NBER WORKING PAPER SERIES

INCOME DIFFERENCES AND PRICES OF TRADABLES

Ina Simonovska

Working Paper 16233
http://www.nber.org/papers/w16233

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
July 2010

I am grateful to my thesis advisors Timothy Kehoe and Fabrizio Perri for their continued guidance and encouragement throughout this project. For their comments and suggestions I especially thank George Alessandria, Cristina Arellano, Costas Arkolakis, John Asker, Robert Feenstra, Marc Melitz, Douglas Miller, Michael Waugh, members of the Trade and DevelopmentWorkshop at the University of Minnesota and seminar participants at USC, Stanford, Stockholm IIES, NHH, Copenhagen Business School, UC Santa Cruz, AEA 2010, Michigan, Chicago Fed, Temple, Dallas Fed, NBER ITI Summer Institute 2009, SED 2009, North American Summer Meeting of the Econometric Society 2009, Midwest Macro Spring Meeting 2009, Midwest International Economics Spring Meeting 2009, International Comparisons Conference at UC Davis, RES 2009, World Bank, Bank of Canada, UBC, UQAM, Montreal, Adelaide, Melbourne, UI Bloomington, Notre Dame, UT Austin, UC Davis, IMF and Minneapolis Fed. I thank all the participants of the Mango-DHL controlled experiment. I thank the World Bank for providing me with the price data from the 2005 ICP round. Financial support from the Graduate Research Partnership Program Fellowship at the University of Minnesota and the Peter B. Kenen Fellowship at Princeton University are gratefully acknowledged. All remaining errors are mine. The views expressed herein are those of the author and do not necessarily reflect the views of the National Bureau of Economic Research.

Income Differences and Prices of Tradables
Ina Simonovska
NBER Working Paper No. 16233
July 2010, Revised June 2013
JEL No. E31,F12,L11

ABSTRACT

I study the positive relationship between prices of tradable goods and per-capita income. I develop a highly tractable general equilibrium model of international trade with heterogeneous firms and non-homothetic consumer preferences that accounts for the observed cross-country variation in prices along two key dimensions. The model yields a new testable prediction that relates prices to measurable variables. I use the prediction to estimate the elasticity of price with respect to per-capita income from unique data featuring prices of 245 identical goods sold exclusively via the Internet in twenty-nine European, Asian, and North American markets. The empirical findings suggest that variable mark-ups account for a third of the observed cross-country differences in prices of tradables.

Ina Simonovska
Department of Economics
University of California, Davis
One Shields Avenue
Davis, CA 95616
and NBER
inasimonovska@ucdavis.edu

1 Introduction

International trade has grown considerably in the post-war period (see Hummels (2007)). In addition, goods exports continue to account for eighty percent of world exports.[1] Since tradable goods constitute a high share of consumption bundles of individuals, their prices directly affect consumer welfare. Consequently, studying the underlying mechanisms that shape the behavior of tradable consumption-good prices across countries has been a major focus of research in international trade.

One of the most robust empirical findings in the literature is that prices of tradable consumption goods are higher in countries that are richer in per-capita terms (see Alessandria and Kaboski (2011)). In this paper, I argue that variable mark-ups make a key contribution toward this relationship between prices of tradables and per-capita income. To that end, I develop a tractable general equilibrium model of international trade with heterogeneous firms and non-homothetic consumer preferences over varieties that accounts for the observed variation in prices across countries with different per-capita incomes and population sizes. The model yields a new testable prediction that links relative prices to measurable variables. I use the prediction to structurally estimate the elasticity of price with respect to per-capita income from a unique database that I construct, which features prices of identical goods sold across countries exclusively via the Internet. Finally, I quantify the role that variable mark-ups play in accounting for the observed cross-country variation in prices of tradable consumption goods using the elasticity estimates and the model.

In the model, trade barriers enable monopolistically-competitive firms with varying productivities to supply their products at destination-specific prices. Due to non-homothetic preferences, different per-capita income levels result in different consumption sets across countries. Non-constant expenditure shares yield varying price elasticities of demand for a given positively-consumed variety across destinations. In particular, rich countries' consumers are less responsive to price changes than those of poor ones, so firms optimally price identical varieties higher in more affluent markets. Moreover, firms suffer competitive pressures in more populated markets and extract lower mark-ups there.

I derive a new testable prediction from the model that relates prices to measurable variables. For a pair of countries, the model predicts that the relative price of an identical item varies with the destinations' relative per-capita incomes, trade barriers, and import shares. The prediction in turn allows me to structurally estimate the elasticity of price with respect to per-capita income from micro-level data.

Specifically, I construct a unique price database for the second largest Spanish apparel manufacturer — Mango. The dataset features prices of 245 identical apparel products sold *exclusively* via the Internet in twenty-nine European, Asian, and North American countries. Tracking identical goods enables me to directly measure price discrimination on the basis of varying demand elasticities in the absence of product-quality differences. Moreover, focusing on prices of goods

[1] World merchandise and service exports for the 2005-2011 period are from the World Development Indicators.

sold *exclusively* online allows me to suppress non-tradable price contributions. Finally, since all "online-only" Mango products are stored and dispatched from a single warehouse via DHL Express to every destination, I am able to control for shipping costs in the analysis.

In particular, I collect DHL Express shipping prices and use them as proxies for Mango's shipping and handling costs. After controlling for shipping costs as well as country-specific import shares (from Spain), sales taxes and tariffs in the apparel and footwear industries, currency-area membership, and income inequality, I find that doubling a destination's per-capita income results in a 17% increase in the price of identical items sold there. Furthermore, I find that identical items are on average 9% cheaper in export markets that share a common currency with the manufacturer's country of origin (Spain). Finally, doubling the cost to ship to a destination results in a 16% price increase in the price of Mango products.

I argue that Mango's degree of shipping-cost pass-through biases the estimates of the elasticity of price with respect to per-capita income upwards. To that end, I use the DHL Express shipping prices to infer the shipping company's pricing rule to different destinations. In line with Hummels et al. (2009), I find that DHL charges systematically lower prices to ship to richer (in per-capita terms) and larger (in population terms) countries and higher prices to deliver items to more distant markets. Given the evident negative relationship between shipping prices and destinations' per-capita income levels and the model's prediction that prices are increasing in the cost of shipping, it is reasonable to conclude that the estimates of the elasticity of price with respect to per-capita income that I report above are biased upwards.

Consequently, I engage in robustness exercises to obtain an unbiased estimate of the key elasticity parameter. Using standard proxies for trade barriers employed by the gravity literature, and following Eaton and Kortum (2002) and Head et al. (2010) in particular, I find that the elasticity of price with respect to per-capita income ranges between 0.05 and 0.11 and centers roughly around 0.07. The magnitude of the estimate suggests that variable mark-ups are potentially important in a quantitative sense. I compare the elasticities that result from the micro-level analysis to estimates that I obtain for the same set of countries for the year 2005 using standard retail price data of aggregate apparel good categories employed by the existing literature. The aggregate data, which potentially reflect variable mark-ups, varying product quality, and varying retail components tied to non-tradable channels, yield a price elasticity of 0.16. Hence, variable mark-ups may be responsible for as much as a third of the cross-country price variation observed in aggregate data.

I contribute to the international pricing literature by developing and using a unique database that features prices of identical products sold across countries via the Internet. One subset of the existing empirical literature that documents strong and persistent deviations from the law of one price for tradable goods relies on retail data. In particular, Alessandria and Kaboski (2011) employ retail prices of aggregate good categories, Crucini et al. (2005a), Crucini et al. (2005b), and Crucini and Shintani (2008) use retail prices of products with identical characteristics, Goldberg and Verboven (2001) and Goldberg and Verboven (2005) track car prices in Europe, and Ghosh and Wolf (1994) and Haskel and Wolf (2001) examine prices of the Economist magazine and IKEA products, respectively. However, as Burstein et al. (2003) and Crucini and Yilmazkuday (2009) argue, retail data reflect the contributions of non-tradable inputs, whose prices vary systematically with countries' per-capita income levels. Consequently, retail prices of tradables may be linked to countries' per-capita income levels through the contributions of non-tradable channels.

To suppress retail components, Hummels and Klenow (2005), Hummels and Lugovskyy (2009), Baldwin and Harrigan (2011), Johnson (2011), Manova and Zhang (2011), Bastos and Silva (2010), Gorg et al. (2010), and Harrigan et al. (2011) use free-on-board unit values to show that importers with high per-capita income levels pay high prices for imports from a given source. The observation may reflect two distinct mechanisms: (i) rich importers demand goods of high quality, as postulated by Verhoogen (2008) and Fajgelbaum et al. (2011); and (ii) exporters extract high mark-ups for identical goods from rich importers with low demand elasticities, as argued in the present paper. While the empirical literature has verified the varying-quality hypothesis, it has been unable to test the presence of variable mark-ups across countries due to the lack of price data of identical goods. In this paper, I aim to fill this gap.

The empirical results that I obtain provide support for an explanation of varying demand elasticities, and therefore variable mark-ups, that builds on non-homothetic preferences. To derive the testable predictions that guide the empirical analysis, I rely on a particular utility function that belongs to the hierarchic-demand class studied by Jackson (1984). Two additional utility functions of this class have been recently introduced to the international-trade literature that features firm heterogeneity. The first is the linear demand system used by Melitz and Ottaviano (2008) and the second is the exponential (CARA) utility used by Behrens et al. (2009). Both frameworks yield identical qualitative predictions as the present model regarding the behavior of prices within a country. An advantage of the utility parametrization that I introduce is that it maintains tractability in general equilibrium and it is especially useful for cross-country empirical analysis. I begin the analysis by describing the model.

2 Model

2.1 Consumer Problem

I consider a world that consists of a finite number of countries, I, engaged in trade of varieties of a final good. Let i represent an exporter and j an importer.

I assume that country j is populated by identical consumers of measure L_j who have preferences over varieties of a good. Varieties originating from different countries enter symmetrically in a consumer's utility function according to the following rule

$$U_j^c = \sum_{i=1}^{I} \int_{\omega \in \Omega_{ij}} \log(q_{ij}^c(\omega) + \bar{q}) d\omega,$$

where $q_{ij}^c(\omega)$ is individual consumption of variety ω from country i in j and $\bar{q} > 0$ is a (non-country-specific) constant. To ensure that the utility function is well defined, I assume that, for all j, $\Omega_j \equiv \sum_{i=1}^{I} \Omega_{ij} \subseteq \bar{\Omega}$, where $\bar{\Omega}$ is a compact set containing all potentially-produced varieties.

Notice that the preference relation described above is non-homothetic. Moreover, the marginal utility from consuming a variety, $(q_{ij}^c(\omega) + \bar{q})^{-1}$, is bounded at any level of consumption. Hence, a consumer may not have positive demand for all varieties.

Let y_j denote consumer income in j. Then, the demand for variety ω originating from i that is consumed in a positive amount in j, $q_{ij}(\omega) > 0$, is given by[2]

$$q_{ij}(\omega) = L_j \left\{ \frac{y_j + \bar{q} P_j}{N_j p_{ij}(\omega)} - \bar{q} \right\}. \tag{1}$$

In the expression above, N_j is the total measure of varieties consumed in j,

$$N_j = \sum_{i=1}^{I} N_{ij}, \tag{2}$$

where N_{ij} is the measure of the set Ω_{ij}, which contains varieties originating from i.

Furthermore, P_j is an aggregate price statistic summarized by

$$P_j = \sum_{i=1}^{I} \int_{\omega \in \Omega_{ij}} p_{ij}(\omega) d\omega. \tag{3}$$

2.2 Firm Problem

The environment is static. Each variety is produced by a single firm using constant-returns-to-scale technology. Labor is the only factor of production. Following Melitz (2003), I assume that firms differ in their productivity, ϕ, and country of origin, i.

In every country i, there exists a pool of potential entrants who pay a one-time cost, $f_e > 0$, which entitles them to a single productivity draw from a distribution, $G_i(\phi)$, with support $[b_i, \infty)$. A measure J_i of firms that are able to cover their marginal cost of production enter. However, only a subset of productive entrants, N_{ij}, produce and sell to market j. These firms are able to charge a low enough price so as to generate non-negative demand in expression (1), while making non-negative profits. Thus, a subset of entrants immediately exit. Hence, in equilibrium, the expected profit of an entrant is zero. Aggregate profit rebates to each consumer are therefore also zero.

[2] See Appendix A.1 for derivation.

Assuming that each consumer has a unit labor endowment—which, when supplied (inelastically) to the local labor market earns a wage rate of w_j—per-capita income necessarily equals w_j.

Having described the market structure, I proceed to set up an operating firm's maximization problem. Let the production function of a firm with productivity draw ϕ be $x(\phi) = \phi l$, where l is the amount of labor used toward the production of final output. Moreover, assume that each firm from country i wishing to sell to destination j faces an iceberg transportation cost incurred in terms of labor units, $\tau_{ij} \geq 1$, with $\tau_{ii} = 1$ $(\forall i)$. An operating firm must choose the price of its variety p, accounting for the demand for its product q. I consider a symmetric equilibrium where all firms of type ϕ from i choose identical optimal pricing rules. Thus, I can index each variety by the productivity and the country of origin of its producer, which allows me to rewrite individual consumer and country demand as follows

$$q_{ij}^{c}(\phi) = \frac{w_j + \bar{q}P_j}{N_j p_{ij}(\phi)} - \bar{q}, \tag{4}$$

$$q_{ij}(\phi) = L_j \left\{ \frac{w_j + \bar{q}P_j}{N_j p_{ij}(\phi)} - \bar{q} \right\}. \tag{5}$$

Using demand from (5), the profit maximization problem of a firm with productivity ϕ from country i that is considering to sell to destination j becomes

$$\pi_{ij}(\phi) = \max_{p_{ij} \geq 0} \quad p_{ij} L_j \left\{ \frac{w_j + \bar{q}P_j}{N_j p_{ij}} - \bar{q} \right\} - \frac{\tau_{ij} w_i}{\phi} L_j \left\{ \frac{w_j + \bar{q}P_j}{N_j p_{ij}} - \bar{q} \right\}. \tag{6}$$

To solve this problem, each firm takes as given the measure of competitors N_j and the aggregate price statistic P_j. Taking first-order conditions, the resulting optimal price that a firm charges for its variety which is supplied in a positive amount is given by

$$p_{ij}(\phi) = \left(\frac{\tau_{ij} w_i}{\phi} \frac{w_j + \bar{q}P_j}{N_j \bar{q}} \right)^{\frac{1}{2}}. \tag{7}$$

2.3 Productivity Thresholds and Firm-Level Mark-Ups

As noted earlier, in this model, not all firms serve all destinations. In particular, for any pair of source and destination countries, i and j, only firms originating from country i with productivity draws $\phi \geq \phi_{ij}^{*}$ sell to market j, where ϕ_{ij}^{*} is a productivity threshold defined by[3]

$$\phi_{ij}^{*} = \sup_{\phi \geq b_i} \{\pi_{ij}(\phi) = 0\}.$$

Thus, a productivity threshold is the productivity draw of a firm that is indifferent between serving a market or not, namely one whose variety's price barely covers the firm's marginal cost

[3] I restrict f_e to ensure that $b_i \leq \phi_{ij}^{*} (\forall i, j)$.

of production and delivery,

$$p_{ij}\left(\phi_{ij}^{*}\right) = \frac{\tau_{ij} w_i}{\phi_{ij}^{*}}. \tag{8}$$

The price that a firm would charge for its variety, however, is limited by the variety's demand, which diminishes as the variety's price rises. In particular, it is the case that consumers in destination j are indifferent between buying the variety of type ϕ_{ij}^{*} or not. To see this, from (5), notice that consumers' demand is exactly zero for the variety whose price satisfies

$$p_{ij}\left(\phi_{ij}^{*}\right) = \frac{w_j + \bar{q} P_j}{N_j \bar{q}}. \tag{9}$$

Combining expressions (8) and (9) yields a simple characterization of the threshold

$$\phi_{ij}^{*} = \frac{\tau_{ij} w_i N_j \bar{q}}{w_j + \bar{q} P_j}. \tag{10}$$

Substituting (10) in (7), the optimal pricing rule of a firm with productivity draw $\phi \geq \phi_{ij}^{*}$ becomes

$$p_{ij}(\phi) = \underbrace{\left(\frac{\phi}{\phi_{ij}^{*}}\right)^{\frac{1}{2}}}_{\text{mark-up}} \underbrace{\frac{\tau_{ij} w_i}{\phi}}_{\text{marginal cost}}. \tag{11}$$

Expression (11) shows that mark-ups vary along two dimensions in this model. First, more productive firms charge higher mark-ups over marginal cost. This prediction is in line with the behavior of Slovenian manufacturers, as documented by Loecker and Warzynski (2009). Second, firms' prices and mark-ups vary systematically with market characteristics, which are summarized by the threshold that firms must surpass in order to serve a destination. The thresholds are, in turn, equilibrium objects. Consequently, I proceed to characterize the equilibrium of the model.

2.4 Equilibrium of the World Economy

The subset of entrants from i who surpass the productivity threshold ϕ_{ij}^{*} serve destination j. These firms, denoted by N_{ij}, satisfy

$$N_{ij} = J_i[1 - G_i(\phi_{ij}^{*})]. \tag{12}$$

Let $g_i(\phi)$ be the pdf corresponding to the productivity cdf $G_i(\phi)$. Then, the conditional density of firms operating in j is

$$\mu_{ij}(\phi) = \begin{cases} \frac{g_i(\phi)}{1-G_i(\phi^*_{ij})} & \text{if } \phi \geq \phi^*_{ij}, \\ 0 & \text{otherwise.} \end{cases} \tag{13}$$

With these definitions in mind, the aggregate price statistic in (3) can be rewritten as

$$P_j = \sum_{i=1}^{I} N_{ij} \int_{\phi^*_{ij}}^{\infty} p_{ij}(\phi)\mu_{ij}(\phi)d\phi. \tag{14}$$

Using the above objects, total sales to country j by firms originating from country i become

$$T_{ij} = N_{ij} \int_{\phi^*_{ij}}^{\infty} p_{ij}(\phi)x_{ij}(\phi)\mu_{ij}(\phi)d\phi. \tag{15}$$

Furthermore, individual firm profits are the sum of profit flows from each destination that a firm sells to. Hence, the average profits of firms originating from country i are

$$\pi_i = \sum_{j=1}^{I}[1 - G_i(\phi^*_{ij})] \int_{\phi^*_{ij}}^{\infty} \pi_{ij}(\phi)\mu_{ij}(\phi)d\phi,$$

where potential profits from destination j are weighted by the probability that they are realized, $1 - G_i(\phi^*_{ij})$. Due to free entry, the average profit, in turn, barely covers the fixed cost of entry

$$w_i f_e = \sum_{j=1}^{I}[1 - G_i(\phi^*_{ij})] \int_{\phi^*_{ij}}^{\infty} \pi_{ij}(\phi)\mu_{ij}(\phi)d\phi. \tag{16}$$

Finally, i's consumers' income, spent on final goods that are produced at home and abroad, is

$$w_i L_i = \sum_{j=1}^{I} T_{ji}. \tag{17}$$

Equilibrium. For $i, j = 1, ..., I$, given $\tau_{ij}, L_j, b_i, f_e, \bar{q}$, and productivity distributions $G_i(\phi)$, an equilibrium is a set of total measures of firms serving j $\hat{N}_j$; productivity thresholds $\hat{\phi}^*_{ij}$; measures of firms from i serving j $\hat{N}_{ij}$; conditional densities of firms from i serving j $\hat{\mu}_{ij}(\phi)$; aggregate price statistics $\hat{P}_j$; total sales of firms from i serving j $\hat{T}_{ij}$; wage rates $\hat{w}_i$; measures of entrants $\hat{J}_i$; and, $\forall \phi \in [\phi^*_{ij}, \infty)$, per-consumer allocations $\hat{q}^c_{ij}(\phi)$, country allocations $\hat{q}_{ij}(\phi)$, firm pricing rules $\hat{p}_{ij}(\phi)$, firm production rules $\hat{x}_{ij}(\phi)$, and firm profits $\hat{\pi}_{ij}(\phi)$, such that: (i) $\hat{q}^c_{ij}(\phi)$ is given by (4) and solves the individual consumer's problem; (ii) $\hat{q}_{ij}(\phi)$ is given by (5) and satisfies a country's aggregate demand for a variety; (iii) $\hat{p}_{ij}(\phi)$ is given by (7) and solves the firm's problem; (iv) $\hat{x}_{ij}(\phi)$ satisfies goods' markets clearing $\hat{q}_{ij}(\phi) = \hat{x}_{ij}(\phi)$; (v) $\hat{\pi}_{ij}(\phi)$ is given by (6); (vi) $\hat{N}_j$, $\hat{\phi}^*_{ij}$, $\hat{N}_{ij}$, $\hat{\mu}_{ij}(\phi)$, $\hat{P}_j$, $\hat{T}_{ij}$,

$\hat{w}_i$, $\hat{J}_i$ jointly satisfy (2), (10), (12), (13), (14), (15), (16), and (17).

