be $p = r^* - q = (r^* - q^*) - \eta = p^* - \eta$. One would then estimate $\beta = \frac{cov(p^* - \eta, r^*)}{var(r^*)} = \frac{cov(p^*, r^*)}{var(r^*)} - \frac{cov(\eta, r^*)}{var(r^*)} = \beta^* - \frac{cov(\eta, r^*)}{var(r^*)}$. If η is uncorrelated with actual revenues r^*, it would not affect the coefficient point estimates but potentially reduce precision. Downward bias would arise, though, if η is positively correlated with r^*, that is, if quantities are systematically inflated in high-revenue transactions. Conversely, β would be overestimated if the opposite were true. Measurement error in revenues could similarly generate either positive or negative bias, depending on how it correlates with the true values of price and revenues.

The extensive set of fixed effects in the regressions help alleviate concerns with ME to a certain degree. The product fixed effects in all specifications ensure that the results are not driven by some goods being easier to monitor by customs officers. Firm-product fixed effects further control for the fact that some exporters might systematically misreport in certain goods. Similarly, destination-product fixed effects account for the possibility that all firms have more incentives to be truthful about exports of some products to certain markets, or that customs officials are more conscientious about given goods in some countries. ME would thus have to vary in very particular ways across firms, products, and markets to explain our findings.

Exploiting the variation across products with varying scope for quality differentiation and across destinations with dissimilar income levels is also useful in dealing with potential measurement error. For example, the ME in quantity would not only have to be negatively correlated with revenue in general, but this correlation would have to be systematically stronger in richer markets and in differentiated, R&D- and advertising-intensive goods to explain the findings in Tables III, IV, and VI. In other words, ME is more likely to affect the coefficients on the main effects than on the interaction terms in the regressions.

To address concerns with ME, we nevertheless perform a number of robustness checks and find that our results continue to hold at comparable levels of economic and statistical significance. Unless reported in the Appendix, the results from these specifications are available on request.

First, all results in Tables II–IX obtain when outliers are removed from the sample. Following common practice in the literature, we identified outliers as firm-product-destination triplets with export value, quantity and/or unit price below the 1st percentile or above the 99th percentile of the respective distribution.[35] This is a conservative classification because observations are labeled as outliers even if only one of these three variables lies in the bottom or top percentile, while the other two do not. Such outliers likely reflect severe measurement error, and it is reassuring that they do not drive the results. Our findings also hold when we instead winsorize the data and set outliers equal to the value at the 1st (99th) percentile of the distribution if they were below (above) this cut-off point.

Second, our results are based on annual data that have been aggregated from raw data at the monthly level. The stylized facts remain unchanged, however, when we instead estimate all specifications in Tables II–IX at the monthly frequency, including month fixed effects. In fact, all coefficients are of comparable magnitudes but often become statistically more significant. It is

35. Qualitatively and quantitatively, the same patterns emerge whether we choose cut-off points in the full distribution in the sample or in product-specific distributions. When the analysis called for aggregation to the firm, firm-product, or product-destination level, we first excluded outliers at the firm-product-destination level before aggregating up.

ex ante unclear whether monthly data are more or less subject to measurement error than annual data, but it is encouraging that the same systematic patterns emerge at both frequencies.

Third, turning specifically to the potential for ME in Tables III, IV, and VI, our results are robust to using the *ranking* of firms' export price and revenues instead of price and revenue *levels*. This approach allows us to rely much less directly on the construction of unit prices. For space considerations, Panel A of Appendix Table A.II reports the rank results only for Table IV; as Section VII explains, this is the most important of the three tables in question. There is a strong positive correlation between firms' rank by price and rank by revenue across firms within a product-destination. It is moreover higher in goods with greater scope for quality differentiation and in richer markets. This sensitivity analysis suggests that our findings are not driven by ME bias, because such bias would have to be quite severe to distort firm rankings in a systematic way.

