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Markups, quality, and trade costs☆

Natalie Chen [a,b,c,*], Luciana Juvenal [d]

[a] Department of Economics, University of Warwick, CAGE, Coventry CV4 7AL, UK
[b] CESifo, Munich, Germany
[c] CEPR, London, UK
[d] International Monetary Fund, Washington, DC, USA

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ABSTRACT

This paper examines how trade costs induced by geographic distance or bilateral tariffs impact the markups of exports differentiated by quality. It relies on a data set that combines Argentinean firm-level wine exports with experts' wine ratings as a measure of quality. Exporters price discriminate across destinations by raising markups in more distant markets, and by lowering them in high-tariff countries. However, the response of markups to changes in trade costs is heterogeneous and weaker for higher quality exports. These empirical patterns can be predicted by trade models featuring demand functions more convex than log-concave, but less than superconvex. They demonstrate that the variation in firm-level export unit values across markets is not only driven by quality differences but also by markup variation conditional on quality.

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* Corresponding author at: Department of Economics, University of Warwick, Coventry CV4 7AL, UK.
E-mail addresses: N.A.Chen@warwick.ac.uk (N. Chen), ljuvenal@imf.org (L. Juvenal).

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1. Introduction

One robust finding in the empirical trade literature shows that exporters set higher Free on Board (FOB) export prices when exporting to more distant countries. This empirical regularity is typically explained by a larger share of higher quality (and therefore more expensive) products being exported to more distant locations. This explanation is consistent with a *composition effect* induced by per-unit trade costs that lower the relative price, and increase the relative demand for higher quality goods in more distant countries (Alchian and Allen, 1964). It is also consistent with a *selection* (or *quality-sorting*) *effect* that occurs if firms choose to export higher quality varieties to more distant markets only.[1] In this paper, we propose a different mechanism: *conditional on quality*, exporters price discriminate and set higher markups and therefore higher prices in more distant countries.[2,3]

Using a unique data set of exports by Argentinean wine producers across destination countries, our paper makes three contributions. First, as we are able to identify exported wines with a given quality, we can decompose, by controlling for appropriate fixed effects, the distance elasticity of export unit values into markups and quality. This enables us to demonstrate that for a given quality, exporters price discriminate and raise markups in more distant countries.[4] Second, as we have access to an observable measure of quality for each wine exported by each producer, we can explore how quality shapes the relationship between markups and distance. We find strong evidence that the distance elasticity of markups is smaller in magnitude for higher quality exports. This implies that exporters price discriminate across countries depending on bilateral distance, but they price discriminate less for higher quality exports. Third, we propose a theoretical model to understand our empirical findings. We extend the general framework of Mrázová and Neary (2017) as it allows us to model the pricing behavior of exporters without having to specify the functional form of the demand system.

The data set we rely on is collected by the Argentinean customs and provides highly disaggregated firm-level wine exports (Chen and Juvenal, 2016, 2018). We observe the name of the exporting firm, the country of destination, the date of shipment, the FOB value (in US dollars) and the volume (in liters) of each wine exported between 2002 and 2009. The data set also provides the name, grape (Chardonnay, Malbec, etc.), type (white, red, or rosé), and vintage year of each wine exported. This level of detail is unique as trade statistics are generally only reported for aggregate product categories (defined, for instance, at the Harmonized System or HS level). While the grape, type, and vintage year are characteristics that can be shared by wines produced by different firms, the wine name is producer specific such that the combination name-grape-type-vintage year unambiguously identifies the producer of each wine. And as we only study wine producers and exclude wholesalers and retailers from the analysis, each wine in our sample is exported by one firm only (i.e., the winemaker).

Another distinguishing feature of our analysis is the availability of an observable measure of quality. We measure the quality of each wine using experts' wine ratings published by the Wine Spectator magazine (Chen and Juvenal, 2016, 2018; Crozet et al., 2012).[5] The Wine Spectator assigns a single quality rating to each wine depending on its name, grape, type, and vintage year which are the same characteristics as the ones we observe for each wine in the customs data set. By merging the wines from the customs data set with the quality ratings of the Wine Spectator by wine name, grape, type, and vintage year, we are therefore able to match each producer's exports of a given wine with a unique quality rating.

In a first step, we estimate the distance elasticity of markups. We regress export unit values as a proxy for export prices at the firm-wine-destination-year level on bilateral distance, and we identify the variation in markups by controlling for wine-year fixed effects (which are also producer specific). The wine-year fixed effects control for selection and composition effects (and therefore for differences in quality) by isolating for each wine with a given quality the variation in unit values across destinations in each

[1] For evidence on the Alchian and Allen (1964) mechanism, see Emlinger and Lamani (2020), Hummels and Skiba (2004), and Takechi (2015). On selection, see Baldwin and Harrigan (2011), Bastos and Silva (2010), Crozet et al. (2012), Harrigan et al. (2015), and Johnson (2012). Also see Görg et al. (2017), Lugovskyy and Skiba (2015, 2016), Manova and Zhang (2012), and Martin (2012).

[2] An older literature on spatial price discrimination studies how firms set markups depending on the distance to the buyer. Hoover (1937) shows that a monopolistically competitive seller can discriminate against more distant buyers by setting markups that increase with distance. Greenhut et al. (1985) propose a spatial pricing model that can explain "reverse dumping" in international trade, whereby domestic firms raise markups in more distant countries. Other models of spatial pricing with monopolistic competition that can deliver a positive relationship between markups and distance include Anderson and de Palma (2000), Chen and Riordan (2007), and MacLeod et al. (1988). For a review, see Thisse and Ushchev (2018).

[3] Composition is a demand-side effect, while selection and price discrimination are supply-side mechanisms. On the supply side, firms may also upgrade their quality for more distant countries (Martin, 2012). This would result in higher quality goods being disproportionately shipped at longer distances, with prices increasing for more distant countries.

[4] Recent empirical work demonstrates that firm-level markups are variable. For instance, markups respond to trade liberalization (De Loecker et al., 2016), exchange rate fluctuations (Berman et al., 2012), and vary with per capita income (Simonovska, 2015). Also see Amiti et al. (2014, 2019), Atkin and Donaldson (2015), Bellone et al. (2014), Chen et al. (2009), Chen and Juvenal (2016, 2018), De Loecker and Warzynski (2012), and Fitzgerald and Haller (2014), among others.

[5] A large body of theoretical and empirical work shows that quality plays a key role as a determinant of global trade flows and prices (Feenstra and Romalis, 2014; Hallak, 2006; Hummels and Klenow, 2005; Hummels and Skiba, 2004; Schott, 2004). As quality is unobserved, trade unit values are often used as a proxy. Recently, some papers have exploited direct measures of product quality. Atkin et al. (2017) use artisan assessments for Egyptian rugs. In Chen and Juvenal (2016, 2018) we use the same quality ratings for Argentinean wines as in this paper. Crozet et al. (2012) use quality scores for Champagne. Emlinger and Lamani (2020) measure the amount of time the eau-de-vie used to produce Cognac spends in oak. Medina (2021) identifies the quality of apparel products from their composition of primary materials. Other papers derive alternative measures of quality. Khandelwal (2010) compares exporters' market shares conditional on price to infer export quality. Piveteau and Smagghue (2019) estimate quality using trade data.

year. And under the assumption that the marginal cost of producing each wine does not vary across destinations, the variation in unit values across markets identifies the variation in markups.[6]

In a second step, we investigate how quality shapes the relationship between markups and distance. We regress export unit values on bilateral distance and its interaction with the quality ratings while controlling for wine-year fixed effects. We find strong evidence that the effect of distance on markups is weaker for higher quality exports. That is, exporters price discriminate across markets depending on bilateral distance, but they price discriminate less for higher quality exports.

Another finding in the empirical trade literature shows that exporters lower export prices in countries with higher tariffs (Görg et al., 2017; Hummels and Skiba, 2004; Lugovskyy and Skiba, 2016). We therefore extend our analysis and decompose the tariff elasticity of export unit values into markups and quality. Conditional on quality, we find that exporters lower markups in more protectionist markets. But the effect of tariffs on markups is weaker for higher quality exports. Our paper is thus the first to establish that distance and tariffs impact export markups across international markets. Moreover, we provide clean evidence that the effects of distance and tariffs on markups are heterogeneous and weaker for higher quality exports.

Quantitatively, our results can be summarized as follows. First, we confirm earlier findings in the literature that export unit values increase with distance and fall with tariffs. On average, a doubling of distance raises unit values by 3.53 percent, while a doubling of tariffs lowers unit values by 1.38 percent. Second, once we hold quality constant, we show that the effects of distance and tariffs on unit values can be explained by variable markups. On average, markups rise by 2.10 percent and fall by 1.28 percent in response to a doubling of distance or tariffs, respectively. Third, we find that the elasticities of markups with respect to distance and tariffs are smaller in magnitude for higher quality exports. At the 5*th* percentile of the quality distribution, markups rise by 4.33 percent and fall by 2.76 percent if distance or tariffs double, respectively. Instead, no changes in markups are detected at the 95*th* percentile. Finally, we document that the heterogeneous effects of distance and tariffs on markups are stronger for exports to richer destinations.

Although exports are reported FOB, one concern is that export unit values may still include some costs of exporting to foreign destinations. This may happen if exporters need to comply with non-tariff measures on product standards and technical regulations that vary across destinations. To address this issue, we control for the incidence of non-tariff measures in our regressions. We find that exporters raise markups in countries with more pervasive non-tariff measures, and this increase is more pronounced for higher quality exports. Still, we continue to observe that markups covary positively with distance and negatively with tariffs, especially for lower quality exports. We therefore conclude that non-tariff measures matter in explaining the pricing decisions of exporters across markets, but they are not driving our results on the effects of distance and tariffs.

The Online Appendix provides extensions to our main specifications. First, we show that the heterogeneous effects of distance and tariffs on markups are predominantly driven by the higher quality firms, the larger firms, and the exporters who own a larger share of the export market. As high performance firms typically charge higher markups, they are better able to adjust markups in response to changes in trade costs. Second, as distance and tariffs may be correlated with other country-level characteristics affecting the pricing decisions of exporters in each quality segment, we control for the heterogeneous effects of additional country-level variables (each country's wine production and consumption per capita, value-added taxes on alcohol, share of wine imports from Argentina, GDP, GDP per capita, and remoteness). Third, we estimate the effects of distance and tariffs on export volumes across quality levels. Exports fall with distance and tariffs, but a higher quality reduces the magnitude of the distance elasticity, and increases the magnitude of the tariff elasticity. Finally, we demonstrate that our results remain robust to a whole set of sensitivity tests, and in particular to controlling for the heterogeneous pricing-to-market behavior of exporters, to using alternative measures of quality, different samples, and to instrumenting tariffs and quality.