3 Model Predictions

In this section, I describe the model's predictions regarding the behavior of firms within and across countries. First, I discuss the entry decisions of firms across markets, which sets the stage for the discussion on price discrimination. Second, I derive novel predictions regarding the firms' pricing decisions across countries. Third, I discuss supplementary predictions on the sales of exporters, which help place the model in an empirical context.

In order to analytically solve the model and to derive stark predictions at the firm and aggregate levels, I follow Chaney (2008) and assume that firm productivities are drawn from a Pareto distribution with cdf $G_i(\phi) = 1 - b_i^\theta/\phi^\theta$, pdf $g_i(\phi) = \theta b_i^\theta/\phi^{\theta+1}$, and shape parameter $\theta > 1$. The support of the distribution is $[b_i, \infty)$, where b_i summarizes the level of technology in country i.[4] Moreover, varying levels of technology are related to per-capita income differences across countries. In particular, a relatively high b_i represents a more technologically-advanced country. Such a country is characterized by relatively more productive firms, whose marginal costs of production are low, and by richer consumers, who enjoy higher wages.[5]

3.1 Firm Entry

In this model, only the most productive subset of domestic entrants serves the foreign destinations, as long as trade barriers are sufficiently high. From expression (12), under the assumption that firm productivities are Pareto-distributed, the subset of entrants from country i who serve market j is inversely related to the productivity threshold ϕ_{ij}^* and given by $L_i b_i^\theta[(\theta+1)f_e(\phi_{ij}^*)^\theta]^{-1}$, where[6]

$$\phi_{ij}^* = \frac{\bar{q}^{\frac{1}{\theta+1}}\tau_{ij}w_i}{[(\theta+1)f_e(1+2\theta)w_j]^{\frac{1}{\theta+1}}}\left\{\sum_{\upsilon=1}^{I}\frac{L_\upsilon b_\upsilon^\theta}{(\tau_{\upsilon j}w_\upsilon)^\theta}\right\}^{\frac{1}{\theta+1}}. \tag{18}$$

The productivity threshold for firms from source i to sell to destination j depends on three sets of parameters: (i) economy-wide parameters $(f_e, \theta, \bar{q})$; (ii) trade costs and per-capita income levels of the pair of countries (τ_{ij}, w_i, w_j); (iii) general equilibrium object $(\sum_{\upsilon=1}^{I} L_\upsilon b_\upsilon^\theta(\tau_{\upsilon j}w_\upsilon)^{-\theta})$. Looking at comparative statics, the last term suggests that the larger and the more productive any country is, the higher is the productivity threshold to access a given destination j. For a given entry cost, larger markets allow for more domestic entrants, thus raising the total number of firms in the

[4]Since the unconditional mean of the Pareto distribution is $b_i\theta/(\theta-1)$, a ratio of b_i's reflects the relative (unconditional) mean productivities of two countries. All predictions derived in the remainder of the paper are identical if instead I set $b_i = b_j = b$ for all $i \neq j$ and let firms' production functions be $x_i(\phi) = A_i\phi l$, where A_i is country-specific total factor productivity.

[5]In Appendix A.2, I show that, in general equilibrium, a relative increase in b_i increases the relative wage in i.

[6]See Appendix A.2 for derivations.

world economy and generating tougher competition for any firm in any market. Similarly, higher expected productivities of average entrants in any country give rise to tougher competition in the world economy for any firm.

Unlike market size and productivity, trade costs and per-capita income levels of different countries have differing effects on productivity thresholds. For exporter i and importer j, a relative increase in the exporter's wage rate or trade cost to destination j raises the productivity threshold that firms from i need in order to access market j. The intuition for this result is simple: the higher is the relative wage rate or trade barrier of an exporting country, the higher is the marginal cost that the firms originating from that country face, relative to other exporters. Consequently, firms from i need a higher productivity level in order to reach destination j. Increases in the marginal cost of production of any other potential exporter to market j on the other hand lower the productivity threshold for firms from i.

Finally, a key characteristic that determines firm access to a destination is the market's per-capita income level. A rise in w_j lowers the threshold in (18), thus raising the measure of entrants there. That result is an artifact of the "income effects" property of consumer preferences. Intuitively, recall that the marginal utility of a variety is bounded at any level of consumption. Since a tiny amount of consumption of a variety does not give infinite increase in utility, the consumer spends her limited income on the subset of potentially-produced items whose prices do not exceed marginal valuations. An increase in an individual's income makes new varieties affordable and the consumer expands her consumption bundle. Hence, the model yields a positive link between countries' per-capita incomes and the set of purchased, including imported, varieties, which is in line with empirical findings by Jackson (1984), Hunter and Markusen (1988), Hunter (1991), Movshuk (2004), and Hummels and Klenow (2005).

Overall, country characteristics systematically affect productivity thresholds and consequently the measure of competitors in each destination. These pro-competitive effects directly translate into varieties' prices, which I examine next.

3.2 Price Discrimination

In this section, I discuss the predictions of the model regarding the variation of relative prices of identical items with respect to key country characteristics. Appendix A.3 contains the proofs.

Expression (11) showed that firm mark-ups across markets depend inversely on the productivity thresholds of the destinations. Moreover, the previous section demonstrates that the threshold is a decreasing function of the per-capita income of the destination. Hence, a rise in the per-capita income in a market raises the price of a variety sold there.

The intuition behind the result lies in the relationship between the elasticity of substitution across varieties and consumer income. Recall that agents expand their consumption bundles when their income rises, as discussed above. However, a rise in consumer income also increases the consumption of each positively-consumed variety. To see this, substitute (10) and (11) into (4) to obtain the following expression for an individual's consumption of an item

$$q_{ij}^{c}(\phi) = \bar{q}\left[\left(\frac{\phi}{\phi_{ij}^{*}}\right)^{\frac{1}{2}} - 1\right]. \tag{19}$$

(19) falls in the cutoff productivity, so the quantity consumed rises in individual income. But, variations in consumption change elasticities of substitution and consequently affect prices of varieties. The elasticity of substitution for any two positively-consumed varieties in j, that are produced by firms with productivities ϕ_1 and ϕ_2, which originate from countries i and i' respectively, is

$$\sigma_{q_{ij}^{c}(\phi_1),q_{i'j}^{c}(\phi_2)} = 1 + \frac{\bar{q}}{2}\left[\frac{1}{q_{ij}^{c}(\phi_1)} + \frac{1}{q_{i'j}^{c}(\phi_2)}\right].$$

As the consumer becomes richer, she consumes more of each variety, which drives down the elasticity of substitution between positively-consumed varieties. Prices of these varieties rise in response.

Another intuitive explanation of the price increase due to higher income involves ordering varieties according to their "importance" to the consumer. As consumer income rises, new varieties produced by less productive firms are added to the consumption set. Conversely, if individual income were to fall, the new varieties are the first to be dropped from a consumer's bundle. Thus, the preference relation is "hierarchic"—a term introduced to the consumer-choice literature by Jackson (1984). The newly-added varieties are less important than the previously-consumed ones, which results in a fall in the demand elasticities of the latter. Hence, as income rises, prices of all previously-consumed varieties also rise.

To see this, from (11) and (19), note that the (absolute value of the) price elasticity of demand for variety (ϕ, i) in j is

$$\epsilon_{ij}(\phi) = \left[1 - \left(\frac{\phi}{\phi_{ij}^{*}}\right)^{-\frac{1}{2}}\right]^{-1}. \tag{20}$$

If the per-capita income in market j rises, the productivity threshold falls. According to expression (20), the demand for a variety becomes less elastic. However, the elasticity of demand is reflected in the price of the item, which can be seen by combining expressions (11) and (20) to obtain

$$p_{ij}(\phi) = \frac{\tau_{ij} w_i}{\phi} \frac{\epsilon_{ij}(\phi)}{\epsilon_{ij}(\phi) - 1}. \tag{21}$$

As consumer income rises, demand becomes less elastic, which allows firms to raise their prices.

Having described the behavior of prices within a country, it is easy to understand how prices of identical items vary across countries. Consider a firm with productivity ϕ, originating from i

and selling an identical variety to markets j and k, that is, $\phi \geq \max[\phi^*_{ij}, \phi^*_{ik}]$. Using expressions (11) and (18), the relative price that this firm charges across the two markets is given by

$$\frac{p_{ij}(\phi)}{p_{ik}(\phi)} = \underbrace{\left(\frac{\tau_{ij}}{\tau_{ik}}\right)^{\frac{1}{2}}}_{\text{trade cost}} \underbrace{\left(\frac{w_j}{w_k}\right)^{\frac{1}{2(\theta+1)}}}_{\text{pc income}} \underbrace{\left(\frac{\sum_\upsilon L_\upsilon b_\upsilon^\theta (\tau_{\upsilon j} w_\upsilon)^{-\theta}}{\sum_\upsilon L_\upsilon b_\upsilon^\theta (\tau_{\upsilon k} w_\upsilon)^{-\theta}}\right)^{-\frac{1}{2(\theta+1)}}}_{\text{general equilibrium object}}. \tag{22}$$

The relative per-capita income levels of the two countries have opposing effects on the relative price of an identical item across destinations. The second term in expression (22) suggests that a relative increase in country j's per-capita income (keeping country k's per-capita income unchanged) raises the relative price of the variety there. This direct effect of per-capita income on prices is due to the assumed non-homotheticity in consumer preferences discussed above. However, the relative rise of country j's per-capita income affects prices via the general equilibrium object in expression (22) as well. To get intuition on this object, it is useful to derive the bilateral trade or market shares. First, multiply (19) by the destination's size L_j to obtain the quantity sold in j by a firm with productivity ϕ from i. To derive i's total sales in j, substitute this quantity, as well as the price from (11), the conditional density from (13) under the Pareto parametrization, and the measure of exporters from the previous subsection into expression (15). Then, using expression (18) and the fact that $\tau_{ij}w_i/\phi^*_{ij} = \tau_{jj}w_j/\phi^*_{jj}$ ($\forall i \neq j$) (which is apparent in expression (10)), the import share of i-goods in j can be defined as

$$\lambda_{ij} \equiv \frac{T_{ij}}{\sum_{\upsilon=1}^{I} T_{\upsilon j}} = \frac{L_i b_i^\theta (\tau_{ij} w_i)^{-\theta}}{\sum_{\upsilon=1}^{I} L_\upsilon b_\upsilon^\theta (\tau_{\upsilon j} w_\upsilon)^{-\theta}}. \tag{23}$$

Finally, substitute (23) into (22) to obtain the following testable prediction that links relative prices to measurable variables

$$\frac{p_{ij}(\phi)}{p_{ik}(\phi)} = \underbrace{\left(\frac{\tau_{ij}}{\tau_{ik}}\right)^{\frac{2\theta+1}{2(\theta+1)}}}_{\text{trade cost}} \underbrace{\left(\frac{w_j}{w_k}\right)^{\frac{1}{2(\theta+1)}}}_{\text{pc income}} \underbrace{\left(\frac{\lambda_{ij}}{\lambda_{ik}}\right)^{\frac{1}{2(\theta+1)}}}_{\text{market share}}. \tag{24}$$

The third object above suggests that the relative price of a given variety from source i in two countries is increasing in the relative market shares of firms from i in the two destinations. The per-capita income levels of the countries in turn affect these market shares. An increase in country j's per-capita income (keeping country k's per-capita income unchanged) raises the marginal cost of production of firms from country j making them less competitive on the world market. As a result, firms from other countries gain world market shares. In particular, firms originating from country i increase their market shares in both destinations j and k. If the increase in market share in j is at least as large as in k, then the effect of relative per-capita income increases on relative prices via market shares is non-negative. A sufficient condition to ensure that relative market shares are non-decreasing in relative per-capita incomes of destinations is that trade barriers obey the triangle inequality. Proposition 1 below summarizes the result.

Proposition 1. *If trade barriers obey the triangle inequality, $(\forall j, k, \upsilon)\tau_{\upsilon j}\tau_{jk} \geq \tau_{\upsilon k}$, then the relative price of a variety sold in two markets is strictly rising in the markets' relative per-capita incomes.*

Intuitively, for a given variety that is sold in two markets, the consumers in the rich country are less responsive to price changes than the consumers in the poor one. A firm exploits this opportunity, amid trade barriers that segment the markets, and charges a high mark-up in the affluent destination.

Before engaging in empirical analysis, it is important to note from expression (23) that the relative market shares are endogenous variables in this model. As discussed above, destinations' per-capita income levels affect market shares. Destinations' population sizes also affect market shares. Consider an increase in the population size of country j, while keeping k's characteristics fixed. Then, the measure of entrants from j increases, which strengthens competition, thus reducing the market shares of other countries. In particular, firms originating from country i experience a fall in their market shares in both destinations j and k. If the fall in market share in j is at least as large as in k, then the effect of relative population size increases on relative prices via market shares is non-positive. A sufficient condition to ensure that relative market shares are non-increasing (strictly decreasing) in relative population sizes of destinations is that trade barriers obey the triangle inequality (strictly for at least one source country). Proposition 2 below summarizes the result.

Proposition 2. *Given relative per-capita income levels, for any two countries, j and k, $j \neq k$, if trade barriers obey the triangle inequality, $(\forall \upsilon)\tau_{\upsilon j}\tau_{jk} \geq \tau_{\upsilon k}$, and if the inequality for at least one $\upsilon \neq j$ is strict, then the relative price of a variety sold in markets j and k is strictly decreasing in the relative population sizes of the markets.*

To summarize, in this model, trade barriers, per-capita income levels, and market shares shape prices across countries. In particular, the relative price of a given variety in a pair of countries is increasing in the relative trade barriers and per-capita income levels of the two destinations. Furthermore, the relative price is increasing in the relative market shares of the exporting country in the two destinations. One key variable that affects relative market shares is destination population size. If trade barriers obey the (strict) triangle inequality, relative prices are (strictly) decreasing in relative population sizes of the two destinations.

3.3 Firm Sales

As discussed in Section 3.1, according to this model, only the most productive domestic entrants export. Moreover, ranking export destinations according to their accessibility, which is summarized by the productivity thresholds, implies that more productive firms export to more destinations. To study the sales behavior of each firm, multiply consumer demand in (19) by the destination's size L_j to obtain the quantity sold in j by a firm with productivity ϕ from i, denoted by $x_{ij}(\phi)$. Firm sales per destination are the product of the quantity and the price and are given by

$$r_{ij}(\phi) \equiv p_{ij}(\phi)x_{ij}(\phi) = \bar{q}L_j \frac{\tau_{ij}w_i}{\phi_{ij}^*}\left[1 - \left(\frac{\phi_{ij}^*}{\phi}\right)^{\frac{1}{2}}\right]. \tag{25}$$

According to expression (25), firm sales in a destination are falling in the productivity threshold that characterizes the market. From the discussion in Section 3.1, it follows that a firm realizes higher sales in a richer (in per-capita terms) market. However, the effect of country size on firm sales is ambiguous. On the one hand, a more populated market yields more sales. On the other hand, larger markets are more competitive and therefore the productivity thresholds associated with them are higher. Hence, from (25), it follows that only the very productive firms will be able to overcome the pro-competitive effects in larger markets and enjoy the benefits of selling to more consumers. Appendix A.3 characterizes the productivity thresholds for the latter firms.

3.4 Relation to Existing Literature

The utility function that I employ in this paper represents a preference relation that is non-homothetic.[7] In particular, it yields hierarchic demand due to bounded marginal utility of consumption.[8] Two additional functional forms that belong to the class of hierarchic demand systems have recently been introduced to the international trade literature featuring firm heterogeneity. First, Melitz and Ottaviano (2008) use linear demand for varieties to study how mark-ups respond to changes in market size and trade policy. Their framework features a numéraire good that is produced with identical linear technology across countries and is freely traded. These assumptions imply wage equalization across countries and thus income effects on prices are absent from their model. In Supplementary Appendix I, I drop the numéraire good and I characterize the general equilibrium of the model of Melitz and Ottaviano (2008) allowing for income effects. I

[7]Non-homothetic preferences have made a come-back in international trade (Markusen (2010) and Fieler (2010)).

[8]This feature of the utility function gives consumption sets that are expanding in per-capita income. Sauré (2009) argues that this mechanism has implications about trade patterns. The author uses the present utility function in the homogeneous monopolistic-competition framework of Krugman (1980) and derives a positive relationship between per-capita income and the extensive margin of imports. The author's theoretical results are consistent with the empirical findings of Hummels and Klenow (2005) and Feenstra (2010). Previously, Young (1991) used the same preference relation in a Ricardian framework to analyze the growth patterns of countries when firms engage in learning-by-doing.

then demonstrate that, in the augmented model, the price of a variety responds to changes in per-capita income and market size in the same qualitative fashion as in the model that I introduce in the present paper. However, upon inspecting the individual firm's pricing rule obtained from Melitz and Ottaviano's (2008) model, one can verify that the behavior of relative prices across countries can only be studied numerically. In addition, a testable prediction linking relative prices to measurable variables across countries cannot be derived since thresholds are not explicit functions of parameters and wages.

Second, Behrens et al. (2009) employ exponential (CARA) utility in a general equilibrium model of international trade with heterogeneous firms. They use the model to quantitatively assess the effects of the Canada-US trade liberalization on regional market aggregates such as wages, productivity, mark-ups, the mass of produced and consumed varieties, as well as welfare. While their model has desirable aggregate properties such as a gravity equation of trade under Pareto-distributed firm productivities, individual-firm prices and mark-ups are characterized via the Lambert-W function. Behrens et al. (2009) demonstrate that the model predicts a similar response of the price of a variety to changes in market characteristics as the two models discussed above. However, due to lack of tractability, relative prices across countries can only be examined numerically and a testable prediction that relates them to measurable variables is not available.

On the contrary, the non-homothetic preference representation that I employ throughout the paper allows me to obtain a testable prediction that links relative prices to measurable variables, one of which is per-capita income. I propose this particular utility function because it offers tractability and it allows me to relate the model's prediction to observed data. In the following empirical section, I use the testable prediction of the model to structurally estimate the elasticity of price with respect to per-capita income from unique price data and to gauge the quantitative relevance of variable mark-ups.

In the model outlined in this paper, the price of a variety reflects the firm's marginal cost of production and delivery and the consumer's demand elasticity in a country, which can be seen from expression (21). Since the elasticity in expression (20) depends on the productivity threshold, it falls in the per-capita income and rises in the size of the destination. The effects are a byproduct of the assumed non-homothetic preference relation.

Before proceeding to the empirical section, it is important to note that alternative explanations of varying demand elasticities, and therefore varying prices, exist. Hummels and Lugovskyy (2009) use a Lancaster (1979) model to argue that richer agents consume more per good, which makes them more finicky and more willing to pay a high price in order to get closer to consuming their ideal variety. In their model, larger and richer (in per-capita terms) markets attract more firms and are consequently more competitive, which forces firms to charge lower prices there. Overall, the pro-competitive effect associated with higher per-capita income dominates the finickiness effect, so their model predicts that relative prices of identical varieties are lower in relatively richer (in per-capita terms) and relatively larger markets. In contrast, the present model predicts that relative prices of identical varieties are higher in markets with relatively higher per-capita income levels. Destinations' market sizes, on the other hand, only affect relative prices to the extent that they influence exporters' market shares. In the empirical section that follows, I find that per-capita income levels systematically shape relative prices across countries. However, I only obtain weak empirical evidence that market size differences negatively affect relative prices across destinations. These results suggest that the non-homothetic framework is better suited to account for the price variations in the dataset that I employ in this paper.

Another strand of literature that studies the interaction between varying demand elasticities and prices emphasizes the importance of search frictions. For example, Lach (2007) hypothesizes that prices of consumption goods in Israel fell in the 1990s because there was a flow of immigrants with low search costs and high demand elasticities into the country during the period. Alessandria and Kaboski (2011) develop a formal model where high-wage earners have a high opportunity cost of searching for goods, which allows firms to charge high prices for identical goods in rich countries.