Fourth, the positive correlation between price and revenue across firms in a destination-product market (Table IV) holds when we change the outcome variable from firms' bilateral price by product and destination to firms' average export price by product (Panel B of Appendix Table A.II). The latter is constructed as the ratio of firms' worldwide export sales and quantity, by product. Because this average price is not directly related to firms' bilateral revenues on the right-hand side of the regression, this specification is less likely to be affected by nonclassical measurement error bias. On the other hand, classical ME may still introduce attenuation bias. The fact that we continue to observe a significant positive coefficient and that it is higher in richer countries and in goods with greater scope for quality upgrading is thus further indication that our results are not driven by ME. This robustness check cannot be applied to Table III, where the unit of observation is at the firm-product level already, or to Table VI, where we include firm-product pair fixed effects.

Finally, the patterns in Tables III, IV, and VI are equally well pronounced in a subsample of sectors that are less likely to suffer from measurement error: textiles and apparel. In these industries, China faced restrictive export quotas under the Multi-Fiber Agreement. These quotas were relaxed on January 1, 2005, but textile and apparel exports remained under scrutiny throughout 2005 (the year of our sample) as many importing countries were concerned about China's rapid export growth. For this reason, firms and customs authorities arguably recorded trade flows in these industries with considerable precision. The robustness of our results in these sectors gives us further confidence in our conclusions.

V.B. Wholesalers vs. Retailers

Our analysis has focused on the operations of firms that both make and trade goods because we are ultimately interested in how firms' production efficiency and product quality affect their export activities. However, since wholesalers and producers compete in the same destination-product markets, their export success should be governed by the same market conditions and underlying mechanisms. In particular, their export prices should exhibit the same patterns across firms in a destination and across destinations within a firm.

In unreported regressions, we have confirmed that all of our results in Tables II–VIII indeed hold in the full sample of Chinese exporting firms that includes both manufacturers and wholesalers. The point estimates in these specifications are almost always qualitatively and quantitatively the same. The only notable exception is Panel A of Table V, where many of the coefficients turn insignificant. As will become clearer, however, this table examines the theoretically ambiguous relationship between firms' average export price and number of export destinations, by product. Because we cannot interpret wholesalers' import transactions as input purchases, we are also not interested in the correlations in Table IX for these firms.

V.C. Functional Form for Distance

Prior researchers have suggested that trade costs as proxied by bilateral distance might have a nonlinear effect on trade flows and unit values (see Baldwin and Harrigan (2011)). In robustness checks, we have allowed the elasticity of export prices with respect to distance to vary nonlinearly in Tables II, VII, and VIII. In particular, we grouped the 179 countries in our sample into three tertiles by distance from China. We then regressed (log) prices on (log) distance and the interactions of (log) distance with dummies for countries that are in the second and third (top) tertile in the distribution. In these specifications, the coefficient on distance captures the baseline elasticity of price to distance in the first tertile of the distribution, and the two interaction terms show whether this elasticity is significantly different for countries at higher tertiles.

The point estimates on the main effect of distance double when we allow for nonlinearity in Table VII, but are less affected in Tables II and VIII (results available on request). The interaction terms typically enter with the opposite sign but are an order of magnitude smaller. This implies that although the elasticity of export prices with respect to distance remains of the same sign at all distance levels, it is generally lower at higher distances.

VI. Heterogeneous Firm Models in the Literature

To interpret the stylized facts we have documented, we first review different models in the literature that feature firm heterogeneity in production efficiency and product quality. We focus on the models' implications for firms' export prices and summarize them in Table X.[36]

In all models we consider, firms can be ranked according to a single exogenous attribute, productivity, which uniquely determines their export status, pricing, revenues, and profits. In the absence of quality differentiation across firms, all producers are assumed to use identical inputs to manufacture symmetric outputs, but more productive firms have lower marginal costs. Models with quality heterogeneity further allow firms to select the quality of their product by choosing the quality of their inputs. We refer to these two frameworks as efficiency and quality sorting.

We focus on four country characteristics in the models we consider: consumer income, total expenditure, bilateral iceberg trade costs, and aggregate price index. These are widely viewed as the theoretical counterparts to our empirical measures of GDP per capita, GDP, bilateral distance, and overall economic remoteness. To see the latter, note that a country that is relatively far from most other economies has high shipping costs, high c.i.f. (cost, insurance, and freight inclusive) import prices, and thus a high aggregate price index.