Our results are important for several reasons. First, they provide evidence that the variation in firm-level export unit values across markets is not only driven by quality differences but also by markup variation conditional on quality. Due to market power, firms price discriminate across destinations. But they price discriminate more aggressively for lower quality exports. Second, as the markup of a given wine with a given quality varies across export markets depending on distance and tariffs, we conclude that trade costs play a key role in generating deviations from the Law of One Price. Trade costs thus matter in explaining the degree of international market segmentation. Lastly, as the heterogeneous effects of distance and tariffs are driven by high performance firms that contribute to the bulk of aggregate exports, we expect our findings to matter in explaining the variation in aggregate export prices across markets.

In a last step, we propose a theoretical framework to understand our empirical findings. We rely on the general setting of Mrázová and Neary (2017) as it enables us to study the pricing behavior of exporters without having to specify the functional form of the demand system. We extend their framework by introducing trade costs that have both a per-unit and an ad valorem component.[7] Under the assumption that per-unit trade costs increase with distance while ad valorem trade costs are independent of distance but vary with tariffs (Hummels and Skiba, 2004; Irarrazabal et al., 2015; Lugovskyy and Skiba, 2015), we can examine how export prices and markups vary with distance and tariffs.[8] The model shows that export prices and markups increase with

[6] Marginal costs could vary across destinations if exporters incur costs in order to comply with each country's non-tariff measures. We address this issue in Section 3.2.

[7] Ad valorem (iceberg, or multiplicative) trade costs are applied as a percentage of the producer price per unit traded, while per-unit (additive, or specific) trade costs are defined as a constant cost per unit traded. For evidence on per-unit trade costs, see Bosker and Buringh (2020), Daudin et al. (2022), Hummels and Skiba (2004), Irarrazabal et al. (2015), Lugovskyy and Skiba (2015), and Takechi (2015).

[8] Per-unit trade costs increase with distance as they vary with the origin and the destination (Irarrazabal et al., 2015). See Section 6.1 for evidence in the case of wine exports.

per-unit trade costs (and therefore with distance), and fall with ad valorem trade costs (and therefore with tariffs) as long as the demand function is more convex than log-concave, but less than superconvex.

Intuitively, the introduction of per-unit trade costs in the model creates a wedge between the elasticity of demand to the FOB price and the elasticity of demand to the CIF (Cost, Insurance, and Freight) price (Crozet et al., 2012; Irarrazabal et al., 2015; Martin, 2012). Moreover, the presence of per-unit trade costs generates an elasticity of demand to the FOB price that depends on both per-unit and ad valorem trade costs. Specifically, the elasticity of demand to the FOB price falls with per-unit trade costs (i.e., distance), and increases with ad valorem trade costs (i.e., tariffs). This induces exporters to raise markups in more distant markets, and to lower them in high-tariff countries. But for higher quality exports, the elasticity of demand perceived by exporters is less sensitive to changes in trade costs. As a result, the response of markups is weaker than for lower quality exports.

The predictions of our model depend crucially on two assumptions. The first is that per-unit trade costs increase with distance while ad valorem trade costs are independent of distance. As we argue, there are strong reasons to believe that distance predominantly increases per-unit trade costs for wine exports. At the same time, we demonstrate that the predictions of our model continue to hold if we allow for the possibility that ad valorem trade costs (such as tariffs) also increase with distance. The second assumption is that ad valorem trade costs can be proxied by tariffs. But some countries also levy tariffs on a per-unit basis. To address this issue, we distinguish in our regressions between the 6-digit HS-level duties that only contain ad valorem tariffs and the ones that include an ad valorem and a per-unit component. We find that tariffs have a negative effect on markups that is weaker for higher quality exports only if tariffs are purely defined on an ad valorem basis.

The remainder of the paper is organized as follows. Section 2 provides a brief background of Argentina's wine export sector. It then describes our data set and provides descriptive statistics. Section 3 presents the empirical methodology and our main results. Section 4 summarizes extensions and robustness checks. Section 5 presents our theoretical framework. Section 6 addresses the relevance of our model assumptions for wine exports. Section 7 concludes. The Online Appendix provides additional results.

2. Data and descriptive statistics

We start with an overview of Argentina's wine export industry. We then proceed with a description of our data set that combines information from different sources: firm-level customs data, wine experts' quality ratings, and macroeconomic indicators.

2.1. Argentina's wine export industry

Until the early 1990s, wine production in Argentina was mainly consumed domestically as wineries produced cheap table wines using traditional old-world winemaking techniques. As wine firms started to produce new-world wines of higher quality, Argentinean wine exports increased from 25 million US dollars in 1993 to 646 million US dollars in 2008.[9] During that period the number of export markets more than doubled, and exports shifted from Latin American countries to OECD markets. By 2008, Argentina had become the tenth largest wine exporter in the world (Artopoulos et al., 2013).

What can explain this substantial growth of Argentinean wine exports, and in particular to high-income countries? According to Artopoulos et al. (2013), firms from developing countries that succeed in consistently exporting differentiated products to high-income economies adopt business practices that differ markedly from those that prevail in their domestic market. They investigate which types of products are demanded by developed countries, and they adapt their products and upgrade their quality in order to satisfy the preferences of consumers in high-income markets. They also interact with foreign distributors who provide key information about evolving trends in foreign markets.

In the case of Argentinean wine, Nicolás Catena Zapata was the first to adopt such business practices and to produce and successfully export new-world wines to high-income countries.[10] His success as an export pioneer was observed by other wine producers who subsequently adopted similar business practices. After 1997 the number of wineries producing new-world wines surged, leading to more exports in the sector. Exports started to grow substantially after the peso devaluation of 2002, with a large share shipped to high-income countries. As our sample spans the period from 2002 to 2009, our analysis concentrates on the period of sustained growth of Argentinean wine exports.

2.2. Customs data

Firm-level wine exports are collected by the Argentinean customs and were purchased from a private vendor called NOSIS (Chen and Juvenal, 2016, 2018). For each transaction between 2002 and 2009 we observe the name of the exporting firm, the destination country, the shipment date, the 12-digit Mercosur Common Nomenclature (MCN) code, the FOB value (in US dollars)

[9] Old-world wines are produced in the traditional winegrowing areas of Europe such as France, Italy, or Spain. New-world wines are produced in Argentina, Australia, Canada, Chile, Mexico, New Zealand, South Africa, and the US, and have a high quality but are substantially cheaper than old-world wines.

[10] Nicolás Catena Zapata spent three years as a visiting professor at UC Berkeley. During this time he visited wineries in Napa Valley and interacted with winemakers specialized in new-world winemaking techniques. He then used these techniques back home in Argentina in order to produce new-world wines in his family winery. To promote his wines abroad, he worked with wine journalists and had his wines reviewed by the Wine Spectator magazine. He also went on promotion tours around the US with Argentinean tango dancers in order to associate the quality of his wines with symbols of Argentina's culture (Artopoulos et al., 2013).

and the volume (in liters) of each wine exported.[11,12] As export values are reported FOB they exclude transport costs, tariffs, and distribution costs in the importing country. We aggregate the data at annual frequency between 2002 and 2009. As we show in Online Appendix C, our results remain robust to using our raw data at the transaction level, and to aggregating the data at quarterly or monthly frequency.

For each wine exported we observe its name, type (red, white, or rosé), grape (Malbec, Chardonnay, etc.), and vintage year.[13] The grape, type, and vintage year are characteristics that can be shared by wines produced by different firms. Instead, the wine name is producer specific such that the combination name-grape-type-vintage year unambiguously identifies the producer of each wine. And as we only study wine producers and exclude wholesalers and retailers from the analysis, each wine in our sample is exported by one firm only (i.e., the winemaker). But as we show in Online Appendix C, our results remain robust to including wholesalers and retailers in the sample.[14]

We compute FOB unit values as a proxy for export prices by dividing the value by the volume exported at the firm-wine-destination-year level. We do not observe the currency of invoicing, but as Datamyne, a private vendor of international trade data, reports that 88 percent of Argentinean wine exports (HS code 22.04) between 2005 and 2008 were priced in US dollars, we measure unit values in US dollars per liter. As unit values are defined for positive exports only, our analysis focuses on the intensive margin of adjustment (we deal with the extensive margin in Online Appendix C).

We argue that our unit values can plausibly be interpreted as prices. On the one hand, they are measured for *individual* wines. This means we can compare the unit values of a given wine exported by a given firm at a given point in time across destinations, holding quality constant. This is clearly an advantage over aggregated unit values (defined, for instance, at the HS level) that measure the *average* price of different varieties with heterogeneous levels of quality. On the other hand, as the volume is only reported in liters, the unit of measurement of unit values is homogeneous across products.

We clean the data in several ways. We only keep FOB transactions and exclude the wines produced outside of Argentina. We drop the shipments containing less than 4.5 liters (which corresponds to six 75cl bottles) to discard commercial samples exported for marketing and promotion. We omit the observations for which the vintage year is reported as being ahead of the shipment year, and the cases where the export value is positive, but the volume is reported as zero. To eliminate potential outliers, for each exporter in each year we calculate the median unit value and we drop the observations for which the unit value exceeds 100 times the median, or falls below the median divided by 100.

2.3. Quality

We measure quality using the time-invariant quality ratings published by the Wine Spectator magazine (Chen and Juvenal, 2016, 2018). The wines are assessed in blind tastings, and the ratings are given on a (50,100) scale according to the wine's name, grape, type, and vintage year. A higher score indicates a higher quality. Table 1 describes the Wine Spectator rating classification.

By merging the wines from the customs data set with the quality ratings of the Wine Spectator by wine name, type, grape, and vintage year, we can match each producer's exports of a given wine with a unique quality rating. We end up with 237 producers, 8793 wines, and 92 destination countries between 2002 and 2009 (Online Appendix A lists the countries included in our sample). Our sample represents 48 percent of the total value of red, white, and rosé wine exported over the period (59,947 observations). We observe 1065 different wine names, three types, 24 grapes, and 22 vintage years (from 1977 to 2009). The lowest rated wine receives a score of 55, and the highest a score of 97.[15]

To illustrate that in our sample each wine is associated with a unique quality rating and is exported by a single firm (i.e., the wine producer), Table 2 provides examples of wines included in our data set. As the firm and wine names are confidential, they are replaced by letters instead.

In our sample we observe that producer A exports many different wines it produces, including wines 1, 2, and 3. Wines 1 and 2 have the same name, type, and grape, but a different vintage year. They also have a different quality. Instead, wines 1 and 3 have the same name, type, and vintage year, but a different grape. They also have a different quality. In our data set, the three wines are counted as three different products, and they each have their own quality rating. Moreover, they are all exported by one firm only, i.e., the wine producer. As the three wines have the same name as the wine producer, it is clear from those examples that the wine name is producer specific. Similar observations apply to wines 4, 5, and 6 except that they do not have the same name as their producer. Still, the three wines are only produced, and in our sample are only exported, by producer B.

