LUND UNIVERSITY

Markups and Export Pricing

Gullstrand, Joakim; Olofsdotter, Karin; Thede, Susanna

2011

Link to publication

Citation for published version (APA):
Gullstrand, J., Olofsdotter, K., & Thede, S. (2011). *Markups and Export Pricing*. Working Papers, Department of Economics, Lund University. http://swopec.hhs.se/lunewp/abs/lunewp2011_037.htm

Total number of authors:
3

General rights
Unless other specific re-use rights are stated the following general rights apply:
Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.
• Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
• You may not further distribute the material or use it for any profit-making activity or commercial gain
• You may freely distribute the URL identifying the publication in the public portal

Read more about Creative commons licenses: https://creativecommons.org/licenses/

Take down policy
If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

LUND UNIVERSITY

PO Box 117
221 00 Lund
+46 46-222 00 00

Markups and export pricing[*]

Joakim Gullstrand
AgriFood Center and Department of Economics, Lund University

Karin Olofsdotter
Department of Economics, Lund University

Susanna Thede
Department of Economics, Lund University

Abstract: We analyze empirically product-price variation across export destinations using detailed firm-product data. Most recent studies using highly disaggregated data emphasize variations in product quality as an explanation as to why firms charge different prices for the same product on different export markets. In this paper, we take an alternative approach and assume that variations in firms' export prices reflect market segmentation and investigate the relationship between price variation and average firm markup. We study an entire supply chain in order to see how price discrimination varies across sectors with different distribution networks. Specifically, we make use of firm-level data for exporting firms in the Swedish food supply chain. The results offer new information about the behavior of exporting firms. Hence, for the food-processing industry, firms with greater ability to discriminate between markets are associated with a higher markup. However, the results also reveal that markups are a complex function of firm characteristics and that the price-setting behavior of firms in the manufacturing sector is not necessarily observed in other sectors of the supply chain.

JEL: D40, F12, F14

[*] We would like to thank seminar participants at IFN in Stockholm, March 2011, and Department of economics in Lund, May 2011. We are also grateful to the conference participants at ETSG in Lausanne, September 2010, CAED Conference in London, September 2010, SNEE Conference in Mölle, May 2011, and the National Conference of Swedish Economists in Uppsala, September 2011. In addition, we thank Hans Carlsson for his advice. Financial support from Jan Wallander and Tom Hedelius Foundation is gratefully acknowledged.

1. Introduction

Recent empirical research has recognized large variations in firms' f.o.b. export prices even at very narrowly defined product classifications. These variations are not only observed across firms but also within a single firm exporting to different destinations (Görg et al., 2010). In international trade studies using detailed product- and/or firm-level data, variations in product quality are proposed as an important explanation to different prices for the same product on different export markets. Much of this work builds on heterogeneous-firms models where quality differences and, hence, price variations are seen as additional important heterogeneity variables across firms.

While product quality may provide a plausible explanation to variation in prices *across* firms, the relevance of quality differences for variations in export prices *within* a single firm appears much more uncertain. One reason is that, in the presence of scale economies, quality differentiation will be costly for the firm. Moreover, as emphasized in the trade mark literature, firms are believed to care about their brand and reputation making quality-to-market less likely (Economides, 1988). In fact, in the industrial-organization literature, price dispersion within single-product lines is primarily explained by price discrimination across market segments.[1] Under market segmentation, which may result from transaction costs or purchasing search costs, firms can charge different prices, net of trade costs, for the same product in different locations.

While other recent studies have focused mainly on the quality-difference explanation, this paper instead argues in favor of segmented markets and price discrimination. In particular, we explore the relationship between export-price variation and average firm markup (defined as price over marginal cost) by studying the individual firm's variations in export prices for products going to different locations and examine whether larger price variations are associated with higher markups. Hence, the paper focuses on the price-setting behavior of exporting firms and acknowledges firms' ability to set prices. This approach is supported by firm surveys providing empirical evidence for the importance of price-discriminating behavior. For instance, Fabiani et al. (2005) reveal that more than 80 percent of firms within the Euro area apply price-discriminating strategies.[2]

To thoroughly investigate firms' ability to set prices and to see how price-discrimination varies across sectors and different distribution networks, we study an entire supply chain. Specifically,

[1] See, e.g., Tirole (1988).
[2] See also Goldberg and Knetter (1999).

we make use of detailed firm-level data for exporting firms in the Swedish food supply chain, consisting of four sectors; agriculture, food processing, wholesale and retail. This supply chain is of particular interest as it is one of the largest supply chains and is highly vertically integrated.

The paper contributes to the existing literature in several ways. First, while previous empirical research on export-price variation across countries has focused on quality differences we use an approach where imperfect competition and market segmentation become meaningful. Second, by considering a whole supply chain, we are able to compare differences in competitive pressures and price-setting behavior across sectors. Finally, as the empirical analysis shows that food-processing firms with greater price dispersion across export markets have on average higher markups, we offer additional information about the behavior of exporting firms in the manufacturing sector.

The paper is organized as follows. Section 2 reviews previous work in international trade on variations in export prices and outlines the approach of the present paper. Section 3 describes the method to estimate markups, presents the data and gives the econometric specification. The results are reported in Section 4. Section 5 offers an extension investigating the determinants of export prices and Section 6 concludes.

2. Theoretical outline and related studies

2.1 Price discrimination and market power

Observed variations in prices across export destinations may be attributed to international price discrimination and geographically segmented markets. Price discrimination across markets requires, besides the existence of arbitrage costs, that firms exert some kind of market power. It is important to notice, though, that the relationship between price dispersion and market power is not straightforward, which becomes clear if we define the export price as a markup over marginal cost. The price may vary with both the markup (determined by the elasticity of demand and the firm's market share) and the costs of production. At the moment, let us disregard cost-based differentials and focus on pure discriminatory behavior. Consider a profit-maximizing firm that is selling its product on two different markets and charges different prices. If the marginal cost of the good is independent of its destination (in f.o.b. prices), then price discrimination implies that at least one export price is greater than the marginal cost and there is a positive markup. Thus, price discrimination or a price dispersion across export markets has to be associated with firm market power. However, consider another firm also selling its product

on two different markets but charging the same price. Clearly, as prices can be above marginal costs on both markets, this does not imply that the firm does not exert market power as prices can be above marginal costs on both markets. Thus, while price discrimination cannot occur without market power, market power may be present without price discrimination.[3] Consequently, it remains an empirical question whether more price discrimination (i.e., more variations in export prices) implies higher markups or not.