36. Each comparative static in Table X is ceteris paribus, and holds when the single-product firm, single-sector models we consider are extended to multiproduct companies in a multisector world. See Bernard, Redding, and Schott (2007, 2009); Mayer, Melitz, and Ottaviano (2009), and Eckel et al. (2010).

TABLE X

FIRM HETEROGENEITY IN EFFICIENCY AND QUALITY

		Firm price									
		Across firms in a destination	Across destinations within a firm					Avg. price across destinations			
Nature of firm heterogeneity	Relevant papers	Export revenue	Export revenue	Income	Market size	Distance	Remoteness	Income	Market size	Distance	Remoteness
Efficiency sorting, CES demand	Melitz (2003)	–	0	0	0	0	0	0	+	–	+
Efficiency sorting, linear demand	Melitz and Ottaviano (2008)	–	+/–	+/–	–	–	+	+/–	–	–	+
Quality sorting, CES demand	Baldwin and Harrigan (2011), Johnson (2007), Kugler and Verhoogen (2011), Verhoogen (2008)	+	0	0	0	0	0	0	–	+	–
Quality sorting, linear demand	Kneller and Yu (2008), Antoniades (2008)	+	+/–	+/–	–	–	+	+/–	+/–	+/–	+/–
Data		+	+	+	+	+	–	+	–	+/–	–

Notes. This table summarizes the predicted behavior of export prices when export success is driven by efficiency or quality sorting across firms. Each cell reports the predicted sign of the correlation between firm or average (product-level) f.o.b. prices with export revenues, income, market size, bilateral distance, or overall remoteness *ceteris paribus*. The column headings indicate whether this correlation is across firms in a destination or across destinations within a firm. The bottom row shows the patterns that obtain in the data.

VI.A. Efficiency and Quality Sorting with CES Demand

Under efficiency sorting and CES demand (Melitz 2003), more productive firms have lower marginal costs, set lower prices, sell higher quantities, and earn larger revenues. This generates a negative correlation between f.o.b. export prices and export revenues across firms offering a particular good in a given destination.

A number of recent publications have incorporated quality differentiation across firms into this framework. In these models, product quality enters the utility function through a quantity-augmenting term and quality-adjusted prices behave as in Melitz (2003). While the micro-foundations of firms' quality choice differ across papers, more successful firms always sell higher-quality goods. For example, quality upgrading may entail a fixed cost that only more productive firms can afford (Johnson 2007), or firms may choose the quality of their inputs (Kugler and Verhoogen 2011; Verhoogen 2008). In view of our results, we discuss the latter framework shortly.

Although more productive firms can process any given input more efficiently, they optimally use more expensive, better-quality inputs to produce higher-quality goods. If quality increases in productivity sufficiently quickly, so will marginal costs and f.o.b. prices. F.o.b. export prices would then be positively correlated with revenues across sellers in a given market. On the other hand, when the elasticity of marginal costs with respect to quality is not sufficiently high, all predictions of the quality-augmented model would be identical to those of Melitz (2003). In Table X and the following discussion, we summarize the former case.

With CES demand, firms optimally charge a constant markup above variable cost in every market. Thus, an exporter's f.o.b. price does not depend on the identity of its trade partner, and does not vary systematically with revenues, market size, income, distance, or remoteness across destinations. This holds under both efficiency and quality sorting.

In the presence of fixed trade costs, only firms above a certain productivity threshold make positive profits and become exporters. Because firm revenues increase with aggregate spending and with the aggregate price index in an economy, this cut-off is lower for bigger[37] and more remote markets. On the other hand,

37. This result holds with free entry in general equilibrium. See Helpman, Melitz, and Yeaple (2004); Helpman, Melitz, and Rubinstein (2008); Chaney (2008); and Baldwin and Harrigan (2011).

it rises with bilateral distance because servicing more distant countries entails higher transportation costs and lower profits. This implies that under efficiency sorting, the average export price across all Chinese firms selling in a given country-product market should rise with destination size and remoteness and fall with bilateral distance. The opposite would hold under quality sorting. Since CES preferences are homothetic, however, GDP per capita would not affect firm selection into exporting or the average price across exporters, all else equal.