In the model of Alessandria and Kaboski (2011), identical households within a country send out shoppers to browse price quotes and to buy goods. Shopping takes time away from work. After obtaining either one or two price quotes, a shopper chooses whether to purchase zero or one unit of the good at the lowest price quote. Shoppers follow a reservation-price rule, such that they only purchase a unit of the good if the lowest price quote is below some reservation level. Each household is indifferent between raising the reservation price and sending out additional shoppers, so the reservation price is higher in higher-wage countries.

In their model, a large number of firms offer the same good to consumers in two different countries and take the price distribution as well as the reservation price of consumers as given. If the firm's price is lower than the reservation price, the firm sells to customers with one price quote. By increasing its price, the firm increases its revenue per sale but decreases the likelihood of a sale, since it increases the probability that customers with two price quotes have a second price quote that is lower than the firm's price. Any price on the support of the distribution results in identical firm profits, so firms choose to randomize. The mean transacted price is higher in the country with a higher wage because consumers search for price quotes less intensively there.

While the search framework of Alessandria and Kaboski (2011) can account for the observed price variation in certain types of consumer goods, there is considerable room for an explanation of the positive relationship between prices of tradables and per-capita income that builds on non-homothetic preferences. In the model of Alessandria and Kaboski (2011), consumers purchase the same set of goods independently of their income levels. Hence, the model yields no systematic relationship between the extensive margin of trade and per-capita income. In contrast, one of the key features of the hierarchic-demand system that I consider is the positive link between the set of consumed varieties and consumers' income, which has been documented by Jackson (1984), Hunter and Markusen (1988), Hunter (1991), Movshuk (2004), and Hummels and Klenow (2005).

In sum, although existing models that generate varying demand elasticities can explain the positive relationship between prices of tradables and per-capita income, a mechanism that combines monopolistically-competitive firms and consumers with non-homothetic preferences does not only account for the observed price variation in the data, but is also consistent with broader empirical regularities in the international trade literature.

4 Empirical Analysis

In this section, I present a unique database that features prices of *identical* goods sold *online*, which allows me to establish a link between demand elasticities and mark-ups across countries. Guided by the model that I develop in previous sections, I estimate the elasticity of price with respect to per-capita income and I use it to evaluate the quantitative importance of variable mark-ups.

4.1 Description of Data

4.1.1 Mango Price Data

I collect price data from the *online-only* catalogues of a Spanish apparel manufacturer called Mango. Mango specializes in the production of clothing, footwear, and accessories for middle-income female consumers, although in 2009, they also established a men's line. The company opened its first store in Barcelona in 1984. As of 2011, Mango had 1757 stores in 104 countries. Mango's financial statement dated December 31, 2010 shows that total annual sales amounted to 1.269 billion Euro, out of which 81 percent was generated from exports. Mango is the second largest textile exporter in Spain and it employs 9775 people.

Table 1: Mango's Sales Per Destination in Year 2010, 95 Countries

Log Export Sales	Log Per-Capita Income	Log Population
Coefficient Estimate	0.7504***	0.4573***
(s.e.)	(0.0830)	(0.0638)

*** significance at 1%-level, R^2=0.5465, N. Obs 94 (Spain is numéraire)

Data Sources: Sales for manufacturer Mango from company's 2010 Annual Report. Nominal per-capita GDP and population for 2010 from WDI.

Viewed through the lenses of the model, Mango is a typical highly-productive exporter. First, Mango serves a very large number of markets. Second, Table 1 shows that Mango exports higher volumes to richer and bigger markets. These observations are in line with the model's predictions discussed in Section 3.3 above.

What makes Mango particularly well suited for the study of pricing to market is the fact that, for a subset of its export markets, the company operates a large-scale online store at http://shop.mango.com.[9] Each participating country has a website and customers from one country cannot buy products from another country's website due to shipping restrictions. Thus, a customer with a shipping address in Germany can only have items delivered to her if purchased from the German Mango website.

Three unique features of the data allow me to empirically test the price-discrimination hypothesis. First, products sold in each market are identical, so quality differences are not responsible for the variation in prices across markets. This feature of the data distinguishes the analysis from studies that employ unit values (see Hummels and Klenow (2005), Hummels and Lugovskyy (2009), Alessandria and Kaboski (2011), Baldwin and Harrigan (2011), Johnson (2011), Manova and Zhang (2011), Bastos and Silva (2010), Gorg et al. (2010), and Harrigan et al. (2011)). Second, the products employed in the analysis are sold *exclusively online* and they are not available in Mango's physical stores ensuring that the items' prices are not set to match the in-store prices, which may reflect non-tradable contributions, as in Hsieh and Klenow (2007), Alessandria and Kaboski (2011), Crucini et al. (2005a), Crucini et al. (2005b), Crucini and Shintani (2008), Crucini and Yilmazkuday (2009), Goldberg and Verboven (2001), Goldberg and Verboven (2005), Ghosh and Wolf (1994) and Haskel and Wolf (2001). Third, the items used in the study are produced in, stored in, and shipped from a single location to all destinations via DHL Express. This observation together with information on DHL's pricing policies allows me to control for transportation costs in the analysis and to isolate the mark-up component of the price. I expand on the three unique features of the price data and I discuss the remaining necessary ingredients for the empirical analysis below.

The online catalogue constitutes an identical basket of more than one thousand products offered in all participating countries each season. Each item in the catalogue has a unique name and an 8-digit code reported in every country. All items are stored and ship out of a single warehouse located in Palau de Plegamans, Spain, regardless of the shipping destination. Thus, prices do not reflect destination-specific production and storage costs. However, a number of items that Mango offers on its website are also sold in the company's physical stores. Should the company be matching the prices of the items via the two outlets, the items' online prices may reflect local non-tradable contributions. For this reason, I restrict the empirical analysis to only those items that are sold *exclusively online*. There are 245 items in total sold *exclusively online* to 29 markets in Europe, North America, and Asia. I consider products from the Summer 2012 catalogue, which became available online in April of 2012.[10]

[9]Recently, Mango's main competitors have begun to operate similar stores online. These companies include Zara (http://www.zara.com)—Spain's largest apparel exporter, H&M (http://www.hm.com/entrance.ahtml)—Sweden's largest apparel exporter, and Miss Sixty (http://www.misssixty.com/Index.aspx)—a division of Italy's Sixty Spa. At the time this study was conducted (in 2012), Mango's online store had the widest coverage of countries and items, which is necessary for the empirical analysis, and it allowed one to collect prices of items in every country. To my knowledge, among the companies listed above, Mango was the only retailer for which one could verify the fact that items were sold *exclusively* online and that they were produced, stored, and shipped from a single location to all the destinations. In fact, Mango's website explicitly labels a subset of its items as online-only.

[10]Summer and Winter 2008 catalogue data yield similar results, which are available upon request. While the

Prices are recorded in local currency. One half of the countries in the sample were members of the Euro area in 2012. For the remaining countries in the sample, I convert prices into Euro using the European Central Bank's average exchange rate for April of 2012—the month when the catalogue was posted online and the data were collected. I also report results that I obtain using exchange rates for February and March of 2012 to capture the fact that Mango may have priced its products one or two months prior to posting the catalogue online.[11] I further control for Eurozone membership in order to capture the effect that currency areas have on price variations.

The items' prices reported on Mango's website are inclusive of value added taxes (VAT) in the EU-member countries and sales taxes and import tariffs in the remaining markets. Therefore, it is important to control for policy instruments in the pricing analysis. I obtain data on VAT rates on apparel for each EU-member country from the European Commission. In addition, I collect data on sales taxes on clothing for the remaining countries from their respective statistical agencies.[12] Finally, I use tariff data on clothing from the World Integrated Trade Solution (WITS) database.

Given Mango's line of work, to measure trade shares λ_{ij}, I focus on the apparel and footwear industries in the year 2008. The numerator in (23) is country j's imports from country i in the industry, which spans commodity codes H0- 61, 62, and 64 in the Comtrade data. I let the denominator in the trade-share expression be Gross Output in the industry. This statistic poses the most severe data constraint in the analysis. I pool gross output data for the apparel and footwear industry from a variety of sources including Stats.OECD, Prodcom, as well as individual countries' statistical agencies. Finally, I use per-capita GDP (in current US dollars) for the year 2010 from the World Development Indicators. In Supplementary Appendix II, I repeat the empirical analysis using five different measures of per-capita income or expenditure: nominal consumption per capita, nominal household consumption per capita, nominal GNI per capita, nominal GNI per capita measured according to the Atlas method, and PPP-adjusted GDP per capita.

4.1.2 DHL Shipping Data

Upon receiving an online order, Mango ships all items via DHL Express.[13] Mango's shipping and handling policy is as follows: (i) In two thirds of the countries in the dataset, no explicit fee is paid

multiple-season data minimizes the possibility of seasonal bias, the number of goods and countries in the 2008 sample is smaller. Moreover, in 2008, Mango's website did not distinguish between items that were available exclusively online versus in physical stores as well. The distinction is very important in order to minimize any biases that arise due to non-tradable price components.

[11] It is redundant to repeat the analysis using exchange rates that were effective three or more months prior to the month when the catalogue was posted online since seasonal catalogues have a lifespan of three months. Given the short product lifespan, exchange rate volatility is likely not a major concern for Mango. Hence, the data are useful for a cross-sectional study such as the one undertaken in this paper. In that respect, the nature of the exercise is very different from typical empirical pricing-to-market investigations, which rely on time variation in prices of products with similar characteristics in order to infer the degree of nominal exchange-rate pass through (see Goldberg and Knetter (1997) for a comprehensive review of the relevant literature).

[12] For Canada, I compute a population-weighted average tax rate across all of its provinces.

[13] I conducted a controlled experiment and collected DHL tracking codes for an identical item sent to all destinations and verified that the shipping and production origin are identical, regardless of destination.

by the consumer on purchases above a minimum value, which differs across countries; (ii) In one third of the countries, an explicit fee is charged even on purchases above a minimum, where both the fee and the minimum value vary across countries. All other purchases incur an explicit shipping and handling fee, which is also country-specific. Some individual items, and most combinations of items, exceed the specified minimum thresholds. However, it is not the case that the same products (or combinations thereof) ship at no (or reduced) fee to different destinations, since the thresholds as well as the actual Euro-denominated prices of the products differ across markets.

The shipping and handling policy of Mango is symptomatic of a quantity-discount pricing rule typically employed by online retailers who face heterogeneous consumers. According to the above-mentioned pricing rule, both the listed item price and the shipping and handling fee reflect the costs of shipping (although the degree of cost pass-through may differ). Hence, in order to minimize any biases that may arise due to quantity discounts, in the benchmark empirical analysis I not only focus on the listed item price only, but I also control for the cost of shipping. In Section 4.2.3, I discuss the quantity-discount model in detail and I conduct robustness exercises that use Mango's listed item prices as well as shipping and handling fees.

As noted above, Mango's shipping and handling provider is DHL. While, information on the actual cost of shipping and handling that Mango incurs is not publicly available, I can proxy the costs by using reported DHL prices.[14]

DHL prices all shipments according to regions made up of one or more countries. To obtain an understanding of DHL's pricing policy, I collect price quotes for one-time identical shipments to all the destinations in the sample from the Spanish DHL website.[15] I first regress the logged shipping price quotes (relative to shipping within Spain) on logged relative per-capita incomes and population sizes of destinations, a constant, and gravity variables: logged distance between Spain and the destination (in km) and dummy variables if the destination shares common legal origin with Spain, if it is landlocked, or if it is an island. I obtain all gravity variables from Head et al. (2010) (referred to as CEPII throughout the paper).

Table 2 presents the results from two specifications: one that includes the log of distance and one that includes the log as well as the square of the log of distance. The high R-squared statistics that result from both specifications suggest that per-capita income, market size, and the gravity variables account for the majority of the variation in DHL shipping charges. The results from both specifications suggest that DHL charges lower prices to ship to both richer (in per-capita terms) and larger markets ($\hat{\gamma}_w$ and $\hat{\gamma}_L$, respectively). Shipping prices are likely falling in market (population) size due to economies of scale as well as due to competition. In addition, shipping prices to richer destinations are likely lower due to better infrastructure and higher efficiency in transportation there, as well as due to higher competition particularly among air carriers as

[14] All information on DHL contained in this and subsequent paragraphs is available at http://www.dhl.es/en.html.

[15] DHL offers discounts for multiple shipments, but the discounts do not affect the *relative* price that a client pays to ship to different destinations.

Table 2: DHL Pricing Rules, 29 Countries

Distance Specification	Linear	Quadratic
Estimate (s.e.)	R^2=0.8351	R^2=0.8713
$\hat{\gamma}_w$	-0.2746***	-0.3140***
(s.e.)	(0.0427)	(0.0421)
$\hat{\gamma}_L$	-0.0701***	-0.0853***
(s.e.)	(0.0218)	(0.0207)
$\hat{\gamma}_l$	0.1978**	0.1186
(s.e.)	(0.0785)	(0.0785)
$\hat{\gamma}_i$	0.1312*	0.0746
(s.e.)	(0.0774)	(0.0740)
$\hat{\gamma}_{lo}$	-0.0954	-0.1837**
(s.e.)	(0.0795)	(0.0810)
$\hat{\gamma}_{d,1}$	0.3514***	-3.2660**
(s.e.)	(0.0504)	(1.5253)
$\hat{\gamma}_{d,2}$		0.2187**
(s.e.)		(0.0922)
$\hat{\gamma}_o$	-0.9489**	13.8983**
(s.e.)	(0.4042)	(6.2684)

* significance at 10% level, ** significance at 5%-level, *** significance at 1%-level, N. Obs 28 (Spain is numéraire)

Data Sources: DHL Express shipping quotes from DHL Spain Online. Gravity variables from CEPII. Nominal per-capita GDP and population for 2010 from WDI.

Cristea et al. (2012) argue. These results are in line with Hummels et al. (2009) who find similar patterns in the shipping prices to the US and Latin American markets.

Table 2 also shows that DHL charges higher prices to ship to more distant markets. In the specification that is log-linear in distance, the positive relationship is captured by $\hat{\gamma}_{d,1}$. The regression that includes the log of distance and the square thereof suggests that there is a non-linearity in DHL's pricing rule. In particular, the estimates of $\hat{\gamma}_{d,1}$ and $\hat{\gamma}_{d,2}$ suggest that the price to ship is increasing in distance for distances that exceed 1800 km.

In the benchmark study of price discrimination below, I use logged DHL shipping prices, normalized by the price to ship within Spain, to approximate Mango's cost to ship to its export markets, relative to the domestic costs of transport.

4.1.3 Summary

I conclude the discussion with a summary of the price data. Table 3 reports the mean product price across all 245 items, denominated in Euro and computed relative to Spain, in each of the twenty-eight export markets used in the analysis. The statistic $\bar{p}_{exp}$ shows that, in the average export market in the sample, items are 37% more expensive than they are in Spain. Trade barriers account for a portion of this price wedge between the domestic country Spain and the export markets. Among export destinations, prices are only 3% higher in Romania and as much as 76% higher in Japan.

Table 3: Per-Capita Income and Average Item Price, Relative to Spain, 29 Countries

Country	Austria	Belgium	Bulgaria	Canada	Cyprus	Czech Rep.
Mean Price	1.2650	1.2517	1.2575	1.6679	1.1625	1.1284
Country	Denmark	Estonia	Finland	Germany	Greece	Hong Kong
Mean Price	1.6235	1.3117	1.2609	1.2650	1.2323	1.6169
Country	Hungary	Ireland	Japan	Lithuania	Luxembourg	Macao
Mean Price	1.3173	1.3951	1.7584	1.2890	1.5079	1.6169
Country	Malta	Netherlands	Norway	Poland	Romania	Slovakia
Mean Price	1.2954	1.1462	1.4949	1.0944	1.0340	1.1724
Country	Slovenia	Sweden	Switzerland	United Kingdom	Spain	Mean, $\bar{p}_{exp}$=1.3655
Mean Price	1.4849	1.3564	1.6548	1.5734	1.0000	(St.Dev.) (0.1994)

$$\log \bar{p}_{exp} = 0.2868^{***} + 0.1103^{***} \log y, \quad R^2{=}0.3134, \quad \text{N. Obs. } 28$$

*** significance at 1%-level

Data Sources: Prices for 245 goods from Summer 2012 exclusive online catalogue of apparel manufacturer Mango. Exchange rate for April 2012 from ECB. Nominal per-capita GDP for 2010 from WDI.

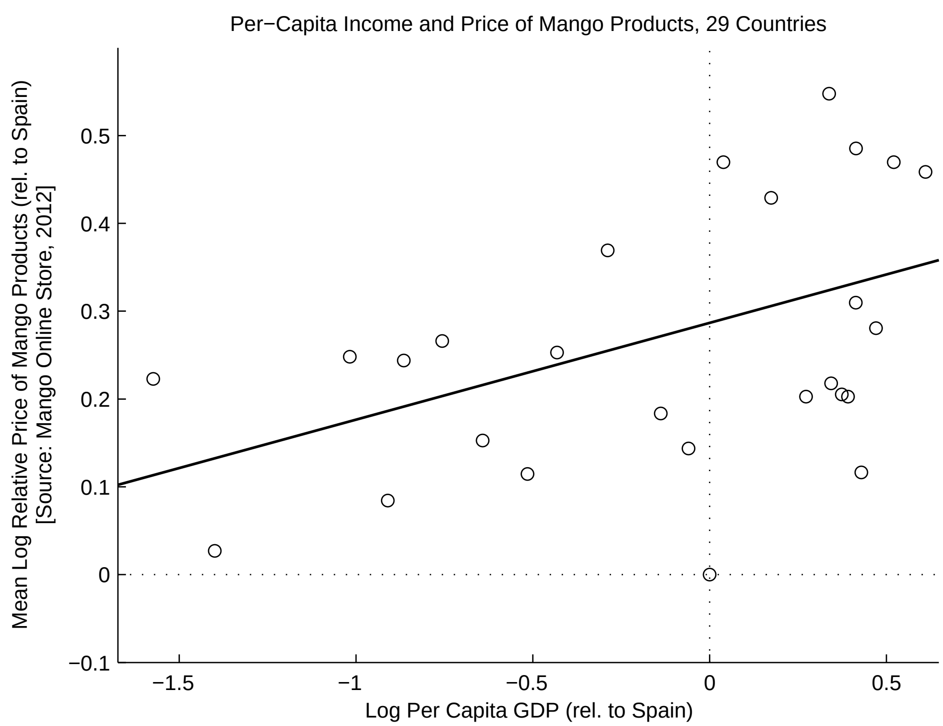

Figure 1: Per-Capita Income and Mean Price of Identical Mango Products

Figure 1 plots the mean of logged prices, relative to Spain, across all products in each export market against the logged relative per-capita income levels. A simple linear regression of the mean logged relative prices against the logged relative per-capita income levels yields a slope coefficient of 0.1103, with statistical significance at the 1% level. Hence, doubling the per-capita income level of a country is associated with an 11% price increase in identical apparel items sold by Mango there. However, a number of additional factors shape the prices of these identical items across countries. In the following sections, I carry out a detailed empirical analysis of the importance of per-capita income in explaining price variations across markets.

4.2 Empirical Test of Model

4.2.1 Econometric Model

To motivate the econometric specification recall the model's testable prediction in expression (24). With the description of the data in mind, I augment the baseline model to incorporate destination-specific taxes and tariffs. In particular, I assume that a consumer's purchase in market j is subject to a per-unit sales tax and a tariff, summarized by $tax_j > 0$, and I denote the gross sales tax and tariff by $\kappa_j \equiv 1 + tax_j$. Appendix B contains the modified consumer's problem.

Denoting the tax-inclusive price in market j for a variety produced by a firm with productivity ϕ from country i by $p^{\kappa}_{ij}(\phi)$, one obtains the following relative pricing rule across destinations (in logs) from the augmented model,

$$\log\left(\frac{p^{\kappa}_{ij}(\phi)}{p^{\kappa}_{ik}(\phi)}\right) = \underbrace{\frac{2\theta+1}{2(\theta+1)}}_{\beta_\tau}\log\left(\frac{\tau_{ij}}{\tau_{ik}}\right) + \underbrace{\frac{1}{2(\theta+1)}}_{\beta_w}\log\left(\frac{w_j}{w_k}\right) + \underbrace{\frac{1}{2(\theta+1)}}_{\beta_\lambda}\log\left(\frac{\lambda_{ij}}{\lambda_{ik}}\right) + \underbrace{\frac{2\theta+1}{2(\theta+1)}}_{\beta_\kappa}\log\left(\frac{\kappa_j}{\kappa_k}\right).$$

The model predicts that, after controlling for relative import shares, international trade barriers, and sales taxes and tariffs, the elasticity of relative prices with respect to relative per-capita incomes is $\beta_w \equiv 1/[2(\theta+1)]$.

