Spatial Dispersion of Retail Margins: Evidence from Turkish Agricultural Prices*

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Abstract

The farmer share of retail prices is shown to be about 16 percent, corresponding to about 84 percent of a distribution share, on average across agricultural products and regions within Turkey. The share of transportation costs in retail prices is only about 7 percent, while the share of retail margins is about 77 percent of retail prices. The dispersion of retail prices across regions is shown to be mostly due to local wages and variable markups, while the contribution of traded-input prices is relatively small. Accordingly, the high dispersion of farmer prices across locations is not reflected in the dispersion of retail prices due to the high contribution of retail margins. These retail margins are also shown to account for about one third of the consumer welfare dispersion across regions and more than half of the consumer welfare dispersion across products.

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Key Words: Agricultural Prices; Farmer Share; Distribution Share; Retail Margins; Consumer Welfare Dispersion.

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1 Introduction

The portion of agricultural retail prices received by farmers, the so-called farmer share, is about 15 percent across countries (e.g., see Canning et al., 2016). Accordingly, the distribution share consisting of transportation costs and retail margins constitute the bigger portion of retail prices. The decomposition of this distribution share into its components is important to understand the welfare and policy implications for both consumers and farmers. For example, if the distribution share is high due to transportation costs, the optimal policy to improve welfare would be to reduce them through investments on infrastructure or subsidies on transportation-related costs, while if the distribution share is high due to retail margins, they can be subject to effective price regulations that can increase consumer welfare due to lower prices and increase farmer welfare due to higher sales (e.g., see Sheshinski, 1976; Selim, 2015; Serra, 2015). Since retail margins increase with the market share (e.g., see Hong and Li, 2017), the effects of retail margins (and thus the corresponding price regulation) may even be higher in regions with higher market power. Accordingly, it is essential to have a decomposition of the distribution share both an average and across regions to achieve optimal policies.

This paper achieves such a decomposition by using retail- and farm-level micro price data on agricultural products across Turkish regions. In order to have an empirical motivation and implications for welfare, a simple model is introduced, where the economic environment consists of regions inhabited by individuals who consume local retail goods and retailers who purchase traded-inputs from producers subject to transportation costs. Since we empirically focus on individual products of green groceries, producers correspond to farmers who produce homogenous goods. Accordingly, each retailer searches for the minimum price across farmers at the product level, subject to transportation costs. Once transportation costs and source farms are identified through estimations based on price data obtained from both farmers and retailers, traded-input prices are determined for retailers. By further introducing a structure on local retail costs through the model, the retail prices are decomposed into farmer prices and distribution costs (consisting of transportation costs and retail margins).

The empirical results show that the farm share is about 16 percent of retail prices on average across agricultural goods and regions, corresponding to about 84 percent of a distribution share; this is consistent with studies such as by Canning et al. (2016) as introduced above. The share of transportation costs in retail prices is only about 7 percent, while retail margins (defined as the ratio of retail to traded-input prices including transportation costs) are about 4.47, implying that about 77 percent of retail prices are accounted for by the retail sector. This result corresponds to slightly higher transportation costs within Turkey compared to similar costs in the U.S. of about 4 percent as shown by Elitzak (1997) for food products. This may be surprising, because the U.S. is a much more spatially dispersed economy (due its land size) and thus one may expect lower transportation costs within Turkey. Nevertheless, since transportation costs between farmers and retailer highly depend on fuel prices as shown by Volpe et al. (2013), the difference in transportation costs of Turkey and the U.S. can easily be attributed to ratio of fuel prices in Turkey to those in the U.S. which has an average of about 2.6 between 1994 and 2011 according to World Development Indicators.

When a comparison is achieved across regions, the dispersion of retail prices is mostly due to local wages and variable markups (95 percent), while the contribution of traded-input prices is relatively small (5 percent). When we further investigate the dispersion of traded-input prices across locations, the contribution of transportation costs dominate by 95 percent, while that of source prices is only 5 percent. It is implied that the high dispersion of farmer prices across locations is not reflected in the dispersion of retail prices due to factors such as local input costs, variable markups, and transportation costs. It is also shown that retail margins are dispersed across regions at the product level. The implications of the model suggest that the dispersion of retail margins (across regions) is explained 52 percent by traded-input prices, and 48 percent by local wages and variable markups. Since the dispersion of traded-input prices is mostly due to transportation costs, it is implied that final consumers face different retail margins across locations due to all of transportation costs, local wages and variable markups.

Finally, using the implications of the model for consumer welfare, on average across individual products, about 30 percent of the consumer welfare dispersion is explained by retail margins across locations, while another 70 percent is explained by differences in either real economic sizes of regions or traded-input prices. On the other hand, within the same location, retail margins contribute by about 60 percent to the consumer welfare dispersion across products. Hence, the retail margin (that can be mostly explained by local wages and variable markups) is one of the key variables in understanding the dispersion of consumer welfare across regions.

The rest of the paper is organized as follows. The next section introduces Turkish data on farmer and retailer prices. Section 3 introduces a summary of the model and the empirical methodology. Section 4 depicts the empirical results. Section 5 discusses the implications for price dispersion across locations and goods, while Section 6 depicts the implications for consumer welfare dispersion. Section 7 concludes. The technical details of the model, together with those of the empirical methodology, are given in the Appendix.