VI.B. Efficiency and Quality Sorting with Linear Demand

Melitz and Ottaviano (2008) provide an alternative treatment of efficiency sorting in which firms face linear demand as in Ottaviano, Tabuchi, and Thisse (2002). Kneller and Yu (2008) extend this framework to embed quality differentiation across firms. In both models, the price elasticity of residual demand is not constant as with CES preferences but depends on the toughness of competition in a market. Chinese firms would then optimally charge lower mark-ups and lower f.o.b. prices for the same product in bigger and more distant destinations. This occurs because larger markets attract a greater number of competitors, while countries further away from China are supplied by relatively more productive Chinese firms that set lower prices. Both forces reduce the aggregate price index and incentivize Chinese exporters to cut their mark-ups. On the other hand, the aggregate price index is higher in remote destinations. Holding bilateral distance from China fixed, a Chinese exporter would thus charge more in remote markets.[38] Because export revenues increase with market size but fall with distance, however, unit values may be either positively or negatively correlated with sales within a firm across destinations.

Because more productive firms have lower marginal costs in Melitz and Ottaviano (2008), they offer lower prices, sell higher quantities, and earn larger revenues, even though they charge higher mark-ups. This efficiency-sorting model thus also delivers a negative correlation between f.o.b. export prices and sales across Chinese exporters in a given market. Quality sorting in Kneller and Yu (2008), on the other hand, implies that better-quality

38. These predictions are not limited to models of variable mark-ups based on linear demand. The translog expenditure function in Feenstra (2003), for example, would deliver similar results.

firms set higher prices because of their larger variable costs, as well as because they charge a bigger mark-up.[39] When quality rises sufficiently quickly with marginal costs, higher-quality firms capture a bigger market share, and f.o.b. prices and revenues are positively correlated across firms in a given destination. Otherwise, the correlation remains negative, as in Melitz and Ottaviano (2008).

With linear demand, demand for any product is zero above a given price and only firms above a certain productivity or quality cut-off become exporters. This threshold is higher for bigger, more distant, and less remote destinations where competition is tougher. Under efficiency sorting, tougher markets both select firms with lower marginal costs and force each exporter to set a lower mark-up. The average f.o.b. price across Chinese exporters to a given country would thus fall with its GDP, bilateral distance, and centrality. On the other hand, the behavior of aggregate prices is ambiguous under quality sorting: while tougher competition attracts firms above a higher quality cut-off that charge higher prices, it also induces lower mark-ups. Finally, since linear demand preferences are not homothetic, the impact of destinations' income on export prices at the firm level, as well as on the average price across Chinese exporters, is theoretically ambiguous.

VII. Interpreting the Stylized Facts

We next interpret the stylized facts we have established in view of the models already described and conclude that none of the existing theoretical frameworks can match all empirical results. We suggest that a successful model should incorporate quality differentiation across firms, as well as across destinations within firms, to rationalize the systematic patterns in the data.

VII.A. Quality Differentiation across Firms

The observed variation in trade activity across Chinese exporters is strongly indicative of quality differentiation across firms. In particular, exporters that charge higher prices earn greater revenues within narrowly defined destination-product

39. Kneller and Yu (2008) directly assume that firms with higher marginal costs produce higher quality. See Antoniades (2008) and Auer and Sauré (2009) for explicit models of firms' quality choice under linear demand.

markets (stylized fact 1). Moreover, firms that sell more abroad and that charge higher export prices import more expensive inputs (stylized fact 2).[40] These results are consistent with the idea that firms using higher-quality inputs, as proxied by steeper input prices, are able to produce more expensive, higher-quality products and thereby enjoy superior export performance. This does not imply that efficiency is unimportant for firms' export success, since productivity can determine firms' optimal choice of input and output quality.