[11] Due to confidentiality reasons, the customs office does not provide the exporter's name. NOSIS therefore uses its own market knowledge to identify a first, a second, and a third probable exporter. To identify the exporter's identity we collected from the Instituto Nacional de Vitivinicultura the name of the producer and of the wholesaler authorized to export each wine and we compared them against the probable exporters reported by NOSIS.

[12] The first six digits of the MCN coincide with the HS and the next two are unique to Mercosur. Argentina adds three more digits and a letter.

[13] We also observe the type of packaging used for shipping. As markups may vary with the packaging type, in Online Appendix Table C2 we define a wine according to its name, grape, type, vintage year, and container type.

[14] In Argentina, a very small share of wine exports is handled by intermediaries. In our data set, this share is equal to 4.80 percent in 2002 and 5.33 percent in 2009.

[15] In Online Appendix Table C6 we show that our results remain robust if we instead use the Robert Parker quality ratings which are also defined on a (50,100) scale according to the wine's name, grape, type, and vintage year.

Table 1
Wine Spectator quality ratings.

Quality bin	Ratings (50,100)
Great	95–100
Outstanding	90–94
Very good	85–89
Good	80–84
Mediocre	75–79
Not recommended	50–74

Note: The Wine Spectator classifies the quality scores into six different bins.

Table 2
Examples of wines included in our sample.

Wine	Producer name	Wine name	Type	Grape	Vintage year	Wine Spectator
1	A	A	Red	Malbec	2002	89
2	A	A	Red	Malbec	2004	85
3	A	A	Red	Merlot	2002	87
4	B	C	White	Chardonnay	2001	85
5	B	C	White	Chardonnay	2005	88
6	B	C	White	Sauvignon	2001	86

Note: The producer and wine names are confidential and are replaced by letters instead.

2.4. Macroeconomic data

We obtain bilateral distances (in kilometers) from the Centre d'Etudes Prospectives et d'Informations Internationales (CEPII). We use the population-weighted great circle distance between the largest cities of two countries. From the United Nations Conference on Trade and Development (UNCTAD) TRAINS database we obtain bilateral ad valorem tariffs, at annual frequency, at the 6-digit HS level.[16] We use the effectively applied weighted average tariff rates in percentage terms (see Section 6.2). We also extract indicators on non-tariff measures (see Section 3.2). Annual GDPs and GDPs per capita (in PPP constant 2011 US dollars) are obtained from the World Bank's World Development Indicators.

2.5. A first glance at the data

Table 3 summarizes our trade data by year.[17] It shows that the number of exporters and of wines exported increased threefold between 2002 and 2009. A total of 937 wines were exported by 70 different producers in 2002, while 191 producers exported 2756 different wines in 2009. The number of export markets rose from 58 in 2002 to 77 in 2009. The mean number of exported wines and of destinations per producer, and the mean number of destinations per wine also increased over time (the number of observations, the number of exporters, and the mean number of destinations per exporter and per wine fell in 2009 due to the global financial crisis, see Chen and Juvenal, 2018).

Table 4 reports descriptive statistics by quality bin of the Wine Spectator. "Good" and "Very good" wines represent the largest share of the sample (in terms of number of observations, exporters, wines, destinations, and export share in the sample). Instead, "Great" and "Not recommended" wines have the smallest coverages. "Great" wines are exported to fewer countries which are, on average, richer. Consistent with quality sorting and the Alchian and Allen (1964) conjecture, "Great" wines are also exported to more distant locations.[18] Higher quality wines are on average more expensive (the correlation between unit values and quality in our sample is 37.6 percent).

Table 5 describes our data by region of destination. North America is the main destination for Argentinean wine exports (in terms of number of exporters, wines, and share of exports). Compared to Europe or Asia/Oceania which have a similar income per capita, North America is larger and is closer to Argentina. South America only imports 13 percent of Argentinean wine exports.

[16] There is very little variation across HS codes in our sample. Most export transactions are classified under code 20.04.21 (59,484 out of 59,947 observations, or 99 percent of the sample). The others are classified under codes 22.04.29 (413 observations), 22.04.10 (46 observations), and 22.04.30 (4 observations).

[17] We describe our data for the full sample of observations. The regressions in Table 6 only use a subset of the 59,947 observations available because the observations perfectly predicted by the fixed effects (i.e., singletons) are omitted.

[18] Argentina's higher income export destinations such as the US and the EU also tend to be farther away. In our sample, the correlation between income per capita and bilateral distance is equal to 58.9 percent.

Table 3
Summary statistics.

Year	Number of observations	Number of exporters	Number of wines	Number of destinations	Wines per exporter	Destinations per exporter	Destinations per wine
2002	2515	70	937	58	35.7	15.5	5.8
2003	3963	94	1241	59	37.3	17.6	7.5
2004	5228	123	1534	65	37.4	18.4	8.6
2005	7006	143	1859	67	39.0	20.7	10.2
2006	8630	166	2209	73	41.8	20.2	10.7
2007	10,627	178	2490	77	42.9	22.5	12.3
2008	11,344	196	2611	77	46.1	21.8	12.2
2009	10,634	191	2756	77	47.8	20.4	10.6

Note: For each year in the sample, the table reports the number of observations, exporters (producers), wines, destinations, and the mean number of wines per exporter, destinations per exporter, and destinations per wine.

Table 4
Descriptive statistics by quality bin of the Wine Spectator.

Quality bin	Number of observations	Number of exporters	Number of wines	Export share	Mean unit value	Number of destinations	Mean distance	Mean GDP per capita
Great	152	7	45	0.09%	29.99	29	9139	32,198
Outstanding	9025	79	1311	16.71%	13.02	79	8955	30,347
Very good	23,054	147	2639	43.92%	4.87	88	9058	29,264
Good	23,733	181	3798	34.04%	4.34	88	9114	30,260
Mediocre	3726	97	935	4.48%	3.98	80	9007	31,989
Not recommended	257	26	65	0.76%	4.11	48	8456	30,467

Note: For each quality bin, the table reports the number of observations, exporters (producers), wines, the export share (in %), the mean unit value (in US dollars per liter), the number of destinations, the mean distance to export markets (in kilometers), and the mean income per capita of the destination countries (in PPP constant 2011 US dollars).

Table 5
Descriptive statistics by region.

Region	Number of observations	Number of exporters	Number of wines	Export share	Unit value		Mean distance	Mean GDP per capita	Mean GDP
					(mean)	(max)			
N. America (19)	16,904	225	5845	48.37%	6.01	263.24	7854	33,947	7051
S. America (10)	13,703	165	4394	12.87%	6.24	84.45	2613	10,938	974
Europe (36)	22,522	189	5664	34.05%	5.61	380.80	11,595	38,295	1229
Asia/Oceania (20)	6509	127	2381	4.61%	5.90	222.85	17,010	32,306	2456
Africa (7)	309	31	224	0.09%	4.10	27.52	8557	6816	135

Note: For each region (listed in the first column, with the number of destination countries in each region between parentheses), the table reports the number of observations, exporters (producers), wines, the export share (in %), the mean and maximum unit value (in US dollars per liter), the mean distance from Argentina (in kilometers), the mean GDP per capita (in PPP constant 2011 US dollars), and the mean GDP (in billion PPP constant 2011 US dollars).

It is the closest region but has a low GDP and GDP per capita. The export share to Africa is negligible, but it is also the smallest and poorest region.

The table also shows that on average, unit values are lowest in Africa. Surprisingly, they are highest in South America. Still, the most expensive wines (above 200 US dollars per liter) are only exported to the largest, richest, and more distant regions (North America, Europe, and Asia/Oceania). Mean unit values do not appear to vary strongly with the mean distance to each region, but regions are an imperfect proxy for distance (Argentina is for instance closer to North America than to Africa, but the distance to Canada is 9391 kilometers against 7702 kilometers to Ghana).

Lastly, we regress (log) export unit values on wine-year and destination country dummy variables. As the wine-year fixed effects enable us to identify the variation in markups (defined as price over marginal cost), the estimated country fixed effects can be interpreted as the mean markup in each destination. In Fig. 1 we plot the country fixed effects against (log) distance. The slope is equal to 0.017, and implies that a doubling of distance increases markups by 1.2 percent ($2^{0.017} - 1$).

The figure shows that markups are on average highest for Luxembourg (LUX) which is a distant country. They are instead lower for Uruguay (URY) which is closer to Argentina. They are also low for Saint Lucia (LCA) and Belarus (BLR) which are, instead, relatively distant from Argentina. One possible explanation is that the variation depicted in Fig. 1 is also affected by

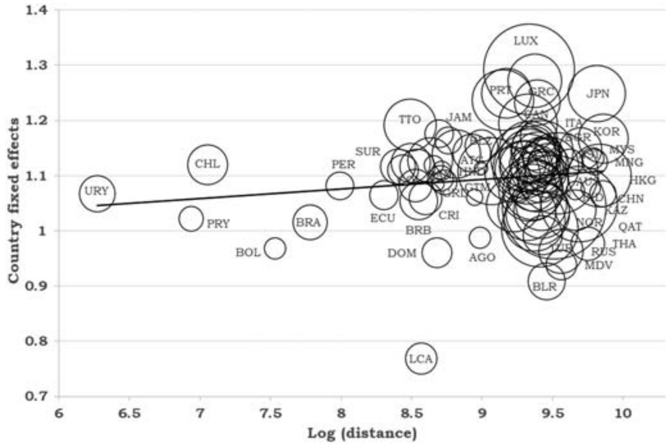

Fig. 1. Destination-specific mean markups against (log) bilateral distance. The mean markups are measured by the estimated country fixed effects obtained from regressing (log) export unit values on wine-year and destination country dummy variables. The circles are proportional to each country's GDP per capita.

differences in GDP per capita.[19] As can be seen from the circles which size is proportional to each country's GDP per capita, Luxembourg has the highest income per capita in the sample, while Saint Lucia and Belarus have much lower GDPs per capita.[20]

3. Empirical analysis

To establish how exporters adjust unit values and markups across destinations depending on distance, tariffs, and the quality of exports, we estimate:

$$\ln uv_{ijk,t} \quad = \quad \alpha_1 \ \ln dist_j + \alpha_2 \ \ln dist_j \times quality_k + \alpha_3 \ \ln\left(1 + tar_{Kj,t}\right) + \alpha_4 \ln\left(1 + tar_{Kj,t}\right) \times quality_k + \alpha_5 z_{j,t} + D_{k,t} + \varepsilon_{ijk,t}, \tag{1}$$

where $uv_{ijk,t}$ is the FOB unit value of wine k exported by firm i to country j in year t (in US dollars per liter). The quality of wine k (expressed in deviation from its mean) is measured by the Wine Spectator ratings and is denoted by $quality_k$. The bilateral distance $dist_j$ between Argentina and country j, and (one plus) the tariff rate $tar_{Kj,t}$ levied by country j on 6-digit HS-level K wine imports from Argentina in year t are both interacted with (demeaned) quality.