2 Data

Turkish consumers purchase major portion of their green groceries (i.e., produce commodities of fruits and vegetables) from open street markets called *bazaars*, where sellers are either local farmers or intermediaries; however, prices of the products sold in bazaars are not recorded. Nevertheless, consumers still purchase about 15 percent of their green groceries from retailers (see Koc et al., 2007 and Bignebat et al., 2009). Since prices at the retail level are recorded at the product level across regions of Turkey, we focus on such prices in this paper. The location and product definition of these retail prices are matched with those of prices received by farmers who sell their products to either wholesalers or retailers (rather than selling them directly at the bazaar or to intermediaries who sell them at the bazaar).[1]

The prices received by farmers cover 111 products from 81 provinces of Turkey, while retail prices cover 440 products from 26 regions of Turkey, where regions are defined as combinations of the very same 81 provinces. Prices received by farmers are per unit first hand selling prices of products (on average across farmers) which are produced or grown and presented to market by producers who are engaged in agriculture; these prices are value added tax exclusive. Retail prices represent per unit average price across retailers within a particular region; these prices are also value added tax inclusive.[2] We focus on the

[1] The data have been downloaded from http://www.turkstat.gov.tr/ where interested readers may find further information.

[2] Since multiplicative value added taxes are determined nationwide within Turkey, they would easily be

intersection of these two data sets covering 37 products. In order to match the location of farmer prices with the location of retail prices, we take the average of farmer prices across provinces forming each retail region at the product level. Therefore, the version of the data we use consists of 37 products from 26 regions.[3] For each product and region, we employ the average prices across the years of 2010 and 2011 in order to eliminate the transitory variations in prices, such as the ones due to product-and-year specific shocks emerging from weather conditions or "sales" events in retailers.[4] The prices are in Turkish liras. A typical observation in the final version of the data is the price of cauliflower per kilogram obtained from the region consisting of the provinces of Kirikkale, Aksaray, Nigde, Nevsehir, Kirsehir; the price is 2.20 Turkish liras at the retail level, while it is 0.42 Turkish liras at the farmer level. This simple example gives clues regarding the distribution or retail margin for green groceries, although we need to consider the full sample in order to talk about a systematic approach.

When retail prices are compared with farmer prices collected from the very same regions, retail prices are about the twice as farmer prices on average across regions. However, the retailer in each region can purchase products from other regions if they would see an arbitrage opportunity (after considering transportation costs). We also observe that the retail prices in

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captured by good fixed effects in a typical regression where the dependent variable would be log retail prices, which is exactly the case in this paper.

[3] The list of the products is given in Online Appendix Table A.1, while the list of regions (and the provinces forming them) is given in Online Appendix Table A.2

[4] For interested readers, such effects are discussed in studies such as by Azzam, (1999), Peltzman (2000) or Chen et al. (2008) who show that the transmission of price changes between farmers and retailers is generally delayed, incomplete, and asymmetric.

any region are, on average, six times the lowest farmer prices across all regions; therefore, as long as transportation costs are lower than the farmer price difference between local farmers and distant farmers, retailers would purchase products from the distant farmers.

The price dispersion across regions (measured by the coefficient of variance across regions for each product in order to control for the scale effects in the measure of standard deviation) ranges between 0.001 (for banana) and 0.308 (for tomato) for retail prices, while it ranges between 0.192 (for banana) and 0.648 (for purslane) for farmer prices. Hence, on average across products, farmer prices are much more dispersed across regions compared to retail prices. This important observation is consistent with the magnitude of the arbitrage opportunities discussed above, because higher dispersion in farmer prices (across regions) means a greater possibility to encounter a lower farmer price in a distant region.

In this paper, by using the implications of a trade model, we investigate whether the potential arbitrage opportunities are taken by retailers on green groceries across regions. Since such arbitrage opportunities are connected to the distance measures across regions, we calculate the great circle distance (in miles) between each region pair by considering the average geographical location of each region (defined as the average longitude/latitude of provinces within that region).[5] Finally, in order to identify markups and marginal costs, we consider local wages for which we use region-specific measures of "Maid and Cleaners' Fee" which is one of the 440 products (covering all 26 regions of Turkey) in the original retail-level price data set.[6]

[5]The internal distance within each region is calculated as the average bilateral distance across the provinces forming that region.

[6]The corresponding distribution of wages across regions is given in Online Appendix Figure A.1. As is evident, Turkish wages range between 27.90 (for Mardin, Batman, Sirnak, Siirt) and 78.85 (for Istanbul)

3 Model and Estimation Methodology

We are interested in understanding the retail/distribution margins of green groceries by introducing a model that is consistent with the existing literature; we further would like to connect the implications of such margins for consumer welfare. Accordingly, we model retailers that sell green groceries (to the final consumers) that they purchase from farmers. The economic environment consists of regions that are inhabited by individuals, retailers and farmers. We do not model the wholesalers on purpose, because the wholesale of green groceries is regulated in Turkey where wholesalers receive 8 percent of their sales price, which corresponds to a gross constant markup of about 1.087 at the wholesale level (see Lemeilleur et al., 2007; Bignebat et al., 2009). Since such constant markups only correspond to scale effects in retail prices, they are practically controlled by any constant in a typical regression where log retail prices represent the dependent variable. This paper achieves such a regression analysis, below (i.e., we choose to control for the effects of wholesalers empirically); accordingly, we keep the model simple by skipping the unnecessary details of wholesalers, although our measures for retail markups/margins will include wholesale markups/margins as well.