Our results for firms' worldwide sales and number of export destinations provide further support for this quality interpretation. Heterogeneous-firm models predict that more productive firms not only have bigger revenues in any given country but also enter more markets because they are above the exporting cut-off for more trade partners. More productive firms thus also enjoy higher global revenues. With quality sorting, export and input prices should thus be positively correlated with worldwide sales and number of destinations across manufacturers of a given product. This is indeed what we find in the data (stylized facts 1 and 2). These correlations would instead have been negative in the absence of quality differentiation across firms.

The systematic variation we document across products with varying scope for quality differentiation and across countries with different income levels further corroborates these conclusions. Though stylized fact 1 holds for all products, it applies to a greater degree to nonhomogeneous goods and sectors intensive in R&D and advertising—precisely the cases where we believe the elasticity of marginal costs and prices with respect to quality to be high.[41] We also expect firms to have greater incentives to invest in quality when serving richer consumers with a higher willingness

40. Exporters who import inputs have bigger sales, more export destinations, and higher prices than exporters who do not (available on request). This suggests that foreign inputs are of higher quality than local inputs, and that more productive firms are able to incur the costs of sourcing inputs from abroad. See also Kugler and Verhoogen (2009). We have also found mixed evidence that firms might improve output quality by buying higher input quantities per unit of output. Although this quantity ratio is positively correlated with firms' export price, it is negatively correlated with firms' export revenues and number of destinations.

41. While the Rauch classification does not distinguish between horizontal and vertical differentiation, R&D and advertising intensity proxy the latter. The robustness of our results across these three measures, as well as the findings for firms' imported inputs, suggest that the variation identified by the Rauch dummy in our data is of a quality nature.

to pay for quality. The next subsection discusses this point in more detail.

The results for firms' imported inputs and number of export destinations are crucial for establishing the quality story. This is because we have considered a prominent yet specific class of models, and frameworks with other market structures could deliver a positive correlation between prices and sales across firms in a market even in the absence of quality differentiation. Conversely, in some environments the correlation might be negative even when firms do in fact differ in product quality.[42] Separately, our robustness checks notwithstanding, measurement error in export unit values could affect the estimated sign of this correlation. Different market structures, however, cannot rationalize the relationship of export performance with input prices or with trade partner intensity. Neither could ME bias, because the data on input values are unrelated to those on export activity, and the number of export markets is unrelated to export values.

VII.B. Quality Differentiation across Destinations within Firms

Although the variation across firms in the data is consistent with existing models of quality sorting, the variation across destinations within a firm cannot be reconciled with any of the heterogeneous-firm models we have examined. In particular, firms charge higher f.o.b. prices for the same product in richer, larger, more distant, and less isolated economies (stylized fact 3). The models we have discussed assume that each firm exports an identical product to all of its trade partners. If so, the firm-product pair fixed effects in our regressions would capture the marginal cost and quality characteristics of the firm's good. Any residual variation in f.o.b. prices across destinations would then have to be due to variable mark-ups. Extant models, however, predict either constant mark-ups (CES demand) or a pattern exactly opposite to that in the data (linear demand).

What can explain our results is that firms adjust not only mark-ups but also the quality of their products to the destination market by varying the quality of their inputs. Firms might thus

42. Price and revenue might be more positively correlated across firms at the lower end of the quality spectrum and less positively or even negatively correlated at the high end. If so, the patterns we document might hold because Chinese producers differ in product quality but nevertheless remain at the bottom of the worldwide quality distribution.

respond to market competition in two ways that are not mutually exclusive: by lowering mark-ups (for a given quality level) and by increasing product quality (for a given mark-up). Both strategies would reduce the quality-adjusted price for their product, thereby making them more competitive and their good more appealing to consumers. If quality upgrading requires more expensive sophisticated inputs, it could raise marginal costs sufficiently to dominate the mark-up reduction. We would then observe firms charging higher export prices in bigger, more distant, and less remote destinations where market competition is tougher.[43] Because our results would capture the net price effect of both the quality and mark-up adjustments, they would provide a lower bound for the former without ruling out the latter.