We control for destination-specific characteristics $z_{j,t}$ including (log) GDP, GDP per capita, and remoteness.[21] As depicted in Fig. 1, we expect GDP per capita to be associated with higher unit values, reflecting that wealthier countries have a stronger preference for quality (Bastos and Silva, 2010; Görg et al., 2017; Hummels and Skiba, 2004; Lugovskyy and Skiba, 2015; Manova and Zhang, 2012; Martin, 2012). As unit values depend on average prices in each export market, they should be higher in remote locations which are less competitive and have higher prices (Martin, 2012). They should instead be lower in larger countries where the degree of competition is strong (Baldwin and Harrigan, 2011; Görg et al., 2017; Harrigan et al., 2015; Martin, 2012).

We perform within estimations and include wine-year fixed effects $D_{k,t}$. The direct effect of quality therefore drops out from the regression. As the wine-year fixed effects isolate for each wine with a given quality the variation in unit values across destinations in each year, they control for selection and composition effects (and therefore for differences in quality).[22] And under the assumption that the marginal cost of producing each wine does not vary across destinations, the variation in unit values across markets identifies the variation in markups.[23] Specifically, define $uv_{ijk,t} = \mu_{ijk,t} c_{ik,t}$ where $\mu_{ijk,t} > 1$ is the markup and $c_{ik,t}$ is the

[19] Differences in alcohol taxes may also explain the variation in markups across countries. But as we show in Online Appendix Table B1, controlling for alcohol taxes does not affect our results.

[20] Visual inspection of the data also provides evidence of price discrimination. If we consider the wine shipped to the largest number of countries in a given year (50 countries in 2008), its unit value in that year varies between 2.17 and 4.57 US dollars per liter for exports to Panama (5126 kilometers) and Belgium (11,305 kilometers). Assuming that the marginal cost is the same across markets, the higher unit value for the more distant country suggests a higher markup. The higher unit value could also reflect higher costs for exporters if Belgium imposes more stringent non-tariff measures on imports than Panama does. In Section 3.2 we show that non-tariff measures cannot explain the positive relationship between distance and markups. Belgium is also richer than Panama but we control for GDP per capita in our regressions.

[21] A country is remote if it is geographically isolated from other countries or is close to small countries but far away from large economies. As in Baldwin and Harrigan (2011) we calculate remoteness as $\left(\sum_j GDP_j/dist_j\right)^{-1}$.

[22] Recall that a wine-year fixed effect is a time-varying fixed effect for each wine where a wine is defined according to a name-grape-type-vintage year combination. As the wine name is specific to the producer, the wine-year fixed effects are producer specific. As we only include wine producers in the sample, each wine is exported by one firm only and the wine-year fixed effects are therefore the same as firm-wine-year fixed effects. Quality is defined for each name-grape-type-vintage year combination and therefore drops out once wine-year fixed effects are included in the regressions.

[23] Selection and composition imply that unit values vary across destinations because different wines are sold in each market. Price discrimination captures that unit values vary across markets conditional on positive exports. By absorbing in each year the wines shipped to a single destination, the wine-year fixed effects control for selection and composition.

marginal cost that does not vary across destinations. Once we control for wine-year fixed effects, we identify the variation in (log) unit values of a wine k exported by firm i in year t between two destinations j and j' as:

$$\begin{aligned} \ln uv_{ijk,t} - \ln uv_{ij'k,t} &= \ln \mu_{ijk,t} + \ln c_{ik,t} - \ln \mu_{ij'k,t} - \ln c_{ik,t}, \\ &= \ln \mu_{ijk,t} - \ln \mu_{ij'k,t}. \end{aligned} \tag{2}$$

That is, the difference in unit values identifies the difference in markups.

Next, we estimate a more stringent specification:

$$\ln uv_{ijk,t} = \phi_1 \ln dist_j \times quality_k + \phi_2 \ln \left(1 + tar_{Kj,t}\right) + \phi_3 \ln \left(1 + tar_{Kj,t}\right) \times quality_k + D_{k,t} + D_{ij,t} + \upsilon_{ijk,t}, \tag{3}$$

where the firm-destination-year fixed effects $D_{ij,t}$ control for the time-varying demand or taste of a country for a firm's exports, or for the existence of contracts negotiated by some exporters in some destinations. They also absorb all destination-specific variables including distance, GDP, GDP per capita, and remoteness. In (1) and (3), robust standard errors are adjusted for clustering at the destination-year level.

3.1. Baseline results

We first revisit evidence from the prior literature that export unit values increase with distance and fall with tariffs. We then turn to our first contribution and decompose the distance and tariff elasticities of export unit values into markups and quality. This allows us to demonstrate that conditional on quality, markups covary positively with distance and negatively with tariffs. Our second contribution is to show that the effects of distance and tariffs on markups are heterogeneous across quality levels.

We start by evaluating the direct effects of distance and tariffs on export unit values. We estimate Eq. (1) but we omit the two interaction terms with quality. Also, we replace the wine-year fixed effects with firm-year dummy variables. The firm-year fixed effects identify for each exporter in each year the variation in unit values of all wines exported to all destinations. This variation can be driven by differences in the quality exported (i.e., selection and composition effects), and/or by variable markups. We also control for wine characteristics by including grape, type, vintage year, MCN-level, and province of origin of the grapes fixed effects. Fixed effects for the wine names are not included as they are collinear with the firm fixed effects (as the wine names are producer specific).

The results are reported in column (1) of Table 6. The estimated coefficient on distance is equal to 0.050 (significant at the one percent level). If distance doubles, export unit values increase by 3.53 percent ($2^{0.050}-1$). This distance elasticity is comparable in size to the elasticities estimated by other authors using firm-level data. Bastos and Silva (2010) report an elasticity of around 0.053, while the estimates of Görg et al. (2017) and Martin (2012) lie between 0.045−0.066 and 0.019−0.051 depending on the specification used, respectively. The smallest estimate is found by Manova and Zhang (2012) at 0.009, while Harrigan et al. (2015) report a larger elasticity of 0.187.

The estimated coefficient on tariffs is equal to −0.099 (significant at the five percent level). A doubling of tariffs (from their mean) therefore lowers unit values by 1.38 percent. Unit values are higher in richer and remote destinations, and lower in larger markets. Column (2) further controls for quality. Consistent with expectations, higher quality wines are exported at a higher price.

Next, in column (3) we decompose the elasticities of export unit values into markups and quality. To achieve this, we replace the firm-year fixed effects with wine-year dummy variables (the fixed effects for the wine characteristics become superfluous as they are perfectly collinear with the wine-year fixed effects). Compared to column (2), quality drops out from the regression, and the number of observations included falls as a larger number of singletons perfectly predicted by the fixed effects are omitted. As these singletons correspond to the wines exported to a single destination in a given year, their omission controls for selection and composition effects and therefore for differences in the quality exported across countries. Notably, the distance coefficient remains positive and the tariff coefficient negative. This specification therefore provides clean evidence that conditional on quality, exporters raise markups in more distant locations, and lower them in countries with higher tariffs.[24] If distance doubles, markups increase by 2.10 percent. A doubling of tariffs (from their mean) lowers markups by 1.28 percent.

Column (4) reports non-parametric estimates and regresses unit values on distance and tariff interval dummy variables while controlling for wine-year fixed effects (the dummies for the first intervals of distance and tariffs are omitted).[25] Distance between 2900 and 7700 kilometers increases markups by 2.6 log points. Markups increase by 5.8 log points if distance lies between 7700 and 14,200 kilometers, and by 6.9 log points if distance is greater than 14,200 kilometers. Instead, markups fall by 4.0 log points if tariffs lie between 20 and 60 percent, and by 5.5 log points for tariffs exceeding 60 percent. According to these estimates, it is again clear that exporters price discriminate and raise markups in more distant countries, and lower them in more protectionist markets.

[24] Markups may be adjusted not by exporters but by their subsidiaries in the destination country. Such transfer pricing is, however, more likely in the case of multinational firms while our sample includes wine producers only.

[25] For distance, the first group (below 2900 kilometers) includes Argentina's neighboring countries. The second (2900–7700 kilometers) contains other Latin American countries. The third (7700–14,200 kilometers) includes the US, Canada, Australia, New Zealand, Africa, Europe, and the Middle East. The last group (above 14,200 kilometers) contains Asian countries.

Table 6
Baseline results.

	(1)	(2)	(3)	(4)	(5)	(6)
ln Distance	0.050^{***} (0.011)	0.048^{***} (0.011)	0.030^{***} (0.009)	–	0.031^{***} (0.009)	–
ln Distance × Quality	–	–	–	–	-0.005^{***} (0.001)	-0.005^{***} (0.001)
2900 km ≤ Distance <7700 km	–	–	–	0.026^{**} (0.011)	–	–
7700 km ≤ Distance <14, 200 km	–	–	–	0.058^{***} (0.018)	–	–
Distance ≥14, 200 km	–	–	–	0.069^{***} (0.021)	–	–
Quality	–	0.037^{***} (0.001)	–	–	–	–
ln (1 + Tariffs)	-0.099^{**} (0.044)	-0.099^{**} (0.045)	-0.091^{**} (0.042)	–	-0.090^{**} (0.043)	-0.180 (0.188)
ln (1 + Tariffs) × Quality	–	–	–	–	0.017^{**} (0.007)	0.018^{***} (0.006)
20% ≤ Tariffs <40%	–	–	–	-0.040^{**} (0.016)	–	–
40% ≤ Tariffs <60%	–	–	–	-0.039^{**} (0.018)	–	–
Tariffs ≥60%	–	–	–	-0.055^{**} (0.024)	–	–
ln Remoteness	0.099^{***} (0.022)	0.098^{***} (0.022)	0.060^{***} (0.019)	0.042^{**} (0.019)	0.061^{***} (0.019)	–
ln GDP	-0.033^{***} (0.004)	-0.032^{***} (0.004)	-0.023^{***} (0.003)	-0.023^{***} (0.003)	-0.023^{***} (0.003)	–
ln GDP/capita	0.031^{***} (0.009)	0.033^{***} (0.009)	0.021^{***} (0.008)	0.014 (0.008)	0.021^{**} (0.008)	–
R-squared	0.527	0.542	0.767	0.767	0.767	0.886
Observations	59,830	59,830	52,894	52,894	52,894	50,735
Firm-year fixed effects	Yes	Yes	No	No	No	No
Wine characteristics fixed effects	Yes	Yes	No	No	No	No
Wine-year fixed effects	No	No	Yes	Yes	Yes	Yes
Firm-destination-year fixed effects	No	No	No	No	No	Yes

Notes: The dependent variable is the (log) FOB unit value of exports (in US dollars per liter). Quality is demeaned. Robust standard errors adjusted for clustering by destination-year between parentheses. *** and ** indicate significance at the one and five percent levels.