Following Behrens and Murata (2007), individuals in each region maximize their utilities based on non-CES preferences; this leads us having variable markups through the optimization problem of the retailers who are assumed to have market power due to the factors that differentiate their product, such as their location, brand, or packaging strategy. This is in line with studies such as by Sexton et al. (2003) who have shown that grocery retailers ex-

across regions.

ercise market power over consumers and by Gardner (1975) who has shown that a constant markup (defined as a fixed percentage margin) cannot accurately depict the relationship between the farm and retail prices. Other studies have confirmed this by showing that retail price variations reflect changes in retail margins rather than changes in costs (see Conlisk, et al., 1984; MacDonald, 2000; Pesendorfer, 2002; Hosken and Reiffen, 2004).

The retailer in each region purchases green groceries as traded-inputs and combine them with local input (e.g., local labor) in order to produce the final retail product; this is consistent with studies such as by Elitzak (1997) who shows that traded-inputs and local labor highly dominate all other inputs with their share in retailing of farm products. For each product sold, the retailers search for the minimum price farmers across all regions due to the homogenous structure of green groceries; this is in line with Rauch (1999) who has created a well-accepted categorization of traded goods where green groceries are categorized as homogenous products.[7]

The technical details of the model are given in the Online Appendix, while a summary of the model is depicted here. According to the model, marginal costs of retailing (implied by a Cobb-Douglas retail-production function) for good g in region r are given as follows:

$$c_r^g = \left(f_r^g\right)^{\beta}\left(w_r\right)^{1-\beta} \tag{1}$$

where f_r^g represents the traded input price of good g, and w_r represents the per unit price/cost of the local input (e.g., wages) that is common across goods. In equilibrium, β represents

[7] We ignore any imported green groceries in the model, because Turkey is a net exporter of these products by a great margin. In particular, Turkey has exported 6,152 (6,695) million U.S. dollars worth of green groceries, while importing only 757 (952) million U.S. dollars worth of them in 2010 (2011). Source: http://www.turkstat.gov.tr/.

the sum of *farm share* and *transportation share*, while $1-\beta$ represents the *retail share* of the retail price; the sum of transportation and retail shares further represents the *distribution share*. The profit maximization results in the following price expression:

$$p_r^g = \mu_r^g c_r^g \tag{2}$$

where μ_r^g represents gross variable retail markups (that change with quantity sold). The retail margin rm_r^g is implied as follows:

$$rm_r^g = \frac{p_r^g}{f_r^g} = \mu_r^g \left(\frac{w_r}{f_r^g}\right)^{1-\beta} \tag{3}$$

which is a function of retail markups, traded-input prices and local retail costs. Since agricultural goods are homogenous when they leave the production farms, the retailer in each region searches for the lowest price across potential farmers, by taking into account the transportation costs between the farmer and the retailer. Accordingly, traded-input prices f_r^g for the retailer in region r are connected to the producer prices by the following expression:

$$f_r^g = f_{rs}^g + \delta d_{rs} \tag{4}$$

where f_{rs}^g is the producer price of good g at the source region s for the retailer in region r. It is important to emphasize that f_{rs}^g changes across destinations due to the retailer (in each region r) searching for the lowest-price farm, after considering the transportation costs; hence, the source farm for each retailer may well be different. Transportation costs are represented by δd_{rs} where d_{rs} is the distance between the source/producer and the retailer in miles, and δ is the transportation cost per mile per unit of good transported. Substituting this expression into the log retail prices, the model implies the following expression as shown in the Online Appendix:

$$\ln p_r^g = \frac{\beta}{2} \underbrace{\ln\left(f_{rs}^g + \delta d_{rs}\right)}_{\text{Traded-Input Prices}} + \gamma^g + \gamma_r + \varepsilon_r^g \tag{5}$$

which can be estimated using data on prices (p_r^g and f_{rs}^g), good fixed effects γ^g, and destination fixed effects γ_r, subject to the determination of the source farm. As shown in the Online Appendix, we achieve the latter by using Simulated Method of Moments (SMM) where we search for the parameter of δ that maximizes the explanatory power of the Ordinary Least Squares (OLS) regression that minimizes the contribution of the residual sum of squares. In terms of economic intuition, this strategy corresponds to calculating the arbitrage opportunities of the retailers across farmers (i.e., searching for the minimum-cost producer) after controlling for transportation costs. Accordingly, when data for retail-level prices p_r^g and farm-level prices f_s^g for all r, s and g are available, both δ and β are identified; thus, the source region (i.e., the lowest-price farm, after considering transportation costs) and the source prices f_{rs}^g $(= \min_s (f_{rs}^g | g))$ for each retailer is identified at the good level.

4 Empirical Results

The estimation results for Equation 5 are given in Table 1. As is evident, the share of traded inputs β is estimated as 0.15; it is significant at the 5 percent level. It is implied that local retail costs correspond to about 85 percent of overall retail costs for green groceries in Turkey. If we presume that local retail costs are correlated with the local income/wage (as in Crucini et al., 2005; or Crucini and Yilmazkuday, 2014), this result is consistent with the "Penn effect" which implies that prices are higher in high-income regions. The transportation cost per mile per unit of good transported δ is estimated as 0.32×10^{-3}, which is also significant at the 5 percent level; it corresponds to a transportation cost of about 3.2 Turkish kurus (i.e., 0.032 Turkish lira) per 100 miles per unit of good transported. The results are supported by the high explanatory power. Nevertheless, we are mostly interested in the implications of these estimates rather than their pure values, which we focus on next.