The positive correlation between f.o.b. prices and destinations' GDP per capita can also be attributed to quality differentiation across markets within a firm. Exporters might offer higher quality versions of their product and/or charge a higher mark-up for it in richer countries because wealthier consumers have a lower marginal utility of income and a greater willingness to pay for quality. This is consistent with the theoretical predictions Verhoogen (2008), Fajgelbaum, Grossman, and Helpman (2009), and Simonovska (2010) derive using nonhomothetic preferences. It can also explain why the effects of market size, proximity, and remoteness are concentrated in richer countries: in response to market toughness, firms have a greater incentive to upgrade quality when prospective consumers are willing to pay more for it.[44]

To illustrate these mechanisms, consider a Chinese shoe maker. This manufacturer can choose cheap man-made upper and low-quality soles to produce a cheap pair of shoes for export to Malaysia. He can then use high-quality leather uppers and expensive waterproof soles to build shoes for the German or U.S. market. This could be optimal because Malaysia is a poor country

43. Depending on modeling assumptions, bilateral distance may or may not affect market toughness once overall remoteness is controlled for.

44. Firms might offer more quality versions of a product in countries with greater income inequality to cater to different consumer segments of the market. We can measure this imperfectly with (i) the standard deviation of export prices across months within a firm, product, and destination triplet; and (ii) the standard deviation of export prices across months and firms within a product-destination pair. Although both are negatively correlated with countries' Gini coefficient on average, the correlation is indeed more positive for products with greater scope for quality upgrading.

where consumers have little taste for quality and the market is not very tough because it is relatively small and close to China but otherwise quite remote. By contrast, U.S. and German buyers are richer and have lower marginal utilities of income. The shoe maker also faces more competition in those big, distant, and more central markets, but could increase profits by improving quality and charging a higher price. Moreover, he need not incur fixed costs for each quality line, but could simply use different inputs and the same assembly technology.

This quality interpretation is furthermore consistent with the other empirical patterns we document. According to stylized fact 5, firms entering more markets offer a broader menu of export prices. This could emerge if firms adjust either mark-ups and/or quality across destinations. However, the relationship is more pronounced for products with greater potential for quality upgrading, which speaks to quality discrimination across countries. Stylized fact 6 in turn provides indirect evidence that firms vary input quality to manufacture multiple quality versions of their output product. In particular, firms that export more, sell to more destinations, and offer a broader menu of export prices buy inputs from more origin countries and pay a wider range of input prices. In the absence of detailed information on firms' domestic input purchases, this evidence is an imperfect signal of the quality range of all their inputs.

The positive correlation between f.o.b. prices and revenue across markets within a firm-product pair is also consistent with firms tailoring quality to each destination (stylized fact 4). Two factors can generate this pattern. First, firms offer higher quality versions of a good in bigger markets, where revenues are higher, and in more distant markets, where sales are lower. If product quality is sufficiently sensitive to market size, the former effect would dominate. Second, if firms both increase quality and lower mark-ups in tougher markets, their quality-adjusted price would fall, raising firm revenues precisely in markets where export prices are high.

While market size, bilateral distance, and centrality are positively correlated with the toughness of competition in the linear demand models we have considered, they need not be more generally. We therefore emphasize that the stylized facts are consistent with firms varying product quality in response to these destination characteristics without arguing that market toughness is necessarily the driving force behind these adjustments.

For example, firms might offer superior quality to bigger markets because of economies of scale in the production or delivery of quality goods. On the production side, upgrading product quality might entail fixed investments in specialized equipment or hiring skilled workers. On the delivery side, goods of expert quality might have higher fixed costs of marketing and distribution because of more sophisticated packaging, costlier transportation, or better trained local sales managers. As long as firms expect to earn higher revenues in larger markets and the destination-specific fixed costs of exporting rise with product quality, firms have an incentive to improve the quality of goods shipped to bigger countries.