Finally, we explore the heterogeneous effects of distance and tariffs on markups differentiated by quality. Column (5) estimates Eq. (1) and therefore includes interaction terms between distance and tariffs and (demeaned) quality. As the distance interaction is negative and the tariff interaction is positive, the elasticities of markups with respect to trade costs are smaller in magnitude for higher quality exports. In other words, exporters price discriminate less for higher quality exports. Column (6) estimates Eq. (3). Due to the addition of firm-destination-year fixed effects, the number of observations included falls. But the distance interaction remains negative while the tariff interaction continues to be positive (the effect of tariffs at the mean value of quality is insignificant).[26]

How large are the heterogeneous effects of distance and tariffs? Based on the estimates of column (5), we evaluate the distance and tariff elasticities at different quality levels in our sample. At the mean value of quality (equal to 85), the distance elasticity is equal to 0.031. It is larger at 0.061 at the 5*th* percentile of the quality distribution (equal to 79), and falls to 0.002 (which is insignificant) at the 95*th* percentile (equal to 91). The tariff elasticity is equal to −0.090 at the mean value of quality. Its magnitude falls from −0.196 at the 5*th* percentile of the quality distribution to 0.012 (which is not significant) at the 95*th* percentile. For the higher quality wines (with a quality rating above 88), the distance and tariff elasticities are insignificant.

To summarize, our results demonstrate that export unit values increase with distance and fall with tariffs. This variation in export unit values across markets can be explained by variable markups. Due to market power, exporters price discriminate across foreign destinations. But they price discriminate less for higher quality exports.

3.2. Non-tariff measures

Although exports are reported FOB, export unit values may still include some costs of exporting to foreign destinations. One example are the costs incurred by exporters in order to comply with non-tariff measures on product standards and technical regulations that may vary across destinations. For instance, strict labelling requirements in the US and the EU may require the printing of different labels for each market, increasing the costs of selling to those destinations. Costs may also arise due to the Sanitary and Phytosanitary (SPS) measures on food safety and the protection of human health that exporters need to satisfy in order to gain access to foreign markets. Developed countries tend to have more stringent regulatory approaches and impose a larger number of non-tariff measures than other countries (UNCTAD, 2018). Wine imports are also highly regulated for quality and health reasons (Santeramo et al., 2019).

[26] Our results are consistent with Cavallo et al. (2021) who find that higher tariffs reduce to a larger extent the export prices of undifferentiated goods.

Table 7
Non-tariff measures.

	(1)	(2)	(3)	(4)	(5)	(6)
ln Distance	0.040*** (0.010)	0.040*** (0.010)	0.039*** (0.010)	0.041*** (0.010)	0.041*** (0.010)	0.040*** (0.010)
ln Distance × Quality	–	–	–	− 0.006*** (0.001)	− 0.006*** (0.001)	− 0.005*** (0.001)
ln (1 + Tariffs)	− 0.129*** (0.049)	− 0.128*** (0.049)	− 0.092** (0.041)	− 0.127** (0.050)	− 0.126** (0.050)	− 0.090** (0.042)
ln (1 + Tariffs) × Quality	–	–	–	0.021** (0.009)	0.021** (0.009)	0.018** (0.008)
ln Frequency ratio	0.015*** (0.005)	–	–	0.015*** (0.005)	–	–
ln Frequency ratio × Quality	–	–	–	0.002*** (0.001)	–	–
ln Coverage ratio	–	0.021*** (0.007)	–	–	0.020*** (0.007)	–
ln Coverage ratio × Quality	–	–	–	–	0.003*** (0.001)	–
NTM dummy	–	–	0.051*** (0.014)	–	–	0.051*** (0.014)
NTM dummy × Quality	–	–	–	–	–	0.004* (0.002)
R-squared	0.767	0.766	0.767	0.767	0.767	0.768
Observations	48,575	48,575	52,894	48,575	48,575	52,894

Notes: The dependent variable is the (log) FOB unit value of exports (in US dollars per liter). Quality is demeaned. Wine-year fixed effects are included. Robust standard errors adjusted for clustering by destination-year between parentheses. ***, **, and * indicate significance at the one, five, and ten percent levels. GDP, GDP per capita, and remoteness are included (not reported).

If the cost of producing each wine varies across destinations, controlling for wine-year fixed effects will not identify the variation in markups (see Eq. (2)). Specifically, if the countries imposing more stringent non-tariff measures (and therefore generating higher costs for exporters) also happen to be more distant or to levy lower tariffs, the distance and tariff elasticities in columns (3) to (5) of Table 6 will capture the effect of non-tariff measures (in column 6 the effect of non-tariff measures is absorbed by the firm-destination-year fixed effects).

To address this concern we control for the incidence of non-tariff measures in our regressions. We extract from UNCTAD's TRAINS database the frequency and coverage ratios of non-tariff measures for each destination country's food imports (HS codes 16–24) which are available for 2016 only.[27] The frequency ratio represents the percentage of 6-digit HS-level food products affected by non-tariff measures. The coverage ratio calculates the share of food import value subject to non-tariff measures.[28] As wine belongs to the food sector, we expect the two indicators to inform us about the pervasiveness of non-tariff measures for each country's wine imports.[29]

We also rely on another data set from TRAINS which is instead disaggregated at the 6-digit HS level.[30] It reports the number of non-tariff measures that apply to each country's imported products in 2016. For wine imports, this number varies between zero and five. But as observing more measures does not necessarily imply more regulatory stringency, we simply compute a dummy variable which is equal to one when a 6-digit HS-level wine import category is affected by non-tariff measures in a destination country (and zero otherwise).

In columns (1) to (3) of Table 7 we estimate Eq. (1) excluding the quality interaction terms. Instead, we include the frequency ratio, the coverage ratio (both for food imports), or the dummy variable for non-tariff measures on each country's wine imports. In columns (4) to (6) we further interact distance, tariffs, and the three indicators of non-tariff measures with quality. As the frequency and coverage ratios for food imports are not available for all the countries included in our sample (see Online Appendix A for the country coverage), the regressions are run on fewer observations than in Table 6.

The coefficients on the three indicators of non-tariff measures and their interactions with quality are all positive. These findings suggest that exporters incur higher costs in order to comply with the standards and regulations of foreign markets, and as a result they charge higher markups, especially for higher quality exports. But importantly, markups continue to increase with distance and to fall with tariffs. Moreover, these effects are larger in magnitude for lower quality exports. In other words, non-tariff measures matter in explaining the pricing behavior of exporters across markets, but they are not driving our results on the effects of distance and tariffs.

[27] UNCTAD collects each country's official and compulsory measures affecting traded goods. Voluntary measures, such as private standards, and international standards that are not compulsory are not included. The data are qualitative and do not provide any information on the stringency of regulations. One single measure could therefore be much more stringent and involve higher costs for exporters than several measures combined.

[28] The data are available at https://wits.worldbank.org/tariff/non-tariff-measures/en/ntm-datadownload. They are disaggregated according to the World Customs Organization (WCO) sector classification. Food products correspond to HS codes 16–24. The data set includes 75 countries (the EU is counted as one country) in 2016 (or earlier for some countries). There are no data for 24 countries in our sample (see Online Appendix A). The coverage ratio is calculated using bilateral import values from UNCTAD's South-South Trade Information System database that estimates missing values by averaging trade flows between 2014, 2015, and 2016.

[29] Food products and alcoholic beverages are among the most highly regulated sectors (UNCTAD, 2018).

[30] The data are available at https://trains.unctad.org/forms/Analysis.aspx for 92 countries (the EU is counted as one country) in 2016 (or earlier for some countries).

Table 8
Income heterogeneity across destinations.

	(1)	(2)
ln Distance	0.031*** (0.009)	0.031*** (0.009)
ln Distance × Quality × Rich	− 0.004*** (0.001)	− 0.005*** (0.001)
ln Distance × Quality × Poor	− 0.003*** (0.001)	− 0.004*** (0.001)
ln (1 + Tariffs)	− 0.103** (0.048)	− 0.087** (0.043)
ln (1 + Tariffs) × Quality × Rich	0.025** (0.012)	0.018** (0.008)
ln (1 + Tariffs) × Quality × Poor	0.002 (0.007)	0.000 (0.014)
R-squared	0.768	0.767
Observations	52,894	52,894
Rich versus Poor	Median GDP/capita	World Bank GNI

Notes: The dependent variable is the (log) FOB unit value of exports (in US dollars per liter). Quality is demeaned. Wine-year fixed effects are included. Robust standard errors adjusted for clustering by destination-year between parentheses. *** and ** indicate significance at the one and five percent levels. GDP, GDP per capita, remoteness, and a dummy variable for the richer destinations are included (not reported).

3.3. Income heterogeneity across destinations

Consumers in richer countries are generally assumed to have a stronger preference for higher quality goods (Chen and Juvenal, 2016, 2018; Crinò and Epifani, 2012; Fajgelbaum et al., 2011; Feenstra and Romalis, 2014; Hallak, 2006; Manova and Zhang, 2012; Simonovska, 2015). To establish whether per capita income matters for our results, we classify countries as rich or poor based on whether their income per capita is above or below the sample median. We estimate Eq. (1) and let the distance and tariff interactions vary between the richer and poorer destinations.

Column (1) of Table 8 shows the results. The coefficient on the interaction of distance with quality is significant for the two groups of countries, but it is larger in magnitude for the richer destinations (at the ten percent level). The effect of tariffs is heterogeneous for the richer markets only.

Column (2) shows that our results remain similar if we split our sample using the World Bank's classification of high and low income countries (the threshold is a GNI per capita of 4035 US dollars in 2011). The heterogeneous effects of trade costs on markups are thus stronger for exports to richer destinations.

4. Extensions and robustness

Online Appendix B reports extensions. First, as distance and tariffs may be correlated with other country-level characteristics affecting the pricing decisions of exporters in each quality segment, we control for the heterogeneous effects of additional country-level variables (real exchange rates, each country's wine production and consumption per capita, value-added taxes on alcohol, share of wine imports from Argentina, GDP, GDP per capita, and remoteness). Second, we find that the heterogeneous effects of distance and tariffs on markups tend to be stronger for the higher quality firms, the larger firms, and the exporters who own a larger share of the export market.

Next, in Online Appendix C we provide robustness checks on the estimation of Eq. (1). First, we implement the three-step estimator of Harrigan et al. (2015) and show that our results remain robust to selection bias across firms. We explain export values using a two-step Heckman estimator and include the residuals as a selection control in the unit values regression. Second, we use different samples and estimate alternative specifications. We include wholesalers and retailers in the sample, as well as the shipments containing less than 4.5 liters. We control for the port of exit from Argentina, the transport mode, and the packaging type. To account for the effects of the Argentinean and financial crises, we omit the years 2002 or 2009 from the sample. We discard Islamic countries which have low rates of alcohol consumption. To account for the possibility that the pricing strategies of exporters depend on shipment size, we control for export volumes and their interaction with quality. We also include the number of years that have elapsed since each wine was first exported to each destination in order to account for the building up of a customer base. As tariffs may be endogenous, we instrument tariffs and their interaction with quality. To deal with heteroskedasticity we estimate our regression by Poisson Pseudo Maximum Likelihood (PPML). Finally, we show that our results remain robust to clustering standard errors by wine-destination, and to multi-level clustering by firm and destination.