We start with the product-level implications on the ratio of estimated transportation costs $\widehat{\delta} d_{rs}$ to the estimated source prices $\widehat{f_{rs}^{g}}$:

$$\tau_{rs}^{g} = \frac{\widehat{\delta} d_{rs}}{\widehat{f_{rs}^{g}}} \tag{6}$$

which is for the retailer located in region r that purchases good g from the farmer in region s (i.e., the lowest-price farm, after considering transportation costs). This ratio provides useful information on transportation costs as a portion of source prices, which is a standard measure (for comparison purposes) across products and/or regions. As shown in Table 2, the average of this ratio (across products and regions) is about 0.39 with a range of between 0.02 and 2.13.[8] Therefore, on average, a green grocery product that is worth 1.00 Turkish lira at the source farm is transported for about 39 Turkish kurus (i.e., 0.39 Turkish liras) to the destination retailer.

An alternative transportation cost measure can also be considered, this time based on the ratio of estimated transportation costs $\widehat{\delta} d_{rs}$ to the fitted retail prices $\widehat{p_{r}^{g}}$:

$$\tau_{rs}^{g} = \frac{\widehat{\delta} d_{rs}}{\widehat{p_{r}^{g}}} \tag{7}$$

which corresponds to the *transportation share* of retail prices. As also shown in Table 2, the

[8] For this and later ratios, the corresponding distributions (across products and regions) are given in Online Appendix Figure A.1.

average transportation costs represent about 7 percent of the retail price, on average across goods and locations. This corresponds to slightly higher transportation costs within Turkey compared to similar costs in the U.S. of about 4 percent as shown by Elitzak (1997) for food products. This may be surprising, because the U.S. has a much more spatially dispersed economy and thus one may expect lower transportation costs within Turkey. Nevertheless, since transportation costs between farmers and retailer highly depend on fuel prices as shown by Volpe et al. (2013), the difference in transportation costs of Turkey and the U.S. can easily be attributed to long-run ratio of fuel prices in Turkey to those in the U.S. which has an average of about 2.6 between 1994 and 2011 according to World Development Indicators.

We estimate the product-level gross retail margin rm_{rs}^{g} as follows:

$$rm_{r}^{g} = \frac{\widehat{p_{r}^{g}}}{\widehat{f_{r}^{g}}} \tag{8}$$

which is the ratio of the fitted retail prices $\widehat{p_{r}^{g}}$ to the fitted traded-input price $\widehat{f_{r}^{g}}$ (including transportation costs) for the retailer in region r regarding good g. As is evident in Table 2, gross retail margins have an average of about 4.47 with a range between 1.48 and 15.04 across products and regions. Thus, on average, a retailer sells a green grocery product, for which she pays 1.00 Turkish liras, for about 4.47 Turkish liras. For sure, this retail margin includes both local retail costs and markups, which we will discuss in details, below.

The gross distribution margin dm_{rs}^{g} at the product level is estimated as follows:

$$dm_{rs}^{g} = \frac{\widehat{p_{r}^{g}}}{\widehat{f_{rs}^{g}}} \tag{9}$$

which is the ratio of fitted retail prices $\widehat{p_{r}^{g}}$ to the fitted source price $\widehat{f_{rs}^{g}}$ (excluding transportation costs) for the retailer in region r that purchases good g from the farmer in region s. This ratio also corresponds to one over the *farm share* in retail prices. As depicted in Table

2, gross distribution margins have an average of 6.10 with a range of 2.21 and 17.37. Thus, on average, a green grocery product that is sold for 1.00 Turkish lira by the producer/farmer is sold for about 6.10 Turkish liras in a typical retailer. It is implied that the distribution share (i.e., the sum of transportation share and retail share) of retail prices is about 84 percent, while the farm share is about 16 percent, on average across goods and regions. This estimated farm share is line with those in the U.S. (14 percent) and Canada (17 percent) as shown by Canning et al. (2016).

Since prices are given as $p_r^g = \mu_r^g \left(f_r^g\right)^{\beta} \left(w_r\right)^{1-\beta}$ according to the model, one can identify the multiplication of markups μ_r^g and local costs $\left(w_r\right)^{1-\beta}$ by using the estimation results (that provide information on β and f_r^g). However, the empirical strategy that we have used so far does not allow us to identify markups μ_r^g versus marginal costs of retailers c_r^g. Accordingly, we take a stand on our model by considering the implications on local costs which we proxy by local wages (as defined in the data section). We achieve this by using the following expression for markups:

$$\widehat{\mu_r^g} = \frac{\widehat{p_r^g}}{\left(\widehat{f_r^g}\right)^{\widehat{\beta}} \left(w_r\right)^{1-\widehat{\beta}}} \tag{10}$$

for which we use fitted retail prices $\widehat{p_r^g}$, data on wages w_r, fitted traded-input prices $\widehat{f_r^g}$, and the estimated coefficient of $\widehat{\beta}$. Since there are potential scale issues between prices and wages, we normalize the implied markups by setting the minimum markup equal to one. The descriptive statistics on estimated markups are given in Table 2, where, on average, gross retail markups are about 4.29.

In sum, Table 2 reveals information on how large the distribution and retail margins can be, while the contribution of transportation costs on retail prices are relatively minor.

However, the distribution of such variables is also of particular interest, because we simply would like to know why there are differences across regions and/or products regarding retail prices, potentially determined by distribution and retail margins as well as transportation costs. While the dispersion across regions would have implications for the Law of One Price (LOP), which states that the price of the same product across two different locations should be the same, the dispersion across products is essential for understanding the contribution of product-specific retail margins/markups to the retail prices, which is among the questions often asked about retail margins (see Wohlgenant, 2001). Such a systematic explanation can be achieved by considering the dispersion of these variables across regions and/or products, which we achieve next.