Firms might also export products of higher quality to more distant nations if they face per-unit transportation costs instead of the iceberg shipping costs assumed in the models above. Per-unit costs lower the relative price of and raise relative demand for high-quality goods. Hence, if firms sell multiple quality versions of a product in each market, they would optimally export relatively more of their expensive, better-quality varieties to less proximate destinations.[45]

Finally, we briefly discuss two peripheral results. First, exporters who vary prices more across markets tend to import more expensive inputs on average (column (4) of Panel A in Table IX). Firms with greater export price dispersion are also more likely to set higher prices in big, distant, and central markets (stylized fact 3). Second, producers charging a higher average export price pay a wider range of import prices and source inputs from more countries (column (3) of Panels B, C, and D in Table IX). This suggests that successful exporters both offer higher-quality products on average and are better at varying product quality across markets.[46]

To summarize, we conclude that theory will have to incorporate both quality differentiation across firms and across destinations within a firm to be consistent with the stylized facts in the data. A successful framework will likely inherit properties of existing heterogeneous-firm models with quality sorting and

45. Alchian and Allen (1964) and Hummels and Skiba (2004) study this effect at the aggregate product level.

46. Exporters that sell more goods also offer more quality versions within each product (available on request). This suggests that a characteristic such as managerial talent may jointly determine firms' capacity to expand their product scope and quality range. Eckel et al. (2010) and Manova and Zhang (2011) study multiproduct, multiquality firms.

endogenous input choice, but also rationalize why firms offer higher quality to richer, bigger, more distant, and less remote markets.

VII.C. Alternative Explanations

Because we do not observe product quality directly, we consider two alternative explanations for our results and find that each of them can match some but not all of the patterns in the data.

First, with CES preferences and per-unit transportation costs, it is optimal for firms to charge higher mark-ups in more distant countries, even in the absence of quality differentiation across firms (Martin 2009). This framework, however, cannot generate a positive correlation between export prices and revenues across firms in a given market or rationalize the systematic patterns we find for firms' imported input prices.

Second, the positive correlation between sales and unit values across firms could be induced by firm-product-destination–specific demand shocks. Combined with market power in input markets, such demand shocks could also produce some of our results for import prices. For example, if exporters have monopsony power in input markets, a positive demand shock could increase their demand for inputs and explain why import prices are positively correlated with export prices and export revenues. Alternatively, if input producers have market power, a positive demand shock could reduce exporters' elasticity of input demand, allowing upstream suppliers to extract a higher price. This explanation, however, cannot rationalize the higher prices exporters charge in richer, bigger, more distant, and less remote markets, unless demand shocks vary systematically across countries. Neither can it account for the relationships we find between firms' range of import prices, range of export prices, and export performance. It also does not explain why the positive correlation between price and revenues increases with goods' scope for quality differentiation or with destination income.

VIII. Conclusion

This article examines the variation in export and import prices across firms, products, and trade partners to shed light on the determinants of firms' export success. We establish six stylized facts using rich data on the universe of Chinese trading firms. These facts have two main implications. First, more successful exporters use higher-quality inputs to produce higher-quality goods. Second, firms vary the quality of their products across destinations with different market size, income, bilateral distance, and overall remoteness by using inputs of different quality levels. We conclude that international trade models should incorporate both of these features to rationalize the systematic patterns in the data. Though we discuss alternative explanations for the effects of country characteristics on firms' quality choice, we remain agnostic about the underlying mechanism driving this decision. Our findings thus point to previously unexplored dimensions of firm heterogeneity and adjustments on the quality margin within firms across destinations that future theoretical and empirical work should pursue.

Understanding the nature of firm heterogeneity is important because of its implications for aggregate trade patterns and growth. Our results raise the possibility that in addition to modifying trade volumes, product scope, and export destinations, firms might also vary product quality within and across markets in response to trade reforms. A fruitful area for future research is how this new margin of adjustment impacts the effects of globalization on aggregate welfare and inequality.