2.2 Markups and export prices in the international trade literature

Until recently, price discrimination and segmented markets have received fairly little attention in the international-trade literature. This can be explained partly by the extensive use of monopolistic competition models with CES preferences and iceberg trade costs in which price discrimination does not occur.[4] Early exceptions can be found in the reciprocal dumping models by Brander (1981) and Brander and Krugman (1983) explaining intra-industry trade in homogenous goods. In these models, firms are able to segment international markets which results in lower markups on exports compared to the domestic market.[5] Lately, variations in markups have been introduced in a heterogeneous-firm framework. Melitz and Ottaviano (2008) propose a monopolistic competition model in which markets are segmented. Particularly, they demonstrate how, with firms facing linear demand as opposed to CES demand, markups will vary across firms and export destinations. In their setting, firms with lower costs (i.e. more productive firms) will charge lower prices and have higher markups. Moreover, the ability to price-discriminate across markets will lead to lower markups and prices on markets characterized by higher competition. Bernard et al. (2003) also model variations in markups across firms using a Ricardian framework with Bertrand competition. Although more efficient firms will have higher markups on average, the markup is not linked to the cost efficiency of the firm. Hence, in their model, a firm's markup and price will be higher on markets where it can exert more market power. The explanation of factors that determine market power is however outside the scope of their study.

The relationship between markups and export status is investigated in De Loecker and Warzynski (2009). Similar to our work, they estimate firms' overall markups across markets from firm-level data. In particular, using data on the Slovenian manufacturing sector, they find

[3] This is analyzed theoretically in McAfee et al. (2006).
[4] See the discussion in Martin (2010).
[5] Also related are papers following the tradition on spatial price discrimination developed by Hoover (1937). See, e.g., Greenhut et al. (1985) on reverse dumping.

that exporters have on average higher markups than non-exporters.[6] This result is consistent with a productivity premium for exporters as suggested in heterogeneous-firm settings. At the same time, De Loecker (2007) using similar data finds that about a third of the higher markup for exporters is not due to costs or productivity.

Some recent empirical studies use detailed firm-level data to investigate within-firm price variations across export destinations.[7] Common for these studies is that they focus on the spatial pattern of export prices, taking both quality and markup explanations into account.[8] For instance, Martin (2010) focuses on how within-firm export prices of French exporting firms vary with distance and finds that firms set higher prices at more distant markets. However, this positive relationship, he argues, cannot be explained by existing international-trade models, whether due to quality upgrading or higher markups.[9] Manova and Zhang (2009) use data on Chinese exporting firms in 2005 and examine how export prices vary with distance and market size in different heterogeneous-firm settings where they, in addition to quality, also consider differences in markups across markets. They find that firms that export more and to a larger number of markets have higher export prices on average and also display higher export price variation. A similar approach is taken by Görg et al. (2010) who use Hungarian export data for the year 2003. Besides quality-to-market they suggest a markup explanation where exporting firms add transport costs to f.o.b. prices implying a higher export price to more distant markets.[10]

Although these papers suggest price discrimination and differences in markups as a possible explanation to variations in export prices, they do not elaborate on this proposition. In this paper, we focus on the segmented-market explanation as to why within-firm-product prices

[6] This result is also found in Görg and Warzynski (2003).
[7] An early paper on price discrimination and markups in export markets is provided by Aw (1993). See also Aw et al. (2001) that investigates price variations across domestic and export markets.
[8] Several empirical studies have identified a positive correlation between average export prices and distance. In international-trade models with heterogeneous producers, this observation is consistent with product quality differences across export destinations. In particular, Baldwin and Harrigan (2007) explain this in a model where higher-quality products are more costly to produce but also more profitable and therefore better at penetrating distant markets. Similarly, Johnson (2009) shows that prices increase with distance and the difficulty of entering a market. In addition, he finds that more productive firms produce higher-quality goods and consequently can charge higher prices.
[9] In order to explain the positive correlation between export prices and distance, he proposes additive trade costs instead of iceberg trade costs, which also makes it possible to maintain the monopolistic-competition setting with CES preferences. Additive trade costs are also considered in Hummels and Skiba (2004).
[10] The argument in Görg et al. (2010) is that when the firm has found an export destination, it buys transport services and adds these to export prices. Thus, in reality f.o.b. prices may contain transport costs.

vary, and, in particular, perform a markup estimation where we investigate how markups correlate with a firm's ability to price-discriminate across markets.

3. Empirical approach

3.1 Markup identification

Our empirical procedure consists in estimating average markups using firm-level data for four sectors constituting the Swedish food supply chain.

In order to identify markups, we consider a general model consistent with an imperfectly competitive market structure. This approach has been adopted *inter alia* by Hall (1988), Levinsohn (1993) and Harrison (1994), who all used the primal Solow residual to measure the markup. We use an extension of the work of Hall (1988) developed by Roeger (1995), which applies both the primal and the dual Solow residual. [11] Hall showed how the markup can be obtained from the primal Solow residual (calculated from the production function) when there is market power. This residual, however, contains a productivity term that may cause endogeneity problems when the markup is estimated. Roeger demonstrated how this problem can be taken care of by subtracting the dual Solow residual (calculated from the cost functions) from the primal residual.[12]

More formally, firm output at time t is determined by a linear homogenous production function with three factors of production; capital (K), labor (L) and material inputs (M)[13]

$$Q_t = \theta_t \mathrm{F}(K_t, L_t, M_t) \tag{1}$$

where θ_t is a Hicks-neutral productivity term. With imperfect competition in product markets, Hall (1988) showed that the primal Solow residual will be

[11] International trade studies using the Roeger method are, e.g., Konings and Vandenbussche (2005) and Badinger (2007). See Tybout (2003) for a discussion of alternative ways to estimate markups.
[12] The drawback with Roeger's method is that it relies on the assumption of constant returns to scale. With increasing returns to scale, the estimated markup will be biased downward. See, e.g., Levinsohn (1993).
[13] The inclusion of materials inputs is suggested by Domowitz et al. (1988) and is an extension of the original Hall approach that only incorporated capital and labor.

$$(\Delta\ln Q_t - \Delta\ln K_t) - \alpha_{Lt}(\Delta\ln L_t - \Delta\ln K_t) - \alpha_{Mt}(\Delta\ln M_t - \Delta\ln K_t) = \beta[(\Delta\ln Q_t - \Delta\ln K_t) + (1 - \beta)\Delta\ln\theta_t \quad (2)$$

where $\alpha = P_{It} I_{It} / P_t Q_t$, $I = L, M$, are factor shares of sales with P_{It} denoting factor prices and P_t the product price. Thus, the residual can be decomposed into a market power term and a productivity term with β being directly related to the markup, μ, of price over marginal cost by $\mu = 1/(1-\beta)$.[14]

As the two terms on the right-hand side of equation (2) are positively correlated, the estimation of β is problematic. Roeger (1995) solves this by deriving the dual Solow residual:

$$\alpha_{Lt}\Delta\ln P_{Lt} + \alpha_{Mt}\Delta\ln P_{Mt} + (1 - \alpha_{Lt} - \alpha_{Mt})\Delta\ln R_t - \Delta\ln P_t = -\beta[(\Delta\ln P_t - \Delta\ln R_t) + (1 - \beta)\Delta\ln\theta_t \quad (3)$$

with R_t denoting the price of capital, and then subtracting equation (3) from equation (2) to obtain the net Solow residual

$$(\Delta\ln Q_t + \Delta\ln P_t) - \alpha_{Lt}(\Delta\ln L_t + \Delta\ln P_t) - \alpha_{Mt}(\Delta\ln M_t + \Delta\ln P_t) - (1 - \alpha_{Lt} - \alpha_{Mt})(\Delta\ln K_t + \Delta\ln R_t) = \beta[(\Delta\ln Q_t + \Delta\ln P_{Lt}) - (\Delta\ln K_t + \Delta\ln R_t)] \quad (4)$$

Notice that in equation (4) the productivity term that causes the endogeneity problem cancels out.