5 Implications for Price Dispersion

We start with the investigation of the price dispersion at the retail level by considering prices $p_r^g = \mu_r^g \left(f_r^g\right)^\beta \left(w_r\right)^{1-\beta}$ given by the model. The variance decomposition of log prices is implied as follows by :

$$\underbrace{var\left(\ln p_r^g\right)}_{\text{Price Dispersion}} = \underbrace{cov\left(\ln \mu_r^g, \ln p_r^g\right)}_{\text{Due to Markups}} + \underbrace{cov\left(\left(1-\beta\right)\ln w_r, \ln p_r^g\right)}_{\text{Due to Local Retail Costs}} + \underbrace{cov\left(\beta \ln f_r^g, \ln p_r^g\right)}_{\text{Due to Traded-Input Prices}} \tag{11}$$

which is achieved by taking covariance of both sides of the log retail price expression with respect to log retail prices. Equation 11 holds with equality due to the properties of the variance operator *var* and the covariance operator *cov*. Since the variance operator considers the deviations from the sample mean by construction, considering the price dispersion across regions would directly corresponds to the deviations from LOP. We achieve this by using Equation 11 for each good g individually. The corresponding results for the price dispersion across regions are given in Table 3, where the contribution of local retail costs and markups dominate the contribution of traded-input prices on average across products. In particular, local retail costs contribute to the price dispersion by about 65 percent, while retail markups contribute by about 30 percent. Therefore, retail margins (rather than overall distribution margins or transportation costs) are essential for understanding the deviations from LOP. The relatively low contribution of traded-input prices in Table 3 also provides insights regarding why the high dispersion of producer prices is reduced to lower levels at the retail level.

When we replicate the same analysis for the retail price dispersion across goods, the contribution of traded-inputs is relatively higher; this is expected, because products potentially have different characteristics. Nevertheless, the contribution of markups dominates the price dispersion across goods, partly by construction, because local retail costs are the same across goods within a particular region. Therefore, whenever retail prices of different products within the same region are compared, the dispersion is mostly due to product-specific retail markups μ_r^g rather than the characteristics of the products reflected in their production or transportation costs.

We continue with investigating the determinants of traded-input prices f_r^g $(= f_{rs}^g + \delta d_{rs})$ using the same variance decomposition methodology, where we use the following expression:

$$\underbrace{var\left(f_r^g\right)}_{\text{Dispersion}} = \underbrace{cov\left(f_{rs}^g, f_r^g\right)}_{\text{Due to Source Prices}} + \underbrace{cov\left(\delta d_{rs}, f_r^g\right)}_{\text{Due to Transportation Costs}} \tag{12}$$

The corresponding results are given in Table 3, where the product-level dispersion of traded-input prices across regions is mostly due to transportation costs rather than source prices. It is implied that the search of the retailers for the minimum price farm results in very similar source prices across farms, while such source prices differentiate at the destination retailer when transportation costs are added. The dispersion across goods is dominated by source prices, mostly reflecting the good characteristics within the very same destination region.

The retail margins are implied as follows:

$$rm_{rs}^{g} = \frac{p_r^g}{f_r^g} = \frac{\mu_r^g \left(f_r^g\right)^{\beta} \left(w_r\right)^{1-\beta}}{f_r^g} = \mu_r^g \left(\frac{w_r}{f_r^g}\right)^{1-\beta} \tag{13}$$

of which log version can be written as follows for a variance decomposition analysis:

$$\begin{aligned} \underbrace{var\left(\ln rm_{rs}^{g}\right)}_{\text{Dispersion}} &= \underbrace{cov\left(\ln \mu_r^g, \ln rm_{rs}^{g}\right)}_{\text{Due to Markups}} + \underbrace{cov\left(\ln \left(w_r\right)^{1-\beta}, \ln rm_{rs}^{g}\right)}_{\text{Due to Local Retail Costs}} \\ & \quad + \underbrace{cov\left(\ln \left(f_r^g\right)^{\beta-1}, \ln rm_{rs}^{g}\right)}_{\text{Due to Traded-Input Prices}} \end{aligned} \tag{14}$$

The corresponding results are depicted in Table 3. As is evident, traded inputs explain most of the retail-margin dispersion across regions at the product level with a contribution of about 52 percent, followed by variable markups with a contribution of about 29 percent; only about 17 percent is explained by local retail costs. Therefore, when we compare the retail margins of the very same product across locations, on average across goods, the difference is attributed to all of traded-input prices, local retail costs and markups. It is also implied that retailers facing different traded-input prices set alternative retail margins. Similarly, when the retail margins of the same region is compared across different products, on average across regions, variable markups explain the lion's share of the dispersion, followed by traded-input prices.

Finally, we investigate the dispersion of marginal costs by using the log version of $c_r^g = (f_r^g)^{\beta} (w_r)^{1-\beta}$ as follows:

$$\underbrace{var\left(\ln c_r^g\right)}_{\text{Dispersion}} = \underbrace{cov\left(\ln\left(f_r^g\right)^{\beta}, \ln c_r^g\right)}_{\text{Due to Traded-Input Prices}} + \underbrace{cov\left(\ln\left(w_r\right)^{1-\beta}, \ln c_r^g\right)}_{\text{Due to Local Retail Costs}} \tag{15}$$

The results given in Table 3 suggest that the contribution of local retail costs dominate when dispersion across regions is considered at the product level, while traded-input prices dominate (by construction since local retail costs $(w_r)^{1-\beta}$ cancel each other out) when dispersion across goods is considered at the regional level. Thus, regarding the implications for LOP, although retailers in different regions face different marginal costs due to the differences in local retail costs, such differences partly disappear when retail markups/margins are set as the dominant factor.