I use Spain as numéraire, drop country-of-origin subscripts, and discretize the set of varieties to obtain the following econometric model

$$\log\left(\frac{p_{jm}}{p_{sm}}\right) = \hat{\beta}_o + \hat{\beta}_\tau \log\left(\frac{t_j}{t_s}\right) + \hat{\beta}_w \log\left(\frac{w_j}{w_s}\right) + \hat{\beta}_\lambda \log\left(\frac{\lambda_j}{\lambda_s}\right) + \hat{\beta}_\kappa \log\left(\frac{\kappa_j}{\kappa_s}\right) + \hat{\beta}_g \log\left(\frac{g_j}{g_s}\right) + \psi_{jm}.$$

In the above expression, p_{jm}/p_{sm} is the Euro-denominated price of item m in country j, relative to Spain. t_j/t_s approximates the relative trade costs from Spain to destination j to the costs to ship within Spain. In the baseline analysis, the relative trade costs are approximated using DHL's destination-specific shipping prices, relative to the price to ship within Spain, as well as a Euro-currency dummy.[16] In summary, I let $t_j/t_s = [t_{j,dhl}/t_{s,dhl}, t_{j,eur}]$. w_j/w_s is the per-capita income of

[16] The dummy takes on the value of 1 if the country's Mango website lists prices denominated in Euro and zero otherwise. Naturally, all Eurozone countries satisfy this category. Interestingly, Mango also prices its items in Euro

country j, relative to Spain. λ_j/λ_s is the import share of country j from Spain, relative to Spain's domestic expenditure share. κ_j/κ_s is the gross sales tax and tariff (for Spanish imports) in country j, relative to Spain's gross sales tax. ψ_{jm} is an error term.

I introduce an additional variable to the econometric model—the Gini coefficient of income inequality in country j, g_j. This is motivated by the fact that Mango's quantity-discount pricing strategy discussed above is optimal in environments in which firms serve markets made up of consumers with various income levels within a country. While I do not explicitly derive the optimal pricing rule in an economy that features heterogeneous consumers within a country, I refer the reader to such extensions of this model considered by Bekkers et al. (2011) and Pieters (2013).

Finally, the $\hat{\beta}$'s represent the estimated coefficients for each variable with $\hat{\beta}_o$ denoting the coefficient estimate for a constant term.

4.2.2 Benchmark Results

Table 4: Benchmark Test of Model, 29 Countries

Exchange Rate	$\hat{\beta}_w$ (s.e.)	$\hat{\beta}_\lambda$ (s.e.)	$\hat{\beta}_\kappa$ (s.e.)	$\hat{\beta}_{dhl}$ (s.e.)	$\hat{\beta}_{eur}$ (s.e.)	$\hat{\beta}_g$ (s.e.)	$\hat{\beta}_o$ (s.e.)
Apr 2012	0.1725***	0.0014	0.4221	0.1576*	-0.0875**	0.2062**	0.0203
R^2=0.2482	(0.0316)	(0.0087)	(0.3356)	(0.0873)	(0.0384)	(0.0923)	(0.1792)
Mar 2012	0.1690***	0.0019	0.4142	0.1588*	-0.0879**	0.1935**	0.0192
R^2=0.2434	(0.0292)	(0.0087)	(0.3189)	(0.0825)	(0.0372)	(0.0910)	(0.1675)
Feb 2012	0.1789***	0.0012	0.4860	0.1783**	-0.0848**	0.2051**	-0.0230
R^2=0.2504	(0.0332)	(0.0090)	(0.3315)	(0.0879)	(0.0380)	(0.0929)	(0.1793)

* significance at 10% level, ** significance at 5%-level, *** significance at 1%-level

Price regressions: N. Obs 6860, Country clusters 28 (Spain is numéraire)

Data Sources: Prices from Summer 2012 exclusive online catalogue of apparel manufacturer Mango. Exchange rates from ECB. Nominal per-capita GDP for 2010 from WDI. Gini coefficient from WIID and CIA. DHL Express shipping quotes from DHL Spain Online. Gravity variables from CEPII. Bilateral trade for 2008 for commodity codes H0- 61, 62, and 64 from Comtrade. Gross output for apparel and footwear for 2008 from Stats.OECD, Prodcom, and national statistical agencies. Tariffs from WITS. Sales taxes from European Commission and national statistical agencies.

I estimate the coefficients in the econometric model above using the OLS estimator and I cluster all errors by destination. The results from the empirical test of the model are reported in Table 4. Across the three exchange-rate specifications, the coefficient estimates on per-capita income are roughly 0.17 and highly statistically significant. Hence, doubling the per-capita income of a country is associated with a 17% increase in the price of identical goods sold by Mango there.

The coefficient on market share is not statistically different from zero. Measurement error, which biases coefficient estimates toward zero, is one possible explanation for this finding. In order to maximize the country coverage: first, the gross output data are pooled from a variety of

in Romania — a non-Eurozone country.

sources; and second, the data are from the year 2008, which is associated with the financial crisis and documented trade collapse (see Levchenko et al. (2010) and Chor and Manova (2012) among others). Hence, the constructed trade shares may not be representative for the sample of countries analyzed here in a typical year. Consequently, in the following subsection, guided by Proposition 2, I conduct robustness analysis using country (population) sizes instead of import shares to capture the pro-competitive effects on prices.

Furthermore, although the model predicts that relative prices should be increasing in relative import shares, the import shares are endogenous variables that reflect all the countries' per-capita incomes, sizes, productivities, and trade barriers. These variables affect prices in different directions and magnitudes and the multiple effects possibly cancel each other out. For example, a linear regression of the twenty-eight logged import shares (relative to the Spanish domestic share) on a constant as well as logged relative per-capita income levels, sizes, and DHL shipping prices for each destination yields an R-squared of 0.5434. Hence, roughly half of the variation in import shares can be attributed to per-capita income, size and shipping price differences across destinations. In particular, the coefficient estimates (standard errors in parenthesis) on DHL shipping prices and country sizes are -3.2794 (0.9801) and -0.6477 (0.1805), respectively, and they are both statistically significant at the 1% level. In contrast, the coefficient estimates of the constant term and per-capita income are not statistically different from zero. While the destination's size and the cost to ship there lower its import share, the model suggests that the two variables have opposing effects on prices. These opposing effects possibly bias the estimates of $\hat{\beta}_\lambda$ toward zero. Once again, the robustness analysis in the following subsection attempts to address this issue by directly controlling for per-capita income levels, country sizes, and trade barriers.

The coefficient estimates of the DHL shipping costs are statistically different from zero and comparable in magnitude to the coefficient estimates of per-capita income. Hence, DHL shipping costs are an important source of variation in the listed prices of Mango products. Sales taxes and tariffs do not appear to have significant effects on the cross-country price differences. Finally, the coefficient estimate of the Euro-currency dummy amounts to roughly -0.08 and it is statistically significant. Hence, denominating prices in the same currency as the source country (Spain) lowers the relative export-to-domestic price by 8 %. This finding is consistent with Rose (1999) who argues that currency union membership effectively reduces trade barriers. In addition, Cavallo et al. (2013) find that law of one price deviations are significantly larger outside of currency areas for products sold by large retailers such as Zara, H&M, Apple, and IKEA.

Fixed and random effects for goods. According to the model, relative prices across destinations do not reflect good-specific characteristics. Consequently, in the benchmark analysis, I do not control for good-specific effects. For robustness, I include good fixed effects in the benchmark regression. The coefficient estimates in Table 4 remain unchanged. However, the results of the F-test suggest that the good-specific fixed effects are significantly different from zero. While this finding is not in line with the model, it does not necessarily lead to the conclusion that the model is rejected by the data. In fact, the data are consistent with an explanation in which the good-specific effects are random and uncorrelated with any country characteristics, so the good-specific effects can be interpreted as pure taste or popularity shocks.

Variance decomposition. With the benchmark estimates in mind, it is of interest to decompose the contribution of the different sources of variation in prices of identical products across countries. I perform two exercises following the variance decomposition methodology employed by Crucini and Yilmazkuday (2009). First, I compute the residuals from the benchmark regression as well as from the specification with good fixed effects. Second, I compute the variance of the logged relative price, and the variance-covariance matrix of all the explanatory variables, scaled by their respective estimated coefficients, and the residuals. Third, I compute the ratio of the variance of each explanatory variable and the variance of the logged relative price. The ratio of the two variances in turn measures the contribution of an explanatory variable to the total observed variation in prices across goods and countries.

Across all three exchange rate specifications, per-capita income differences can account for roughly 30% of the variation in prices. DHL shipping costs account for no more than 6% of the observed price variation. Variations in import shares, taxes and tariffs, Gini coefficients, and currency membership do no account for more than 4% each. In the specification that does not include good fixed effects, the residual accounts for up to 75% of the variation of prices across goods and countries. In contrast, once good fixed effects are employed, the contribution of the residual drops to 42%, which is in line with the conclusions above regarding the importance of good-specific components to the cross-good and cross-country price variation.

4.2.3 Robustness Analysis

I. Alternative measures of trade barriers

In the benchmark analysis, I rely on DHL shipping prices to isolate the effect that Mango's shipping costs have on relative prices across countries. As shown in Table 2, DHL charges lower prices to ship to richer markets. Mango in turn passes through (albeit imperfectly) these costs onto its customers, which is evident in Table 4. One concern is that DHL's shipping prices are a noisy measure of Mango's true costs of shipping and may be a source of bias in the estimates of the elasticity of price with respect to per-capita income, $\hat{\beta}_w$. Consequently, I explore alternative measures of trade costs that do not systematically vary with per-capita income. These results can be seen as representing a lower bound on the estimates of $\hat{\beta}_w$.

I follow the gravity literature and I assume that trade barriers depend on trading partners' geographical and cultural attributes. I consider two specifications. The first is motivated by the study of DHL's pricing rule in Table 2 and includes the logged distance between Spain and the destination (in km), the square thereof, and dummy variables if the destination shares common legal origin with Spain, if it is landlocked, or if it is an island. The second specification replaces the

Table 5: Test With Alternative Measure of Competition and Trade Barriers I, 29 Countries

Specification	Competition = Trade Share (λ)			Competition = Market Size (L)		
Column	i.	ii.	iii.	iv.	v.	vi.
Exchange Rate	Apr 2012	Mar 2012	Feb 2012	Apr 2012	Mar 2012	Feb 2012
Estimate (s.e.)	R^2=0.6007	R^2=0.5971	R^2=0.6029	R^2=0.6427	R^2=0.6413	R^2=0.6440
$\hat{\beta}_w$	0.0587**	0.0565*	0.0532*	0.0743***	0.0731***	0.0699***
(s.e.)	(0.0284)	(0.0284)	(0.0288)	(0.0205)	(0.0198)	(0.0204)
$\hat{\beta}_\lambda$ (iv-vi: $\hat{\beta}_L$)	0.0116	0.0122	0.0122	-0.0494***	-0.0503***	-0.0492***
(s.e.)	(0.0103)	(0.0101)	(0.0106)	(0.0127)	(0.0122)	(0.0126)
$\hat{\beta}_\kappa$	0.2577	0.2383	0.2966	1.2725***	1.2704***	1.3040***
(s.e.)	(0.3239)	(0.3208)	(0.2982)	(0.3809)	(0.3602)	(0.3596)
$\hat{\beta}_{eur}$	-0.0854**	-0.0861**	-0.0837**	-0.0921***	-0.0930***	-0.0905***
(s.e.)	(0.0349)	(0.0344)	(0.0349)	(0.0268)	(0.0257)	(0.0264)
$\hat{\beta}_l$	-0.0445	-0.0429	-0.0435	-0.0690**	-0.0677**	-0.0675*
(s.e.)	(0.0494)	(0.0489)	(0.0502)	(0.0339)	(0.0332)	(0.0354)
$\hat{\beta}_i$	-0.0037	-0.0097	-0.0035	-0.0120	-0.0175	-0.0107
(s.e.)	(0.0428)	(0.0423)	(0.0424)	(0.0311)	(0.0291)	(0.0291)
$\hat{\beta}_{lo}$	-0.0699	-0.0681	-0.0703	-0.1288**	-0.1277***	-0.1283**
(s.e.)	(0.0441)	(0.0439)	(0.0440)	(0.0501)	(0.0488)	(0.0506)
$\hat{\beta}_{d,1}$	-3.0941***	-3.0060***	-3.2897***	-4.8988***	-4.8280***	-5.0594***
(s.e.)	(1.0845)	(1.0769)	(1.1106)	(1.0532)	(1.0260)	(1.0772)
$\hat{\beta}_{d,2}$	0.1937***	0.1882***	0.2063***	0.3032***	0.2988***	0.3136***
(s.e.)	(0.0666)	(0.0661)	(0.0683)	(0.0646)	(0.0629)	(0.0661)
$\hat{\beta}_g$	-0.0739	-0.0798	-0.1013	0.0630	0.0612	0.0376
(s.e.)	(0.1371)	(0.1371)	(0.1379)	(0.1278)	(0.1230)	(0.1270)

* significance at 10% level, ** significance at 5%-level, *** significance at 1%-level

Price regressions: N. Obs 6860, Country clusters 28 (Spain is numéraire), Fixed Effects 244 (relative to good 1)

Data Sources: Prices from Summer 2012 exclusive online catalogue of apparel manufacturer Mango. Exchange rates from ECB. Nominal per-capita GDP and population for 2010 from WDI. Gini coefficient from WIID and CIA. DHL Express shipping quotes from DHL Spain Online. Gravity variables from CEPII. Bilateral trade for 2008 for commodity codes H0- 61, 62, and 64 from Comtrade. Gross output for apparel and footwear for 2008 from Stats.OECD, Prodcom, and national statistical agencies. Tariffs from WITS. Sales taxes from European Commission and national statistical agencies.

continuous measure of distance with five dummy variables that correspond to standard distance intervals employed in the gravity literature (see Eaton and Kortum (2002)). Finally, motivated by the results from the variance-decomposition exercise above, I use good-specific fixed effects in all the specifications that follow.[17]

Columns i.-iii. in Table 5 report the results from the exercise that uses a continuous (non-linear) distance measure. In line with the benchmark results, prices are increasing in per-capita income. In addition, markets that share a currency with the exporting country enjoy significantly lower prices. Finally, items' prices are increasing in distance albeit in a non-linear way which resembles

[17] I do not report the coefficient estimates of the good-specific fixed effects due to space constraints.

Table 6: Test With Alternative Measure of Competition and Trade Barriers II, 29 Countries

Specification	Competition = Trade Share (λ)			Competition = Market Size (L)		
Column	i.	ii.	iii.	iv.	v.	vi.
Exchange Rate	Apr 2012	Mar 2012	Feb 2012	Apr 2012	Mar 2012	Feb 2012
Estimate (s.e.)	R^2=0.5997	R^2=0.5968	R^2=0.6011	R^2=0.6317	R^2=0.6311	R^2=0.6332
$\hat{\beta}_w$	0.0672**	0.0643**	0.0619**	0.1074***	0.1061***	0.1051***
(s.e.)	(0.0306)	(0.0306)	(0.0308)	(0.0237)	(0.0226)	(0.0242)
$\hat{\beta}_\lambda$ (iv-vi: $\hat{\beta}_L$)	0.0129	0.0136	0.0146	-0.0456***	-0.0470***	-0.0463***
(s.e.)	(0.0128)	(0.0126)	(0.0130)	(0.0143)	(0.0136)	(0.0140)
$\hat{\beta}_\kappa$	-0.0120	-0.0339	0.1777	0.9006	0.9033	1.0918*
(s.e.)	(0.4838)	(0.4751)	(0.4825)	(0.6073)	(0.5764)	(0.5952)
$\hat{\beta}_{eur}$	-0.0764*	-0.0775**	-0.0712*	-0.0827**	-0.0840**	-0.0781**
(s.e.)	(0.0391)	(0.0381)	(0.0392)	(0.0370)	(0.0354)	(0.0366)
$\hat{\beta}_l$	-0.0466	-0.0460	-0.0442	-0.0699*	-0.0697*	-0.0667
(s.e.)	(0.0524)	(0.0516)	(0.0533)	(0.0381)	(0.0369)	(0.0399)
$\hat{\beta}_i$	0.0217	0.0145	0.0194	0.0280	0.0215	0.0284
(s.e.)	(0.0437)	(0.0422)	(0.0430)	(0.0448)	(0.0423)	(0.0428)
$\hat{\beta}_{lo}$	-0.0483	-0.0480	-0.0468	-0.0951***	-0.0959***	-0.0927***
(s.e.)	(0.0396)	(0.0396)	(0.0395)	(0.0339)	(0.0325)	(0.0339)
$\hat{\beta}_{r,1}$	-0.0817	-0.0820	-0.1081*	-0.0454	-0.0437	-0.0664
(s.e.)	(0.0589)	(0.0575)	(0.0599)	(0.0433)	(0.0417)	(0.0448)
$\hat{\beta}_{r,2}$	-0.2312**	-0.2264**	-0.2838**	-0.2507**	-0.2447**	-0.2950***
(s.e.)	(0.1116)	(0.1079)	(0.1126)	(0.1095)	(0.1037)	(0.1072)
$\hat{\beta}_{r,3}$	-0.2714**	-0.2667**	-0.3214***	-0.3531***	-0.3488***	-0.3946***
(s.e.)	(0.1145)	(0.1117)	(0.1166)	(0.1197)	(0.1137)	(0.1170)
$\hat{\beta}_{r,4}$	-0.0681	-0.0648	-0.1326	-0.1608	-0.1588	-0.2199*
(s.e.)	(0.1040)	(0.1014)	(0.1049)	(0.1176)	(0.1115)	(0.1151)
$\hat{\beta}_g$	-0.1103	-0.1186	-0.1290	0.0259	0.0231	0.0162
(s.e.)	(0.1390)	(0.1390)	(0.1413)	(0.1076)	(0.1024)	(0.1113)

* significance at 10% level, ** significance at 5%-level, *** significance at 1%-level

Price regressions: N. Obs 6860, Country clusters 28 (Spain is numéraire), Fixed Effects 244 (relative to good 1)

Distance Intervals (in miles): $[0, 750)$, $[750, 1500)$, $[1500, 3000)$, $[3000, 6000)$, $[6000, \infty)$; Interval 5 is numéraire

Data Sources: Prices from Summer 2012 exclusive online catalogue of apparel manufacturer Mango. Exchange rates from ECB. Nominal per-capita GDP and population for 2010 from WDI. Gini coefficient from WIID and CIA. DHL Express shipping quotes from DHL Spain Online. Gravity variables from CEPII. Bilateral trade for 2008 for commodity codes H0- 42, 61, 62, and 64 from Comtrade. Gross output for apparel and footwear for 2008 from Stats.OECD, Prodcom, and national statistical agencies. Tariffs from WITS. Sales taxes from European Commission and national statistical agencies.

DHL's pricing rule documented in Table 2.

Columns i.-iii. in Table 6 report the results from the exercise that splits countries into five regions according to their distance from Spain. The coefficient estimates of the dummy variables for each region are relative to the most distant set of countries, which include all non-European destinations. Hence, relative to the non-European destinations, European countries that belong to the mid-distant regions enjoy significantly lower prices. This finding is once again symptomatic of the non-linearity in DHL's pricing rule with respect to distance. In addition, prices remain higher in richer countries and lower in markets that share a currency with Spain.

The estimates of the elasticity of price with respect to per-capita income from the robustness exercises are roughly a third of the ones found in the benchmark specification (Table 4). This finding suggests that systematic variations in trade barriers across countries with different income levels are an important contributor toward the observed relationship between prices of tradable goods and per-capita income, as argued by Waugh (2010).