To obtain a direct estimate of the markup μ, equation (4) can be rewritten

$$(\Delta\ln Q_t + \Delta\ln P_t) - (\Delta\ln K_t + \Delta\ln R_t) = \mu_t\{\alpha_{Lt}[(\Delta\ln L_t + \Delta\ln P_{Lt}) - (\Delta\ln K_t + \Delta\ln R_t) + (\alpha_{Mt}[(\Delta\ln M_t + \Delta\ln P_{Mt}) - (\Delta\ln K_t + \Delta\ln R_t)]\} \quad (5)$$

[14] Notice that under perfect competition when price equals marginal cost the Solow residual is given by $\Delta\ln\theta_t = (\Delta\ln Q_t - \Delta\ln K_t) - \alpha_{Lt}(\Delta\ln L_t - \Delta\ln K_t) - \alpha_{Mt}(\Delta\ln M_t - \Delta\ln K_t)$. If price exceeds marginal costs, however, factor share in costs increases to $(P / mc)\,\alpha_{It}$. The Solow residual should therefore be modified to $\Delta\ln\theta_t = (\Delta\ln Q_t - \Delta\ln K_t) - (1 - \beta)^{-1}\alpha_{Lt}(\Delta\ln L_t - \Delta\ln K_t) - (1 - \beta)^{-1}\alpha_{Mt}(\Delta\ln M_t - \Delta\ln K_t)$ where β is the Lerner index $(P - mc)/P$.

In order to estimate (5), only nominal data on firm sales and values of input factors are required. To simplify notation, let ΔY_t denote the left-hand side and ΔX_t the term within the bracket on the right hand side of equation (5)

$$\Delta Y_t = \mu \Delta X_t \tag{6}$$

where, thus, ΔY_t is the growth rate of sales per value of capital, ΔX_t reflects growth rates of the input factors weighted by their shares in sales and μ is the markup to be estimated.[15]

3.2 Data

We make use of detailed firm-level data provided by Statistics Sweden for exporting firms in the Swedish food chain, covering the period 1997-2006 for food processing firms and the period 2003-2006 for firms in the agricultural, wholesale and retail part of the food chain.[16][17] The food chain is an interesting case study for several reasons. First, food products constitute a large and stable share of consumers' expenditures, accounting for about 15 per cent of the expenditures during the last decade.[18] Hence, the pricing behavior of firms in this chain has a major impact on consumers' welfare. Second, the food chain is an important part of the Swedish economy since it employs around 6 per cent of all employees in Sweden (the dataset in this study covers around 220 000 employees) and food processing ranks as the third to fourth largest manufacturing industry in the country (depending on whether one focuses on the number of employees or on sales).[19] Third, the different parts of the food chain are highly integrated but are at the same time characterized by very different market situations.[20] The production chain may be described as a chain of imperfect markets where the agricultural sector is the most competitive one, with firms having the least market power, while the wholesale and retailing sectors are the least competitive. Thus, we have a unique possibility to compare pricing behavior of exporters when we follow products downstream.

---

[15] Exact definitions of ΔY_t and ΔX_t are given in the Appendix.

[16] We only consider firms that exist for at least three consecutive years. All estimations control for time effects so the longer time period for the food-processing sector only adds precision to the estimates. Restricting the period for food processors to 2003-2006 provides similar results to the ones discussed.

[17] Only wholesalers concentrating on agricultural products and food products as well as retailers mainly focusing on or specializing in food products are included in the analysis.

[18] These figures stem from LivsmedelsSverige (a joint platform between the industry, consumer groups and academia) and can be found on the following web page (downloaded 28th June 2011) http://www.livsmedelssverige.se/hem/statistik/livsmedelskedjan.html.

[19] In accordance with the standard Swedish industry classification, the food-processing industry includes production of beverages.

[20] McCorriston (2002) argues that the European food chain market consists of a multi-stage oligopoly where one "*oligopolistic sector sells its output to another oligopolistic sector*".

At the same time, the structure of the food chain varies across countries. According to McCorriston (2002), the concentration ratio of the five largest firms in the retail sector in the EU15 varied from around 96 per cent in Finland to 30 per cent in Italy in the mid-1990s, and a similar variation is found in the food processing sector. Since the structure of the food chain differs across countries, we can expect a Swedish firm selling its product to different foreign markets to exert varying market power across its export destinations.

The export behavior of firms in the Swedish food chain has been found to resemble the behavior of firms in other countries and sectors (Greenaway et al., 2010, Gullstrand, 2011). Hence, the number of exporting firms is quite small when all firms are considered. In 2003, the share of exporting firms was around 1 percent in agriculture and retailing, 14 per cent in food processing and 16 per cent in wholesale. In addition, a comparison between exporters and non-exporters within sub-sectors support the findings of other studies, i.e. that exporters are more productive.[21] Since export firms in the Swedish food chain display an otherwise representative behavior, their export-pricing strategies are also likely to be generally applicable.

The data set reports export values and quantities by product and trading partners at the 8-digit level of the Combined Nomenclature. The information on values and quantities is used to calculate export unit prices (values divided by quantities) for each product and export destination. The reason for using a very detailed product classification is that we want to compare one firm's price of a narrowly defined product on different export destinations. As products are defined at a highly disaggregated level, we thus minimize the problem of comparing prices of products with different quality.[22]

Table 1 presents some descriptive figures for our sample divided into single- and multi-destination exporters (i.e. firms exporting the same product to several destinations) in the different parts of the food chain. Notice that a single-destination exporter may be active in more than one destination if it exports several products but to different markets. The figures reveal a common pattern throughout the food chain. Multi-destination exporters are bigger, both in terms of sales and number of employees, more productive, and they export a greater number of products than single-destination exporters. The only exception to this pattern is that single-

[21] Exceptions are found in the agricultural sector when it comes to mixed farming, pig farming and cereal production.