6 Implications for Consumer Welfare Dispersion

As shown in the Online Appendix, the model implies the following expression for consumer welfare at the good level:

$$U_r^g = - \underbrace{\ln\left(f_{rs}^g + \delta d_{rs}\right)}_{\text{Due to Traded-Input Prices}} - \underbrace{\ln rm_{rs}^g}_{\text{Due to Retail Margins}} + \phi_r + \phi^g \tag{16}$$

which depends on traded-input prices, retail margins, the real economic size (represented by ϕ_r), and good specific factors (represented by ϕ^g). Using the fitted markups (as in Equation 10) as the left hand side variable and considering the fitted values of traded-input prices, retail margins, destination fixed effects, and good fixed effects as the right hand side variables, the same variance decomposition methodology (by taking the covariance of both sides of this expression with respect to αq_r^g), the results in Table 4 are obtained.

As is evident, retail margins contribute by about 30 percent to the dispersion of consumer welfare across locations, while the combination of traded-input prices and the real economic size of regions has another contribution of about 70 percent; good characteristics cancel each other out across locations by construction. Similarly, consumers within the same location receive different sub-utilities from different products due to the dispersion of retail margins across products (with a contribution of about 60 percent) followed by traded-input prices. Therefore, retail margins are important determinants of the dispersion of consumer welfare across locations and products.

7 Conclusion

The decomposition of retail prices into producer prices, transportation costs and retail margins is important to understand the welfare implications of alternative policies. This paper has shown by using Turkish micro price data on agricultural products that retail margins explain the lion's share of retail prices, followed by producer prices and transportation costs. It is implied that the high dispersion of producer prices across locations is suppressed by local retail margins, and the dispersion of retail prices does not reflect that of producer prices; instead, it reflects differences across locations due to local input costs and variable markups. Retail margins are shown to be dispersed across locations mostly due to traded-input prices faced by retailers, followed by the contributions of variable markups and local input costs. When these retail margins are further connected to the dispersion of consumer welfare across locations, it is shown that about one third of consumer welfare differences can be attributed to retail margin differences. Within the same location, retail margins also explain more than half of the consumer welfare dispersion across products.

It is important to emphasize that our measures regarding markups/margins of retailers include that of wholesalers as well, although they do not affect any of our analyses based on dispersion across locations or products, because wholesale margins are constant across locations and products according to the Turkish regulations (see Lemeilleur et al., 2007; Bignebat et al., 2009) for the products in our sample. The results also have important implications for potential markets that connect farmers directly with final consumers (i.e., direct-to-consumer sales). In particular, since the contributions of local retail costs and variable markups to retail prices dominate that of producer farm prices, there is room for potential increases in both farmer and consumer welfare through such innovations. As discussed by Bignebat et al. (2009), this is important especially in Turkey, where producers are not aware of the final buyer of their produce due to the intermediaries hindering the visibility of the marketing channel. Nevertheless, as shown by Park et al. (2014), if such direct-to-consumer sales come with the lack of management and marketing skills, farmer welfare may easily go down due to lower earnings. In sum, any optimal policy should consider the trade-off between having high retail margins versus high management/marketing costs of direct-to-consumer sales.

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Table 1 - Estimation Results

	Dependent Variable: Log Retail Prices
β	0.15**
	(0.08)
δ	0.320**
	(0.143)
Good Fixed Effects	YES
Destination Fixed Effects	YES
Adjusted R-Squared	0.96
Sample Size	814

Notes: **represents significance at the 5% level. Standard errors are given in parenthesis; Delta method has been used for the standard deviation of β. The numbers regarding δ have been multiplied by 10^{-3}; thus, they correspond to per unit transportation costs for 1000 miles. The estimation is by SMM.

Table 2 - Costs versus Margins

	Average	Standard Deviation	Minimum	25th Percentile	Median	75th Percentile	Maximum
Transportation Costs over Producer Prices	0.389	0.345	0.022	0.154	0.279	0.514	2.131
Transportation Costs over Retail Prices	0.067	0.051	0.003	0.027	0.057	0.093	0.314
Gross Retail Margins	4.465	2.063	1.481	3.051	3.924	5.414	15.037
Gross Distribution Margins	6.097	2.825	2.210	4.027	5.330	7.566	17.374
Gross Retail Markups	4.285	3.095	1.000	2.592	3.417	4.486	29.406
Retail Marginal Costs	0.580	0.091	0.245	0.536	0.583	0.637	0.826

Notes: The numbers represent the average values across regions and goods.

