European Review of Agricultural Economics Vol **00 (00)** (2022) pp. 1–28
doi:https://doi.org/10.1093/erae/jbac018

Distance to destination and export price variation within agri-food firms

Dela-Dem Doe Fiankor*

Economic Modelling and Policy Analysis Group, Agroscope, Ettenhausen, Switzerland

Received January 2022; final version accepted August 2022

Abstract

This paper assesses how bilateral distance affects within-firm-product variation in free-on-board (FOB) export prices across destinations. I estimate linear models that regress firm-product-destination-time FOB unit values on distance, firm-product-time fixed effects and destination country controls. If distance doubles, the average Swiss agri-food firm increases its FOB export price by 2.3 per cent. However, the positive distance elasticity of export prices reflects product quality differences and/or variable markups. I disentangle both mechanisms and show that, for a given product quality, exporting firms charge higher markups in distant markets. Nevertheless, this form of price discrimination is less pronounced for higher-quality products.

Keywords: agricultural trade, export unit values, product quality, markups, Switzerland

JEL classification: F14, Q17, Q18

1. Introduction

It is now obvious that there is substantial within-firm variation in export prices for the same goods—even within narrowly defined product categories—destined for different countries. This is also the case in the agri-food sector. For instance, a Swiss firm exported the same HS8-digit product ‘hard cheese (HS 04069099)’ to 18 different countries and charged free-on-board (FOB) prices ranging from a low of 10.70 Swiss franc per kilogram (CHF/kg) in Peru to a high of 16.00 CHF/kg in South Korea (see Figure 3). This strong empirical regularity has been explained by not only factors including destination country characteristics (e.g. size, income and domestic price levels) but also trade costs. In this paper, I focus on the latter, specifically the bilateral distance.

*Corresponding author: E-mail: dela-demdoe.fiankor@agroscope.admin.ch

The role of distance in explaining the spatial variation in export prices across destinations has received some attention in the manufacturing sector. Yet, the evidence from the agri-food sector is scarce or non-existent. Indeed, in some cases, existing contributions (e.g. Görg, Halpern and Muraközy, 2017) exclude the agricultural and food sectors entirely from the analyses. However, the agricultural and manufacturing sectors are characterised by different market situations. Thus, it is imperative to assess whether and to what extent these findings hold in the agri-food sector. This paper accomplishes that.

The study is based on Swiss firm-level HS8-digit customs data covering all agri-food exporting firms over the period 2016 to 2020. This level of detail allows me to examine the heterogeneity of within-firm-product prices across destinations, which is currently obscured by the use of country-product data. The Swiss agri-food sector makes for an interesting case study for different reasons. Competing via quality rather than price is especially feasible in a high-income and high-cost country like Switzerland. It is a small market with high demand and the necessary purchasing power to pay for high-quality products (Hillen and Cramon-Taubadel, 2019). This positioning of Swiss products into a differentiated, high-quality segment also extends to their export. Unlike raw agricultural products where quality differentiation is not commonplace, Swiss agri-food exports are mainly processed products where quality sorting is prevalent. The destinations of Swiss agri-food exports are also mostly rich countries where consumer demand for quality is high.

Empirically, I compute FOB export unit values (UVs) as a proxy for export prices at the firm product-destination level and investigate the pricing strategies of exporting firms in response to bilateral distance. Consistent with other firm-level studies, I estimate a log–log linear specification that regresses FOB UVs on distance, firm-product-time fixed effects and different controls for destination country characteristics. Previewing my results, I document a positive relationship between distance and HS8-digit FOB export prices within firms. If distance doubles, then the average Swiss agri-food firm increases its FOB export price by 2.3 per cent. In all cases, the estimates are statistically significant at the 1 per cent level, and the coefficient of the distance variable is identified solely from the within-firm-product variation of UVs across destination countries. I test my findings across different firm structures and the agriculture and food sectors. The latter offer additional insights by reducing any potential aggregation bias due to sector heterogeneity. Finally, I discuss the different mechanisms underlying the findings and attempt to isolate them.

My contribution to this literature is twofold. First, for manufacturing firms, a few studies examine export price variation across destinations using firm-level data, including Martin (2012) for France, Bastos and Silva (2010) for Portugal, Görg, Halpern and Muraközy (2017) for Hungary, Manova and Zhang (2012) for China and Harrigan, Ma and Shlychkov (2015) for the USA. I show that Swiss agri-food exporting firms behave in a manner similar to manufacturing firms. For a given macroeconomic context, export performance can differ greatly across firms. However, as highlighted by Gaigné and Gouel

(2022) in the Handbook of Agricultural Economics, international comparisons are limited since few countries offer the same level of details on their firms. I contribute to this literature by documenting for the first time a set of empirical regularities that characterise the export activity of agri-food firms in Switzerland by decomposing firm-product level exports across destinations. Similar to patterns in manufacturing (Arkolakis and Muendler, 2013), I show that the frequency with which exporting firms serve multiple markets declines quickly to the point where at most a single firm serves a very large number of markets. The pattern is very much the same when we consider the number of products exported. The modal Swiss agri-food exporting firm serves only one destination. From a policy perspective, I document that the patterns in the food sector are similar to those found in manufacturing.

Second, different mechanisms may explain the positive distance elasticity of export prices. The effects could be driven by quality—firms may find it more profitable to sell only high-quality products in distant countries (i.e. selection effect), and per-unit trade costs may increase the relative demand for higher-quality goods in distant markets (i.e. Alchian-Allen)—or markups. Existing explanations of the per-unit trade cost and price effect (e.g. Martin, 2012; Görg, Halpern and Muraközy, 2017; Kamal, 2021; Emlinger and Guimbard, 2021) embed mechanisms closely related to prices (i.e. quality and markups). Understanding the contribution of these mechanisms is the next step before we can precisely evaluate the gains from trade linked with this empirical regularity in trade data (Martin, 2012). My second contribution is to decompose the distance elasticity of export prices into quality and markups, following recent work of Chen and Juvenal (2022). In doing so, I extend the existing literature in two ways.

I contribute to the empirical trade literature that tests the Alchian and Allen (AA) conjecture using a proxy for quality as the dependent variable. For example, Curzi and Pacca (2015) report a positive relationship between specific tariffs and product quality in the food sector. Emlinger and Guimbard (2021) extend the analysis and confirm this finding for all agricultural products, but show that the effects are more pronounced for developed country exporters. Miljkovic and co-authors (2019, 2019) examine the relative demand for quality-differentiated coffee varieties exported globally and confirm that a common per-unit charge increases the overall quality of coffee demanded. I validate these empirical tests of the AA effect for agri-food products using firm-level customs transaction data. Because existing works (Curzi and Pacca, 2015; Miljkovic and Gómez, 2019; Miljkovic *et al.*, 2019; Emlinger and Guimbard, 2021) used aggregate country-product data, their inherent drawback is the implicit assumption of a representative firm per country. Since advances in the trade literature make it clear that firms behave differently, a question that remains unanswered in the agricultural trade literature is whether the AA effect is due to selection across or within firms (Emlinger and Lamani, 2020). Furthermore, these country-level studies use product data at the aggregated HS6-digit level. My within-firm-HS8-digit product analysis provides granular insights—much more detailed than any work existing in the agri-trade literature—into this firm behaviour within the agri-food sector.

By decomposing the distance elasticity of FOB prices into quality and markups (i.e. a measure of the ability of a firm to charge prices above its marginal costs), I also contribute to the literature on firm-level markups in the agri-food sector. Recent empirical work demonstrates that firm-level markups are variable. For French food processing firms, Curzi, Garrone and Olper (2021) study how firm-level markups respond to changes in import competition, while Jafari *et al*. (2022) investigate the impact of markups on firms' decisions to export and the resulting export intensity. No studies in the agricultural trade literature have assessed how firm-level markups respond to distance. The exception is Haase *et al*. (2022), who show that for Italian firms, markups rise with distance and fall with tariffs, with the effects being moderated by consumer taste in the destination country. However, Haase *et al*. (2022) focused on ham- and cheese-producing firms. My contribution targets the entire agri-food sector. I identify the variation in markups by controlling for product quality and firm-product-year fixed effects. I show that, conditional on product quality, markups covary positively with distance. From this perspective, my results are consistent with recent trade literature (Chen and Juvenal, 2022).

The increasing integration of the global economy has strengthened research and policy interest in understanding how exporters set their prices for internationally traded goods. While market power is an advantage for firms, competition in agri-food supply chains is desirable for consumers to minimise food expenditures. Since agri-food products constitute a large and stable share of consumers' expenditures, my work offers further insights into the pricing behaviour of firms in the agri-food sector as this has consequences for consumer welfare (Gullstrand, Olofsdotter and Thede, 2014).

The rest of this paper is organised as follows: Section 2 reviews the relevant theoretical literature that guides the interpretation of my findings. I present detailed data and stylised facts on Swiss agri-food exporting firms in Section 3. This is followed by the empirical analysis in Section 4. I present and discuss the results in Section 5. In Section 6, I conduct further extensions and test the mechanisms driving the baseline findings. Section 7 concludes.

2. Theoretical background

How does an increase in bilateral distance affect a firm's incentive to vary its FOB product prices by destination? In this section, I discuss theoretical predictions based on extensions of the literature on heterogeneous firms that will guide the interpretation of my findings.