[22] For instance, in our data material products with the CN-code 09102090 and 04031039 are described as *crushed or ground saffron* and *yogurt (excl. flavored or with added fruit, nuts or cocoa), with added sugar or other sweetening matter, of a fat content, by weight, of > 6,0%*, respectively. These categories are also examples of products that display high export-price variation at the firm level.

destination firms seem to be more productive in retailing. The figures resemble those in recent studies focusing on differences between exporting manufacturing firms and intermediary exporters in wholesale and retail. That is, intermediary exporters are in general found to be smaller, have higher industry diversification but are less geographically diversified (Bernard et al., 2010).

[Table 1 about here]

Figure 1 shows how export prices vary across destinations in the food chain based on the coefficient of variation of firm-product prices across markets for the 2003 to 2006 time period (when data is available for all sectors). As can be seen from the figure, exporters use very different prices across markets and there is greater price dispersion in agriculture and wholesale compared to food processing and retailing. Besides capturing export price deviations using the coefficient of variation, we introduce an alternative measure based on the identification of whether export prices vary considerably across export markets. Specifically, we construct a dummy variable defining a firm-product export price to be local when it deviates from the mean with more than 40 percent, and global (i.e. more or less the same on all markets) otherwise.[23] Figure 2 displays the share of local prices in firm-product observations for the different parts of the supply chain as well as between different product groups using the Rauch (1999) classification of product complexity. In addition, the pattern of local versus global price setting is compared between only multi-destination exports and all exports where single-destination exports are included and defined as global price setting. The pattern, however, is similar. Local pricing of export firms is most common in the upstream part of the food chain. Also, these large price variations are more common for differentiated products.

[Figure 1 about here]

[Figure 2 about here]

3.3 Empirical specification

To analyze how variations in firms' export prices are associated with market power, we study how the markup given by (6) changes with price variations at the firm-product level for each sector in the food chain separately. In particular, we focus on the interaction between price

[23] As this threshold is somewhat arbitrary, different thresholds are used in the analysis as a robustness check.

variations and the input growth composite, ΔX_t. The full model to be estimated by Roeger's (1995) method is given by

$$\Delta Y_{ijt} = \mu_1 \Delta X_{ijt} + \mu_2 [\Delta X_{ijt} \times PriceVar_{ijt}] + \boldsymbol{\mu} [\Delta X_{ijt} \times \mathbf{Z}_{i,k,t}] + \beta PriceVar_{ijt} + \boldsymbol{\gamma} \mathbf{Z}_{i,k,t} + \alpha_{ij} + \tau_t + \varepsilon_{ijt} \quad (7)$$

In (7), μ_1 is the average markup (for the whole sector) while μ_2 reflects how the markup *changes* with the variation in firm *i*'s export price of product *j* at time *t*, with $PriceVar_{ijt}$ denoting the price-variation variable. Additional changes in the markup linked to various control variables (reflected by the vector $\mathbf{Z}_{i,k,t}$ and including variables at the firm level and at the country level of the destination market (*k*)) are captured by $\boldsymbol{\mu}$. β and $\boldsymbol{\gamma}$ denote the direct effects of the price variable and the control variables, respectively. In addition, α_{ij} are firm-product fixed effects to control for heterogeneity of products, τ_t a year dummy, and ε_{ijt} is a white-noise error term. Descriptive statistics for the price-variation variables and information about the additional control variables are presented in Table 2.

[Table 2 about here]

4. Results

We estimate markups using firm-level data on sales and total expenditures on inputs for the different parts of the food chain. As a benchmark, we start by estimating the average markup for each sector without interaction terms or other control variables.[24] The results from the benchmark estimations partly support our expectations as we identify positive markups downstream but not upstream. Specifically, while no markup is found in the agricultural sector, the food-processing industry and the wholesale sector have markups of 1.27 and 1.14 respectively. These results are consistent with the findings in other studies.[25] Notice that the markups are determined by the market structure on both the Swedish and international markets as we do not differentiate between domestic and foreign sales. For retail, the average markup is below one, suggesting negative profits for firms in this sector. This may be a result of a small sample; since very few retailers export, the behavior of individual retailers will have a large impact on the markup. Another explanation is that retailers in general tend to display a very

[24] These results are not presented but are available upon request.
[25] See for example De Loecker and Warzynski (2009) and Wilhelmsson (2006).

different export behavior compared to firms in other parts of the food chain.[26] This is also confirmed by the earlier observation from Table 1 that single-destination exporters appear to be more productive than multi-destination exporters.

Table 3 reports the results when the interaction terms between the markup and the price-variation variables are included. While the results are upheld for the estimated average markups (as given by the marginal effects), the markup seems only to vary with the export-price variation in the food-processing industry. For this industry, both measures of price variation interact positively with the markup, implying that markups are higher for firms with a more diversified pricing behavior on the export market. For the other parts of the food chain, the results are inconclusive. While firms with a larger export-price variation in the agricultural sector have a higher markup as long as we categorize firms into local versus global price setters with the help of our dummy variable, no such effect is found when we use the coefficient-of-variation variable. Furthermore, the results indicate that firms charging different prices on different markets may even have a lower markup in the wholesale sector while no effect is found in retailing. The results are all robust for a change in the threshold of the local market dummy.[27]

[Table 3 about here]

The results in Table 3 might reflect that the ability to reach several markets as well as to price-discriminate between markets is correlated with other characteristics influencing the markup pattern across firms. Hence, more productive firms and/or more international firms (with higher export intensity or a greater number of export destinations) may be associated with a higher ability to price-discriminate and higher markups. Table 4 reports the results from including additional firm and average market characteristics of the export destinations. In particular, we add firm productivity (measured as total factor productivity), export intensity, number of destinations and the weighted distance (using export shares as weights). All regressions also include the direct effects of the variables interacted with the markup μ but these are excluded for brevity.

The results in Table 4 not only suggest that the markup is indeed a complex function of firm characteristics but also make the impact of the firm-product price variation on markups more

[26] One reason is that wholesalers act as a distribution channel for retailers who instead are more inclined to engage in local marketing (see Gullstrand and Jörgensen, 2011).
[27] We have used 0.3 and 0.5 as alternative thresholds. These results are not presented but are available upon request.

conclusive. Specifically, it is only in food processing that firms with a greater price variation are associated with a higher markup. This result provides evidence of price discrimination in this particular sector. In other sectors the markup does not vary with variations in export prices. The lack of price-discriminating behavior among exporters in the agricultural sector is likely to reflect the standard use of reference pricing on agricultural products. In addition, the contrasting price-setting behavior between exporters in the food-processing sector and exporters in the wholesale and retail sector is in line with reported discrepancies in the use of price discrimination between firms in the manufacturing and trade sector. For instance, Fabiani et al. (2005) show that firms in the trade sectors more often choose uniform pricing strategies.[28]

When it comes to the other results in Table 4, productivity seems to be positively correlated with markups in the food processing and trade sectors, but not for agriculture. Notably, firm productivity has a strong impact on markups in the retail sector. Our estimations also provide evidence of a positive correlation between the firm's markup and export intensity in the agricultural, food processing and wholesale sector. Again, the results point to a different export behavior amongst retailers. The different role of trade within intermediaries is also displayed by the negative correlation between the markup and the number of destinations to which the product is exported in the wholesale and retail sector. As revealed by our results, the positive impact of price variation on the markup in the food-processing industry is not just a reflection of firms having a stronger international focus and/or reaching out to more markets. Finally, the markup seems to be independent of whether the firm exports to more distant markets or not.