Table 3 - Dispersion of Prices, Margins, and Marginal Costs

Dispersion across:	Variance of:	Percentage Contribution of:	
	Retail Prices	Local Retail Costs and Markups (Local Retail Costs, Markups)	Traded-Input Prices
Regions	0.011	95.05% (64.63%, 29.94%)	4.95%
Goods	0.299	91.25% (0.00%, 91.25%)	8.75%
Goods and Regions	0.310	91.22% (2.21%, 89.01%)	8.78%
	Traded-Input Prices	Source Prices	Transportation Costs
Regions	0.004	4.87%	95.13%
Goods	0.068	94.15%	5.85%
Goods and Regions	0.070	91.28%	8.72%
	Retail Margins	Local Retail Costs and Markups (Local Retail Costs, Markups)	Traded-Input Prices
Regions	0.018	48.41% (17.45%, 29.43%)	51.59%
Goods	0.158	84.92% (0.00%, 84.92%)	15.08%
Goods and Regions	0.167	81.09% (1.57%, 79.51%)	18.91%
	Retail Marginal Costs	Local Retail Costs	Traded-Input Prices
Regions	0.028	96.88%	3.12%
Goods	0.005	0.00%	100.00%
Goods and Regions	0.032	82.67%	17.33%

Notes: The numbers represent the median values across regions and/or goods.

Table 4 - Dispersion of Consumer Welfare

Dispersion across:	Variance	Percentage Contribution of: Traded-Input Prices	Retail Margin	Real Economic Size	Good Characteristics
Regions	0.024	-12.16%	30.26%	81.67%	0.00%
Goods	0.251	55.46%	59.40%	0.00%	-14.86%
Goods and Regions	0.274	51.18%	55.35%	7.07%	-13.60%

Notes: The numbers represent the median values across regions or goods.

Online Appendix
Spatial Dispersion of Retail Margins: Evidence from Turkish Agricultural Prices

1 The Model

Individuals in region r has the following utility U_r maximization out of consuming goods each denoted by g :

$$\max U_r = \sum_g \kappa^g \left(1 - \exp\left(-U_r^g\right)\right) \tag{1}$$

where $U_r^g = \alpha q_r^g$, q_r^g is the quantity consumed of good g, while κ^g and α represent taste parameters. Maximization of this utility function results in the following demand function:

$$q_r^g = \frac{\ln \kappa^g}{\alpha} - \frac{\ln p_r^g}{\alpha} + \frac{E_r - \frac{1}{\alpha}\sum\limits_{g'} \ln\left(\frac{\kappa^{g'}}{p_r^{g'}}\right) p_r^{g'}}{\sum\limits_{g'} p_r^{g'}} \tag{2}$$

where p_r^g represents the price per unit of q_r^g, and E_r $\left(= \sum\limits_g p_r^g q_r^g\right)$ represents the overall consumer expenditure (i.e., the economic size) in region r. As is evident, the taste parameter κ^g acts as a demand shifter, while the taste parameter α can be connected to the price elasticity of demand.[1]

[1] In particular, the price elasticity of demand can be calculated as follows:

$$\varepsilon = -\frac{p_r^g}{q_r^g}\frac{\partial q_r^g}{\partial p_r^g} = \frac{1}{\alpha q_r^g}$$

which decreases with the quantity consumed q_r^g. As will be evident below, the price elasticity of demand can also be connected to the markups according to the following expression:

$$\mu_r^g = \frac{\varepsilon}{\varepsilon - 1} = \frac{1}{1 - \alpha q_r^g}$$

where markups increase with the quantity sold by the retailer.

We assume that agricultural goods are homogenous when they leave the production farms; however, they are distinguished with respect to how they are sold to the final consumer at the retail level (e.g., bagged potatoes, boxed strawberries, washed/cleaned spinach, bunched parsley, etc.). Accordingly, taking the demand function for good g into account, the retailer in region r maximizes its good g specific profits given by:

$$\pi_r^g = q_r^g \left(p_r^g - c_r^g \right)$$

where c_r^g represents marginal costs of retailing (implied by a Cobb-Douglas retail-production function) given as follows:

$$c_r^g = \left(f_r^g \right)^{\beta} \left(w_r \right)^{1-\beta}$$

where f_r^g represents the traded input price of good g, w_r represents the per unit price/cost of the local input (e.g., wages) that is common across goods, and β is the input share of traded inputs. The profit maximization results in the following price expression:

$$p_r^g = \mu_r^g c_r^g \tag{3}$$

where $\mu_r^g = \left(1 - \alpha q_r^g \right)^{-1}$ represents gross markups (that change with quantity sold). The retail margin rm_r^g is implied as follows:

$$rm_r^g = \frac{p_r^g}{f_r^g} = \mu_r^g \left(\frac{w_r}{f_r^g} \right)^{1-\beta}$$

which is a function of retail markups, traded-input prices and local retail costs.

By combining Equations 2 and 3, together with using the following expression for log gross markups:[2]

$$\ln \mu_r^g = \ln \left(1 - \alpha q_r^g \right)^{-1} \approx \alpha q_r^g \tag{4}$$

[2]Since this approximation is achieved by using $\ln(1+x) \approx x$ when x is a small number, it has been supported by studies such as by Yilmazkuday (2015) who has shown that the parameter α is in fact a very small number.

the equilibrium price can be written as follows:

$$\ln p_r^g = \frac{\beta \ln f_r^g}{2} + \frac{\ln \kappa^g}{2} + \frac{\alpha E_r + \sum_{g'} \ln\left(\frac{p_r^{g'}}{\kappa^{g'}}\right) p_r^{g'}}{2 \sum_{g'} p_r^{g'}} + \frac{(1-\beta)\ln w_r}{2} \tag{5}$$

where log retail prices depend on traded-input prices f_r^g, good-specific preferences κ^g, and destination-specific variables consisting of overall local expenditure E_r, local retail input costs w_r and aggregated price indices.