The first mechanism is a selection or quality-sorting effect. This occurs if firms find it profitable to export higher-quality varieties to more distant markets only. This is a supply-side mechanism that will induce some form of quality-sorting behaviour as firms can vary the quality of their outputs by choosing the quality of their inputs.[1] The firms that are more productive will use more expensive, higher-quality inputs to produce high-quality goods. These firms may then choose to sell higher-quality versions of their products—e.g. those that use more durable packaging—in remote destinations and thus charge higher prices or markups (Martin, 2012). In the end, the exit of cheaper and lower-quality exports from more distant markets implies that, on average, export prices rise with distance. This situation is linked to the self-selection of heterogeneous firms across destinations, with only higher-quality producers entering more distant markets (Bastos and Silva, 2010).

The second mechanism is a demand-driven composition effect, also known as the Alchian and Allen (1964) 'shipping the good apples out' effect (Hummels and Skiba, 2004). It predicts that higher per-unit trade costs—in this case, a per-unit transport cost—tend to reduce the relative price of high-quality products vis-à-vis lower-quality products subject to the same cost. As higher-quality goods are more expensive, firm-level prices increase with distance. To understand the mechanism, consider a competitive sector in country i that exports two quality grades (q) of the same product k. Let $q = H, L$ represents high- and low-quality grades of k, respectively. For each grade, we hold income constant and consider the following Hicksian demand function at destination country j:

$$X_{jk} = f\left(p_{jH}, p_{jL}, U\right), \quad \text{where} \quad k = H, L \tag{1}$$

where p_{jH} and p_{jL} are the prices of the high- and low-quality goods, respectively, at destination country j, with $p_{jH} > p_{jL}$, and U is the level of utility. Prices at j depend on prices at i (p_{iH}, p_{iL}) and a per-unit charge, t_j, such that $p_{jk} = p_{ik} + t_j$. Suppose that there is no loss in quality due to transport, and consumers in the destination perceive H and L as two grades of the same good, the AA theorem holds that an increase in t_j will lower the relative price of, and raise the relative demand for, high-quality goods, i.e. $\delta\left(X_{jH}/X_{jL}\right)/\delta t_j > 0$.[2] As a result, per-unit transport costs lead firms to ship high-quality goods abroad while holding lower-quality goods at home. For the analysis to hold, consumers at destination j must perceive the high- and low-quality products as two grades of the same good rather than two different goods.

Firms may also price discriminate and charge higher markups, resulting in higher prices when exporting to countries that are farther away. This arises naturally if the elasticity of demand for products is a decreasing function of distance. This is the case in constant elasticity of substitution (CES) models with additive transport costs (Martin, 2012). Unless there is perfect competition, prices contain a markup component reflecting the ability of a firm to set a

1 This mechanism is consistent with trade models where firms endogenously choose destination-specific quality for their products. The alternative is to use efficiency sorting models or models of price competition wherein there is no quality sorting (Melitz, 2003). Here, all firms use identical inputs to produce symmetric outputs but firms that are more productive have lower marginal costs.

2 For a full derivation, see Emlinger and Lamani (2020).

price above marginal cost. The markups are an integrated component of export pricing in trade models, which typically adopt the assumption of monopolistic competition. However, in the Melitz (2003) model with CES preferences and iceberg trade costs, heterogeneous exporters charge a constant markup above marginal cost across countries and price discrimination is absent. Melitz and Ottaviano (2008) extend Melitz's (2003) setup and use linear demand to introduce endogenous variations in markups across destinations, which respond to the toughness of competition in a market. They show that larger markets exhibit tougher competition in the form of hosting more and larger competing firms, leading to lower markups and prices. Kugler and Verhoogen (2012) also extend the Melitz (2003) setup with an endogenous choice of input and output quality and suggest that if the scope for quality differentiation is sufficiently large, then more capable plants purchase higher-quality inputs, sell higher-quality outputs, charge higher prices and thus have higher markups.

3. Data—sources and patterns

3.1. Firm-level customs transaction-level data

To test my hypothesis, I used annual firm-level export data on Swiss agricultural and food exporting firms from 2016–2020. The data come from transaction-level declarations filed by exporting firms with customs in Switzerland. They contain information on HS8-digit product codes, FOB trade values in CHF, trade volumes in kilograms, export destinations and year for every shipment within the HS01–HS24 category. With these data at hand, I calculate firm-specific HS8-digit FOB UVs as $UV_{fjkt} = \text{Export value}_{fjkt}/\text{Export volume}_{fjkt}$, where f denotes the exporting firm, j is the destination country, k is the HS8-digit product and t is the year.

I clean up the data in several steps.[3] To focus on the agri-food sector, I merge the HS codes with the Broad Economic Category (BEC) classifications and then limit the sample to foods and beverages mainly intended for household consumption (i.e. BEC codes 112 and 122).[4] I also exclude firm-product combinations that occur only once.[5] Because UVs can be noisy, I exclude UVs less than $50\bar{x}_k$ and greater than $1/50\bar{x}_k$, where $\bar{x}_k$ is the sample median UV for product k (Berthou and Emlinger, 2011) and trim extreme values in the fifth and 95th percentiles of the UV distribution. With these data cleaning steps, I eliminate 34 per cent of the original sample.

3 The total sample in the original trade data is 158,185 observations. Excluding the non-food sector eliminates 35,037 observations. Merging the data set with the distance data set from CEPII further reduces the total observations by 734. Countries omitted include American Samoa, Bonaire Sint Eustatius and Saba, Canary Islands, Saint Barthélemy, Curaçao, Guam, the British Indian Ocean Territory, Montenegro, Mayotte, South Georgia and the South Sandwich Islands, Serbia, South Sudan, Sint Maarten, Timor-Leste, the Holy See, Virgin Islands and Kosovo. This results in a total sample of 122,410 before eliminating outliers.

4 This excludes agricultural products such as tobacco and live animals from the analysis.

5 Their inclusion does not affect the results.

Table 1. HS8-digit classifications within the HS6 digit code 040690

HS8	HS8-digit description
04069011	Brie, Camembert, Crescenza, Italico, Pont-l'Évêque, Reblochon, Robiola, Stracchino
04069019	Soft cheese (excluding blue-veined cheese or containing veins, and Brie, Camenbert)
04069021	Green cheese (herb cheese), hard or semi-hard
04069031	Caciocavallo, Canestrato, Aostataler Fontina, Parmigiano Reggiano, semi-hard cheese
04069039	Caciocavallo, Canestrato, Aostataler Fontina, Parmigiano Reggiano, hard cheese
04069051	Asiago, Bitto, Brà, Fontal, Montasio, Saint-Paulin, Saint Nectaire, semi-hard cheese
04069059	Asiago, Bitto, Brà, Fontal, Montasio, Saint-Paulin, Saint Nectaire, hard cheese
04069060	Cantal
04069091	Semi-hard cheese, n.e.s.
04069099	Hard cheese, n.e.s.

These data have several advantages for the empirical analysis. First, Swiss customs have been careful about maintaining consistent units of measurement within product categories. The trade quantities are all reported in kilograms. Thus, our UVs are denominated in CHF/kg. Second, the data are reported in CHF FOB across all destination countries, which enables a cross-country comparison of UV net of the transportation cost component—i.e. cost, insurance and freight. Third, working at the HS8-digit level allows us to observe a scope sufficiently detailed to detect product-specific quality differentiation. At such a granular level, we reduce the incidence of comparing prices of products of different quality, as is the case at the HS6 digit level. For instance, within the HS6-digit cheese category, we observe more granular cheese products, such as hard cheese, soft cheese and semi-soft cheese, amongst others (Table 1). Thus, at the HS8-digit level, the variations in FOB prices we observe within firms across destinations may well reflect differences in product quality (Flach, 2016). Finally, the Swiss agri-food sector is focused on exporting value-added (Figure A1). Swiss exports in terms of value are mainly roasted coffee and extracts thereof, non-alcoholic beverages, cheese, chocolates and edible preparations (Table A1). These agri-food products involve quality differentiation. For example, roasted coffee quality can range from instant coffee to whole beans. Sustainability issues are also rife in the cocoa and coffee sectors, with consumers willing to pay more for certified quality beans signalling higher quality (e.g. 4C, Rainforest Alliance/UTZ). In Figure A2a, we also observe that Swiss exports are mainly destined for countries with high levels of quality requirements (the EU, the USA and Canada).

Table 2. Swiss agri-food exporters and their exporting characteristics by year

Year	*N*	Firms	Products	Destinations	Exports per firm		Products	Destinations
					Mean	Median	per firm	per firm
2016	20,374	1,724	593	172	332.88	5.15	9.62	4.30
2017	20,217	1,829	623	163	352.43	5.17	9.77	3.95
2018	19,252	1,914	608	157	383.33	5.16	10.12	3.79
2019	18,593	1,888	599	160	401.39	4.95	10.11	3.73
2020	16,788	1,695	577	162	430.90	5.23	9.27	3.77

Notes: The mean and median values are in 1,000 CHF.