[Table 4 about here]

5. Extension: The determinants of export prices

While the primary focus of this paper is placed on price discrimination and markups, the firm decision to charge a particular export price in a market merits its own study. Previous empirical work studying firm pricing behavior in foreign markets has focused on the relationship between export prices and various gravity variables (see Görg et al., 2010, Manova and Zhang, 2009, and Martin, 2010). We replicate this research by looking at the determinants of unit value export prices for our data set, using the firm-product-destination export price for every observation as our independent variable. Figure 3 displays how the average firm-product export price change

[28] The negative average markup, as given by the marginal effect, for agriculture in Table 4 is difficult to interpret but in line with a high dependency on subsidies in order to survive for firms in this sector.

with distance in the different parts of the food chain, revealing quite different patterns across sectors. Notably, while export prices increase with distance in food processing and wholesale, they decrease in retail. In the agricultural sector, the relationship is nonlinear.

[Figure 3 about here]

In Table 5, we present the estimation results for all exporting firms in each of the investigated sectors. Our findings resemble those identified by other researchers. In particular, GDP per capita, expected to capture the income level of a country, influences prices positively in the food processing, wholesale and retail sectors. In addition, distance has a positive effect on export prices in food processing and retail, suggesting that firms in these sectors charge higher prices on more distant markets.[29] The positive effect of distance has acquired a lot of attention in prior research, not least because it contradicts expectations on basis of the Melitz and Ottaviano (2008) model. In most previous studies, this has been interpreted as supporting the notion of quality differences. It should be noted, however, that these findings also lend support to the existence of segmented markets. As there is both a cost and a price effect on the markup, a higher markup could be associated with factors on the demand side. In particular, the elasticity of demand might vary on foreign markets or consumers could value goods differently (see, e.g., De Loecker and Warzynski, 2010). In the presence of search costs in consumption, the fact that price information is more costly in markets where the product is less well-established could result in a positive correlation between distance and export prices.

Our results also show that the firm's export intensity is positively correlated with export prices in the agricultural, food-processing and wholesale sectors. This finding, which is similar to that identified in previous studies (i.e., Görg et al., 2010, and Manova and Zhang, 2009), clearly indicates that markets are segmented and that demand-side factors in the destination countries matter for the firm's pricing decision.

Notably, of the firm characteristics, only skill intensity seems to influence the firms' pricing decision, whereas we do not find any effects of productivity. The skill intensity has a positive correlation with export prices of firms in the wholesale and retail sector, indicating that skill-abundant intermediaries charge higher prices. Although the lack of correlation between a firm's productivity level and its export price should be interpreted with caution as the estimations

[29] The different results for agriculture may again reflect the standard use of reference pricing in the sector. This explanation is in accordance with the estimation results in Görg et al. (2010), which show that gravity variables do not affect export prices on homogenous products.

include firm-product fixed effects, the result could suggests that product quality has little influence on the firm's foreign-price decision.[30]

[Table 5 about here]

6. Conclusions

This paper starts from the observation that firms charge different prices on different export markets. We propose an explanation based on segmented markets and argue that these price variations reflect price discrimination. We then investigate markups within the different parts of the Swedish food chain and whether within-firm price variations are correlated with firm markup. Thus, the study offers a comprehensive analysis of pricing behavior of exporters when we follow products downstream.

The results from the markup estimations show that the pricing decision varies for firms in different parts of the supply chain. In particular, it is only in the food-processing industry that firms with a greater variation in export prices are associated with a higher markup. In other sectors the markup does not vary with variations in export prices. This result lends support to survey findings suggesting that price discrimination is more prevalent in the manufacturing sector than in other sectors. In highlighting the different pricing behavior of manufacturing and trade firms, the study also adds to the recent research on intermediary firms in international trade. In addition, the paper identifies other variations across different parts of the supply chain showing how price setting and markups are a complex function of firm characteristics. Together, these results suggest that the conclusions of firm behavior from other studies focusing on firms in the manufacturing sector cannot easily be extended to firms in other sectors of the economy.

[30] Görg et al. (2010) also controls for firm productivity in their estimations. They find a positive productivity effect on export prices at a more aggregated product level (the 6-digit HS industry level).

References

Aw, B.Y., 1993. Price discrimination and markups in export markets. *Journal of Development Economics*, 42 (2): 315-336.

Aw, B.Y., Baatra, G., and M.J. Roberts, 2001. Firm heterogeneity and export–domestic price differentials: A study of Taiwanese electronics products. *Journal of International Economics*, 54(1): 149-169.

Aw, B.Y., Chung, S., and M. Roberts, 2003. Productivity, Output, and Failure: A Comparison of Taiwanese and South Korean Manufacturers. *Economic Journal*, 113: 485-510.

Badinger, H., 2007. Has the EU's single markup programme fostered competition? Testing for a decrease in mark-up ratios in EU industries. *Oxford Bulletin of Economics and Statistics*, 69(4): 497- 519.

Baldwin, R., and J. Harrigan, 2007. Zeros, quality and space: trade theory and trade evidence. NBER Working paper No. 13214.

Bernard, A., Grazzi, M., and C. Tomasi, 2010. Intermediaries in international trade: Direct versus indirect modes of export. National Bank of Belgium, Working Paper No. 199.

Bernard, A., Eaton, J., Jensen, J.B., and S. Kortum, 2003. Plants and productivity in international trade. *American Economic Review*, 93(4): 1268-1290.

Brander, J., 1981.Intra-industry trade in identical commodities. *Journal of International Economics*, 11(1): 1-14.

Brander, J., and P. Krugman, 1983. A "reciprocal dumping" model of international trade. Journal of International Economics, 15 (3-4): 313-321.

De Loecker, J., 2007. Do export generate higher productivity? Evidence from Slovenia. *Journal of International Economics*, 73: 69-98.

De Loecker, J., and F. Warzynski, 2009. Markups and firm-level export status. NBER Working Paper No. 15198.

Domowitz, I., Hubbard, R., and B. Petersen, 1988. Market structure and cyclical fluctuations in US manufacturing. *Review of Economics and Statistics*, 70(1): 55-66.

Economides, N.S., 1988. The economics of trademarks. *Trademark Reporter*, 78: 523-539.

Fabiani, S., Druant, M., Hernando, I., Kwapil, C., Landau, B., Loupias, C., Martins, F., Mathä, T., Sabbatini, R., Stahl, H., and A. Stokman, 2005. The pricing behavior of firms in the euro area: new survey evidence. ECB Working Paper No. 535.