The utility function give in Equation 1 suggests that the sub-utility received at the product level is given by $\kappa^g \left(1 - \exp\left(-U_r^g\right)\right)$ which differs across locations only due to $U_r^g = \alpha q_r^g$ which corresponds to the relative love of variety as shown by Zhelobodko et al. (2012).[3] We would like to know the reasons behind the dispersion of U_r^g across regions, which we accept as a measure for the dispersion of consumer welfare in this section. We are particularly interested in the relationship between consumer welfare and retail margins. Accordingly, using Equations 2 and **??**, we can have an expression for our consumer welfare measure of U_r^g as follows:

$$\begin{aligned} U_r^g \quad = \quad & - \underbrace{\ln\left(f_{rs}^g + \delta d_{rs}\right)}_{\text{Due to Traded-Input Prices}} - \underbrace{\ln rm_{rs}^g}_{\text{Due to Retail Margins}} \\ & + \underbrace{\frac{\alpha E_r + \sum_{g'} \ln\left(\frac{p_r^{g'}}{\kappa^{g'}}\right) p_r^{g'}}{\sum_{g'} p_r^{g'}}}_{\text{Due to the Real Economic Size}} + \underbrace{\frac{\ln \kappa^g}{2}}_{\text{Due to Good Characteristics}} \end{aligned}$$

which is the expression we use in the main text.

[3] The relative love of variety is defined as follows:

$$RLV_r^g = -\frac{q_r^g U_r''\left(q_r^g\right)}{U_r'\left(q_r^g\right)}$$

which is at the product and region levels.

2 Estimation Methodology

In the case in which data for both retail prices p_r^g and traded-input prices f_r^g are available, Equation 5 can be estimated using good fixed effects and destination fixed effects. However, our data cover prices received by farmers rather than traded-input prices paid by retailers. Therefore, we need to connect the prices received by farmers to the traded-input prices paid by retailers. Following studies such as by Volpe et al. (2013) who show that distance is one of the most important determinants of transportation costs that affect prices of green groceries, we achieve the connection between farmer and retail prices by considering transportation costs that increase with distance and are additive to the prices received by farmers.

Since agricultural goods are homogenous when they leave the production farms, the retailer in each region searches for the lowest price across potential farmers, by taking into account the transportation costs between the farmer and the retailer. Accordingly, traded-input prices f_r^g for the retailer in region r are connected to the producer prices by the following expression:

$$f_r^g = f_{rs}^g + \delta d_{rs}$$

where f_{rs}^g is the producer price of good g at the source region s for the retailer in region r. It is important to emphasize that f_{rs}^g changes across destinations due to the retailer (in each region r) searching for the lowest-price farm, after considering the transportation costs; hence, the source farm for each retailer may well be different. Transportation costs are represented by δd_{rs} where d_{rs} is the distance between the source/producer and the retailer in miles, and δ is the transportation cost per mile per unit of good transported. Substituting this expression into the log retail prices, we obtain the following expression:

$$\ln p_r^g = \underbrace{\frac{\beta}{2} \ln \left(f_{rs}^g + \delta d_{rs} \right)}_{\text{Traded-Input Prices}} + \underbrace{\frac{\ln \kappa^g}{2}}_{\text{Good Fixed Effects}} + \underbrace{\left(\frac{\alpha E_r + \sum_{g'} \ln \left(\frac{p_r^{g'}}{\kappa^{g'}} \right) p_r^{g'}}{2 \sum_{g'} p_r^{g'}} + \frac{(1-\beta) \ln w_r}{2} \right)}_{\text{Destination Fixed Effects}} \tag{6}$$

of which stochastic version can be estimated using data on prices, good fixed effects, and destination fixed effects, subject to the determination of the source farm. We achieve the latter by using Simulated Method of Moments (SMM) where we search for the parameter of δ that maximizes the explanatory power of the Ordinary Least Squares (OLS) regression that minimizes the contribution of the residual sum of squares. In technical terms, the SMM estimator is defined as follows:

$$\widehat{\delta} = \arg \min_{\delta} \left[y(\delta)' \mathbf{W} y(\delta) \right]$$

where $y(\delta) = \ln p_r^g - \ln \widehat{p_r^g}$ is the distance between the log price data $\ln p_r^g$ and the corresponding fitted values $\ln \widehat{p_r^g}$ for any given δ, while $\mathbf{W}$ is the identity matrix.

In terms of economic intuition, this strategy corresponds to calculating the arbitrage opportunities of the retailers across farmers (i.e., searching for the minimum-cost producer) after controlling for transportation costs. Accordingly, when data for retail-level prices p_r^g and farm-level prices f_s^g for all r, s and g are available, both δ and β are identified; thus, the source region (i.e., the lowest-price farm, after considering transportation costs) and the source prices f_{rs}^g $(= \min_s (f_{rs}^g | g))$ for each retailer is identified at the good level.

The standard error of the SMM estimator δ is calculated by using a bootstrap technique. In particular, for each bootstrap b, (i) we resample the log retail prices in Equation 6 by adding its fitted values to randomly selected numbers obtained from a normal distribution with a mean of zero (implied by the OLS regression) and a standard deviation that is equal to the standard deviation of the residuals, (ii) estimate Equation 6 with the resampled left hand side in order to obtain the bootstrap b specific $\delta(b)$. We repeat this exercise 100 times and compute the bootstrap standard error of δ as follows:

$$\text{S.E.}(\delta) = \left(\frac{1}{100} \sum_{b=1}^{100} \left(\delta(b) - \widehat{\delta} \right)^2 \right)^{\frac{1}{2}}$$

where $\widehat{\delta}$ is the SMM estimator.

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