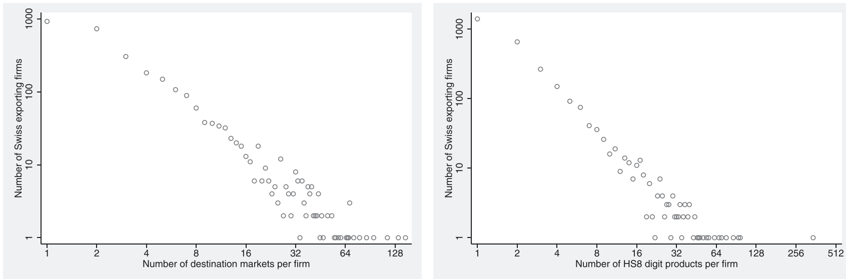
3.2. Swiss agri-food exporting firms—stylised facts

I begin by describing the structure of Swiss agri-food exporting firms (Table 2). There are 2794 distinct firms and 183 destination countries over the course of the panel.[6] The number of firms exporting, the number of products they export and the number of destinations they serve increased between 2016 and 2019. Given the COVID-19 pandemic, the drop in 2020 is as expected. The mean and median export values also increased over time. The average firm exported about 10 HS8-digit products to four destinations.

The literature suggests that serving international markets requires certain features of a firm and explains the particular characteristics exhibited by exporters vís-à-vís firms who serve only the domestic market. Sunk costs are involved in entering new foreign markets. These include the costs of establishing distribution systems, market research, product design and standards compliance. These entry costs can be substantial. As a result, only the more productive and efficient firms, which have the means to incur these costs, enter export markets. In Figure 1, we observe a similar pattern for Swiss exporting firms. The frequency with which more markets are served declines smoothly and monotonically to the point where at most a single firm serves a very large number of firms (Figure 1a). The qualitative pattern is very much the same when we consider the number of products exported (Figure 1b). Here again, the number of firms exporting multiple products also decreases monotonically. The modal exporting firm serves only one destination. This is in line with recent theories that emphasise the role of firm heterogeneity and selection in international trade. Firms that are more productive are more likely to engage in exporting, and the most productive of the exporting firms ship more goods to more markets (Bernard *et al.*, 2007). Graphically, this depiction is in line with the evidence provided by Arkolakis and Muendler (2013) for manufacturing firms in Brazil, Chile, Denmark and Norway.

A number of patterns are visible in Figure 2. In many countries, markets are made up of a few large firms and many small firms. The same is true for Swiss agri-food exporting firms. In Figure 2a, we see that firm structure, specifically, firm size (here measured by the number of employees), matters

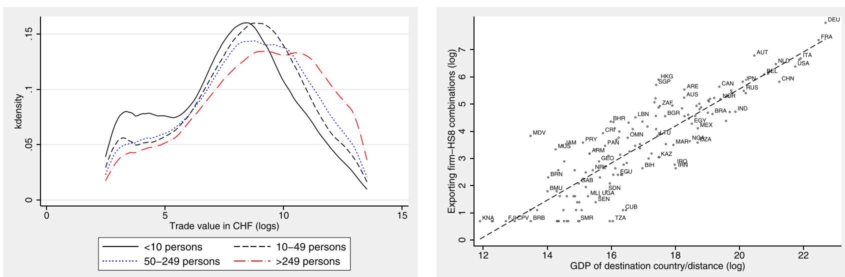
6 This is after I cleaned the data set for outliers. See Table A2 for the complete list of destination countries.



(a) Destination markets

(b) HS8-digit products

Fig. 1. Swiss firms, destination markets and HS8-digit products.
Notes: Whilst the axes are reported as absolute values, for simplicity, I follow Arkolakis and Muendler (2013) and impose a log–log specification on the distribution to ease the depiction of both relationships.



(a) Exports by firm size

(b) Export market attractiveness

Fig. 2. Exports by firm size and destination market attractiveness. (a) Exports by firm size. (b) Export by market attractiveness.

for exports. On average, bigger firms export more in value terms relative to smaller firms. In my data set, firms with more than 240 employees account for 61 per cent of all observed trade values. Empirical evidence shows that, conditional on firm size, exporters sell higher-quality products and charge higher prices, as well as pay higher input prices and higher wages (Curzi and Olper, 2012; Kugler and Verhoogen, 2012). In Figure 2b, we observe a gravity relationship: the number of products exported to a destination and the number of firms exporting to a particular destination increase with the market size of the destination—here measured as gross domestic product (GDP)—and decrease with bilateral distance. In other words, after controlling for distance, the economic size of the destination country is associated with more firm-HS8-digit product combinations.

Finally, is it really the case that within-firm prices vary for the same products shipped to different locations, even within narrowly defined product categories? To answer this question, I use the case of a particular firm exporting hard cheese and semi-hard cheese to multiple destinations in 2016. In Figure 3, firm-specific FOB prices for hard cheese range from a low of 10.70 CHF/kg in

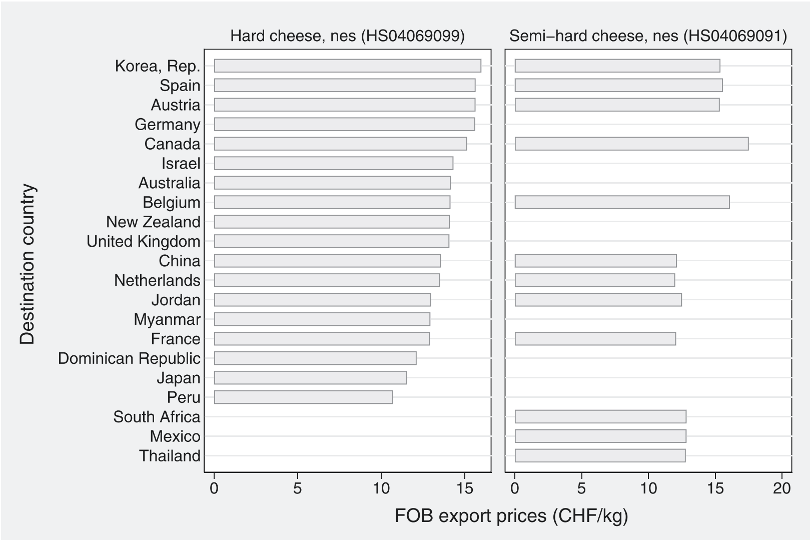


Fig. 3. Within-firm product variation in FOB UVs.

Peru to a maximum of 16.00 CHF/kg in the Republic of Korea. For semi-hard cheese, FOB export prices range from a low of 12 CHF/kg in France to a high of 18 CHF/kg in Canada. This is the sort of variation I exploit across multiple HS8-digit products to assess the role of bilateral distance.

3.3. Country-level data

I also combine the firm-product data with country data for the destination country level. Country-level macroeconomic data on GDP and GDP per capita come from the World Bank World Development Indicators. We retrieve tariff data from the United Nations Commission on Trade and Development via the World Integrated Trading System. Data on bilateral distance come from Centre d'Etudes Prospectives et d'Informations (CEPII). Finally, we calculate country-level HS6 digit average prices in the importing country using trade data from the Base pour l'Analyse du Commerce International (BACI) database. The BACI data corrects discrepancies between import values, expressed as Cost Insurance Freight (CIF), and export values, expressed as FOB. Summary statistics on all variables are reported in Table A3.

4. Empirical analysis

To test how within-firm variations in agri-food FOB prices are related to distance, I estimate the following equation using ordinary least squares (OLS):

$$\ln\text{UV}_{fjkt} = \beta_0 + \beta_1 \ln\text{Distance}_j + \mathbf{b}'\mathbf{w}_{jkt} + \varphi_{fkt} + \varepsilon_{fjkt} \quad (2)$$

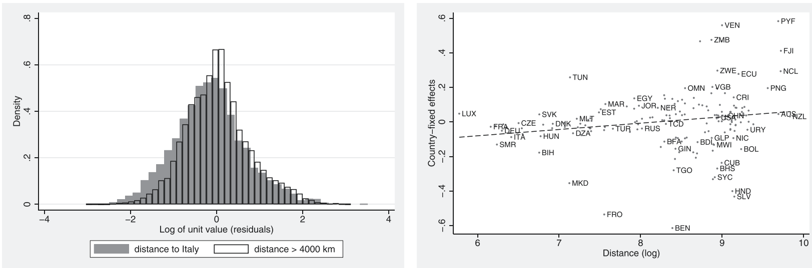
where UV_{fjkt} is the price (UV), expressed in Swiss Francs per kilogram, of product *k* (defined at the HS8-digit level) exported by Swiss firm *f* to destination country *j* in year *t*. Distance_j is the bilateral distance between Switzerland and country *j*. ε_{fjkt} are standard errors that are clustered at the destination-year level. φ_{fkt} are firm-product-time fixed effects (FE). They control for all observable (e.g. firm size) and unobservable firm- and product-specific effects that may affect the UVs. Their inclusion means that we use only within-firm variation across markets to identify β_1. This allows a direct test of the hypothesis that firms vary their export prices systematically by export market characteristics. This means that, for the empirical analysis, I only include firms that export to at least two destination countries. In this way, I can assess whether and to what extent they vary their FOB export prices in different destination markets (Figure 3).