Goldberg, P.K., and M.M. Knetter, 1999. Measuring the intensity of competition in export markets. *Journal of International Economics*, 47: 27-60.

Görg, H., Halpern, L., and B. Muraközy, 2010. Why do within firm-product export prices differ across markets? Kiel Working Papers No. 1596, Kiel Institute for the World Economy.

Görg, H., and F. Warzynski, 2003. Price cost margins and exporting behavior: Evidence from firm-level data. German Institute for Economic Research Discussion Paper No. 365.

Greenaway, D., Gullstrand, J., and R. Kneller, 2008. Firm heterogeneity and the geography of international trade. University of Nottingham, GEP Discussion Papers No. 08/41.

Greenhut, M.L., Ohta, H., and J. Sailors, 1985. Reverse dumping: A form of spatial discrimination. *The Journal of Industrial Economics*, 34(2): 176-181.

Gullstrand, J., and C. Jörgensen, 2011. Local Price Competition: The Case of Swedish Food Retailers. AgriFood Working Paper No. 2011:3.

Gullstrand, J., 2011. Firm and destination-specific export costs: The case of the Swedish food sector. *Food Policy*, 36(2): 204-213.

Hall, R.E., 1988. The relation between price and marginal costs in U.S. industry. *Journal of Political Economy*, 96(5): 921-947.

Harrison, A., 1994. Productivity, imperfect competition and trade reform: Theory and evidence. *Journal of International Economics*, 36: 53-73.

Hoover, E., 1937. Spatial price discrimination. The Review of Economic Studies, 4(3): 182-191.

Hummels, D., and A. Skiba, 2004. Shipping the good apples out? An empirical confirmation of the Alchian-Allen conjecture. *Journal of Political Economy*, 112(6): 1384-1402.

Johnson, R.C., 2009. Trade and prices with heterogeneous firms. Working paper, Dartmouth College.

Konings, J., and H. Vandenbussche, 2005. Antidumping protection and markups of domestic firms. *Journal of International Economics*, 65: 151-165.

Levinsohn, J., 1993. Testing the import-as-market-discipline hypothesis. *Journal of International Economics*, 35: 1-22.

Manova, K., and Z. Zhang, 2009. Quality heterogeneity across firms and export destinations. Working Paper No 15342.

McAfee, R.P., Mialon, H.M., and S.H. Mialon, 2006. Does large price discrimination imply great market power? *Economic Letters*, 92: 360-367.

McCorriston, S., 2002. Why should imperfect competition matter to agricultural economists? *European Review of Agricultural Economics*, 29: 349-371.

Melitz, M.J., and G.I. Ottaviano, 2008. Market size, trade, and productivity. *Review of Economic studies*, 75(1): 295-316.

Martin, J., 2010. Markups, quality and transport costs. Working paper, Paris School of Economics.

Rauch, J.E., 1999. Networks versus markets in international trade. *Journal of International Economics*, 48: 7-35.

Roeger, W., 1995. Can imperfect competition explain the difference between primal and dual productivity measures? Estimates for U.S. manufacturing. *Journal of Political Economy*, 103(2): 316-330.

Tirole, J., 1988. *Theory of Industrial Organization*. Cambridge, MA:MIT.

Tybout, J.R., 2003. Plant and firm-level evidence on "new" trade theories. In Choi, K. and J. Harrigan (eds.), *Handbook of International Trade*, Oxford: Basil-Blackwell.

Wilhelmsson, F., 2006. Market power and European competition in the Swedish food industry. *Journal of Agricultural & Food Industrial Organization*, 4(1): article 7.

Tables

Table 1. Descriptive figures

	Agriculture		Food processing		Wholesale		Retail	
	Multi-destination	Single destination	Multi-destination	Single destination	Multi-destination	Single destination	Multi-destination	Single destination
Average number of employees	22	2.4	230	49	39.6	10	167	17
Average sales (1 000 SEK)	53 000	3 800	562 000	116 000	288 000	70 000	1 910 000	259 000
Average export value (1 000 SEK)	15 100	130	75 000	1 200	15 000	840	9 100	590
Average number of destinations	5.4	1	10	1.3	6.0	1.2	4.9	1.2
Average number of exported products	6.4	1.3	16	2.5	19	3.4	48.7	3.1
Average total factor productivity	2.4	1.9	3.2	1.3	2.0	1.8	1.0	3.6
Number of firm-product-destination observations	856	2 314	75 247	3 667	48 618	9 952	4 740	1 217
Number of firms	43	1 287	337	568	612	1 604	46	256

Table 2. Data descriptives

Variables	Definition	Mean	Standard deviation
Price variation variables			
Coefficient of variation	The coefficient of variation of the unit value export price defined at the firm-product level.	0.28	0.40
Local market dummy	Variable taking the value one if a firm's product unit exports value deviates by more than 40 percent from the average firm-product price.	0.30	0.46
Other firm characteristics			
Productivity (TFP)	Multilateral index of firm *i*'s total factor productivity defined as in Aw et al. (2003), $\ln TFP_t^i = (q_t^i - \bar{q}_t) + \sum_{s=2}^{t}(\bar{q}_s - \bar{q}_{s-1}) - \{\sum_j \frac{1}{2}(\alpha_{tj}^i - \bar{\alpha}_{tj})(x_{tj}^i - \bar{x}_{tj}) + \sum_{s=2}^{t}\sum_j \frac{1}{2}(\bar{\alpha}_{sj} - \bar{\alpha}_{s-1j})(\bar{x}_{sj} - \bar{x}_{s-1j})\}$, where lower-case letters indicate the natural logarithm of output (q) and each input j (x_j), bars indicate the un-weighted average over all firms (and hence the hypothetical firm used as a reference), and α denote input-cost shares. Output is measured by firm sales. Inputs used are number of employees, capital stock and raw materials.	1.25	0.52
Export intensity	Export values as a share of total sales.	0.21	0.26
Number of export destinations	Number of markets a firm export to.	16	19
Average export distance	Weighted average of firms export distance in kilometers (defining weights by the share of total export to each destination).	1215	1773
Skill intensity	Defined as firms belonging to the highest quintile (within each sub-part of the food chain) of firms' share of employees with university degree.	0.24	0.43
Export market characteristics			
Distance	The distance, in kilometers, from Stockholm to the capital of the export destination (cepii's population weighted distance) weighted with firm export shares, calculated with the great circle distance formula from CSI's World Fact.	2018	2951
GDP	Gross domestic product (millions of current US$, cepii) weighted with firm export shares	756340	1920223
GDP per capita	GDP divided by population (cepii) weighted with firm export shares	32813	18683