II. Alternative measure of competition

Table 7: Test of Model With Alternative Measure of Competition, 29 Countries

Exchange Rate	$\hat{\beta}_w$ (s.e.)	$\hat{\beta}_L$ (s.e.)	$\hat{\beta}_\kappa$ (s.e.)	$\hat{\beta}_{dhl}$ (s.e.)	$\hat{\beta}_{eur}$ (s.e.)	$\hat{\beta}_g$ (s.e.)
Apr 2012	0.1709***	-0.0091	0.5122	0.1371	-0.0955**	0.2332***
R^2=0.5767	(0.0348)	(0.0108)	(0.3793)	(0.0925)	(0.0375)	(0.0889)
Mar 2012	0.1673***	-0.0106	0.5167	0.1339	-0.0970***	0.2249***
R^2=0.5779	(0.0325)	(0.0101)	(0.3666)	(0.0862)	(0.0363)	(0.0884)
Feb 2012	0.1778***	-0.0070	0.5542	0.1622	-0.0908**	0.2257***
R^2=0.5762	(0.0365)	(0.0117)	(0.3607)	(0.0959)	(0.0379)	(0.0886)

* significance at 10% level, ** significance at 5%-level, *** significance at 1%-level

Price regressions: N. Obs 6860, Country clusters 28 (Spain is numéraire), Fixed Effects 244 (relative to good 1)

Data Sources: Prices from Summer 2012 exclusive online catalogue of apparel manufacturer Mango. Exchange rates from ECB. Nominal per-capita GDP and population for 2010 from WDI. Gini coefficient from WIID and CIA. DHL Express shipping quotes from DHL Spain Online. Tariffs from WITS. Sales taxes from European Commission and national statistical agencies.

According to the model, an exporting country's market share in each destination captures the effects of various country characteristics on the measure of entrants, which in turn alter the level of competition in each location and therefore the prices of goods there. One concern is that the market share data are measured with error. First, the gross output data are pooled from a variety of sources. Second, market share may not be the most relevant measure of competition. For example, Melitz and Ottaviano (2008) argue that mark-ups vary negatively with market size, measured by the population size of the country. Prices are also decreasing in market size in the Hummels and Lugovskyy (2009) model. In fact, Proposition 2 establishes that the model developed in the present paper also predicts that relative prices are decreasing in relative market sizes, under reasonable parameter restrictions.

For these reasons, I repeat the benchmark analysis as well as the analysis in I. above using relative country population sizes (with coefficient $\hat{\beta}_L$) instead of relative market shares. I summarize the findings from three distinct exercises. First, columns iv.-vi. in Table 5 report the results from the exercise that approximates trade costs using gravity variables and in particular a continuous (non-linear) distance measure. Second, columns iv.-vi. in Table 6 report the results from the exercise that approximates trade costs using gravity variables and groups countries into five regions according to their distance from Spain. Both exercises suggest that prices are lower in larger markets since the estimates of $\hat{\beta}_L$ are negative and statistically significant. These findings are in line with the predictions of the model developed in this paper as well as with the work by Hummels and Lugovskyy (2009) and Melitz and Ottaviano (2008).

However, it is worth to note that the negative relationship between the prices of Mango's items and the size of the destination may be in large part due to DHL's pricing rule. Recall that DHL charges systematically lower prices to ship items to larger markets, as documented in Table 2. In an attempt to draw a conclusion regarding the importance of market size on price, I repeat the benchmark exercise (which relied on DHL shipping prices as proxies for transport costs) with country size as a measure of competition. The results are presented in Table 7. In this case, neither country size nor the DHL shipping price have a statistically significant effect on relative prices, while per-capita income and the currency union dummy continue to account for the bulk of cross-country price variations. Hence, overall, I find no conclusive evidence that prices of tradable goods are lower in larger markets.[18]

III. Quantity-discount pricing

I now address the issue of quantity-discount pricing. In a standard two-type quantity-discount pricing model, a firm faces low- and high-valuation consumers in a given market, where valuation is positively linked to consumer income in preference specifications that feature income effects (see Chapter 3 in Tirole (1988)). In order to serve both consumer types, the firm offers the following price menu: a low per-unit price for purchases above a cutoff (the quantity discount) and a high per-unit price otherwise. With this pricing strategy, the firm extracts a higher mark-up (over marginal cost) from low- than high-valuation consumers in a market. Across segmented markets, the firm price discriminates as predicted by the model developed in the present paper. In particular, the firm enjoys higher mark-ups in markets with higher per-consumer income due to the higher average valuation of the good there.

Within the context of Mango, the low per-unit price would represent the listed item price on the website, while the high per-unit price would constitute the listed price plus the shipping and handling fee. Furthermore, markets where Mango charges an explicit shipping fee above the minimum can be thought of as consisting of a continuum of types, where the highest valuation type pays the (lowest) listed price, with the per-unit price rising as consumers' valuations fall.

Two observations should be noted. First, the shipping and handling fee incurred by the low-valuation consumers would reflect a mark-up determined according to the average income in the

[18] Notice that the results on the link between export prices and destination population size do not contradict the findings by Manova and Zhang (2011), Bastos and Silva (2010), Gorg et al. (2010), and Harrigan et al. (2011). The authors demonstrate that export unit values are increasing in destination per-capita income and population, and they argue that differences in product quality can account for the two observations. First, richer countries demand higher quality goods, which sell at a higher price. Second, firms increase product quality but reduce mark-ups in more competitive (larger) markets. Since the present paper examines prices of identical items, all the empirical finding should be interpreted as conditional on product quality being held fixed.

market. Second, both the listed item price and the shipping and handling fee would reflect the costs of shipping (although the degree of cost pass-through may differ). Since Mango charges destination-specific shipping and handling fees, the charges alter the effective per-unit price incurred by customers. Therefore, the estimates of the elasticity of price with respect to per-capita income ($\hat{\beta}_w$) obtained thus far can be thought of being informative about the behavior of high-valuation consumers in each market.

It is of interest to verify whether the effective price incurred by lower-valuation types yields different estimates of $\hat{\beta}_w$. Moreover, one should anticipate that the elasticity of price with respect to the DHL shipping price from the benchmark regression, $\hat{\beta}_{dhl}$, should now be larger and more significant, since the effective price incurred by low-valuation types would reflect the shipping costs to a larger degree.

I repeat the benchmark exercise with two sets of prices. The first set includes the effective price paid by consumers who spend an amount that barely exceeds the "minimum-shipping" threshold in each country. I label these consumers as "Medium-Valuation Types". In particular, I let the effective price of an item be the sum of the item's price and the shipping charge for purchases above the "minimum-shipping" threshold. Notice that as the consumers purchase more items, each item's effective price will reflect a smaller portion of the shipping charge and it will ultimately converge toward the listed price analyzed in the exercises above.

The second set of prices includes the effective price paid by consumers who spend an amount below the "minimum-shipping" threshold in each country. I label these consumers as "Low-Valuation Types". In this case, I let the effective price of an item be the sum of the item's price and the shipping charge for purchases below the "minimum-shipping" threshold. Once again, as the consumers purchase more items, each item's effective price will reflect a smaller portion of the high shipping charge, and the effective price will ultimately converge toward the price paid by the "Medium-Valuation Types".

Table 8 shows that the estimates of the elasticity of price with respect to per-capita income are practically unchanged compared to the benchmark specification. Hence, the presence of quantity discounts does not affect the elasticity of price with respect to per-capita income. However, the coefficient estimates on the DHL shipping prices are sharply increasing as the valuation of the consumer decreases. This suggests that Mango passes through a larger portion of the cost of shipping onto low-valuation consumers, as predicted by the quantity-discount model.

To evaluate the contribution of per-capita income differences and DHL shipping costs toward the variation of prices faced by the different types of consumers, I repeat the variance decomposition exercise using the two sets of prices discussed above. For the middle-valuation consumer types, per-capita income differences and DHL shipping costs account for a quarter each of the observed cross-country price variations. In contrast, for the low-valuation types, per-capita income differences contribute toward 20%, while shipping costs account for as much as 50% of the price variation.

Table 8: Test of Model With Medium- and Low-Valuation Types, 29 Countries

Effective price above threshold (Medium-Valuation Types)

Exchange Rate	$\hat{\beta}_w$ (s.e.)	$\hat{\beta}_\lambda$ (s.e.)	$\hat{\beta}_\kappa$ (s.e.)	$\hat{\beta}_{dhl}$ (s.e.)	$\hat{\beta}_{eur}$ (s.e.)	$\hat{\beta}_g$ (s.e.)
Apr 2012	0.1628***	0.0192	0.4729	0.3363***	-0.0564	0.0438
R^2=0.5417	(0.0390)	(0.0128)	(0.4146)	(0.0945)	(0.0533)	(0.1269)
Mar 2012	0.1593***	0.0195	0.4621	0.3365***	-0.0567	0.0309
R^2=0.5427	(0.0381)	(0.0128)	(0.4063)	(0.0868)	(0.0521)	(0.1252)
Feb 2012	0.1691***	0.0194	0.5397	0.3580***	-0.0539	0.0428
R^2=0.5470	(0.0378)	(0.0130)	(0.3934)	(0.0949)	(0.0522)	(0.1216)

Effective price below threshold (Low-Valuation Types)

Exchange Rate	$\hat{\beta}_w$ (s.e.)	$\hat{\beta}_\lambda$ (s.e.)	$\hat{\beta}_\kappa$ (s.e.)	$\hat{\beta}_{dhl}$ (s.e.)	$\hat{\beta}_{eur}$ (s.e.)	$\hat{\beta}_g$ (s.e.)
Apr 2012	0.1472***	0.0108	0.8965	0.5039***	-0.1033**	0.0872
R^2=0.6759	(0.0278)	(0.0088)	(0.5911)	(0.0874)	(0.0450)	(0.1149)
Mar 2012	0.1438***	0.0111	0.8851	0.5042***	-0.1035**	0.0742
R^2=0.6781	(0.0272)	(0.0087)	(0.5892)	(0.0859)	(0.0443)	(0.1140)
Feb 2012	0.1535***	0.0110	0.9633	0.5256***	-0.1007**	0.0862
R^2=0.6804	(0.0282)	(0.0088)	(0.5918)	(0.0868)	(0.0446)	(0.1143)

* significance at 10% level, ** significance at 5%-level, *** significance at 1%-level

Price regressions: N. Obs 6860, Country clusters 28 (Spain is numéraire), Fixed Effects 244 (relative to good 1)

Data Sources: Prices from Summer 2012 exclusive online catalogue of apparel manufacturer Mango. Exchange rates from ECB. Nominal per-capita GDP for 2010 from WDI. Gini coefficient from WIID and CIA. DHL Express shipping quotes from DHL Spain Online. Gravity variables from CEPII. Bilateral trade for 2008 for commodity codes H0- 42, 61, 62, and 64 from Comtrade. Gross output for apparel and footwear for 2008 from Stats.OECD, Prodcom, and national statistical agencies. Tariffs from WITS. Sales taxes from European Commission and national statistical agencies.

4.3 Quantitative Analysis and The Importance of Variable Mark-ups

Across the various empirical exercises, the estimates of the elasticity of price with respect to per-capita income range between roughly 0.06 and 0.17. The estimates can be divided into two sets. The high estimates that range between 0.14-0.18 are obtained using data on DHL shipping prices as a main proxy for trade barriers. These values reflect the pricing policy of the clothing manufacturer Mango as well as the shipping company DHL. The more conservative estimates that range between 0.05-0.11 are obtained using proxies for trade barriers that are typically employed in the gravity literature. Given that the choice to ship products via DHL Express may be specific to Mango, I center the discussion in this section around the second set of estimates. The median among these estimates is roughly 0.07.

Overall, it is reasonable to conclude that doubling a country's per-capita income results in at least a seven-percent rise in the price level of tradable apparel and footwear products due to variable mark-ups. Does this mean that variable mark-ups are important in accounting for the observed differences in prices of tradables across countries?

A simple way to answer this question is to compare the elasticity estimates arising from the exercises above to estimates obtained from aggregate data. The existing literature typically uses data from the International Comparison Program (ICP) in order to study the relationship between prices of tradables and per-capita income (see Alessandria and Kaboski (2011) for example). Following this literature, I obtain the latest ICP data for the year 2005, which includes prices of aggregate good categories, or basic headings, collected in retail locations across countries. In these data, prices potentially differ across countries due to variable mark-ups (as argued in this paper), varying product quality (perhaps due to non-homothetic preferences over quality as in Verhoogen (2008) and Fajgelbaum et al. (2011)), and varying retail components tied to non-tradable channels (as in Burstein et al. (2003) and Crucini and Yilmazkuday (2009)).

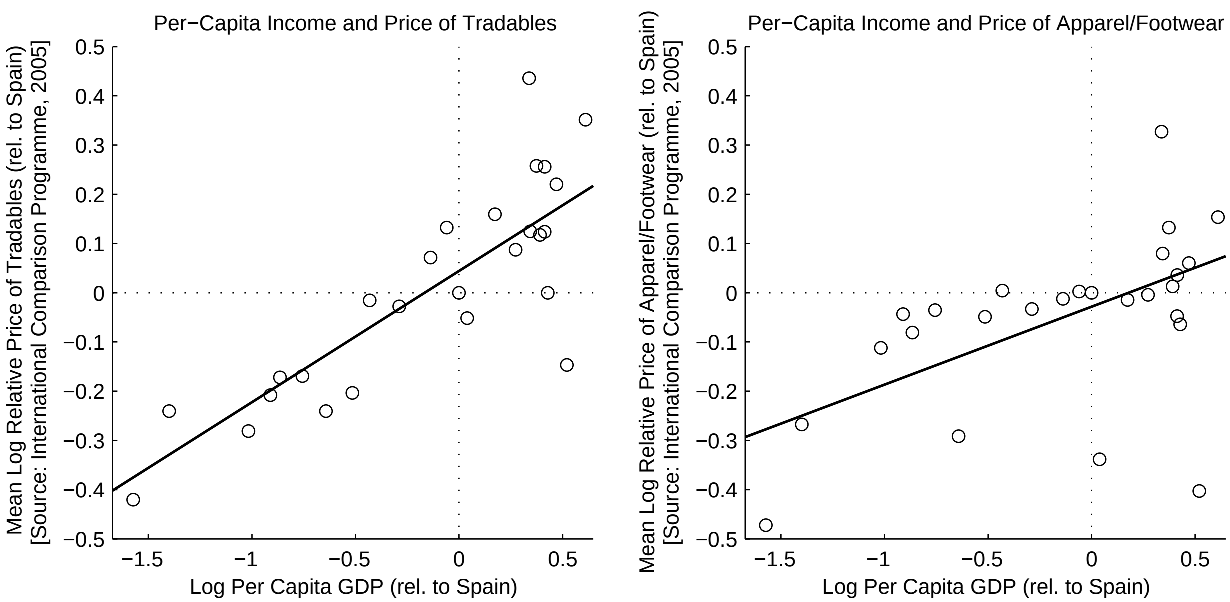

Figure 2: Per-Capita Income and Prices

In the left panel of Figure 2, I plot the logged price levels of tradables against the logged per-capita incomes of the countries in Table 3, relative to Spain. Following the literature, I compute the price level of tradables as the geometric average of prices of basic headings that correspond to tradable good categories. Clearly, prices of tradables are higher in countries with higher per-capita incomes. A linear regression of logged price levels of tradables, relative to Spain, on a constant and logged per-capita incomes, relative to Spain, yields a slope coefficient of 0.2666 and a t-statistic of 7.78 (see Table 9 in Appendix C). This result is robust in the literature. Hsieh and Klenow (2007) and Alessandria and Kaboski (2011) find an elasticity of 0.3 using the 1996 ICP data across a large set of countries.

The observations in the left panel of the figure, however, span across industries, so it is difficult to relate them to the statistics obtained in this paper. For this reason, in the right panel of the figure, I plot the log of the geometric average of prices of basic headings corresponding to apparel, footwear, and accessories. A linear regression of logged prices of these products on logged per-capita income and a constant yields a slope coefficient of 0.16 and a t-statistic of 3.89 (again see Table 9). Notice that prices of apparel and footwear products are higher in richer countries, albeit the elasticity estimate is less precise, given that these products span only three of the 62 basic headings that comprise the bundle of tradable goods.

One simple way to assess the importance of variable mark-ups is to compare the slope coefficient estimate of 0.16 with the estimate of 0.07, which resulted from the structural analysis that used prices of identical products in the same industry across the same set of countries. The ratio of the two elasticities suggests that variable mark-ups may be responsible for roughly a third of the observed variation in prices of apparel across countries. So, while mark-ups are potentially important, combining a price-discrimination mechanism with theories of varying product quality and non-tradable distribution channels would allow one to obtain a complete picture of the cross-country behavior of prices of tradables and to quantitatively assess consumers' welfare gains from trade.

5 Conclusion

In this paper, I argue that firms' variable mark-ups represent a key contributor toward the empirically-documented regularity that tradable consumer goods' prices are systematically positively related to countries' per-capita incomes. I outline a parsimonious and highly tractable heterogeneous-firm model of international trade that relates prices of tradable goods to per-capita income differences. I use the model's testable prediction to structurally estimate the elasticity of price with respect to per-capita income from a unique database that features prices of identical apparel products sold exclusively via the Internet to twenty-nine markets in Europe, Asia, and North America. Finally, I assess the importance of variable mark-ups in accounting for cross-country variations in prices of tradable goods.

On a broader scale, this paper emphasizes the role that income differences play in shaping cross-country price variations in tradable consumption goods as well as in determining aggregate consumption patterns. Since tradable goods that are acquired over the Internet account for an ever increasing portion of consumption bundles of individuals, their prices directly affect consumer welfare. Hence, having obtained an understanding of one of the key mechanisms that affect the behavior of prices across countries, we can further pursue the measurement of welfare of consumers in an integrated world economy.

References

Alessandria, G. and J. P. Kaboski (2011): "Pricing-to-Market and the Failure of Absolute PPP," *American Economic Journal: Macroeconomics*, 3, 91–127.

Alvarez, F. and R. J. Lucas (2007): "General Equilibrium Analysis of the Eaton-Kortum Model of International Trade," *Journal of Monetary Economics*, 54, 1726–1768.

Baldwin, R. and J. Harrigan (2011): "Zeros, Quality, and Space: Trade Theory and Trade Evidence," *American Economic Journal: Microeconomics*, 3, 60–88.

Bastos, P. and J. Silva (2010): "The quality of a firm's exports: Where you export to matters," *Journal of International Economics*, 82, 99–111.

Behrens, K., G. Mion, Y. Murata, and J. Sdekum (2009): "Trade, Wages and Productivity," CEP Discussion Papers dp0942, Centre for Economic Performance, LSE.

Bekkers, E., J. Francois, and M. Manchin (2011): "Import Prices, Income, and Inequality," *Johannes Kepler University of Linz, unpublished manuscript.*

Burstein, A., J. Neves, and S. Rebelo (2003): "Distribution costs and real exchange rate dynamics during exchange-rate-based stabilizations," *Journal of Monetary Economics*, 50, 1189–1214.

Cavallo, A., B. Neiman, and R. Rigobon (2013): "Product Introductions, Currency Unions, and the Real Exchange Rate," *Chicago Booth, unpublished manuscript.*

Chaney, T. (2008): "Distorted Gravity: The Intensive and Extensive Margins of International Trade," *American Economic Review*, 98 (4), 1707–21.

Chor, D. and K. Manova (2012): "Off the cliff and back? Credit conditions and international trade during the global financial crisis," *Journal of International Economics*, 87, 117–133.

Cristea, A., D. Hummels, and B. Roberson (2012): "Estimating the Gains from Liberalizing Services Trade: The Case of Passenger Aviation," *University of Oregon, unpublished manuscript.*

Crucini, M. and M. Shintani (2008): "Persistence in law of one price deviations: Evidence from micro-data," *Journal of Monetary Economics.*

Crucini, M., C. Telmer, and M. Zachariadis (2005a): "Price Dispersion: The Role of Borders, Distance and Location," *Carnegie Mellon University, unpublished manuscript.*

——— (2005b): "Understanding European Real Exchange Rates," *American Economic Review*, 95 (3), 724–738.

Crucini, M. J. and H. Yilmazkuday (2009): "A Model of International Cities: Implications for Real Exchange Rates," NBER Working Papers 14834, National Bureau of Economic Research.

Eaton, J. and S. Kortum (2002): "Technology, Geography, and Trade," *Econometrica*, 70 (5), 1741–1779.

Fajgelbaum, P., G. M. Grossman, and E. Helpman (2011): "Income Distribution, Product Quality, and International Trade," *Journal of Political Economy*, 119, pp. 721–765.