Product variant and invariant destination country controls are captured in the vector $\mathbf{w}_{jkt}$. It includes, at the country level, a measure of the market size (i.e. GDP) and a demand-related control (i.e. real GDP per capita). At the country-product level, we control for HS6-digit bilateral tariffs and non-tariff measures[7] imposed on imports from Switzerland, remoteness—which I construct as the logarithm of GDP-weighted averages of bilateral distance (Baier and Bergstrand, 2009)—similarities in food taste[8] and average prices of HS6-digit product imports from all origins in the destination.[9]

7 FOB export UVs may also include some costs of exporting to foreign destinations if, for instance, exporters need to meet non-tariff measures that vary across destinations. To capture non-tariff measures, I use specific trade concerns (STCs) raised against sanitary and phytosanitary (SPS) measures maintained by a destination country. STCs are issues raised at the World Trade Organisation by exporting countries affected by SPS measures that they consider unjustified and particularly restrictive (Olper, 2016). Raising an STC is a formal mechanism by which a country can introduce a complaint against another country's SPS policies regulating imports. Standards may be trade barriers but can also be measures for market creation. As a result, measures that form strong barriers to trade and are motivated by protectionism—rather than preventing legitimate health risks—are likely to be raised as a concern by other members of the WTO. In the agricultural trade literature, it has been used as a measure of restrictive standards in Curzi *et al.* (2020) and Fiankor, Haase and Brümmer (2021a).

8 This measure is taken from Kohler and Wunderlich (2022) and is based on a novel data set, including all the ingredients in the national dishes of 171 countries. With this data set, the authors construct a time-invariant country-pair measure for similarity in food tastes between countries. My *a priori* expectation is that consumer tastes in the destination market will drive the pricing strategy of exporting firms.

9 The multilateral average UVs of imported products in a destination country depend on the number of firms serving the market and their FOB and CIF prices of exports. We expect that in competitive markets where the multilateral UV is low, the exporting firms charge lower prices to gain market share. For each HS6-digit product *p* in destination country *j*, I calculate quantity-weighted UVs as $\text{UV}_{jpt} = \sum q_{ijpt} UV_{ijpt}$, where UV_{ijpt} and q_{ijpt} are the UVs of imports and quantity imported from country *i* in *j* of product *p* at the HS6-digit level.



(a) Distributions of unit values by distance

(b) Destination-specific prices and distance

Fig. 4. Unit values and distance. (a) Distributions of unit values by distance. (b) Destination-specific prices and distance.

5. Results

5.1. The distance and within-firm product price effect

First, I provide descriptive evidence on the distance to the export destination and the price effect. Figure 4a shows the relationship between (demeaned) firm-product destination UVs and distance. To do this, I regress ln UV_{fjkt} on a set of HS8-digit product fixed effects and plot the residuals from this distribution by distance in a histogram (also see Baldwin and Harrigan, 2011; Bastos and Silva, 2010). The shaded bars depict products shipped from Switzerland to its neighbour Italy. The transparent bars depict the average UVs for products shipped over a distance above 4,000 km. On average, exports to farther destinations are skewed more to the right. In Figure 4b, I regress UVs on firm-product-time and destination fixed effects. A large destination country fixed effect implies that average within-firm FOB export prices are higher in this country than in other destinations. I then plot the destination country fixed effects against bilateral distance. With a slope coefficient of 0.032 and an R^2 value of 0.35, distance is positively related to firm-specific FOB UVs and explains a third of the variation in within-firm pricing across destinations. In summary, Figure 4 provides preliminary descriptive evidence that firm-product-destination UVs increase with distance.

Next, I discuss the empirical results from estimating Equation 2. The results are presented in Table 3. In column (1), I control for only bilateral distance and find an elasticity of 0.031. Conditional on exporting, within-firm product prices increase with bilateral distance. This is consistent with the descriptive evidence in Figure 4. In columns (2) and (3), I add further controls. My findings remain unchanged; only the magnitude has reduced from 0.031 to 0.023. If bilateral distance doubles, then the average exporting firm increases its FOB export price by 2.3 per cent *ceteris paribus*. In all cases, the estimates are statistically significant at the 1 per cent level, and the coefficient of the distance variable is identified solely from the within-firm-product variation of UVs across destination countries. Thus, my findings imply that firms choose

Table 3. The effect of distance on unit values

	(1)	(2)	(3)
Log distance$_j$	0.031***	0.024***	0.024***
	(0.003)	(0.004)	(0.004)
Log GDP$_{jt}$		−0.032***	−0.032***
		(0.007)	(0.007)
Log GDP per capita$_{jt}$		0.005	0.006
		(0.004)	(0.004)
Log remoteness$_{jt}$		0.017***	0.015***
		(0.005)	(0.005)
Log (1 + Tariff$_{jkt}$)		0.009***	0.010***
		(0.002)	(0.002)
Non-tariff measures$_{jkt}$		0.033***	0.053***
		(0.011)	(0.012)
Taste$_j$		0.006	0.047**
		(0.022)	(0.022)
Log unit value$_{jkt}$			0.011
			(0.008)
Firm-product-time FE	Yes	Yes	Yes
Observations	78,773	76,049	58,036
Adjusted R^2	0.761	0.760	0.768

Notes: The dependent variable is the log of free-on-board unit values of firm *f*, HS8-digit product *k* to destination *j* in year *t*. All models are estimated using ordinary least squares. *p* values are in parentheses.
***, ** and *denote significance at 1, 5 and 10 per cent, respectively. Intercepts are included but not reported.

higher-quality and more expensive goods when they decide to export to more distant markets.[10]

How do my findings fit within the existing literature? Since this is the first paper to focus on the agri-food sector, the findings are not directly comparable to existing estimates. However, the plausibility of the estimates may be checked by comparison with results from the manufacturing sector. For manufacturing firms, existing estimates on the within-firm product elasticity of price to bilateral distance range between 2 and 5 per cent for France (Martin, 2012), 5 per cent for Portugal (Bastos and Silva, 2010), 5 per cent for Hungary (Görg, Halpern and Muraközy, 2017), 3.53 per cent for Argentina (Chen and Juvenal, 2022), 1 per cent for Germany (Wagner, 2016) and 1 per cent for China (Manova and Zhang, 2012). My estimate of 2.3 per cent falls within the range established in the existing literature. Thus, Swiss agri-food firms behave in a way consistent with the manufacturing firms in other countries within and outside Europe.

10 The differences in the estimates across the columns are not due to the differences in sample sizes. If I estimate the models in columns (1) and (2) on the sample used in column (3), then the estimates are 0.028 and 0.022, respectively (see Table A4). Going forward, all other estimates will be based on this restricted sample for consistency in the number of observations.

5.2. Control variables

GDP has a negative effect on export prices. In larger countries—measured here in terms of their GDPs—competition is tougher (since they are more likely to host many more firms in terms of numbers and size), which means prices and markups are lower (Melitz and Ottaviano, 2008). On the other hand, per capita GDP has a positive effect on prices, which may arise from the fact that in richer countries, consumers have a higher willingness to pay (Bastos and Silva, 2010). The estimates of the remoteness index are positive and statistically significant, confirming that, all else equal, prices are higher in more remote export destinations.

Bilateral tariffs have positive effects on prices. Whilst this contradicts findings by Martin (2012) and Chen and Juvenal (2022), it is consistent with the agricultural trade literature where per-unit duties are more concentrated (Emlinger and Guimbard, 2021; Fiankor, Curzi and Olper, 2021). However, different mechanisms may be at play here. Firms may charge lower prices in countries with higher tariffs to increase their competitiveness. But they may also pass through the cost of tariffs to consumers in their destination countries in the form of higher prices or sell only the most competitive, high-quality varieties of their products in countries with higher tariffs. The direction of the tariff–price effect may also depend on the type of tariff applied by the importing country. Specific tariffs are positively correlated with prices, whilst *ad valorem* tariffs are negatively correlated with prices (Curzi and Pacca, 2015). Non-tariff measures, here measured as specific trade concerns, induce a statistically significant increase in firm-level export prices (Curzi *et al.*, 2020; Kamal, 2021; Chen and Juvenal, 2022). Similarities in taste across countries also have a positive effect on UVs (Haase *et al.*, 2022). In column (3), I include a control for the average price of HS6-digit product p in the destination country. Here, I attempt to capture further competition effects in the destination market. Firms may vary their prices across destinations, keeping in mind the level of prices or competition existing in a particular market. I identify a positive but statistically insignificant destination market price effect. However, the distance variable retains its positive and statistically significant effect. Thus, this form of price competition does not appear to be driving our results.