APPENDIX TABLE A.I
THE CORRELATION BETWEEN PRICE, REVENUE, AND QUANTITY: AN ILLUSTRATION

Observation	Case 1 Revenue	Quantity	Price = R/Q	Case2 Revenue	Quantity	Price = R/Q
1.	10	10	1	60	60	1
2.	20	10	2	60	30	2
3.	30	10	3	60	20	3
4.	40	10	4	60	15	4
5.	50	10	5	60	12	5
Corr. (price,revenue)		1.000			NA	
Corr. (price,quantity)		NA			−0.902	
	Case 3 Revenue	Quantity	Price = R/Q	Case4 Revenue	Quantity	Price = R/Q
1.	10	10	1	18	18	1
2.	30	15	2	30	15	2
3.	36	12	3	30	10	3
4.	76	19	4	24	6	4
5.	70	14	5	15	3	5
Corr. (price,revenue)		0.941			−0.277	
Corr. (price,quantity)		0.560			−0.996	
	Case 5 Revenue	Quantity	Price = R/Q	Case 6 Revenue	Quantity	Price = R/Q
1.	15	15	1	1	1	1
2.	18	9	2	6	3	2
3.	18	6	3	15	5	3
4.	28	7	4	8	2	4
5.	20	4	5	5	1	5
Corr. (price,revenue)		0.643			0.307	
Corr. (price,quantity)		−0.902			−0.094	

Notes. This table illustrates that constructing unit prices as the ratio of revenues and quantities does not restrict the sign of the correlation between price and revenue or between price and quantity. The table shows six hypothetical scenarios in which five observations have the same price profile but very different revenue and quantity profiles.

APPENDIX TABLE A.II
ALTERNATIVE SPECIFICATIONS FOR TABLE IV

	Variation across firms Within destination-product pairs					
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. Dep. variable: (log) rank of a firm's f.o.b. export price, by HS-8 product and destination						
(log) Revenue rank	0.077***		0.026***	0.073***	0.051***	0.057***
	(41.63)		(3.05)	(30.06)	(13.60)	(5.53)
(log) Quantity rank		−0.254***				
		(− 189.44)				
(log) Revenue rank x different. good			0.059***			
			(6.69)			
(log) Revenue rank x R&D intensity				0.192***		
				(2.65)		
(log) Revenue rank x adv. + R&D intensity					0.973***	
					(8.49)	
(log) Revenue rank x (log) GDP per capita						0.002*
						(1.85)
Destination-product FE	Y	Y	Y	Y	Y	Y
R-squared	0.796	0.808	0.795	0.796	0.796	0.796
# observations	2,179,923	2,179,923	1,494,839	2,130,413	2,139,735	2,098,634
# dest-product pairs	258,056	258,056	163,873	247,867	249,874	242,403

APPENDIX TABLE A.II
(CONTINUED)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel B. Dep. variable: (log) f.o.b. export price, by firm and HS-8 product							
(log) Revenue	0.065***		0.023***	0.065***	0.061***	0.054***	0.061***
	(58.85)		(6.38)	(48.40)	(53.05)	(30.22)	(3.61)
(log) Quantity		−0.154***					
		(− 126.72)					
(log) Revenue x different. good			0.050***				
			(13.02)				
(log) Revenue x R&D intensity				0.007			
				(0.11)			
(log) Revenue x high R&D intensity					0.009***		
					(4.00)		
(log) Revenue x adv. + R&D intensity						0.417***	
						(7.41)	
(log) Revenue x (log) GDP per capita							0.005***
							(7.23)
Destination-product FE	Y	Y	Y	Y	Y	Y	Y
R-squared	0.762	0.784	0.748	0.758	0.758	0.758	0.760
# observations	2,185,553	2,185,553	1,499,163	2,136,030	2,136,030	2,145,355	2,103,953
# dest-product pairs	258,382	258,382	164,083	248,190	248,190	250,199	242,710

Notes. This table examines the relationship between firms' bilateral export prices and revenues. It exploits the variation across firms within a destination-product market by including country–HS-8 product pair fixed effects. The outcome variable in Panel A is the (log) rank of the f.o.b. export price of a firm in a destination and HS-8 product; the (log) revenue rank on the right-hand side is similarly defined. The outcome variable in Panel B is the (log) average f.o.b. export price by firm and HS-8 product, constructed as the ratio of worldwide revenues and quantities exported by firm and product; the right-hand-side variable is the firm's (log) revenue by HS-8 product and destination. Products' scope for quality differentiation is proxied as in Table III. All regressions include a constant term and cluster errors by destination-product. t-statistics in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

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