Table 3. Price variations and markup

	Agriculture		Food processing		Wholesale		Retail	
	Price variation coefficient	Local market (0.40)	Price variation coefficient	Local market (0.40)	Price variation coefficient	Local market (0.40)	Price variation coefficient	Local market (0.40)
Markup (μ)	**1.371**	-0.146	**1.234**	**1.250**	**1.156**	**1.154**	**0.872**	**0.872**
	(0.00)	(0.78)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
PriceVar	0.1817	0.087	**-0.021**	**-0.0014**	0.002	0.003	**0.031**	**0.016**
	(0.61)	(0.53)	(0.00)	(0.00)	(0.77)	(0.51)	(0.00)	(0.00)
μ × PriceVar	-0.303	**1.491**	**0.208**	**0.077**	-0.062	**-0.038**	0.018	-0.009
	(0.71)	(0.01)	(0.01)	(0.03)	(0.07)	(0.04)	(0.74)	(0.47)
Marginal effect w.r.t. the input growth composite (ΔX)	*1.314*	*0.221**	*1.280**	*1.275**	*1.146**	*1.146**	*0.873**	*0.871**
N	97	97	8 046	8 046	6 643	6 643	963	963
R^2	0.57	0.61	0.86	0.86	0.86	0.86	0.99	0.99

Note: The regressions include firm-product fixed effects and time dummies (not shown here). P-values within brackets are based on robust standard errors.
The marginal effect w.r.t. the input growth composite is interpreted as the average markup, which has been evaluated at the mean using the delta method and * indicates a markup significantly different from 1.

Table 4. Price variations and markup, extended

	Agriculture		Food processing		Wholesale		Retail	
	Price variation coefficient	Local market (0.40)	Price variation coefficient	Local market (0.40)	Price variation coefficient	Local market (0.40)	Price variation coefficient	Local market (0.40)
Markup (μ)	**2.949**	**2.676**	**1.274**	**1.281**	**1.444**	**1.441**	**1.231**	**1.229**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
PriceVar	0.056	-0.008	**-0.018**	-0.0016	0.005	0.004	-0.0001	-0.0005
	(0.75)	(0.96)	(0.00)	(0.56)	(0.50)	(0.39)	(0.91)	(0.45)
μ × PriceVar	-0.219	0.100	**0.202**	**0.068**	0.004	-0.004	-0.003	-0.0003
	(0.58)	(0.84)	(0.01)	(0.05)	(0.90)	(0.83)	(0.39)	(0.82)
μ × ln(tfp)	-1.811	-1.814	**0.281**	**0.290**	0.048	0.048	**1.551**	**1.551**
	(0.26)	(0.34)	(0.00)	(0.00)	(0.08)	(0.08)	(0.00)	(0.00)
μ × ln(export intensity)	**0.314**	0.311	**0.047**	**0.046**	**0.037**	**0.037**	**-0.102**	**-0.102**
	(0.02)	(0.11)	(0.00)	(0.01)	(0.00)	(0.00)	(0.01)	(0.01)
μ × number of destinations	-0.081	-0.202	-0.032	-0.030	**-0.037**	**-0.037**	**-0.638**	**-0.638**
	(0.78)	(0.67)	(0.23)	(0.27)	(0.00)	(0.00)	(0.00)	(0.00)
μ × ln(dist)	-0.06	-0.005	0.003	0.003	-0.024	-0.024	-0.0001	-0.00000
	(0.56)	(0.83)	(0.86)	(0.86)	(0.16)	(0.16)	(0.98)	(0.98)
Marginal effect w.r.t. the input growth composite (ΔX)	*-0.237**	*-0.254**	*1.257**	*1.255**	*1.087**	*1.088**	*0.489**	*0.489**
N	97	97	8 046	8 046	6 643	6 643	963	963
R^2	0.94	0.94	0.89	0.88	0.91	0.91	0.99	0.99

Note: The regressions include firm-product fixed effects and time dummies (not shown here). P-values within brackets are based on robust standard errors.
The marginal effect w.r.t. the input growth composite is interpreted as the average markup, which has been evaluated at the mean using the delta method and * indicates a markup significantly different from 1.

Table 5. Determining export prices

	Agriculture	Food processing	Wholesale	Retail
ln(tfp)	-0.008	-0.009	-0.016	-0.132
	(0.90)	(0.68)	(0.58)	(0.28)
ln (skill intensity)	-0.106	-0.009	**0.062**	**0.322**
	(0.34)	(0.42)	(0.02)	(0.00)
ln(export intensity)	**0.186**	**0.023**	**0.035**	0.066
	(0.00)	(0.01)	(0.00)	(0.17)
ln(gdp)	0.029	-0.006	-0.009	0.017
	(0.68)	(0.14)	(0.06)	(0.44)
ln(gdp per capita)	0.064	**0.062**	**0.025**	**0.144**
	(0.49)	(0.00)	(0.00)	(0.01)
ln(distance)	-0.037	**0.066**	-0.002	**0.201**
	(0.76)	(0.00)	(0.89)	(0.00)
N	3161	77750	57852	5920
R^2 (within)	0.030	0.008	0.002	0.047
Rho	0.881	0.821	0.878	0.838

Note: The regressions include firm-product fixed effects and time dummies (not shown here). P-values within brackets are based on robust standard errors.

Figures

Figure 1. Firm-product price dispersion for multi-destination exports (2003-2006)

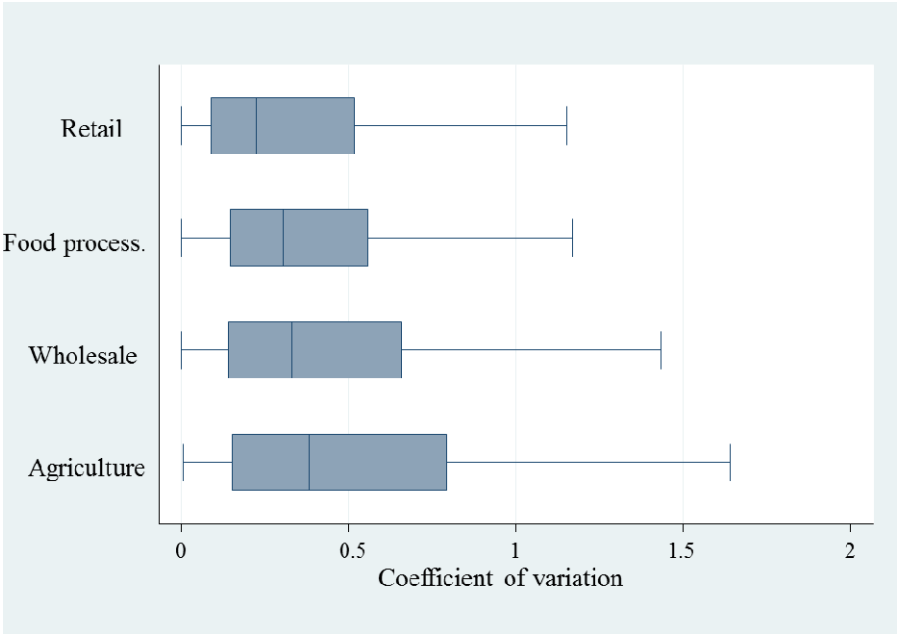


Figure 2. Share of local price setting (2003-2006)