5.3. Extensions

5.3.1. Does firm size matter?

Emlinger and Guimbard (2021) show that the elasticity of bilateral distance to per-unit trade costs depends on the size—measured as the income level—of the exporting country. Taking this idea to the firm level, I test if my findings depend on the firm structures presented in Figure 2a. Larger, more productive firms charge higher prices, which may be consistent with quality upgrading on their part. The positive effect of distance on export prices is confirmed for all firm sizes (Column 1 of Table 4), and the magnitudes are increasing with firm size. Furthermore, small firms usually export low values. As a result, I drop trade values below 500 CHF (which is about the average exports per firm) to

Table 4. The effect of distance on unit values—sample split by firm structure

	Firm size	Exports > 500 CHF	Destinations >20
	(1)	(2)	(3)
Log Distance$_j$	0.019***	0.034***	0.026***
	(0.005)	(0.004)	(0.006)
Log Distance$_j$ × Firm size 2	0.006*		
	(0.003)		
Log Distance$_j$ × Firm size 3	0.003		
	(0.004)		
Log Distance$_j$ × Firm size 4	0.008*		
	(0.005)		
Log GDP$_{jt}$	−0.031***	−0.024***	−0.027***
	(0.008)	(0.007)	(0.010)
Log GDP per capita$_{jt}$	0.006	0.011***	0.007
	(0.004)	(0.004)	(0.005)
Log Remoteness$_{jt}$	0.015***	0.007	0.012*
	(0.005)	(0.005)	(0.006)
Log (1 + Tariff$_{jkt}$)	0.010***	0.009***	0.012***
	(0.002)	(0.002)	(0.003)
Non-tariff measures$_{jkt}$	0.053***	0.066***	0.073***
	(0.012)	(0.012)	(0.016)
Taste$_j$	0.047**	0.049**	−0.022
	(0.022)	(0.023)	(0.032)
Log Unit value$_{jkt}$	0.011	0.003	−0.011
	(0.008)	(0.008)	(0.011)
Firm-product-time FE	Yes	Yes	Yes
Observations	57,676	43,903	26,104
Adjusted R^2	0.768	0.838	0.767

Notes: The dependent variable is the log of free-on-board unit values of firm *f*, HS8-digit product *k* to destination *j* in year *t*. All models are estimated using ordinary least squares. *p* values are in parentheses.
***, ** and *denote significance at 1, 5 and 10 per cent, respectively. Intercepts are included but not reported. Firm size 2 refers to firms with 10–49 employees, Firm size 3 refers to firms with 50–249 employees and Firm size 4 refers to firms with more than 249 employees. The reference group is thus firms with less than 10 employees.

test if small firms are driving the main results. The findings remain qualitatively the same; if anything, the magnitudes are reinforced (see Column 2 in Table 4). Another measure of size is how many destinations a firm serves. If we keep only firms that export to more than 20 destinations, the main findings are again confirmed (Column 3 in Table 4).

5.3.2. Sector-specific estimates

Trade costs may affect primary and processed agri-food products differently, as these products have varying levels of protection, substitutability and importance to consumers. In Switzerland, processed agricultural products find themselves in a unique position between industrial goods (free trade) and agricultural products (agricultural protection). Whilst Switzerland is a net importer

Table 5. Differences across the agriculture and food sector

	Agriculture		Food	
	(1)	(2)	(3)	(4)
Log Distance$_j$	0.106***	0.042**	0.028***	0.023***
	(0.017)	(0.020)	(0.003)	(0.004)
Log GDP$_{jt}$		−0.237***		−0.026***
		(0.045)		(0.008)
Log GDP per capita$_{jt}$		−0.027		0.008**
		(0.021)		(0.004)
Log Remoteness$_{jt}$		0.135***		0.012**
		(0.027)		(0.005)
Log (1 + Tariff$_{jkt}$)		0.037*		0.011***
		(0.020)		(0.002)
Non-tariff measures$_{jkt}$		0.262***		0.046***
		(0.080)		(0.012)
Taste$_j$		−0.125		0.050**
		(0.122)		(0.022)
Log Unit value$_{jkt}$		0.031		0.010
		(0.032)		(0.008)
Firm-product-time FE	Yes	Yes	Yes	Yes
Observations	2,475	2,475	55,561	55,561
Adjusted R^2	0.751	0.756	0.768	0.769

Notes: The dependent variable is the log of free-on-board unit values of firm f, HS8-digit product *k* to destination *j* in year *t*. All models are estimated using ordinary least squares. *p* values are in parentheses.
***, ** and *denote significance at 1, 5 and 10 per cent, respectively. Intercepts are included but not reported.

of raw agricultural products, they are a net exporter of processed products. As a result, we test the difference between primary (agriculture) and processed (food) products (Table 5).[11] In the Swiss case, I find that the price elasticity of distance is higher for primary agricultural products compared to processed food. This contradicts the quality-sorting literature given the vertical nature of the food sector vis-à-vis the agriculture sector. However, since the positive distance estimate can also be explained by variable markups, the findings are not entirely surprising. I revisit this in Section 6.[12]

6. Discussion

What explains the positive relationship between variations in within-firm export prices and distance? For one, this finding is contrary to many workhorse

11 The alternative of using interaction terms generates qualitatively similar results (Table A5).

12 I conclude this section by obtaining industry-specific estimates of the distance–UV elasticity. I assess how the effects differ by HS2-digit codes. For brevity and clarity of exposition, I only report the results that are of central interest to the study (i.e. the distance estimates). Overall, the estimates at the industry level from Table A6 largely reinforce my conclusions. Where the effects are statistically significant, they are always positive, with magnitudes in line with the baseline model results. An alternate approach is to estimate the equation for each HS2-digit sector. This approach generates results qualitatively similar to those reported here.

trade models. Trade models where firms partly absorb transportation costs (e.g. Melitz and Ottaviano, 2008) predict a negative relationship between distance and export prices. In others (Eaton and Kortum, 2002; Melitz 2003), exporting firms charge the same FOB price to all destinations. My findings, on the other hand, indicate (i) quality differentiation by firms across destinations, (ii) variable markups or (iii) a combination of both mechanisms. In this section, I discuss the different channels.

The positive distance elasticity of UVs may be driven by product quality differentiation. It is possible that Swiss agri-food firms are 'shipping their good apples out' (Alchian and Allen, 1964; Hummels and Skiba, 2004). Per-unit trade costs (e.g. distance) tend to reduce the relative price of high-quality products vis-à-vis lower-quality products subject to the same cost. As a result, they increase the relative demand for higher-quality goods in more distant countries. Given that higher-quality goods are more expensive, firm-level prices increase with distance. This is the so-called composition effect and requires that firms can differentiate their goods even within narrow product categories. If we consider UVs as a proxy for product quality, we can interpret the positive distance elasticity as evidence of an AA-type effect. This is consistent with country-product level findings in the agricultural trade literature (Curzi and Pacca, 2015; Emlinger and Guimbard, 2021). It could also be driven by a selection effect where firms find it profitable to export higher-quality varieties to more distant markets only. More productive firms will use more expensive, higher-quality inputs to produce high-quality goods and may then choose to sell higher-quality versions of their products in remote destinations and thus charge higher prices.

Firms may also price discriminate and charge higher markups and therefore higher prices when exporting to countries that are farther away. This arises naturally if the elasticity of demand for products is a decreasing function of distance. As the demand in more distant markets becomes less elastic to changes in the export price, exporters find it profitable to raise their prices (by raising their markups) to compensate for the lower demand they face due to higher transportation costs.

6.1. Isolating the quality and markup channels

However, an explanation that bundles both mechanisms—i.e. quality differentiation by firms across destinations and/or variable markups—is useful only to a limited extent in evaluating the gains from trade linked with this empirical regularity in trade data. In this section, I disentangle the positive distance effects into quality and markups.

In a recent contribution, Chen and Juvenal (2022) show that conditional on quality, exporters price discriminate and set higher markups and therefore higher prices in more distant countries. By identifying exported products with a given quality, we can decompose the distance elasticity of export UVs into markups and quality by controlling for appropriate fixed effects. I tested this mechanism at the multi-product level.

Before we proceed, two important considerations must be made. First, as in any study of price discrimination that relies on price data, the challenge is to disentangle the variation in markups from the variation in marginal costs. We can identify the variation in markups by comparing the UVs of a given product k exported by a given firm f at a given point in time across destinations j. If the markup is defined as price over marginal costs and product-specific marginal costs do not vary across destinations mc_{fkt}, then the variation in prices across markets captures the variation in markups (Chen and Juvenal, 2022).[13] This is because the firm-product-time fixed effects (φ_{fkt}) capture destination-invariant marginal costs (mc_{fkt}) and thus render the variation in UVs to markups.

The second is how to measure unobserved product quality. There are only a few products in the agri-food sector for which direct measures of quality exist, e.g. wine (Chen and Juvenal, 2022) and coffee (Miljkovic and Gómez, 2019). Because our analysis focuses on multiple products, we lack such precise measures of quality. Instead, I follow Khandelwal, Schott and Wei (2013) and recover quality directly from observed trade data. The intuition is that, conditional on prices, firm-product-destination-year quadruplets with higher market shares are assigned higher-quality. Empirically, I estimate product quality as the residual from the following OLS regression:

$$\ln q_{fjkt} + \sigma_{jk} \ln p_{fjkt} = \alpha_k + \alpha_{jt} + e_{fjkt} \tag{3}$$

where q_{fjkt} and p_{fjkt} are, respectively, the quantity and the price of product k, exported by firm f to destination j at time t. α_k are product fixed effects that capture differences in prices and quantities across product categories. α_{jt} are importer-year fixed effects that account for destination price indices, income and other destination-specific effects. σ_{jk} are destination-product elasticities of substitution taken from Broda, Greenfield and Weinstein (2017). Estimating (3) separately for each country and product pair, estimated quality is given as $\ln \hat{q}_{fjkt} \equiv \frac{\hat{e}_{fjkt}}{(\sigma_{jk}-1)}$.[14] Given that quality differentials explain some of the variations we observe in UVs across countries (Feenstra and Romalis, 2014), I checked how my quality estimates correlate with UVs. A graph of $\ln p_{fjkt}$ against $\ln \hat{q}_{fjkt}$ (Figure 5) shows that our estimated quality and UVs are positively correlated.