To check the robustness of our findings to the measurement of quality, we use the experts' wine ratings published by Robert Parker. We also rescale the Wine Spectator ratings between one and six. We exclude "Great" wines, as well as the US, from the sample. As endogeneity could arise due to measurement error in the quality ratings (Chen and Juvenal, 2016, 2018), we use the Parker scores to instrument the Wine Spectator ratings. Based on Khandelwal's (2010) methodology, we estimate quality for each 6-digit HS-level wine product category by firm-destination-year. We also show that the effects of distance and tariffs on markups are equally heterogeneous for the Wine Spectator bins of higher ("Very good," "Outstanding," and "Great") and lower ("Not recommended," "Mediocre," and "Good") quality. Finally, to address the possibility that the quality ratings are released after the first shipments take place, we exclude from the sample exports in the year (and in the year following the year) each wine is produced.

We measure unit values at quarterly, monthly, and transaction-level frequency. We account for the dynamic adjustment of prices, and estimate the cross-sectional variation of our coefficients. Finally, in Online Appendix D we estimate the effects of distance and tariffs on export volumes across quality levels. Exports fall with distance and tariffs, but a higher quality reduces the magnitude of the distance elasticity, and increases the magnitude of the tariff elasticity.

5. Theoretical framework

As is well known, CES preferences are extremely convenient analytically, but they are also very restrictive in their theoretical and empirical implications. For instance, when combined with monopolistic competition they predict that all firms have the same markup, which is inconsistent with empirical evidence.

In trade models, one way to address this issue is to relax the assumption that trade costs are ad valorem only. As shown by Martin (2012), the introduction of per-unit trade costs in a monopolistic competition model with CES demand generates variable markups that depend on trade costs.[31] In particular, markups (and therefore export prices) increase with per-unit trade costs, and fall with ad valorem trade costs (see, also, Crozet et al., 2012, and Irarrazabal et al., 2015).[32] In Chen and Juvenal (2019) we demonstrate that these predictions continue to hold if we replace CES preferences with translog (Feenstra, 2003) or additively quasi-separable utility (Behrens and Murata, 2007). Instead, they do not hold with quadratic, non-separable utility (Ottaviano et al., 2002).

In the model we propose below, we rely on the general setting of Mrázová and Neary (2017) that characterizes the relationship between prices and pass-through without having to specify the functional form of the demand system. We extend their framework by introducing trade costs that have both a per-unit and an ad valorem component. By assuming that per-unit trade costs increase with distance while ad valorem trade costs are independent of distance but can be proxied by tariffs (Hummels and Skiba, 2004; Irarrazabal et al., 2015; Lugovskyy and Skiba, 2015), we can examine how export prices and markups vary with distance and tariffs.[33]

We consider that producing a higher quality entails higher marginal costs as it requires sophisticated inputs, skilled workers, and specialized equipment which are expensive. In addition, we assume that quality reduces the elasticity of demand perceived by exporters such that a higher quality is associated with higher markups (Amiti et al., 2014; Atkeson and Burstein, 2008; Chen and Juvenal, 2016). A higher quality therefore increases export prices through two different channels: by increasing marginal costs, and by generating higher markups. For simplicity, we assume that firms export a single good.

5.1. Setup

Consider a monopolistically competitive exporter facing trade costs on exports to each destination country. Trade costs are typically modelled ad valorem such that more expensive products are more costly to trade. As in Martin (2012) we instead assume that trade costs t have the following structure:

$$t(q) = p^{cif}(q) - p^{fob}(q) = (\tau - 1)p^{fob}(q) + T, \tag{4}$$

where $p^{cif}(q)$ and $p^{fob}(q)$ are the CIF and FOB prices of the exporter, and τ and T are the ad valorem and per-unit components of trade costs, respectively. Trade costs are ad valorem only if T is zero, while they are per unit only if τ is equal to one. As long as T is positive, trade costs are less than proportional to the FOB price. The quantity sold by the exporter in each destination market (which depends on p^{cif}) is denoted by q.

The relationship between CIF and FOB prices can therefore be expressed as:

$$p^{fob}(q) = \frac{p^{cif}(q) - T}{\tau}. \tag{5}$$

We assume that the inverse demand faced by the exporter in each destination market simply shows the CIF price as a strictly decreasing function of firm exports q, i.e., $\partial p^{cif}/\partial q = p_q^{cif} < 0$.

When exporting to each destination market, the firm maximizes profits π:

$$\pi = \left(p^{fob}(q) - c\right)q, \tag{6}$$

[31] The theoretical model is available in the Martin (2010) working paper.

[32] In many models, including perfect competition models such as Eaton and Kortum (2002), or monopolistic competition models such as Krugman (1980) or Melitz (2003), markups are invariant to changes in trade costs.

[33] Some models yield predictions for the effects of distance and tariffs on export prices while assuming that markups are invariant to trade costs. For instance, see Baldwin and Harrigan (2011), Fajgelbaum et al. (2011), Hummels and Skiba (2004), Johnson (2012), and Lugovskyy and Skiba (2015, 2016).

where c is the marginal cost of the exporter.

The first-order condition is:

$$\pi_q = p^{fob}(q) + qp_q^{fob} - c = 0, \tag{7}$$

and states that marginal revenue is equal to marginal cost. The second-order condition is:

$$\pi_{qq} = 2p_q^{fob} + qp_{qq}^{fob} = p_q^{fob}(2-\rho) < 0, \tag{8}$$

and shows that at the optimum, marginal revenue is declining in output. The two conditions can be expressed in terms of two parameters that characterize the slope and curvature of the demand function. The first parameter is the elasticity of demand perceived by the exporter which is defined with respect to the FOB price, ϵ^{fob}:

$$\epsilon^{fob} = -\frac{p^{fob}(q)}{qp_q^{fob}} = -\frac{p^{cif}(q) - T}{qp_q^{cif}} > 0, \tag{9}$$

while the second parameter ρ captures the curvature of the demand function:

$$\rho = -\frac{qp_{qq}^{fob}}{p_q^{fob}} = -\frac{qp_{qq}^{cif}}{p_q^{cif}} \gtrless 0, \tag{10}$$

and its sign is determined by p_{qq}. For any well-behaved demand function, Mrázová and Neary (2017) define the "manifold" as the curve that relates the elasticity to the convexity of demand in the (ϵ, ρ)-space.

A monopolistically competitive firm that maximizes profits must be at a point on its demand curve where the elasticity is greater than one $(\epsilon > 1)$ and the convexity is less than two $(\rho < 2)$.[34] This admissible region in the (ϵ, ρ)-space can be split into two sub-regions that imply different comparative statics depending on how the elasticity of demand varies with firm output. The two regions are separated by the locus of CES demands, for which the elasticity does not vary with output such that all firms face the same markup. For a given elasticity, demands less convex than CES (i.e., "subconvex") have an elasticity that instead falls with output. Larger firms have a lower demand elasticity and higher markups, which is consistent with empirical evidence. For demand functions more convex than CES (i.e., "superconvex"), these predictions are reversed.[35]

Using the first-order condition (7) and Eq. (9) we can express the FOB price as a markup over marginal cost and introduce a role for quality θ:

$$p^{fob}(q, \theta) = \mu^{fob}(\theta)c(\theta) = \frac{\epsilon^{fob}(\theta)}{\epsilon^{fob}(\theta) - 1}c(\theta), \tag{11}$$

where $c(\theta)$ is the marginal cost of the exporter which is now assumed to increase with quality θ (i.e., $c_\theta > 0$). Producing a higher quality entails higher marginal costs because it requires higher quality and therefore more expensive inputs (Crinò and Epifani, 2012; Feenstra and Romalis, 2014; Johnson, 2012; Kugler and Verhoogen, 2012; Manova and Zhang, 2012; Verhoogen, 2008).[36] The markup $\mu^{fob}(\theta)$ is given by $\epsilon^{fob}(\theta)/\epsilon^{fob}(\theta) - 1 > 1$. We assume that a higher quality reduces the elasticity of demand perceived by the exporter, i.e., $\epsilon_\theta^{fob} < 0$ (Amiti et al., 2014; Atkeson and Burstein, 2008; Chen and Juvenal, 2016). This condition is satisfied if $p_{q\theta}^{fob} < 0$ (i.e., the slope of the demand curve decreases with quality), and implies that a higher quality is associated with higher markups (i.e., $\mu_\theta^{fob} > 0$). A higher quality therefore increases the FOB price through two different channels: by increasing marginal costs, and by generating higher markups. The assumption that higher quality exports are more expensive is consistent with the results reported in column (2) of Table 6.

5.2. Trade costs

We assume that T increases with distance while τ is independent of distance but varies with ad valorem tariffs (Hummels and Skiba, 2004; Irarrazabal et al., 2015; Lugovskyy and Skiba, 2015). The derivatives of the FOB price and markup with respect to T and τ can therefore be interpreted as derivatives with respect to distance and tariffs, respectively.

To convince the reader that these assumptions are reasonable, in Section 6.1 we argue there are strong reasons to believe that distance predominantly increases per-unit trade costs for wine exports. But if we allow for the possibility that ad valorem trade

34 The condition $\rho < 2$ ensures that the second-order condition (8) is satisfied.

35 See Eq. (6) in Mrázová and Neary (2020). The elasticity of demand varies with firm output according to $\epsilon_q = (\epsilon/q)(\rho - (\epsilon+1)/\epsilon)$. With CES demand, $\rho = (\epsilon+1)/\epsilon$ such that $\epsilon_q = 0$. For subconvex demands, $\rho < (\epsilon+1)/\epsilon$ such that $\epsilon_q < 0$. For superconvex demands, $\rho > (\epsilon+1)/\epsilon$ such that $\epsilon_q > 0$.

36 For evidence that producing higher quality wines entails higher marginal costs, see Chen and Juvenal (2016). For instance, the oak barrels in which higher quality wines mature are more costly than stainless-steel tanks.

costs (such as tariffs) also increase with distance, we can show that the predictions of our model continue to hold. In Section 6.2 we question whether tariffs are a suitable proxy for ad valorem trade costs. We discuss the existence of non-ad valorem tariffs and examine how they affect our empirical results.