Feenstra, R. (2010): *Product Variety and the Gains from International Trade*, MIT Press.

Fieler, A. C. (2010): "Non-Homotheticity and Bilateral Trade: Evidence and a Quantitative Explanation," *Econometrica, forthcoming.*

Ghosh, A. and H. Wolf (1994): "Pricing in International Markets: Lessons From The Economist," *NBER Working Paper.*

Goldberg, P. and F. Verboven (2001): "The Evolution of Price Dispersion in the European Car Market," *The Review of Economic Studies*, 68 (4), 811–848.

——— (2005): "Market integration and convergence to the Law of One Price: evidence from the European car market," *Journal of International Economics*, 65 (1), 49–73.

Goldberg, P. K. and M. M. Knetter (1997): "Goods Prices and Exchange Rates: What Have We Learned?" *Journal of Economic Literature*, 35, 1243–1272.

Gorg, H., L. Halpern, and B. Murakozy (2010): "Why do within firm-product export prices differ across markets?" Kiel Working Papers 1596, Kiel Institute for the World Economy.

Harrigan, J., X. Ma, and V. Shlychkov (2011): "Export Prices of U.S. Firms," NBER Working Papers 17706, National Bureau of Economic Research, Inc.

Haskel, J. and H. Wolf (2001): "The Law of One Price-A Case Study," *Scandinavian Journal of Economics*, 103 (4), 545–558.

Head, K., T. Mayer, and J. Ries (2010): "The erosion of colonial trade linkages after independence," *Journal of International Economics*, 81, 1–14.

Hsieh, C. and P. Klenow (2007): "Relative prices and relative prosperity," *American Economic Review*, 97, 562–585.

Hummels, D. (2007): "Transportation Costs and International Trade in the Second Era of Globalization," *Journal of Economic Perspectives*, 21, 131–154.

Hummels, D. and P. J. Klenow (2005): "The Variety and Quality of a Nation's Exports," *The American Economic Review*, 95, 704–723.

Hummels, D. and V. Lugovskyy (2009): "International Pricing in a Generalized Model of Ideal Variety," *Journal of Money, Credit and Banking*, 41, 3–33.

Hummels, D., V. Lugovskyy, and A. Skiba (2009): "The trade reducing effects of market power in international shipping," *Journal of Development Economics*, 89, 84–97.

Hunter, L. (1991): "The contribution of nonhomothetic preferences to trade ," *Journal of International Economics*, 30, 345–358.

Hunter, L. and J. Markusen (1988): "Per Capita Income as a Determinant of Trade ," *Empirical Methods for International Economics*, by R. Feenstra, (MIT Press).

Jackson, L. (1984): "Hierarchic Demand and the Engel Curve for Variety." *Review of Economics & Statistics*, 66 (1), 8–15.

Johnson, R. C. (2011): "Trade and Prices with Heterogeneous Firms," *Journal of International Economics, Forthcoming.*

Krugman, P. (1980): "Scale Economies, Product Differentiation, and the Pattern of Trade," *The American Economic Review*, 70, pp. 950–959.

Lach, S. (2007): "Immigration and Prices," *Journal of Political Economy*, 115, 548–587.

Lancaster, K. (1979): *Variety, Equity, and Efficiency*, Columbia University Press.

Levchenko, A., L. Lewis, and L. Tesar (2010): "The collapse of international trade during the 20082009 crisis: in search of the smoking gun," *IMF Economic Review*, 58, 214–253.

Loecker, J. D. and F. Warzynski (2009): "Markups and firm-level export status," Working Paper 15198, National Bureau of Economic Research.

Manova, K. B. and Z. Zhang (2011): "Export Prices across Firms and Destinations," *Quarterly Journal of Economics, Forthcoming.*

Markusen, J. R. (2010): "Putting Per-Capita Income Back into Trade Theory," Working Paper 15903, National Bureau of Economic Research.

Mas-Colell, A., M. Whinston, and J. Green (1995): *Microeconomic Theory*, Oxford University Press.

Melitz, M. and G. Ottaviano (2008): "Market Size, Trade, and Productivity," *Review of Economic Studies*, 75 (1), 295–316.

Melitz, M. J. (2003): "The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity," *Econometrica*, 71 (6), 1695–1725.

Movshuk, O. (2004): "International Differences in Consumer Preferences and Trade: Evidence from Multicountry, Multiproduct Data," *Toyama University, unpublished mimeo.*

Pieters, G. (2013): "Trade and Within-Country Consumption Inequality," *Trinity University, unpublished manuscript.*

Rose, A. K. (1999): "One Money, One Market: Estimating the Effect of Common Currencies on Trade," NBER Working Papers 7432, National Bureau of Economic Research, Inc.

Sauré, P. (2009): "Bounded Love of Variety and Patterns of Trade," Working Paper 2009-10, Swiss National Bank.

Tirole, J. (1988): *The Theory of Industrial Organization*, The MIT Press.

Verhoogen, E. A. (2008): "Trade, Quality Upgrading, and Wage Inequality in the Mexican Manufacturing Sector," *The Quarterly Journal of Economics*, 123, 489–530.

Waugh, M. E. (2010): "International Trade and Income Differences," *American Economic Review*, 100, 2093–2124.

Young, A. (1991): "Learning by Doing and the Dynamic Effects of International Trade," *The Quarterly Journal of Economics*, 106, 369–405.

A Appendix: Theory

A.1 Consumer Problem and Demand

The maximization problem of a consumer in j, potentially buying varieties from $i = 1, ..., I$ is

$$\max_{\{q^c_{ij}(\omega)\}_{i=1}^{I} \geq 0} \quad \sum_{i=1}^{I} \int_{\omega \in \Omega_{ij}} \log(q^c_{ij}(\omega) + \bar{q}) d\omega \quad \text{s.t.} \quad \nu_j \left[\sum_{i=1}^{I} \int_{\omega \in \Omega_{ij}} p_{ij}(\omega) q^c_{ij}(\omega) d\omega \leq y_j \right],$$

where ν_j is the Lagrange multiplier. The FOCs yield ($\forall q^c_{ij}(\omega) > 0$)

$$\nu_j p_{ij}(\omega) = \frac{1}{q^c_{ij}(\omega) + \bar{q}}. \tag{a.1}$$

Let $\Omega_j \equiv \sum_{i=1}^{I} \Omega_{ij}$ be the set of all positively-consumed varieties in country j. Letting N_{ij} be the measure of set Ω_{ij}, the measure of Ω_j, N_j, is given by $N_j = \sum_{i=1}^{I} N_{ij}$.

For any pair of varieties $\omega_{ij}, \omega'_{vj} \in \Omega_j$, (a.1) gives

$$p_{ij}(\omega)(q^c_{ij}(\omega) + \bar{q}) = p_{vj}(\omega') q^c_{vj}(\omega') + p_{vj}(\omega') \bar{q}.$$

Integrating over all $\omega'_{vj} \in \Omega_j$, keeping in mind that the measure of Ω_{vj} is N_{vj}, yields the consumer's demand for any variety $\omega_{ij} \in \Omega_j$

$$\int_{\Omega_j} \left[p_{ij}(\omega)(q^c_{ij}(\omega) + \bar{q}) \right] d\omega' = \int_{\Omega_j} \left[p_{vj}(\omega') q^c_{vj}(\omega') + p_{vj}(\omega') \bar{q} \right] d\omega',$$

$$\Rightarrow \left[p_{ij}(\omega)(q^c_{ij}(\omega) + \bar{q}) \right] \sum_{v=1}^{I} \int_{\Omega_{vj}} 1 d\omega' = \sum_{v=1}^{I} \int_{\Omega_{vj}} \left[p_{vj}(\omega') q^c_{vj}(\omega') + p_{vj}(\omega') \bar{q} \right] d\omega',$$

$$\Rightarrow \left[p_{ij}(\omega)(q^c_{ij}(\omega) + \bar{q}) \right] \sum_{v=1}^{I} N_{vj} = y_j + \sum_{v=1}^{I} \int_{\Omega_{vj}} p_{vj}(\omega') \bar{q} d\omega',$$

$$\Rightarrow \left[p_{ij}(\omega)(q^c_{ij}(\omega) + \bar{q}) \right] N_j = y_j + \bar{q} P_j,$$

$$\Rightarrow q^c_{ij}(\omega) = \frac{y_j + \bar{q} P_j}{N_j p_{ij}(\omega)} - \bar{q},$$

where $P_j \equiv \sum_{v=1}^{I} \int_{\Omega_{vj}} p_{vj}(\omega') d\omega'$ is an aggregate price statistic.

The total demand for variety ω from i by consumers in j becomes

$$q_{ij}(\omega) = L_j \left[\frac{y_j + \bar{q} P_j}{N_j p_{ij}(\omega)} - \bar{q} \right].$$

A.2 Equilibrium: Characterization, Existence, and Uniqueness

In this section, I rely on the Pareto distribution of firm productivities and characterize the equilibrium objects of the model. I express all objects in terms of wages and I derive a set of equations that solve for the wage rates of all countries simultaneously. I use υ as a counter throughout.

Using the optimal price (11), the measure of firms (12), and the conditional density (13) under the Pareto distribution in (14) yields

$$P_j = \sum_{\upsilon=1}^{I} J_\upsilon \left(\frac{b_\upsilon}{\phi^*_{\upsilon j}}\right)^\theta \int_{\phi^*_{\upsilon j}}^{\infty} \frac{\tau_{\upsilon j} w_\upsilon}{\left(\phi \phi^*_{\upsilon j}\right)^{\frac{1}{2}}} \frac{\theta \left(\phi^*_{\upsilon j}\right)^\theta}{\phi^{\theta+1}} d\phi = \sum_{\upsilon=1}^{I} J_\upsilon \left(\frac{b_\upsilon}{\phi^*_{\upsilon j}}\right)^\theta \frac{\tau_{\upsilon j} w_\upsilon}{\phi^*_{\upsilon j}} \frac{\theta}{\theta + 0.5}. \tag{a.2}$$

Then, using (2), (10), and (12) into (a.2) gives

$$P_j = \frac{2\theta w_j}{\bar{q}}. \tag{a.3}$$

Moreover, using (a.3) and (10) into (2) yields

$$N_j = \left[\left(\frac{(1+2\theta) w_j}{\bar{q}}\right)^\theta \sum_{\upsilon=1}^{I} \frac{J_\upsilon b_\upsilon^\theta}{\left(\tau_{\upsilon j} w_\upsilon\right)^\theta}\right]^{\frac{1}{\theta+1}}. \tag{a.4}$$

Substituting (a.3) and (a.4) into (10) gives the following expression for the cutoff productivity

$$\phi^*_{ij} = \tau_{ij} w_i \left[\frac{\bar{q} \sum_{\upsilon=1}^{I} J_\upsilon b_\upsilon^\theta (\tau_{\upsilon j} w_\upsilon)^{-\theta}}{(1+2\theta) w_j}\right]^{\frac{1}{\theta+1}}. \tag{a.5}$$

In order to solve the model, it is necessary to jointly determine the wages, w_i, and the measures of entrants, J_i, $\forall i$. The system of equilibrium equations consists of the free entry condition, (16), and the income/spending equality, (17), for each country.

Free entry requires that average profits cover the fixed cost of entry, so

$$w_i f_e = \sum_{\upsilon=1}^{I} \left(\frac{b_i}{\phi^*_{i\upsilon}}\right)^\theta \frac{\bar{q} \tau_{i\upsilon} w_i L_\upsilon}{\phi^*_{i\upsilon} (\theta+1)(2\theta+1)}. \tag{a.6}$$

The income/spending identity requires that country i's consumers spend their entire income on imported and domestically-produced varieties, so

$$w_i L_i = \sum_{\upsilon=1}^{I} J_i \left(\frac{b_i}{\phi^*_{i\upsilon}}\right)^\theta \frac{\bar{q} \tau_{i\upsilon} w_i L_\upsilon}{\phi^*_{i\upsilon} (2\theta+1)}. \tag{a.7}$$

Expressions (a.6) and (a.7) yield

$$J_i = L_i[(\theta+1)f_e]^{-1}. \tag{a.8}$$

Substituting (a.8) into (a.5) yields expression (18) for the cutoff productivity in the text.

To characterize wages, use the definition for import shares (23) and trade balance $\sum_j T_{ij} = \sum_j T_{ji}$ in the definition of income/spending (17) to express income as $w_i L_i = \sum_j T_{ij} = \sum_j w_j L_j \lambda_{ij}$. Finally, in this expression, substitute out import shares using (23) to obtain

$$\frac{w_i^{\theta+1}}{b_i^{\theta}} = \sum_{j=1}^{I} \left(\frac{L_j w_j}{{\tau_{ij}}^{\theta} \sum_{\upsilon=1}^{I} L_\upsilon b_\upsilon^{\theta} (\tau_{\upsilon j} w_\upsilon)^{-\theta}} \right). \tag{a.9}$$

(a.9) implicitly solves for the wage rate w_i for each country i as a function of the remaining countries' wages. Rearrange (a.9) and use it to define

$$Z_i(w) \equiv \frac{b_i^{\theta}}{w_i^{\theta+1}} \sum_{j=1}^{I} \left(\frac{L_j w_j}{{\tau_{ij}}^{\theta} \sum_{\upsilon=1}^{I} L_\upsilon b_\upsilon^{\theta} (\tau_{\upsilon j} w_\upsilon)^{-\theta}} \right) - 1.$$

$Z_i(w)$ is the i-th contribution to the system of I equations that characterizes the equilibrium wage vector. Equilibrium wages satisfy $Z_i(w) = 0$ $(\forall i)$. It is straightforward to show that there exists a unique equilibrium wage vector that satisfies the system equality, after setting one w_i to be a numéraire (see Alvarez and Lucas (2007)). The idea is to treat the system above as an aggregate excess demand function of an exchange economy. For existence, it suffices to verify that the system satisfies properties 1-5 listed in Proposition 17.B.2 of Mas-Colell et al. (1995), p. 581. Existence follows from Proposition 17.C.1 of Mas-Colell et al. (1995), p. 585, which is essentially a reference to Kakutani's fixed point theorem. For uniqueness, notice that the system has the gross substitution property (differential version of Definition 17.F.2 in Mas-Colell et al. (1995), p. 612), $\forall i, k, k \neq i, \partial Z_i(w)/\partial w_k > 0$, and the result follows from Proposition 17.F.3 of Mas-Colell et al. (1995), p. 613.

When gross substitution holds, comparative static exercises with respect to wages are straightforward. Let $B \equiv \{\tau_{ij}, L_j, b_i, \theta\}_{i,j=1,\dots,I}$ denote the set of relevant parameters. Then the equilibrium system can be written as $Z(w; B)$. Let w^* be the unique wage vector corresponding to B^*; $Z(w^*; B^*) = 0$. WLOG, consider a positive productivity shock in country I, namely a rise in b_I. To determine the effect on wages, I need to characterize $Dw(B^*)$. By Implicit Function Theorem,

$$Dw(B^*) = -[D_w Z(w^*; B^*)]^{-1} D_B Z(w^*; B^*).$$

Since the system has the gross substitution property, Proposition 17.G.3 in Mas-Colell et al. (1995), p. 618, ensures that $[D_w Z(w^*; B^*)]^{-1}$ has all its entries negative. Moreover, differentiation shows that $D_B Z(w^*; B^*) db_I << 0$ for the first $I-1$ countries (and therefore the sign is positive for country I). Then, $Dw(B^*)db_I << 0$ for the first $I-1$ countries. Hence, a positive productivity shock in I lowers the wages of all countries relative to I; or, it raises I's relative wage. A more detailed proof is beyond the scope of the paper and is available upon request.

A.3 Proofs

In this section, I prove Propositions 1 and 2 and I derive sufficient conditions such that firm sales are strictly increasing in destination population size.

Proof of Proposition 1. Consider expression (22), which represents the price of variety ϕ from i in destination j relative to k, $k \neq j$. Since I can always relabel countries, without loss of generality, consider an increase in w_j, keeping w_k fixed. The goal is to show that $\partial(p_{ij}(\phi)/p_{ik}(\phi))/\partial w_j > 0$. Using (18) in (22), it suffices to show that $\partial(\phi^*_{ij}/\phi^*_{ik})/\partial w_j < 0$.

Using expression (18) for destination j and rewriting the sum in (18) for destination k so as to isolate the j-term yields

$$\frac{\phi^*_{ij}}{\phi^*_{ik}} = \frac{\tau_{ij}}{\tau_{ik}} \left[\frac{\frac{L_j b_j^\theta}{\tau_{jj}^\theta w_j^{\theta+1}} + \sum_{\upsilon \neq j} \frac{L_\upsilon b_\upsilon^\theta}{w_j (\tau_{\upsilon j} w_\upsilon)^\theta}}{\frac{L_j b_j^\theta}{w_k \tau_{jk}^\theta w_j^\theta} + \sum_{\upsilon \neq j} \frac{L_\upsilon b_\upsilon^\theta}{w_k (\tau_{\upsilon k} w_\upsilon)^\theta}} \right]^{\frac{1}{\theta+1}}. \tag{a.10}$$

Differentiating (a.10) with respect to w_j yields

$$\frac{\partial(\phi^*_{ij}/\phi^*_{ik})}{\partial w_j} = \frac{\frac{\tau_{ij}}{\tau_{ik}} \frac{1}{\theta+1}}{\left[\frac{L_j b_j^\theta}{w_k \tau_{jk}^\theta w_j^\theta} + \sum_{\upsilon \neq j} \frac{L_\upsilon b_\upsilon^\theta}{w_k (\tau_{\upsilon k} w_\upsilon)^\theta}\right]^2} \left[\frac{\frac{L_j b_j^\theta}{\tau_{jj}^\theta w_j^{\theta+1}} + \sum_{\upsilon \neq j} \frac{L_\upsilon b_\upsilon^\theta}{w_j (\tau_{\upsilon j} w_\upsilon)^\theta}}{\frac{L_j b_j^\theta}{w_k \tau_{jk}^\theta w_j^\theta} + \sum_{\upsilon \neq j} \frac{L_\upsilon b_\upsilon^\theta}{w_k (\tau_{\upsilon k} w_\upsilon)^\theta}} \right]^{\frac{1}{\theta+1}-1} \left[-\frac{L_j^2 b_j^{2\theta}}{\tau_{jj}^\theta w_k w_j^{2\theta+2} \tau_{jk}^\theta} \cdots \right.$$
$$\cdots - \frac{L_j b_j^\theta}{\tau_{jj}^\theta w_j^{\theta+2} w_k} \sum_{\upsilon \neq j} \frac{L_\upsilon b_\upsilon^\theta}{(\tau_{\upsilon k} w_\upsilon)^\theta} - \frac{L_j b_j^\theta}{w_k w_j^{\theta+2} \tau_{jk}^\theta} \sum_{\upsilon \neq j} \frac{L_\upsilon b_\upsilon^\theta}{(\tau_{\upsilon j} w_\upsilon)^\theta} - \frac{1}{w_k w_j^2} \sum_{\upsilon \neq j} \frac{L_\upsilon b_\upsilon^\theta}{(\tau_{\upsilon j} w_\upsilon)^\theta} \sum_{\upsilon \neq j} \frac{L_\upsilon b_\upsilon^\theta}{(\tau_{\upsilon k} w_\upsilon)^\theta} \cdots$$
$$\left. \cdots - \theta \frac{L_j b_j^\theta}{w_j^{\theta+2} w_k} \left\{ \sum_{\upsilon \neq j} \frac{L_\upsilon b_\upsilon^\theta}{(\tau_{jj} \tau_{\upsilon k} w_\upsilon)^\theta} - \sum_{\upsilon \neq j} \frac{L_\upsilon b_\upsilon^\theta}{(\tau_{\upsilon j} \tau_{jk} w_\upsilon)^\theta} \right\} \right]. \tag{a.11}$$

A sufficient condition for (a.11) to be strictly negative is that the term in the curly bracket is non-negative. Since, by assumption $\tau_{jj} = 1$ $(\forall j)$, the term in the curly bracket is non-negative when trade barriers obey the triangle inequality, $(\forall j, k, \upsilon) \tau_{\upsilon j} \tau_{jk} \geq \tau_{\upsilon k}$. □

Proof of Proposition 2. Consider expression (22), which represents the price of variety ϕ from i in destination j relative to k, $k \neq j$. Since I can always relabel countries, without loss of generality, consider an increase in L_j, keeping L_k fixed. The goal is to show that $\partial(p_{ij}(\phi)/p_{ik}(\phi))/\partial L_j < 0$. Using (18) in (22), it suffices to show that $\partial(\phi^*_{ij}/\phi^*_{ik})/\partial L_j > 0$.