13 If $UV_{fjkt} = \mu_{fjkt} \times mc_{fkt}$, where $\mu_{fjkt} > 1$ is the markup and mc_{fkt} is the firm-specific marginal cost, which is assumed to not vary across destinations. By accounting for φ_{fkt}, we identify the variation in UVs of product k exported by firm f in year t between destinations j and j' as follows:

$$\begin{aligned} \ln UV_{fjkt} - \ln UV_{fj'kt} &= \ln \mu_{fjkt} + \ln mc_{fkt} - \ln \mu_{fj'kt} - \ln mc_{fkt} \\ &= \ln \mu_{fjkt} - \ln \mu_{fj'kt}. \end{aligned}$$

14 Since this approach to estimating quality is almost standard in the agricultural trade literature (see, e.g., Movchan, Shepotylo and Vakhitov, 2020; Curzi *et al.*, 2020; Fiankor, Curzi and Olper, 2021; Curzi and Huysmans, 2022), I do not go through the entire derivation process but refer the reader to the listed references.

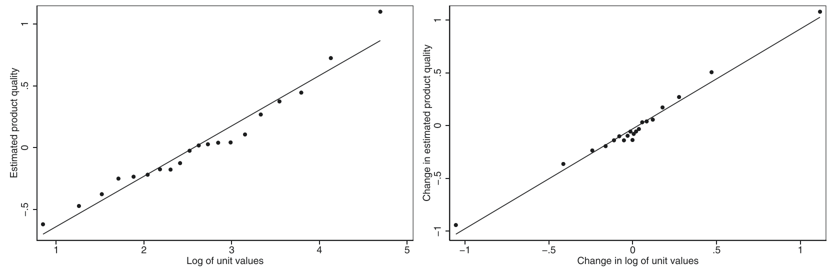


Fig. 5. Relationship between unit values and estimated product quality.
Notes: Both figures present binned scatter plots of product quality estimated following Khandelwal, Schott and Wei (2013) and UVs. The left panel plots the cross-sectional values, and the right panel presents the changes (calculated as the differences between the first and last years of the data set). All values are divided into 20 equal-sized groups, with each dot representing the mean value within each bin. In each plot, the line shows the line of best fit estimated via OLS.

I then introduce the estimated product quality (expressed in deviations from its mean) as an additional control variable in the baseline estimation equation. This allows me to decompose the distance elasticity of UVs reported in Table 3 into quality and markups. The results presented in Table 6 show that high-quality products are indeed sold at higher prices, confirming the graphical evidence in Figure 5. A 10 per cent increase in product quality is associated with a 1.23 per cent increase in UVs, *ceteris paribus* (see also Haase *et al.*, 2022). However, our distance variable retains its positive and statistically significant coefficient. Under the assumption that the marginal cost of producing each product k does not vary across destinations, the variation in UVs across destination countries identifies variations in markups (Chen and Juvenal, 2022). In this specification, the φ_{fkt} term also controls for selection and composition effects. Thus, the interpretation of our distance effect is that for a given quality, exporting firms price discriminate and charge higher markups and therefore higher prices in distant markets.

To capture any potential variations in quality over distance, I interact the two terms (i.e. ln Distance$_j$ × ln Product Quality$_{fjkt}$). The inclusion of this interaction term also allows me to specify a more stringent model that includes firm-destination-time fixed effects (Column 4 in Table 6). Whilst the main distance variable drops from this specification together with all other destination time-specific variables, the coefficient on the interaction term still allows us to conclude on the heterogeneity of quality over distance. Across the different model specifications, we find that, conditional on quality, within-firm-product markups rise with distance but less so for higher-quality products. Consistent with Chen and Juvenal (2022), the elasticities of markups with respect to distance are smaller in magnitude for higher-quality exports. Put differently, exporters price discriminate less for higher-quality exports.[15]

15 We can reconcile this with the findings in Table 5, where the price elasticity of distance is higher for primary agricultural products compared to processed food. The higher the quality of the product,

Table 6. Mechanisms: quality and markups

	(1)	(2)	(3)	(4)
Log Distance$_j$	0.026***	0.027***	0.025***	
	(0.003)	(0.004)	(0.005)	
Product Quality$_{fjkt}$	0.123***	0.276***	0.276***	0.272***
	(0.010)	(0.050)	(0.050)	(0.047)
Log Distance$_j$ × Product Quality$_{fjkt}$		−0.020***	−0.020***	−0.016**
		(0.007)	(0.007)	(0.006)
Log GDP$_{jt}$			−0.008	
			(0.013)	
Log GDP per capita$_{jt}$			0.001	
			(0.007)	
Log Remoteness$_{jt}$			0.003	
			(0.008)	
Log (1 + Tariff$_{jkt}$)			0.009***	0.017**
			(0.003)	(0.008)
Non-tariff measures$_{jkt}$			0.032**	0.032**
			(0.015)	(0.016)
Taste$_j$			0.114***	
			(0.032)	
Log Unit values$_{jkt}$			0.010	−0.045
			(0.012)	(0.015)
Firm-product-time FE	Yes	Yes	Yes	Yes
Firm-destination-time FE	No	No	No	Yes
Observations	34,081	34,081	34,081	26,144
Adjusted R^2	0.778	0.778	0.778	0.803

Notes: The dependent variable is the log of free-on-board unit values of firm *f*, HS8-digit product *k* to destination *j* in year *t*. All models are estimated using ordinary least squares. *p* values are in parentheses.
***, ** and *denote significance at 1, 5 and 10 per cent, respectively. Intercepts are included but not reported.

7. Conclusion

At the core of this paper, is a simple question: how does distance affect spatial variation in product-specific export prices within agri-food exporting firms? This paper is the first to analyse how distance affects within-firm product export price variations across countries in the agri-food sector. Existing works have been conducted at the country-product level and ignore the heterogeneity across firms within countries. My work contributes to filling this gap. Estimating linear models that regress firm-product-destination-time FOB UVs on distance, firm-product-time fixed effects and destination country controls, I find that if distance doubles, the average Swiss agri-food firm increases its FOB export price by 2.3 per cent. This finding holds true when controlling for the wealth, size, tariffs, non-tariff measures and level of price competition in the destination country. This finding is in line with the Alchian-Allen effect,

the lower the price discrimination. This explains why we see comparatively lower estimates of the distance elasticity for the food sector—where there is more room for quality upgrading than in the agricultural sector, where most products are only horizontally differentiated. It appears that Swiss agri-food firms are price discriminating and charging higher markups on their agricultural exports relative to their food exports.

within-firm selection of product quality across destination markets or reflect changes in markups. Because these effects are indicative of variable markups and/or quality differentiation by firms across destinations, I decompose the observed effect into markups and quality. I show that for a given product quality, exporting firms price discriminate and charge higher markups in distant markets. More importantly, they price discriminate less for higher-quality products.

Acknowledgements

I thank three anonymous referees and the editor, Timothy Richards, for providing constructive and helpful comments on earlier drafts. I also acknowledge the comments from Bernhard Dalheimer, Oliver-Ken Haase, Judith Irek and participants of the 96th Annual Conference of the Agricultural Economics Society (KU Leuven, Belgium), the 2022 Annual Conference of the Swiss Society for Agricultural Economics and Rural Sociology (Frick, Switzerland) and the 2022 Agricultural & Applied Economics Association meeting (Anaheim, USA). That being said, all remaining errors contained herein are mine alone.

References

Alchian, A. A. and Allen, W. R. (1964). *University Economics*. Belmont, California: Wadsworth Publishing Company.

Arkolakis, C. and Muendler, M.-A. (2013). Exporters and their products: a collection of empirical regularities. *CESifo Economic Studies* 59: 223–248. 10.1093/cesifo/ifs028.

Baier, S. L. and Bergstrand, J. H. (2009). Estimating the effects of free trade agreements on international trade flows using matching econometrics. *Journal of International Economics* 77: 63–76. 10.1016/j.jinteco.2008.09.006.

Baldwin, R. and Harrigan, J. (2011). Zeros, quality, and space: trade theory and trade evidence. *American Economic Journal: Microeconomics* 3: 60–88. 10.1257/mic.3.2.60.

Bastos, P. and Silva, J. (2010). The quality of a firm's exports: where you export to matters. *Journal of International Economics* 82: 99–111. 10.1016/j.jinteco.2010.07.001.

Bernard, A. B., Jensen, J. B., Redding, S. J. and Schott, P. K. (2007). Firms in international trade. *Journal of Economic Perspectives* 21: 105–130. 10.1257/jep.21.3.105.

Berthou, A. and Emlinger, C. (2011). The trade unit values database. *Economie Internationale* 128: 97–117. https://doi.org/10.1016/S2110-7017(13)60005-0.

Broda, C., Greenfield, J. and Weinstein, D. E. (2017). From groundnuts to globalization: a structural estimate of trade and growth. *Research in Economics* 71: 759–783. 10.1016/j.rie.2017.10.001.

Chen, N. and Juvenal, L. (2022). Markups, quality, and trade costs. *Journal of International Economics* 137: 103627. 10.1016/j.jinteco.2022.103627.

Curzi, D., Schuster, M., Maertens, M. and Olper, A. (2020). Standards, trade margins and product quality: firm-level evidence from Peru. *Food Policy* 91: 101834. 10.1016/j.foodpol.2020.101834.

Curzi, D., Garrone, M. and Olper, A. (2021). Import competition and firm markups in the food industry. *American Journal of Agricultural Economics* 103: 1433–1453. 10.1111/ajae.12175.