5.2.1. Per-unit trade costs

To evaluate the effect of a change in per-unit trade costs on the FOB price and markup, we totally differentiate the first-order condition (7) with respect to T. We get $dq/dT = -\pi_{qT}/\pi_{qq}$, which implies $dp^{fob}/dT = p_T^{fob} - p_q^{fob}(\pi_{qT}/\pi_{qq})$ and $d\mu^{fob}/dT = \mu_T^{fob} - \mu_q^{fob}(\pi_{qT}/\pi_{qq})$. Once we evaluate the two expressions we get:

$$\frac{dp^{fob}}{dT} = -\frac{(1-\rho)}{\tau(2-\rho)} \gtreqless 0, \tag{12}$$

$$\frac{d\mu^{fob}}{dT} = -\frac{(1-\rho)}{c\tau(2-\rho)} \gtreqless 0. \tag{13}$$

The FOB price and markup increase with per-unit trade costs (i.e., $dp^{fob}/dT > 0$ and $d\mu^{fob}/dT > 0$), and therefore with distance, only if $\rho > 1$. As demand functions with $\rho = 1$ are log-concave, we conclude that the export price and markup increase with per-unit trade costs for any demand function that is more convex than log-concave.

5.2.2. Ad valorem trade costs

To evaluate the effect of a change in ad valorem trade costs on the FOB price and markup, we follow the same procedure and totally differentiate the first-order condition (7) with respect to τ. This gives $dq/d\tau = -\pi_{q\tau}/\pi_{qq}$, which implies $dp^{fob}/d\tau = p_\tau^{fob} - p_q^{fob}(\pi_{q\tau}/\pi_{qq})$ and $d\mu^{fob}/d\tau = \mu_\tau^{fob} - \mu_q^{fob}(\pi_{q\tau}/\pi_{qq})$. By evaluating the two expressions we obtain:

$$\frac{dp^{fob}}{d\tau} = -\frac{p^{fob}\left(1-\rho+\frac{1}{\epsilon^{fob}}\right)}{\tau(2-\rho)} \gtreqless 0, \tag{14}$$

$$\frac{d\mu^{fob}}{d\tau} = -\frac{\mu^{fob}\left(1-\rho+\frac{1}{\epsilon^{fob}}\right)}{\tau(2-\rho)} \gtreqless 0. \tag{15}$$

When $T = 0$, with CES demand we have $\epsilon^{fob} = \epsilon^{cif} = \sigma$ where σ is the elasticity of substitution which is constant (where ϵ^{cif} is defined as $-p^{cif}(q)/qp_q^{cif}$). As the convexity of CES demand is given by $\rho = (\sigma+1)/\sigma$, it follows that $1-\rho+1/\epsilon^{fob} = 0$ and the expressions in (14) and (15) are zero. Instead, if $T > 0$, $\epsilon^{fob} < \epsilon^{cif} = \sigma$ (see Eq. (9)) such that $1-\rho+1/\epsilon^{fob} > 0$ and the expressions in (14) and (15) are negative.[37] In other words, in the case of CES demand we obtain that the introduction of a per-unit trade cost in the model induces the FOB price and markup to decrease with ad valorem trade costs (Chen and Juvenal, 2019; Crozet et al., 2012; Irarrazabal et al., 2015; Martin, 2012).

More generally, for the export price and markup to decrease with ad valorem trade costs (i.e., $dp^{fob}/d\tau < 0$ and $d\mu^{fob}/d\tau < 0$), and therefore with tariffs, ρ needs to be less than its CES value with $T = 0$ or $\rho < 1 + 1/\epsilon^{fob}$ such that $1-\rho+1/\epsilon^{fob} > 0$. In other words, the demand function needs to be less than superconvex.

5.2.3. Parameter space

Our analysis shows that the combination $d\mu^{fob}/dT > 0$ and $d\mu^{fob}/d\tau < 0$, which is consistent with our empirical findings, implies demand functions characterized by $1 < \rho < 1 + 1/\epsilon^{fob}$. This range is empirically relevant as it involves subconvex demands (such that larger firms have higher markups). As a matter of fact, $d\mu^{fob}/dT > 0$ and $d\mu^{fob}/d\tau < 0$ is the only possible and empirically relevant combination. On the one hand, $d\mu^{fob}/dT > 0$ and $d\mu^{fob}/d\tau > 0$ implies superconvex demands (as $\rho > 1 + 1/\epsilon^{fob}$). On the other hand, although the combination $d\mu^{fob}/dT < 0$ and $d\mu^{fob}/d\tau < 0$ implies subconvex demands, the range defined by $\rho < 1$ and $\rho < 1 + 1/\epsilon^{fob}$ is ambiguous.

In Fig. 2, each point on the curve labelled CES in the (ϵ, ρ)-space corresponds to a different CES demand (the CES manifold is given by $\rho = (\epsilon+1)/\epsilon$). The grey shaded area shows the parameter space consistent with our empirical findings (for $\epsilon > 1$ and $\rho < 2$). For a given demand elasticity, the shaded area includes demand functions more convex than log-concave ($\rho > 1$), and less than superconvex ($\rho < 1 + 1/\epsilon^{fob}$).

Our findings are consistent with Chen and Juvenal (2019) where we show that allowing for per-unit trade costs in models with CES, translog, or additively separable demands can generate markups that covary positively with per-unit trade costs, and

37 As can be seen from Eqs. (9)–(10), the per-unit trade cost reduces the elasticity of demand ϵ^{fob} but does not affect the convexity ρ. The per-unit trade cost therefore shifts the manifold down in the (ϵ, ρ)-space.

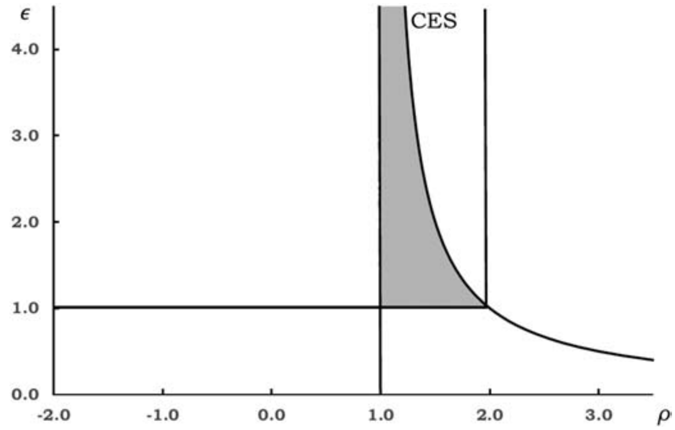

Fig. 2. The grey shaded area shows the parameter space consistent with our empirical findings. It includes demand functions more convex than log-concave and less than superconvex.

negatively with ad valorem trade costs. These demand functions are subconvex, and their manifolds cross our empirically relevant space defined by $1 < \rho < 1 + 1/\epsilon^{fob}$.

Instead, in the case of quasi-linear demand, our analysis in Chen and Juvenal (2019) shows that markups fall with per-unit and ad valorem trade costs (see, also, Martin, 2012). As this demand function has a convexity of zero, it satisfies the condition $\rho < 1 + 1/\epsilon^{fob}$ for markups to decrease with ad valorem trade costs, but it is inconsistent with $\rho > 1$ which is required for markups to increase with per-unit trade costs.

5.2.4. Mechanisms

The predictions that markups increase with per-unit trade costs, and fall with ad valorem trade costs, are driven by the introduction of per-unit trade costs in the model (Crozet et al., 2012; Irarrazabal et al., 2015; Martin, 2012). As can be seen from Eq. (9), if trade costs are ad valorem only (i.e., $T = 0$), the elasticity of demand to the FOB price and the elasticity of demand to the CIF price are identical. Moreover, the elasticity of demand to the FOB price is invariant to changes in ad valorem trade costs.

Once we allow for both per-unit and ad valorem trade costs, the additive component of trade costs creates a wedge between the elasticity of demand to the FOB price and the elasticity of demand to the CIF price such that $\epsilon^{fob} < \epsilon^{cif}$.[38] In addition, the presence of per-unit trade costs generates an elasticity of demand to the FOB price that depends on both per-unit and ad valorem trade costs. This can be seen by calculating the derivative of ϵ^{fob} with respect to T/τ which is given by:

$$\frac{\partial \epsilon^{fob}}{\partial (T/\tau)} = -\frac{\epsilon^{fob}}{p^{fob}} < 0. \tag{16}$$

For a given τ, ϵ^{fob} falls with per-unit trade costs (i.e., distance). As the demand in more distant markets is less elastic to changes in the FOB price, exporters find it profitable to raise markups and prices to compensate for the lower demand they face due to higher transport costs. Instead, for a given T, ϵ^{fob} increases with ad valorem trade costs (i.e., tariffs). The demand faced by exporters in more protectionist markets is more elastic to changes in the FOB price. This induces exporters to reduce markups and prices to compensate for the lower demand they face due to higher tariffs.

What about the heterogeneous effects of T and τ on markups differentiated by quality? As can be seen from Eq. (16), given that a higher quality increases the export price (i.e., $p_\theta^{fob} > 0$) and reduces the elasticity of demand perceived by the exporter (i.e., $\epsilon_\theta^{fob} < 0$), the sensitivity of ϵ^{fob} to changes in trade costs decreases with quality. For higher quality exports, ϵ^{fob} varies less with per-unit and ad valorem trade costs. The response of markups to changes in trade costs is therefore weaker than for lower quality exports. This prediction is consistent with our empirical results showing that the effects of distance and tariffs on markups are smaller in magnitude for higher quality exports. It is also consistent with theoretical derivations showing that with CES, and with translog and additively quasi-separable utility (but for some parameter values only), the elasticity of ϵ^{fob} with respect to per-unit trade costs is negative and increases with the FOB price (Irarrazabal et al., 2015), while the elasticity of ϵ^{fob} with respect to ad valorem trade costs is positive and decreases with the FOB price (Chen and Juvenal, 2019).[39]

In Online Appendix E we estimate how ϵ^{fob} varies with per-unit (i.e., distance) and ad valorem (i.e., tariffs) trade costs depending on the quality of exports. We find that ϵ^{fob} decreases with distance and increases with tariffs, and in both cases the effect is more modest for higher quality exports. This induces exporters to raise markups in more distant markets, and to lower them in countries with higher tariffs, especially for lower quality exports.

[38] If we express ϵ^{fob} as $\epsilon^{fob} = \epsilon^{cif}/(1 + T/\tau p^{fob})$, we can also see that $\epsilon^{fob} = \epsilon^{cif}$ if $T = 0$ while $\epsilon^{fob} < \epsilon^{cif}$ if $T > 0$.

[39] With quadratic preferences, the elasticities of ϵ^{fob} with respect to per-unit and ad valorem trade costs are instead positive and increase with the FOB price and therefore with quality (Chen and Juvenal, 2019; Irarrazabal et al., 2015). But as explained earlier, quasi-linear demand does not belong to our empirically relevant space.