Differentiating (a.10) with respect to L_j yields

$$\frac{\partial(\phi^*_{ij}/\phi^*_{ik})}{\partial L_j} = \frac{\frac{\tau_{ij}}{\tau_{ik}}\frac{1}{\theta+1}}{\left[\frac{L_j b_j^\theta}{w_k \tau_{jk}^\theta w_j^\theta} + \sum_{\upsilon\neq j}\frac{L_\upsilon b_\upsilon^\theta}{w_k(\tau_{\upsilon k}w_\upsilon)^\theta}\right]^2}\left[\frac{\frac{L_j b_j^\theta}{\tau_{jj}^\theta w_j^{\theta+1}} + \sum_{\upsilon\neq j}\frac{L_\upsilon b_\upsilon^\theta}{w_j(\tau_{\upsilon j}w_\upsilon)^\theta}}{\frac{L_j b_j^\theta}{w_k \tau_{jk}^\theta w_j^\theta} + \sum_{\upsilon\neq j}\frac{L_\upsilon b_\upsilon^\theta}{w_k(\tau_{\upsilon k}w_\upsilon)^\theta}}\right]^{\frac{1}{\theta+1}-1} \ldots$$

$$\ldots \frac{b_j^\theta}{w_j^{\theta+1}w_k}\left\{\sum_{\upsilon\neq j}\frac{L_\upsilon b_\upsilon^\theta}{(\tau_{jj}\tau_{\upsilon k}w_\upsilon)^\theta} - \sum_{\upsilon\neq j}\frac{L_\upsilon b_\upsilon^\theta}{(\tau_{\upsilon j}\tau_{jk}w_\upsilon)^\theta}\right\}. \tag{a.12}$$

A sufficient condition for (a.12) to be strictly positive is that the term in the curly bracket is strictly positive. Since, by assumption $\tau_{jj} = 1$ $(\forall j)$, the term in the curly bracket is strictly positive when the trade barriers for j and k obey the triangle inequality, $(\forall \upsilon)\tau_{\upsilon j}\tau_{jk} \geq \tau_{\upsilon k}$, and when the inequality for at least one $\upsilon \neq j$ is strict. □

Finally, I derive a lower bound on firm productivity such that firm sales are strictly increasing in destination population size. Substituting (18) into (25) and rewriting the sum so as to isolate the j-term yields

$$r_{ij}(\phi) = \bar{q}^{\frac{2\theta+1}{2(\theta+1)}}(\tau_{ij}w_i)^{\frac{1}{2}}[(\theta+1)f_e(1+2\theta)w_j]^{\frac{1}{2(\theta+1)}}\ldots$$

$$\ldots\left[\frac{[(\theta+1)f_e(1+2\theta)w_j]^{\frac{1}{2(\theta+1)}}}{\bar{q}^{\frac{1}{2(\theta+1)}}(\tau_{ij}w_i)^{\frac{1}{2}}\left[\frac{b_j^\theta}{(\tau_{jj}w_j)^\theta L_j^\theta} + \sum_{\upsilon\neq j}\frac{L_\upsilon b_\upsilon^\theta}{(\tau_{\upsilon j}w_\upsilon)^\theta L_j^{\theta+1}}\right]^{\frac{1}{\theta+1}}} - \frac{1}{\phi^{\frac{1}{2}}\left[\frac{b_j^\theta}{(\tau_{jj}w_j)^\theta L_j^{2\theta+1}} + \sum_{\upsilon\neq j}\frac{L_\upsilon b_\upsilon^\theta}{(\tau_{\upsilon j}w_\upsilon)^\theta L_j^{2(\theta+1)}}\right]^{\frac{1}{2(\theta+1)}}}\right]$$

Differentiating with respect to L_j and using expression (18) obtains

$$\frac{\partial r_{ij}(\phi)}{\partial L_j} = \frac{\bar{q}^{\frac{2\theta+1}{2(\theta+1)}}(\tau_{ij}w_i)^{\frac{1}{2}}[(\theta+1)f_e(1+2\theta)w_j]^{\frac{1}{2(\theta+1)}}}{(\theta+1)\left[\sum_{\upsilon=1}^{I}\frac{L_\upsilon b_\upsilon^\theta}{(\tau_{\upsilon j}w_\upsilon)^\theta}\right]^{\frac{2\theta+3}{2(\theta+1)}}}\ldots$$

$$\ldots\left\{\frac{1}{(\phi^*_{ij})^{\frac{1}{2}}}\left[(\theta+1)\sum_{\upsilon\neq j}\frac{L_\upsilon b_\upsilon^\theta}{(\tau_{\upsilon j}w_\upsilon)^\theta} + \theta\frac{b_j^\theta L_j}{(\tau_{jj}w_j)^\theta}\right] - \frac{1}{\phi^{\frac{1}{2}}}\left[(\theta+1)\sum_{\upsilon\neq j}\frac{L_\upsilon b_\upsilon^\theta}{(\tau_{\upsilon j}w_\upsilon)^\theta} + (\theta+0.5)\frac{b_j^\theta L_j}{(\tau_{jj}w_j)^\theta}\right]\right\}$$

The term in the curly bracket is strictly positive for highly productive firms, namely, if and only if

$$\phi > \phi^*_{ij}\left[1 + \frac{\frac{b_j^\theta L_j}{2(\tau_{jj}w_j)^\theta}}{(\theta+1)\sum_{\upsilon\neq j}\frac{L_\upsilon b_\upsilon^\theta}{(\tau_{\upsilon j}w_\upsilon)^\theta} + \theta\frac{b_j^\theta L_j}{(\tau_{jj}w_j)^\theta}}\right]^2.$$

B Appendix: Model With Destination-Specific Taxes

Suppose that the consumer in destination j pays a tax/tariff $tax_j > 0$. Let $\kappa_j \equiv 1 + tax_j$ be the gross tax. The maximization problem of a consumer in j, potentially buying varieties from $i = 1, ..., I$, is given below, and the solution steps of the model are identical to the basic model.

$$\max_{\{q^c_{ij}(\omega)\}_{i=1}^{I} \geq 0} \quad \sum_{i=1}^{I} \int_{\omega \in \Omega_{ij}} \log(q^c_{ij}(\omega) + \bar{q}) d\omega \quad \text{s.t.} \quad \nu_j \left[\sum_{i=1}^{I} \int_{\omega \in \Omega_{ij}} \kappa_j p_{ij}(\omega) q^c_{ij}(\omega) d\omega \leq y_j \right]$$

C Appendix: Tables

Table 9: Per-Capita Income and Price of Tradables, ICP 2005

Basic Headings	Log Per-Capita Income (s.e.)	Constant (s.e.)	R-squared
Tradables	0.2666***	0.0442	0.6994
	(0.0343)	(0.0241)	
Apparel, Footwear,	0.1582***	-0.0283	0.3675
and Accessories	(0.0407)	(0.0286)	

*** significance at 1%-level, N. Obs 28 (Spain is numéraire).

Data Sources: Prices of basic headings from International Comparison Program, 2005. Nominal per-capita GDP for 2010 from WDI.

Supplementary Appendix I: Linear Demand in General Equilibrium

In this section, I characterize the equilibrium of a heterogeneous-firm model of international trade with linear demand à la Melitz and Ottaviano (2008). I assume that the market structure is identical to the one in the main body of the paper, so I let per-capita income equal the wage rate.

The maximization problem of a consumer in country j is

$$\max_{q_j^c(\omega)\geq 0} \int_{\omega\in\Omega_j} q_j^c(\omega)d\omega - \frac{1}{2}\alpha \int_{\omega\in\Omega_j} (q_j^c(\omega))^2 d\omega - \frac{1}{2}\eta \left(\int_{\omega\in\Omega_j} q_j^c(\omega)d\omega\right)^2 \text{ s.t. } \quad \nu_j \left[\int_{\omega\in\Omega_j} p_j(\omega) q_j^c(\omega)d\omega \leq w_j\right],$$

where η and α are positive parameters, and high values of α make the varieties less substitutable. Taking the ratio of FOCs for a pair of varieties and integrating out ν_j yields individual demand for $q_{ij}^c(\omega) > 0$

$$q_{ij}^c(\omega) = \frac{1}{\alpha P_j}\left[P_j(1-\eta Q_j^c) - p_{ij}(\omega)(N_j - \alpha Q_j^c - \eta Q_j^c N_j)\right], \tag{c.1}$$

where $Q_j^c \equiv \sum_{v=1}^{I} \int_{\Omega_{vj}} q_{vj}^c(\omega')\, d\omega'$ is an aggregate demand statistic for a consumer. In the above expression, aggregate statistics P_j and N_j are defined in (3) and (2), respectively. The total demand from country j is simply the product of individual demand (c.1) and country size L_j.

After relabeling a variety by the productivity and the country of origin of the firm that produces it, I use (c.1) in the firm problem in (6) and maximize with respect to price to obtain

$$p_{ij}(\phi) = \frac{1}{2}\left(\frac{\tau_{ij}w_i}{\phi} + \frac{P_j(1-\eta Q_j^c)}{N_j - \alpha Q_j^c - \eta Q_j^c N_j}\right). \tag{c.2}$$

To characterize the cutoff productivity $\bar{\phi}_{ij}$ combine zero-demand and zero-profit to obtain

$$\bar{\phi}_{ij} = \frac{\tau_{ij}w_i(N_j - \alpha Q_j^c - \eta Q_j^c N_j)}{P_j(1-\eta Q_j^c)}. \tag{c.3}$$

Substituting (c.3) into (c.2) yields the following pricing rule

$$p_{ij}(\phi) = \frac{\tau_{ij}w_i}{2}\left[\frac{1}{\phi} + \frac{1}{\bar{\phi}_{ij}}\right]. \tag{c.4}$$

Next, I modify the steps in Appendix A.2 to characterize the equilibrium in the present model. After relabeling varieties, substitute (c.4) into (c.1) and use (c.1) in the definition of Q_j^c to obtain

$$Q_j^c = \frac{N_j}{2\alpha(\theta+1) + \eta N_j}, \tag{c.5}$$

where $N_j \equiv \sum_{\upsilon=1}^{I} J_\upsilon b_\upsilon^\theta \bar{\phi}_{\upsilon j}^{-\theta}$. Then, using the optimal price from (c.4) in the price index P_j yields

$$P_j = \frac{2\theta+1}{2\theta+2}\frac{w_j}{\bar{\phi}_{jj}} N_j.$$

To solve the model, it is necessary to jointly determine wages, w_i, and measures of entrants, J_i, $\forall i$. The system of equilibrium equations consists of a free entry condition and an income/spending equality for each country. Free entry requires that average profits cover the fixed cost of entry, so

$$w_i f_e = \sum_{\upsilon=1}^{I} \frac{b_i^\theta}{\bar{\phi}_{i\upsilon}^\theta} \frac{L_\upsilon(1-\eta Q_\upsilon^c)}{2\alpha(\theta+1)(\theta+2)} \frac{\tau_{i\upsilon} w_i}{\bar{\phi}_{i\upsilon}}. \tag{c.6}$$

The income/spending identity requires that country i's consumers spend their entire income on imported and domestically-produced varieties, so

$$w_i L_i = \sum_{\upsilon=1}^{I} J_i \frac{b_i^\theta}{\bar{\phi}_{i\upsilon}^\theta} \frac{L_\upsilon(1-\eta Q_\upsilon^c)}{2\alpha(\theta+2)} \frac{\tau_{i\upsilon} w_i}{\bar{\phi}_{i\upsilon}}. \tag{c.7}$$

Expressions (c.6) and (c.7) yield

$$J_i = L_i[(\theta+1)f_e]^{-1}. \tag{c.8}$$

Substituting (c.8) and (c.5) in (c.7) for country j obtains the following characterization of cutoffs

$$\frac{\theta+1}{\theta+2} = \frac{\eta w_j \bar{\phi}_{ij}}{w_i \tau_{ij}} + \frac{2\alpha(\theta+1)^2 f_e w_j (\bar{\phi}_{ij})^{\theta+1}}{(\tau_{ij} w_i)^{\theta+1} \sum_{\upsilon=1}^{I} L_\upsilon b_\upsilon^\theta (\tau_{\upsilon j} w_\upsilon)^{-\theta}}. \tag{c.9}$$

Finally, to characterize wages, first derive import shares, which are identical to the model in the main text and are given by (23). Together with trade balance $\sum_j T_{ij} = \sum_j T_{ji}$, substitute them into the income/spending equality (c.7) to arrive at

$$\frac{w_i^{\theta+1}}{b_i^\theta} = \sum_{j=1}^{I} \left(\frac{L_j w_j}{{\tau_{ij}}^\theta \sum_{\upsilon=1}^{I} L_\upsilon b_\upsilon^\theta (\tau_{\upsilon j} w_\upsilon)^{-\theta}} \right). \tag{c.10}$$

(c.10) implicitly solves for the wage rate w_i for each country i as a function of the remaining countries' wages.

It is straightforward to verify that the price of a variety is increasing in a destination's per-capita income and falling in a destination's market size. From the pricing rule in (c.4), notice that it is sufficient to examine how productivity cutoffs vary with destination-specific characteristics.

Using the implicit function theorem and the characterization of thresholds in (c.9) yields

$$\frac{\partial\bar{\phi}_{ij}}{\partial w_j} = -\left[\frac{\frac{\eta\bar{\phi}_{ij}}{\tau_{ij}w_i} + \frac{2\alpha(\theta+1)^2 f_e(\bar{\phi}_{ij})^{\theta+1}\left[(\theta+1)L_j b_j^{\theta}(\tau_{jj}w_j)^{-\theta} + \sum_{\upsilon\neq j} L_\upsilon b_\upsilon^{\theta}(\tau_{\upsilon j}w_\upsilon)^{-\theta}\right]}{(\tau_{ij}w_i)^{\theta+1}\left[\sum_{\upsilon=1}^{I} L_\upsilon b_\upsilon^{\theta}(\tau_{\upsilon j}w_\upsilon)^{-\theta}\right]^2}}{\frac{\eta w_j}{w_i\tau_{ij}} + \frac{2\alpha(\theta+1)^3 f_e w_j(\bar{\phi}_{ij})^{\theta}}{(\tau_{ij}w_i)^{\theta+1}\sum_{\upsilon=1}^{I} L_\upsilon b_\upsilon^{\theta}(\tau_{\upsilon j}w_\upsilon)^{-\theta}}}\right] < 0,$$

$$\frac{\partial\bar{\phi}_{ij}}{\partial L_j} = \frac{\frac{2\alpha(\theta+1)^2 f_e(\bar{\phi}_{ij})^{\theta+1} w_j b_j^{\theta}(\tau_{jj}w_j)^{-\theta}}{(\tau_{ij}w_i)^{\theta+1}\left[\sum_{\upsilon=1}^{I} L_\upsilon b_\upsilon^{\theta}(\tau_{\upsilon j}w_\upsilon)^{-\theta}\right]^2}}{\frac{\eta w_j}{w_i\tau_{ij}} + \frac{2\alpha(\theta+1)^3 f_e w_j(\bar{\phi}_{ij})^{\theta}}{(\tau_{ij}w_i)^{\theta+1}\sum_{\upsilon=1}^{I} L_\upsilon b_\upsilon^{\theta}(\tau_{\upsilon j}w_\upsilon)^{-\theta}}} > 0.$$

Thresholds are falling in the per-capita income and rising in the size of the destination, so the opposite is true of the price of a variety. However, since prices feature additive mark-ups, it is not trivial to determine how the relative price of an identical variety behaves across countries.

Supplementary Appendix II: Different Measures of Per-Capita Income

Guided by the structure of the model, the analysis throughout the main body of the paper relies on nominal per-capita GDP as a measure of per-capita income. In this section, I repeat the empirical analysis using five different measures of per-capita income or expenditure: nominal consumption per capita, nominal household consumption per capita, nominal GNI per capita, nominal GNI per capita measured according to the Atlas method, and PPP-adjusted GDP per capita. I present results from all the specifications using exchange rates for April of 2012. The results with different exchange rates (February and March of 2012) are both qualitatively and quantitatively similar and are available upon request. For comparison purposes, I also include the results that use the benchmark measure of per-capita income, namely per-capita GDP.

The main finding throughout the numerous robustness exercises is that per-capita income remains a key determinant of price variation across countries. In fact, in almost all of the exercises, the coefficient estimates on per-capita income are higher than the benchmark estimates that use GDP per capita as a measure of income. Finally, in only one specification, which uses trade shares to capture competition and a continuous measure of distance to proxy the trade barrier, the coefficients on three of the five measures of per-capita income are not estimated precisely. The empirical results from all the exercises and the detailed discussion thereof can be found below.

Table 10 reports the results from the benchmark regression using six different measures of per-capita income. The first row corresponds to the benchmark estimates reported in the main body of the paper. Throughout the robustness exercises, the coefficient estimates of per-capita income are higher than the benchmark estimate and statistically significant. Hence, prices are increasing in destinations' per-capita income and expenditure. Furthermore, prices are increasing in the cost to ship products to each destination and in the Gini coefficient of income inequality in all specifications except for the one that uses PPP-adjusted GDP per-capita as a measure of per-capita income. Finally, prices of exports are lower in countries that share a currency with the exporter — Spain.

Table 10: Benchmark Test of Model With Alternative Measure of Per-Capita Income, 29 Countries

PC Income Measure	$\hat{\beta}_w$ (s.e.)	$\hat{\beta}_\lambda$ (s.e.)	$\hat{\beta}_\kappa$ (s.e.)	$\hat{\beta}_{dhl}$ (s.e.)	$\hat{\beta}_{eur}$ (s.e.)	$\hat{\beta}_g$ (s.e.)	$\hat{\beta}_o$ (s.e.)
GDP	0.1725***	0.0014	0.4221	0.1576*	-0.0875**	0.2062**	0.0203
R^2=0.2482	(0.0316)	(0.0087)	(0.3356)	(0.0873)	(0.0384)	(0.0923)	(0.1792)
Consumption	0.1895***	0.0044	0.0880	0.1904**	-0.0903**	0.1858*	-0.0145
R^2=0.2518	(0.0307)	(0.0092)	(0.2894)	(0.0785)	(0.0366)	(0.0938)	(0.1547)
HH Cons.	0.1877***	0.0041	0.0729	0.1732**	-0.0972***	0.1388	0.0241
R^2=0.2483	(0.0327)	(0.0097)	(0.3257)	(0.0777)	(0.0364)	(0.0948)	(0.1516)
GNI Atlas	0.1840***	0.0042	0.3696	0.1830*	-0.0896**	0.2204**	-0.0066
R^2=0.2435	(0.0374)	(0.0105)	(0.3560)	(0.0942)	(0.0373)	(0.1014)	(0.1828)
GNI	0.1940***	0.0087	0.5038	0.2161**	-0.0870**	0.2217**	-0.0555
R^2=0.2578	(0.0355)	(0.0084)	(0.3489)	(0.0897)	(0.0369)	(0.0939)	(0.1810)
GDP PPP	0.2560***	-0.0026	0.4641	0.1007	-0.0987**	0.1393	0.1164
R^2=0.2233	(0.0629)	(0.0089)	(0.5011)	(0.0873)	(0.0403)	(0.1036)	(0.1910)

* significance at 10% level, ** significance at 5%-level, *** significance at 1%-level

Price regressions: N. Obs 6860, Country clusters 28 (Spain is numéraire), Exchange rate for April, 2012.

Data Sources: Prices from Summer 2012 exclusive online catalogue of apparel manufacturer Mango. Exchange rate for April 2012 from ECB. Nominal per-capita GDP, nominal per-capita consumption, nominal per-capita household consumption, and PPP-adjusted GDP per capita for 2010 from WDI. Nominal per-capita GNI and Atlas-method per-capita GNI for 2009 from WDI. Gini coefficient from WIID and CIA. DHL Express shipping quotes from DHL Spain Online. Gravity variables from CEPII. Bilateral trade for 2008 for commodity codes H0-61, 62, and 64 from Comtrade. Gross output for apparel and footwear for 2008 from Stats.OECD, Prodcom, and national statistical agencies. Tariffs from WITS. Sales taxes from European Commission and national statistical agencies.