Curzi, D. and Huysmans, M. (2022). The impact of protecting EU geographical indications in trade agreements. *American Journal of Agricultural Economics* 104: 364–384. 10.1111/ajae.12226.

Curzi, D. and Olper, A. (2012). Export behavior of Italian food firms: does product quality matter? *Food Policy* 37: 493–503. 10.1016/j.foodpol.2012.05.004.

Curzi, D. and Pacca, L. (2015). Price, quality and trade costs in the food sector. *Food Policy* 55: 147–158. 10.1016/j.foodpol.2015.06.007.

Eaton, J. and Kortum, S. (2002). Technology, geography, and trade. *Econometrica* 70: 1741–1779. 10.1111/1468-0262.00352.

Emlinger, C. and Guimbard, H. (2021). Shipping the good agricultural products out: the differentiated impact of per-unit duties on developing countries. *European Review of Agricultural Economics* 48: 598–623. 10.1093/eurrag/jbaa016.

Emlinger, C. and Lamani, V. (2020). International trade, quality sorting and trade costs: the case of cognac. *Review of World Economics* 156: 1–31. https://doi.org/10.1007/s10290-019-00372-z.

Feenstra, R. C. and Romalis, J. (2014). International prices and endogenous quality. *The Quarterly Journal of Economics* 129: 477–527. 10.1093/qje/qju001.

Fiankor, -D.-D.-D., Curzi, D. and Olper, A. (2021). Trade, price and quality upgrading effects of agrifood standards. *European Review of Agricultural Economics* 48: 835–877. 10.1093/erae/jbaa026.

Fiankor, -D.-D.-D., Haase, O. K. and Brümmer, B. (2021a). The heterogeneous effects of standards on agricultural trade flows. *Journal of Agricultural Economics* 72(1): 25–46. 10.1111/1477-9552.12405.

Flach, L. (2016). Quality upgrading and price heterogeneity: evidence from Brazilian exporters. *Journal of International Economics* 102: 282–290. 10.1016/j.jinteco.2016.07.005.

Gaigné, C. and Gouel, C. (2022). Trade in agricultural and food products. In C. B. Barrett and D. R. Just (eds), *Handbook of Agricultural Economics* 6: 4845–4931. https://doi.org/10.1016/bs.hesagr.2022.03.004.

Görg, H., Halpern, L. and Muraközy, B. (2017). Why do within-firm–product export prices differ across markets? Evidence from hungary. *The World Economy* 40: 1233–1246. 10.1111/twec.12442.

Gullstrand, J., Olofsdotter, K. and Thede, S. (2014). Markups and export-pricing strategies. *Review of World Economics* 150: 221–239. 10.1007/s10290-013-0178-x.

Haase, O., Raimondi, V., Solazzo, R., Olper, A. and Curzi, D. (2022). Markups, taste and quality. Working Paper, University of Milano.

Harrigan, J., Ma, X. and Shlychkov, V. (2015). Export prices of US firms. *Journal of International Economics* 97: 100–111. 10.1016/j.jinteco.2015.04.007.

Hillen, J. and Cramon-Taubadel, S. (2019). Protecting the Swiss milk market from foreign price shocks: public border protection vs. quality differentiation. *Agribusiness* 35: 516–536. 10.1002/agr.21602.

Hummels, D. and Skiba, A. (2004). Shipping the good apples out? An empirical confirmation of the Alchian-Allen conjecture. *Journal of Political Economy* 112: 1384–1402. 10.1086/422562.

Jafari, Y., Koppenberg, M., Hirsch, S. and Heckelei, T. (2022). Markups and export behavior: firm level evidence from the French food processing industry. *American Journal of Agricultural Economics*. 10.1111/ajae.12292.

Kamal, Y. (2021). Determinants of export pricing at the firm-level: evidence from Egypt. *The Journal of International Trade & Economic Development* 30: 1–19. https://doi.org/10.1080/09638199.2021.1938639.

Khandelwal, A. K., Schott, P. K. and Wei, S.-J. (2013). Trade liberalization and embedded institutional reform: evidence from Chinese exporters. *American Economic Review* 103: 2169–2195. 10.1257/aer.103.6.2169.

Kohler, A. and Wunderlich, A. (2022). How migrants' food tastes shape international agro-food trade. *Applied Economics Letters* 29: 469–476. 10.1080/13504851.2021.1912695.

Kugler, M. and Verhoogen, E. (2012). Prices, plant size, and product quality. *The Review of Economic Studies* 79: 307–339. 10.1093/restud/rdr021.

Manova, K. and Zhang, Z. (2012). Export prices across firms and destinations. *The Quarterly Journal of Economics* 127: 379–436. 10.1093/qje/qjr051.

Martin, J. (2012). Markups, quality, and transport costs. *European Economic Review* 56: 777–791. 10.1016/j.euroecorev.2012.02.004.

Melitz, M. J. (2003). The impact of trade on intra-industry reallocations and aggregate industry productivity. *Econometrica* 71: 1695–1725. 10.1111/1468-0262.00467.

Melitz, M. J. and Ottaviano, G. I. (2008). Market size, trade, and productivity. *The Review of Economic Studies* 75: 295–316. 10.1111/j.1467-937X.2007.00463.x.

Miljkovic, D., Gómez, M. I., Sharma, A. and Puerto, S. A. (2019). Testing the Alchian–Allen theorem for three goods using the pseudo-Poisson model. *Agricultural Economics* 50: 793–802. 10.1111/agec.12525.

Miljkovic, D. and Gómez, M. I. (2019). Shipping the good coffee out: the Alchian–Allen theorem and relative demand for Brazilian Arabica and Robusta coffees. *European Review of Agricultural Economics* 46: 697–712. 10.1093/erae/jby051.

Movchan, V., Shepotylo, O. and Vakhitov, V. (2020). Non-tariff measures, quality and exporting: evidence from microdata in food processing in Ukraine. *European Review of Agricultural Economics* 47: 719–751. https://doi.org/10.1093/erae/jbz034.

Olper, A. (2016). The political economy of trade-related regulatory policy: environment and global value chain. *Bio-based and Applied Economics* 5: 287–324. 10.13128/BAE-20270.

Wagner, J. (2016). Quality of firms' exports and distance to destination countries: first evidence from Germany. *Open Economies Review* 27: 811–818. 10.1007/s11079-016-9395-y.

Appendix

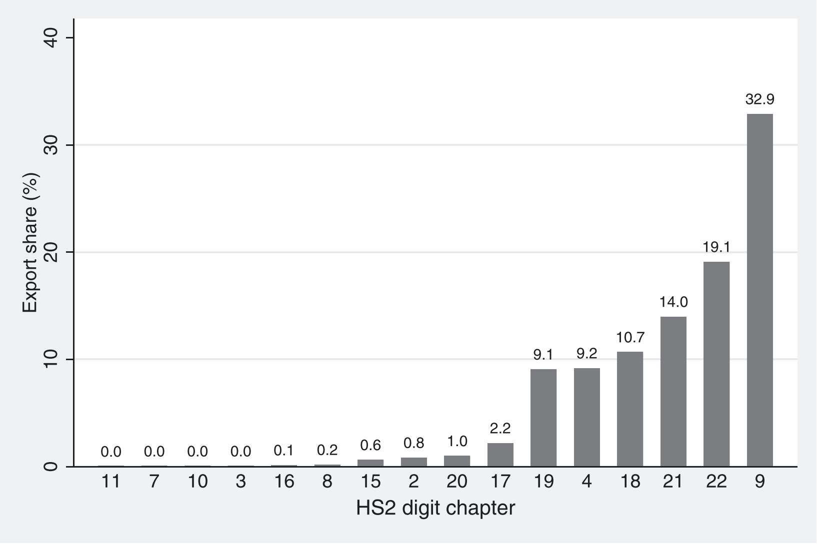


Fig. A1. Export values by HS2 chapter.

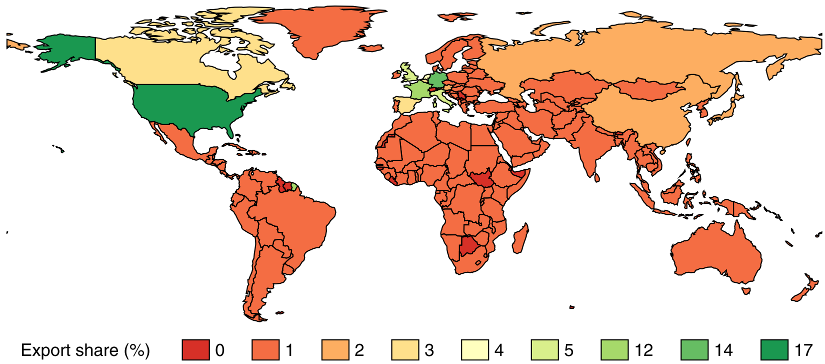


Fig. A2. Export destinations of Swiss agri-food exports (2016–2020).