6. Relevance of model assumptions

In our model, we assume that per-unit trade costs increase with distance while ad valorem trade costs are independent of distance. In Section 6.1 we discuss the relevance of these assumptions in the case of wine. In Section 6.2 we address the issue that tariffs are not always defined ad valorem and investigate how the presence of non-ad valorem tariffs affects our results.

6.1. Trade costs and bilateral distance

Irarrazabal et al. (2015) assume that distance only increases per-unit trade costs and estimate that the elasticity of T/τ with respect to distance is equal to 0.23 (see, also, Hummels and Skiba, 2004, and Lugovskyy and Skiba, 2015). Instead, other authors assume that distance increases both per-unit and ad valorem trade costs but they expect the effect to be larger for per-unit trade costs such that T/τ rises with distance (Crozet et al., 2012; Feenstra and Romalis, 2014; Martin, 2012; Takechi, 2015). In our model, we assume that only per-unit trade costs increase with distance. How plausible is this assumption in the case of wine?

First of all, shipping costs depend on the volume as opposed to the value exported and are quoted by case of wine bottles or by container type (for wine shipped in bulk). Shipping costs are higher for bottled wine which is heavier and bulkier than bulk wine (glass accounts for more than 40 percent of a bottle's filled weight), and they vary with the transport mode. Shipping wine by water is the cheapest option (ships use much less fuel per liter of wine), while transporting by road or air is more expensive.[40] But by transport mode, shipping costs increase with the distance between the origin and the destination. According to Cardebat et al. (2017), the cost of shipping by sea one bottle of wine from Bordeaux to New York is 0.290 euros, but 0.403 euros from Bordeaux to Hong Kong. By plane, these costs are higher at 29.2 and 33.3 euros per bottle, respectively.[41]

Freight insurance for wine is instead defined on an ad valorem basis. As damage and loss can happen during shipping or while loading or unloading, freight insurance covers the value of the wine from the source to the destination and is therefore quoted as a percentage of the total value transported. The wine is insured for the entire duration of the trip, irrespective of how long it takes or how far the destination is.[42] Freight insurance is therefore independent of the distance shipped. This is confirmed by Cardebat et al. (2017) who report that insurance costs are the same (i.e., 0.3 percent of shipment value) for wine shipped from Bordeaux to New York or Hong Kong.

What about tariffs? In our model, we assume that tariffs are ad valorem trade costs and are independent of distance (see Section 6.2 for the issue of per-unit tariffs). In our data set, we observe a positive but moderate correlation (0.31) between distance and tariffs. This positive relationship arises because Argentina benefits from preferential access to the markets of Mercosur countries which are also close geographically. But outside of free trade areas, there is no reason for tariffs to increase with distance. For instance Hong Kong, which is one of Argentina's most distant export markets, imposes no import duties on wine. If we exclude Mercosur countries and their associate members from the sample, the correlation between distance and tariffs drops to 0.11.

We therefore view the assumption that tariffs are independent of distance as reasonable. But to the extent that a positive correlation does exist (due, for instance, to regional trade agreements), we believe it should be weaker than the correlation between per-unit trade costs (such as shipping costs) and distance. As a result, T/τ would rise with distance. To account for this possibility, we derive expressions (12) and (13) with respect to T/τ (as opposed to T), and our predictions for the effect of distance on prices and markups continue to hold as:

$$\frac{dp^{fob}}{d(T/\tau)} = -\frac{(1-\rho)}{(2-\rho)} \gtrless 0, \tag{17}$$

$$\frac{d\mu^{fob}}{d(T/\tau)} = -\frac{(1-\rho)}{c(2-\rho)} \gtrless 0, \tag{18}$$

where the two expressions are positive only if $\rho > 1$.

To conclude, evidence shows that per-unit trade costs (such as shipping costs) increase with distance while ad valorem trade costs (such as freight insurance) are independent of distance. If we allow for the possibility that ad valorem trade costs such as tariffs increase (to some extent) with distance, the predictions of our model remain unchanged.

[40] See https://wineeconomist.com/2012/05/07/the-rise-of-big-really-big-box-wine and https://www.decanter.com/learn/advice/wine-shipping-costs-ask-decanter-327086-327086/.

[41] Shipping costs also increase with domestic distance. For instance, the average cost of shipping by road a case of 12 bottles of wine from California to bordering states is 50 US dollars, and it increases to 74 US dollars to other states. By air, these costs rise to 249 and 280 US dollars, respectively. See https://thewinecheck.com/cost-of-shipping-wine.

[42] See https://www.sourcinghub.io/the-cost-of-ocean-freight-insurance/.

Table 9
Ad valorem versus non-ad valorem tariffs.

	(1)	(2)	(3)
ln Distance	0.029*** (0.009)	0.031*** (0.009)	–
ln Distance × Quality	–	− 0.004*** (0.001)	− 0.004*** (0.001)
ln (1 + Tariffs) × Ad valorem	− 0.129*** (0.048)	− 0.133*** (0.048)	− 0.026 (0.342)
ln (1 + Tariffs) × Ad valorem × Quality	–	0.026** (0.010)	0.022** (0.009)
ln (1 + Tariffs) × Non-Ad valorem	− 0.175* (0.105)	− 0.174* (0.104)	− 0.339 (0.276)
ln (1 + Tariffs) × Non-Ad valorem × Quality	–	− 0.001 (0.008)	0.005 (0.012)
R-squared	0.767	0.768	0.886
Observations	52,894	52,894	50,735
Wine-year fixed effects	Yes	Yes	Yes
Firm-destination-year fixed effects	No	No	Yes

Notes: The dependent variable is the (log) FOB unit value of exports (in US dollars per liter). Quality is demeaned. Robust standard errors adjusted for clustering by destination-year between parentheses. ***, **, and * indicate significance at the one, five, and ten percent levels. GDP, GDP per capita, and remoteness are included (not reported). Dummy variables for ad valorem tariffs and for tariffs with a per-unit component are included in column (1). The two dummy variables are further interacted with quality in columns (2) and (3).

6.2. Ad valorem versus non-ad valorem tariffs

Our theoretical framework assumes that tariffs are ad valorem trade costs. But some countries also levy non-ad valorem tariffs such as per-unit tariffs, mixed tariffs, or compound tariffs.[43] In this section we address how the presence of non-ad valorem tariffs affects our empirical results.[44]

The effectively applied tariff rates we obtain from the TRAINS database are the lowest tariffs available (i.e., preferential rates if they exist, and Most Favoured Nation ones otherwise). They are determined at the tariff line level which is country specific. For each importing country, UNCTAD converts the non-ad valorem tariffs into ad valorem equivalents.[45] The ad valorem tariffs and ad valorem equivalents (both in percentage terms) at the tariff line level are then averaged at the 6-digit HS level, using import values as weights.

To identify the ad valorem tariffs in our sample, we extract the 6-digit HS-level effectively applied weighted tariff rates, either including or excluding the ad valorem equivalents.[46] This allows us to distinguish at the 6-digit HS level between ad valorem tariffs and the tariffs with a per-unit component (which are reported as ad valorem equivalents). We construct dummy variables for the two types of tariffs, and assume that zero tariffs belong to the two categories.

In column (1) of Table 9 we estimate Eq. (1) without the quality interaction terms. Instead, we interact tariffs with dummy variables for ad valorem tariffs and for tariffs with a per-unit component. Markups increase with distance and fall with the two categories of tariffs. Ad valorem tariffs are strongly significant at the one percent level, while tariffs with a per-unit component are only significant at the 10 percent level. As tariffs with a per-unit component capture the effects of both per-unit and ad valorem tariffs, it is possible that the effects of the two types of tariffs work against each other such that tariffs with a per-unit component are less significant in explaining markups.

In column (2) we interact distance and the two categories of tariffs with quality. Markups decrease with ad valorem tariffs, and to a larger extent for lower quality exports. They also decrease with tariffs including a per-unit component, but the effect is not heterogeneous across quality levels. In column (3) we add firm-destination-year fixed effects. At the mean value of quality the two tariff variables are insignificant. But the effect of ad valorem tariffs continues to vary across quality levels. We therefore conclude that tariffs have a negative effect on markups that is weaker for higher quality exports only if tariffs are purely defined on an ad valorem basis.

7. Concluding remarks

Our paper shows that exporters adjust markups across destinations depending on distance and tariffs. Exporters raise markups in more distant markets, but lower them in high-tariff countries. Moreover, the effects of distance and tariffs on markups are heterogeneous and smaller in magnitude for higher quality exports. This heterogeneity is stronger for exports to richer countries, and

[43] A mixed tariff is expressed per unit or ad valorem depending on the revenue each component generates. For instance, India levies a mixed tariff of 15 percent ad valorem or 87 rupees per square meter of rayon fabrics, whichever is higher. A compound tariff has both a per-unit and an ad valorem component. For example, Pakistan levies a compound tariff of 0.88 rupees per liter of fuel products plus 25 percent ad valorem (World Bank, 2011).

[44] For the countries included in our sample, the share between 2002 and 2009 of manufacturing tariff lines with a per-unit component is equal to 22 percent (World Bank World Development Indicators).

[45] The ad valorem tariff equivalent is the equivalent in percentage of a per-unit, mixed, or compound duty. If a per-unit tariff of 1.00 US dollar per kilogram is levied on a product with a unit value of 10.00 US dollars per kilogram, the ad valorem equivalent is equal to 10 percent (1.00/10.00). To calculate ad valorem equivalents, UNCTAD uses each country's import unit values at the tariff line level. If unavailable, 6-digit HS-level unit values are used instead.

[46] We extract tariffs from the World Integrated Trade Solution (WITS) application which gives us the option to download the data including or excluding the ad valorem tariff equivalents.

is predominantly driven by the higher quality firms, the larger firms, and the exporters who own a larger share of the export market.

To understand our empirical findings, we propose a theoretical framework based on the general setting of Mrázová and Neary (2017). Markups increase with per-unit trade costs, and fall with ad valorem trade costs, if the demand function is more convex than log-concave, but less than superconvex. Exporters adjust markups across destinations because their perceived elasticity of demand varies with trade costs. But for higher quality exports, the perceived elasticity of demand is less responsive to changes in trade costs such that the variation in markups is weaker than for lower quality exports.

Our results are important because they show that the variation in firm-level export unit values across markets is not only driven by quality differences but also by markup variation conditional on quality. Due to market power, firms price discriminate across destinations, but the way and the extent to which they do so depends on the size and the nature of trade costs (i.e., distance versus tariffs), and on the quality of their exports. Trade costs play a key role in inducing deviations from the Law of One Price, and they thus contribute to the degree of international market segmentation. And as the heterogeneous effects of distance and tariffs tend to be driven by high performance firms that generate the bulk of aggregate exports, we expect our results to matter in explaining the variation in aggregate export prices across markets. Understanding the welfare implications of our results would be an important next step.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jinteco.2022.103627.

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