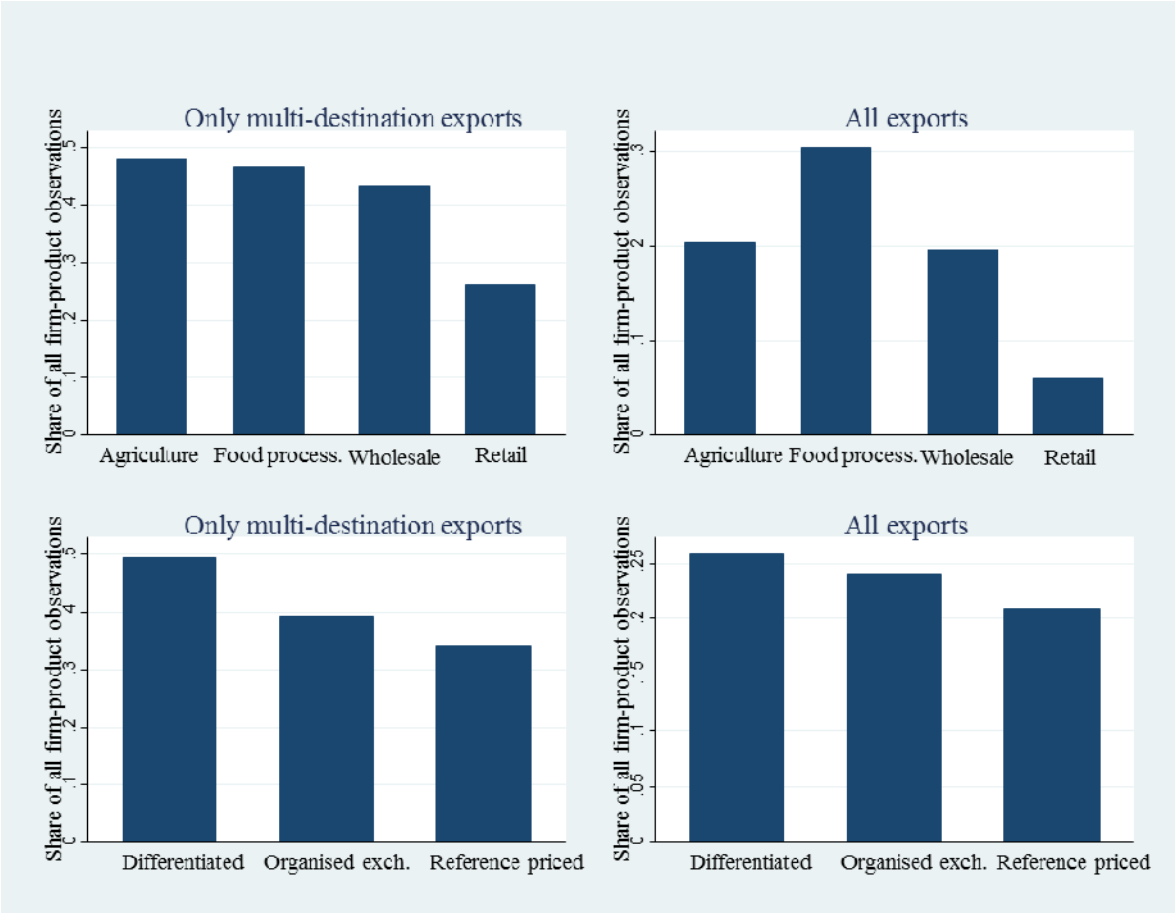
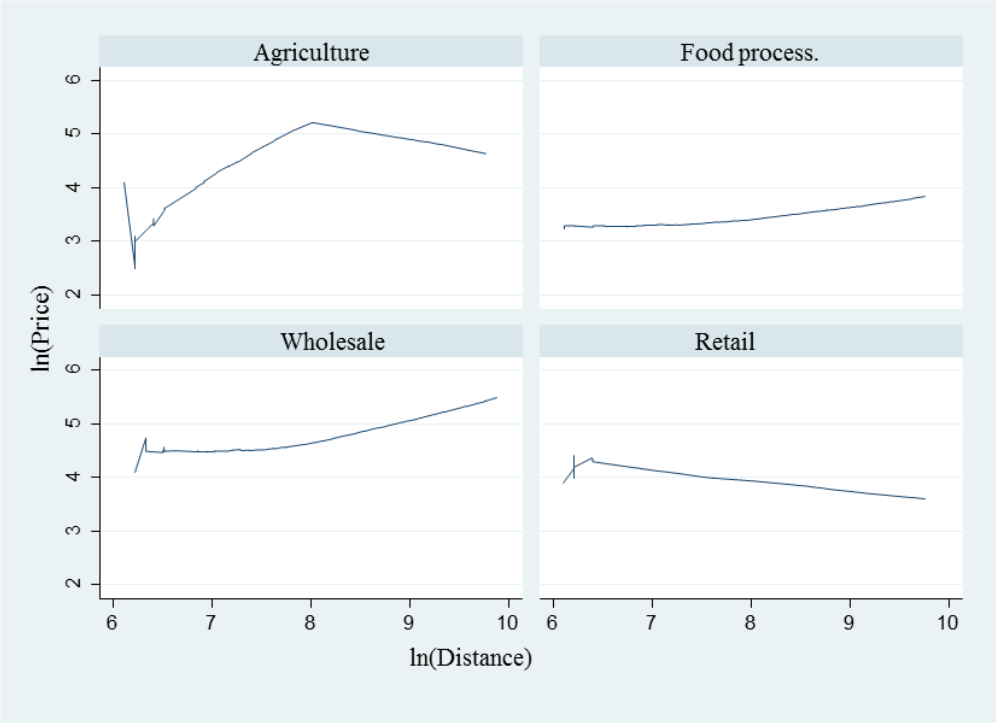


Figure 3. Export prices and distance (2006)



Appendix

Markup variables

The variables in equation (6) are defined as follows:

$\Delta Y_{it} = \Delta\ln(sales) - \Delta\ln(value\ of\ capital)$

$\Delta X_{it} = \alpha_{Lit}L_{it}[\Delta\ln(wage\ costs) - \Delta\ln(value\ of\ capital)] +$

$\alpha_{Mit}M_{it}[\Delta\ln(costs\ of\ raw\ materials) - \Delta\ln(value\ of\ capital)]$

where

$\alpha_{Lit}L_{it}$ = *labor costs share in output = (wage costs) / (sales)*

$\alpha_{Mit}M_{it}$ = *raw material costs share in output = (costs of raw material) / (sales)*

which is calculated for each product *j* defined at the 8-digit level of the Combined Nomenclature (CN8). The capital stock is calculated by the perpetual method using book value the first year. Depreciation rate for equipment and for buildings are 0.1 and 0.05, respectively.