Table A1. Top 30 Swiss agri-food export values by HS8 chapter (2016–2020)

Product description	HS8	Export (m. CHF)	Export share (%)
Roasted coffee, not decaffeinated	9012100	10,680	27
Non-alcoholic beverages	22029990	5,251	13.27
Hard cheese, n.e.s.)	4069099	1,739	4.4
Vegetable juice, non-alcoholic, diluted with water	22029090	1,389	3.51
Food preparations for infant use	19011020	1,286	3.25
Chewing gum and sweets, tablets and pastilles	21069040	1,262	3.19
Semi-hard cheese, n.e.s.	4069091	1,003	2.54
Roasted, decaffeinated coffee	9012200	978	2.47
Milk chocolate, in blocks, slabs or bars of $\leq$ 2kg	18063210	820	2.07
Chocolate and other food preparations containing cocoa	18063290	762	1.93
Extracts, essences and concentrates of coffee	21011102	739	1.87
Preparations for sauces and prepared sauces;	21039000	507	1.28
Food preparations, n.e.s., not containing fat	21069094	494	1.25
Food preparations, not containing fat, n.e.s.	21069100	407	1.03

(continued)

Table A1. (Continued)

Product description	HS8	Export (m. CHF)	Export share (%)
Food preparations, n.e.s.	21069074	354	0.9
Moulded sugar confectionery	17049042	329	0.83
White chocolate	17049010	290	0.73
Soups and broths and preparations	21041000	277	0.7
Meat of bovine animals, salted, in brine	2102090	241	0.61
Edible mixtures or preparations of animal or vegetable fats and oil	15179091	211	0.54
Bread, pastry, cakes, biscuits and other bakers	19059084	204	0.52
Mixes and doughs for the preparation of bakers' wares	19012096	194	0.49
Food preparations, n.e.s.	21069072	182	0.46
Pasta, stuffed with meat or other substances	19022000	160	0.41
Food preparations, n.e.s., containing milkfat	21069064	154	0.39
Fresh cheese [unripened or uncured], incl. whey cheese	4061090	133	0.34
Prepared foods obtained by the swelling or roasting of cereals	19041090	120	0.3
Chocolate and other preparations containing cocoa	18063112	118	0.3
Jams, jellies, marmalades, purées or pastes	20079930	114	0.29
Waffles and wafers, whether or not containing cocoa	19053220	100	0.25

n.e.s.: not elsewhere specified.

Table A2. List of destination countries

Afghanistan, Albania, Algeria, Andorra, Angola, Anguila, Antigua and Barbuda, Argentina, Armenia, Aruba, Australia, Austria, Azerbaijan, Bahamas, The, Bahrain, Bangladesh, Barbados, Belarus, Belgium, Belize, Benin, Bermuda, Bolivia, Bosnia and Herzegovina, Brazil, British Virgin Islands, Brunei, Bulgaria, Burkina Faso, Burundi, Cambodia, Cameroon, Canada, Cape Verde, Cayman Islands, Central African Republic, Chad, Chile, China, Colombia, Democratic Republic of the Congo, Republic of the Congo, Costa Rica, Cote d'Ivoire, Croatia, Cuba, Cyprus, Czech Republic, Denmark, Djibouti, Dominican Republic, Ecuador, Egypt, El Salvador, Equatorial Guinea, Eritrea, Estonia, Ethiopia (excludes Eritrea), Faeroe Islands, Fiji, Finland, France, French Guiana, French Polynesia, Gabon, Georgia, Germany, Ghana, Gibraltar, Greece, Greenland, Guadeloupe, Guatemala, Guinea, Haiti, Honduras, Hong Kong, China, Hungary, Iceland, India, Indonesia, Iran, Iraq, Ireland, Israel, Italy, Jamaica, Japan, Jordan, Kazakhstan, Kenya, Korea, Dem. Rep., South Korea, Kuwait, Kyrgyz Republic, Laos, Latvia, Lebanon, Libya, Lithuania, Luxembourg, Macao, Macedonia, Madagascar, Malawi, Malaysia, Maldives, Mali, Malta, Martinique, Mauritania, Mauritius, Mexico, Moldova, Mongolia, Morocco, Mozambique, Myanmar, Namibia, Nepal, Netherlands, New Caledonia, New Zealand, Nicaragua, Niger, Nigeria, Norway, Oman, Pakistan, Palestine, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Poland, Portugal, Qatar, Reunion, Romania, Russian Federation, Rwanda, Samoa, San Marino, Saudi Arabia, Senegal, Seychelles, Sierra Leone, Singapore, Slovak Republic, Slovenia, Somalia, South Africa, Spain, Sri Lanka, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Sudan, Swaziland, Sweden, Syrian Arab Republic, Taiwan, Tajikistan, Tanzania, Thailand, Togo, Trinidad and Tobago, Tunisia, Turkey, Turkmenistan, Turks and Caicos Isl., Uganda, Ukraine, United Arab Emirates, United Kingdom, United States, Uruguay, Uzbekistan, Vanuatu, Venezuela, Vietnam, Yemen, Zambia, Zimbabwe

Table A3. Summary statistics

Variable	Mean	S.D.	Min	Max	*N*
Trade value (million CHF)	0.38	7.42	0	896.12	95,224
Trade quantity (million kg)	0.05	1.99	0	296.41	95,224
Unit value (CHF/kg)	22.02	26.71	1.97	176.23	95,224
Distance (km)	3358.87	3917.52	322.15	18,635.84	95,180
GDP (billion USD)	2334.14	3897.77	0.79	21,433.22	93,930
GDP per capita ('000 USD)	35.76	19.58	0.27	117.10	93,770
Tariff	8.02	25.5	0	277.00	95,224

Table A4. The effect of distance on unit values (restricted sample)

	(1)	(2)	(3)
Log Distance$_j$	0.030***	0.025***	0.024***
	(0.003)	(0.004)	(0.004)
Log GDP$_{jt}$		−0.033***	−0.032***
		(0.007)	(0.007)

(continued)

Table A4. (Continued)

	(1)	(2)	(3)
Log GDP per capita$_{jt}$		0.007*	0.006
		(0.004)	(0.004)
Log Remoteness$_{jt}$		0.016***	0.015***
		(0.005)	(0.005)
Log (1 + Tariff$_{jkt}$)		0.010***	0.010***
		(0.002)	(0.002)
Non-tariff measures$_{jkt}$		0.054***	0.053***
		(0.012)	(0.012)
Taste$_j$		0.047***	0.047**
		(0.022)	(0.022)
Log Unit value$_{jkt}$			0.011
			(0.008)
Firm-product-time FE	Yes	Yes	Yes
Observations	58,036	58,036	58,036
Adjusted R^2	0.768	0.768	0.768

Notes: The dependent variable is the log of free-on-board unit values of firm *f*, HS8-digit product *k* to destination *j* in year *t*. All models are estimated using ordinary least squares. *p* values are in parentheses.
***, ** and *denote significance at 1, 5 and 10 per cent, respectively. Intercepts are included but not reported.

Table A5. Differences across agriculture and food sectors

	(1)	(2)
Log Distance$_j$	0.106***	0.102***
	(0.016)	(0.015)
Log Distance$_j$ × Food sector	–0.078***	–0.081***
	(0.016)	(0.016)
Log GDP$_{jt}$		–0.033***
		(0.007)
Log GDP per capita$_{jt}$		0.007*
		(0.004)
Log Remoteness$_{jt}$		0.016***
		(0.005)
Log (1 + Tariff$_{jkt}$)		0.012***
		(0.002)
Non-tariff measures$_{jkt}$		0.048***
		(0.012)
Taste$_j$		0.045**
		(0.022)
Log Unit value$_{jkt}$		0.011
		(0.008)
Firm-product-time FE	Yes	Yes
Observations	58,036	58,036
Adjusted R^2	0.768	0.769

Notes: The dependent variable is the log of free-on-board unit values of firm *f*, HS8-digit product *k* to destination *j* in year *t*. All models are estimated using ordinary least squares. *p* values are in parentheses.
***,** and *denote significance at 1, 5 and 10 per cent, respectively. Intercepts are included but not reported.

Table A6. The effect of distance on unit values: HS2 digit sector estimate

	OLS
Log Distance$_j$ × HS2	−0.072***
	(0.025)
Log Distance$_j$ × HS3	0.128***
	(0.023)
Log Distance$_j$ × HS4	0.037***
	(0.007)
Log Distance$_j$ × HS7	0.041
	(0.060)
Log Distance$_j$ × HS8	0.038
	(0.037)
Log Distance$_j$ × HS9	0.059***
	(0.012)
Log Distance$_j$ × HS10	0.065
	(0.075)
Log Distance$_j$ × HS11	0.047
	(0.030)
Log Distance$_j$ × HS15	0.017
	(0.023)
Log Distance$_j$ × HS16	0.017
	(0.034)
Log Distance$_j$ × HS17	0.062***
	(0.009)
Log Distance$_j$ × HS18	0.012**
	(0.005)
Log Distance$_j$ × HS19	0.014*
	(0.007)
Log Distance$_j$ × HS20	0.024***
	(0.008)
Log Distance$_j$ × HS21	0.036***
	(0.008)
Log Distance$_j$ × HS22	0.011
	(0.010)
Firm-product-time FE	Yes
Observations	58,036
Adjusted R^2	0.769

Notes: The dependent variable is the log of free-on-board unit values of firm *f*, HS8-digit product *k* to destination *j* in year *t*. *p* values are in parentheses.
***, **, *denote significance at 1, 5 and 10 per cent, respectively. Intercepts are included but not reported. Estimations include firm-product-time fixed effects. Controls for GDP, GDP per capita, Remoteness, Tariffs and average UVs in the importing country have their expected signs and are statistically significant but are omitted from the table for brevity.