Table 11 repeats the above exercise using destination population size instead of the export share as a proxy for competition. All measures of per-capita income yield positive and statistically significant coefficient estimates. Furthermore, the specifications that rely on the two consumption expenditure measures also yield negative and statistically significant estimates of the coefficients on market size.

Table 12 reports the results with different per-capita income measures from the specification that approximates trade barriers from standard gravity variables and treats distance as a continuous variable. This specification yields the weakest empirical results. In particular, although the coefficient estimates for per-capita consumption, household consumption and GNI (measured according to the Atlas method) are similar to the ones obtained for per-capita GDP, the former three objects are not precisely estimated. The coefficients on per-capita GNI and PPP-adjusted GDP on the other hand are precisely estimated and higher than the benchmark estimate of per-capita GDP. In addition, the distance between the exporter and its import partners as well as the currency of denomination remain significant determinants of the cross-country price variations

Table 11: Test With Alternative Measure of PC Income and Competition, DHL Costs, 29 Countries

PC Income Measure	$\hat{\beta}_w$ (s.e.)	$\hat{\beta}_L$ (s.e.)	$\hat{\beta}_\kappa$ (s.e.)	$\hat{\beta}_{dhl}$ (s.e.)	$\hat{\beta}_{eur}$ (s.e.)	$\hat{\beta}_g$ (s.e.)	$\hat{\beta}_o$ (s.e.)
GDP	0.1709***	-0.0091	0.5122	0.1371	-0.0955**	0.2332***	0.0422
R^2=0.2503	(0.0348)	(0.0108)	(0.3793)	(0.0925)	(0.0375)	(0.0889)	(0.1893)
Consumption	0.1984***	-0.0222**	0.3815	0.1564*	-0.1051***	0.2684***	0.0022
R^2=0.2637	(0.0367)	(0.0106)	(0.3411)	(0.0831)	(0.0343)	(0.0971)	(0.1753)
HH Cons.	0.2020***	-0.0255**	0.4436	0.1420*	-0.1138***	0.2366**	0.0305
R^2=0.2642	(0.0389)	(0.0112)	(0.3459)	(0.0838)	(0.0338)	(0.0946)	(0.1732)
GNI Atlas	0.1858***	-0.0158	0.5454	0.1487	-0.1012***	0.2730***	0.0222
R^2=0.2494	(0.0422)	(0.0120)	(0.4086)	(0.0986)	(0.0361)	(0.0979)	(0.1989)
GNI	0.1935***	-0.0166	0.6264	0.1625*	-0.0986***	0.2698***	-0.0044
R^2=0.2620	(0.0402)	(0.0106)	(0.4181)	(0.0925)	(0.0351)	(0.0945)	(0.1947)
GDP PPP	0.2519***	-0.0017	0.4871	0.1028	-0.1018**	0.1437	0.1187
R^2=0.2231	(0.0677)	(0.0157)	(0.4910)	(0.1108)	(0.0407)	(0.0923)	(0.2161)

* significance at 10% level, ** significance at 5%-level, *** significance at 1%-level

Price regressions: N. Obs 6860, Country clusters 28 (Spain is numéraire), Exchange rate for April, 2012.

Data Sources: Prices from Summer 2012 exclusive online catalogue of apparel manufacturer Mango. Exchange rate for April 2012 from ECB. Nominal per-capita GDP, nominal per-capita consumption, nominal per-capita household consumption, PPP-adjusted GDP per capita, and population for 2010 from WDI. Nominal per-capita GNI and Atlas-method per-capita GNI for 2009 from WDI. Gini coefficient from WIID and CIA. DHL Express shipping quotes from DHL Spain Online. Gravity variables from CEPII. Tariffs from WITS. Sales taxes from European Commission and national statistical agencies.

across all specifications.

Table 13 repeats the above exercise using destination population size as a measure of competition instead of Spain's export share. As in the benchmark specification that uses per-capita GDP, all other exercises suggest that prices are increasing in per-capita income and falling in destination market size.

Tables 14 and 15 report the results from the above two exercises, where the continuous measure of distance has been replaced with five regional dummies that capture the destinations' proximity to Spain. As in the corresponding benchmark specifications that use per-capita GDP, all other exercises suggest that prices are increasing in per-capita income.

Finally, Table 16 repeats the exercises that examine the impact of Mango's quantity-discount policy on the estimated elasticities of price with respect to per-capita income. In line with the findings from all the exercises above, the results are robust across all the different measures of per-capita income.

Table 12: Test With Alternative Measure of Per-Capita Income and Trade Barriers I, 29 Countries

Specification	Competition = Trade Share (λ)					
PC Income	GDP	Cons.	HH Cons.	GNI Atlas	GNI	GDP PPP
Estimate (s.e.)	R^2=0.6007	R^2=0.5981	R^2=0.5981	R^2=0.5978	R^2=0.6014	R^2=0.5978
$\hat{\beta}_w$	0.0587**	0.0510	0.0513	0.0483	0.0604*	0.0887*
(s.e.)	(0.0284)	(0.0325)	(0.0313)	(0.0326)	(0.0306)	(0.0507)
$\hat{\beta}_\lambda$	0.0116	0.0144	0.0146	0.0146	0.0133	0.0120
(s.e.)	(0.0103)	(0.0103)	(0.0100)	(0.0106)	(0.0101)	(0.0114)
$\hat{\beta}_\kappa$	0.2577	0.1440	0.1600	0.2544	0.2347	0.3422
(s.e.)	(0.3239)	(0.3250)	(0.3210)	(0.3370)	(0.3258)	(0.3509)
$\hat{\beta}_{eur}$	-0.0854**	-0.0882**	-0.0902**	-0.0873**	-0.0875**	-0.0853**
(s.e.)	(0.0349)	(0.0357)	(0.0366)	(0.0353)	(0.0348)	(0.0355)
$\hat{\beta}_l$	-0.0445	-0.0434	-0.0454	-0.0429	-0.0379	-0.0534
(s.e.)	(0.0494)	(0.0520)	(0.0509)	(0.0523)	(0.0523)	(0.0468)
$\hat{\beta}_i$	-0.0037	-0.0109	-0.0129	-0.0098	-0.0002	-0.0037
(s.e.)	(0.0428)	(0.0436)	(0.0430)	(0.0444)	(0.0443)	(0.0436)
$\hat{\beta}_{lo}$	-0.0699	-0.0648	-0.0619	-0.0661	-0.0644	-0.0784*
(s.e.)	(0.0441)	(0.0473)	(0.0468)	(0.0472)	(0.0458)	(0.0432)
$\hat{\beta}_{d,1}$	-3.0941***	-3.2108***	-3.2416***	-3.3469***	-2.9816***	-3.3621***
(s.e.)	(1.0845)	(1.1824)	(1.1358)	(1.1478)	(1.1520)	(1.0241)
$\hat{\beta}_{d,2}$	0.1937***	0.2015***	0.2034***	0.2098***	0.1872***	0.2102***
(s.e.)	(0.0666)	(0.0726)	(0.0696)	(0.0704)	(0.0706)	(0.0630)
$\hat{\beta}_g$	-0.0739	-0.1101	-0.1261	-0.1030	-0.0738	-0.1107
(s.e.)	(0.1371)	(0.1341)	(0.1249)	(0.1426)	(0.1348)	(0.1358)

* significance at 10% level, ** significance at 5%-level, *** significance at 1%-level

Price regressions: N. Obs 6860, Country clusters 28 (Spain is numéraire), Fixed Effects 244 (relative to good 1)

Data Sources: Prices from Summer 2012 exclusive online catalogue of apparel manufacturer Mango. Exchange rate for April 2012 from ECB. Nominal per-capita GDP, nominal per-capita consumption, nominal per-capita household consumption, and PPP-adjusted GDP per capita for 2010 from WDI. Nominal per-capita GNI and Atlas-method per-capita GNI for 2009 from WDI. Gini coefficient from WIID and CIA. DHL Express shipping quotes from DHL Spain Online. Gravity variables from CEPII. Bilateral trade for 2008 for commodity codes H0-61, 62, and 64 from Comtrade. Gross output for apparel and footwear for 2008 from Stats.OECD, Prodcom, and national statistical agencies. Tariffs from WITS. Sales taxes from European Commission and national statistical agencies.

Table 13: Test With Alternative Measure of Per-Capita Income and Trade Barriers I, 29 Countries

Specification	Competition = Market Size (L)					
PC Income	GDP	Cons.	HH Cons.	GNI Atlas	GNI	GDP PPP
Estimate (s.e.)	R^2=0.6427	R^2=0.6487	R^2=0.6511	R^2=0.6441	R^2=0.6469	R^2=0.6354
$\hat{\beta}_w$	0.0743***	0.0888***	0.0938***	0.0790***	0.0850***	0.1065***
(s.e.)	(0.0205)	(0.0214)	(0.0217)	(0.0222)	(0.0229)	(0.0330)
$\hat{\beta}_L$	-0.0494***	-0.0550***	-0.0564***	-0.0527***	-0.0519***	-0.0472***
(s.e.)	(0.0127)	(0.0121)	(0.0117)	(0.0127)	(0.0125)	(0.0131)
$\hat{\beta}_\kappa$	1.2725***	1.2228***	1.2810***	1.3491***	1.2952***	1.3111***
(s.e.)	(0.3809)	(0.3557)	(0.3480)	(0.3953)	(0.3914)	(0.3885)
$\hat{\beta}_{eur}$	-0.0921***	-0.0961***	-0.0997***	-0.0948**	-0.0952***	-0.0925***
(s.e.)	(0.0268)	(0.0257)	(0.0256)	(0.0262)	(0.0259)	(0.0276)
$\hat{\beta}_l$	-0.0690**	-0.0607*	-0.0632*	-0.0609*	-0.0584*	-0.0798**
(s.e.)	(0.0339)	(0.0335)	(0.0318)	(0.0346)	(0.0348)	(0.0338)
$\hat{\beta}_i$	-0.0120	-0.0151	-0.0183	-0.0123	-0.0034	-0.0106
(s.e.)	(0.0311)	(0.0297)	(0.0295)	(0.0310)	(0.0316)	(0.0305)
$\hat{\beta}_{lo}$	-0.1288**	-0.1242***	-0.1203***	-0.1229**	-0.1225***	-0.1348**
(s.e.)	(0.0501)	(0.0446)	(0.0413)	(0.0489)	(0.0473)	(0.0540)
$\hat{\beta}_{d,1}$	-4.8988***	-4.7698***	-4.7976***	-4.9956***	-4.6732***	-5.1874***
(s.e.)	(1.0532)	(0.9751)	(0.9151)	(1.0226)	(1.0133)	(1.0885)
$\hat{\beta}_{d,2}$	0.3032***	0.2956***	0.2973***	0.3095***	0.2896***	0.3210***
(s.e.)	(0.0646)	(0.0598)	(0.0561)	(0.0627)	(0.0621)	(0.0668)
$\hat{\beta}_g$	0.0630	0.0909	0.0764	0.0826	0.0908	0.0021
(s.e.)	(0.1278)	(0.1202)	(0.1123)	(0.1324)	(0.1318)	(0.1194)

* significance at 10% level, ** significance at 5%-level, *** significance at 1%-level

Price regressions: N. Obs 6860, Country clusters 28 (Spain is numéraire), Fixed Effects 244 (relative to good 1)

Data Sources: Prices from Summer 2012 exclusive online catalogue of apparel manufacturer Mango. Exchange rate for April 2012 from ECB. Nominal per-capita GDP, nominal per-capita consumption, nominal per-capita household consumption, PPP-adjusted GDP per capita, and population for 2010 from WDI. Nominal per-capita GNI and Atlas-method per-capita GNI for 2009 from WDI. Gini coefficient from WIID and CIA. DHL Express shipping quotes from DHL Spain Online. Gravity variables from CEPII. Tariffs from WITS. Sales taxes from European Commission and national statistical agencies.

Table 14: Test With Alternative Measure of Per-Capita Income and Trade Barriers II, 29 Countries

Specification	Competition = Trade Share (λ)					
PC Income	GDP	Cons.	HH Cons.	GNI Atlas	GNI	GDP PPP
Estimate (s.e.)	R^2=0.5997	R^2=0.5965	R^2=0.5949	R^2=0.5963	R^2=0.6016	R^2=0.5994
$\hat{\beta}_w$	0.0672**	0.0603*	0.0580	0.0577*	0.0705**	0.1192**
(s.e.)	(0.0306)	(0.0357)	(0.0371)	(0.0335)	(0.0321)	(0.0525)
$\hat{\beta}_\lambda$	0.0129	0.0153	0.0162	0.0159	0.0136	0.0114
(s.e.)	(0.0128)	(0.0135)	(0.0134)	(0.0134)	(0.0131)	(0.0129)
$\hat{\beta}_\kappa$	-0.0120	-0.1771	-0.1625	-0.0337	-0.0848	0.2434
(s.e.)	(0.4838)	(0.5004)	(0.5099)	(0.4973)	(0.4754)	(0.4916)
$\hat{\beta}_{eur}$	-0.0764*	-0.0803*	-0.0829*	-0.0780*	-0.0804**	-0.0708*
(s.e.)	(0.0391)	(0.0409)	(0.0430)	(0.0340)	(0.0386)	(0.0389)
$\hat{\beta}_l$	-0.0466	-0.0428	-0.0448	-0.0430	-0.0384	-0.0551
(s.e.)	(0.0524)	(0.0555)	(0.0558)	(0.0549)	(0.0548)	(0.0506)
$\hat{\beta}_i$	0.0217	0.0160	0.0131	0.0179	0.0269	0.0282
(s.e.)	(0.0437)	(0.0444)	(0.0453)	(0.0460)	(0.0431)	(0.0438)
$\hat{\beta}_{lo}$	-0.0483	-0.0411	-0.0380	-0.0414	-0.0437	-0.0515
(s.e.)	(0.0396)	(0.0431)	(0.0439)	(0.0425)	(0.0413)	(0.0388)
$\hat{\beta}_{r,1}$	-0.0817	-0.1066*	-0.1165*	-0.1024	-0.0947	-0.0454
(s.e.)	(0.0589)	(0.0602)	(0.0596)	(0.0613)	(0.0600)	(0.0653)
$\hat{\beta}_{r,2}$	-0.2312**	-0.2481**	-0.2560**	-0.2596**	-0.2239**	-0.2480**
(s.e.)	(0.1116)	(0.1153)	(0.1151)	(0.1114)	(0.1097)	(0.1054)
$\hat{\beta}_{r,3}$	-0.2714**	-0.2835**	-0.2914**	-0.2990**	-0.2584**	-0.2863***
(s.e.)	(0.1145)	(0.1220)	(0.1214)	(0.1179)	(0.1157)	(0.1077)
$\hat{\beta}_{r,4}$	-0.0681	-0.0664	-0.0730	-0.0768	-0.0462	-0.0960
(s.e.)	(0.1040)	(0.1070)	(0.1078)	(0.1071)	(0.1038)	(0.0994)
$\hat{\beta}_g$	-0.1103	-0.1439	-0.1692	-0.1380	-0.1027	-0.1206
(s.e.)	(0.1390)	(0.1455)	(0.1402)	(0.1456)	(0.1431)	(0.1371)

* significance at 10% level, ** significance at 5%-level, *** significance at 1%-level

Price regressions: N. Obs 6860, Country clusters 28 (Spain is numéraire), Fixed Effects 244 (relative to good 1)

Distance Intervals (in miles): $[0, 750)$, $[750, 1500)$, $[1500, 3000)$, $[3000, 6000)$, $[6000, \infty)$; Interval 5 is numéraire

Data Sources: Prices from Summer 2012 exclusive online catalogue of apparel manufacturer Mango. Exchange rate for April 2012 from ECB. Nominal per-capita GDP, nominal per-capita consumption, nominal per-capita household consumption, and PPP-adjusted GDP per capita for 2010 from WDI. Nominal per-capita GNI and Atlas-method per-capita GNI for 2009 from WDI. Gini coefficient from WIID and CIA. DHL Express shipping quotes from DHL Spain Online. Gravity variables from CEPII. Bilateral trade for 2008 for commodity codes H0-61, 62, and 64 from Comtrade. Gross output for apparel and footwear for 2008 from Stats.OECD, Prodcom, and national statistical agencies. Tariffs from WITS. Sales taxes from European Commission and national statistical agencies.

Table 15: Test With Alternative Measure of Per-Capita Income and Trade Barriers II, 29 Countries

Specification	Competition = Market Size (L)					
PC Income	GDP	Cons.	HH Cons.	GNI Atlas	GNI	GDP PPP
Estimate (s.e.)	R^2=0.6317	R^2=0.6377	R^2=0.6366	R^2=0.6320	R^2=0.6376	R^2=0.6281
$\hat{\beta}_w$	0.1074***	0.1232***	0.1282***	0.1125***	0.1171***	0.1764***
(s.e.)	(0.0237)	(0.0247)	(0.0265)	(0.0254)	(0.0252)	(0.0425)
$\hat{\beta}_L$	-0.0456***	-0.0539***	-0.0548***	-0.0500***	-0.0491***	-0.0424***
(s.e.)	(0.0143)	(0.0141)	(0.0138)	(0.0145)	(0.0141)	(0.0144)
$\hat{\beta}_\kappa$	0.9006	0.8007	0.8412	0.9718	0.8526	1.2106*
(s.e.)	(0.6073)	(0.5804)	(0.5767)	(0.6119)	(0.5761)	(0.6430)
$\hat{\beta}_{eur}$	-0.0827**	-0.0912**	-0.0980***	-0.0871**	-0.0897**	-0.0736*
(s.e.)	(0.0370)	(0.0360)	(0.0369)	(0.0363)	(0.0351)	(0.0380)
$\hat{\beta}_l$	-0.0699*	-0.0602	-0.0610	-0.0587	-0.0577	-0.0825**
(s.e.)	(0.0381)	(0.0384)	(0.0379)	(0.0407)	(0.0404)	(0.0363)
$\hat{\beta}_i$	0.0280	0.0206	0.0166	0.0283	0.0373	0.0350
(s.e.)	(0.0448)	(0.0421)	(0.0425)	(0.0441)	(0.0423)	(0.0458)
$\hat{\beta}_{lo}$	-0.0951***	-0.0935***	-0.0868***	-0.0862**	-0.0912***	-0.0969***
(s.e.)	(0.0339)	(0.0311)	(0.0297)	(0.0337)	(0.0338)	(0.0358)
$\hat{\beta}_{r,1}$	-0.0454	-0.0821*	-0.1005**	-0.0677	-0.0637	0.0014
(s.e.)	(0.0433)	(0.0415)	(0.0439)	(0.0443)	(0.0427)	(0.0456)
$\hat{\beta}_{r,2}$	-0.2507**	-0.2561**	-0.2574**	-0.2695**	-0.2382**	-0.2848***
(s.e.)	(0.1095)	(0.1059)	(0.1072)	(0.1090)	(0.1050)	(0.1100)
$\hat{\beta}_{r,3}$	-0.3531***	-0.3587***	-0.3590***	-0.3731***	-0.3359***	-0.3811***
(s.e.)	(0.1197)	(0.1133)	(0.1138)	(0.1189)	(0.1132)	(0.1211)
$\hat{\beta}_{r,4}$	-0.1608	-0.1666	-0.1744	-0.1687	-0.1309	-0.2011
(s.e.)	(0.1176)	(0.1126)	(0.1137)	(0.1186)	(0.1115)	(0.1208)
$\hat{\beta}_g$	0.0259	0.0522	0.0261	0.0459	0.0525	-0.0146
(s.e.)	(0.1076)	(0.1043)	(0.0970)	(0.1122)	(0.1129)	(0.1093)

* significance at 10% level, ** significance at 5%-level, *** significance at 1%-level

Price regressions: N. Obs 6860, Country clusters 28 (Spain is numéraire), Fixed Effects 244 (relative to good 1)

Distance Intervals (in miles): $[0, 750)$, $[750, 1500)$, $[1500, 3000)$, $[3000, 6000)$, $[6000, \infty)$; Interval 5 is numéraire

Data Sources: Prices from Summer 2012 exclusive online catalogue of apparel manufacturer Mango. Exchange rate for April 2012 from ECB. Nominal per-capita GDP, nominal per-capita consumption, nominal per-capita household consumption, PPP-adjusted GDP per capita, and population for 2010 from WDI. Nominal per-capita GNI and Atlas-method per-capita GNI for 2009 from WDI. Gini coefficient from WIID and CIA. DHL Express shipping quotes from DHL Spain Online. Gravity variables from CEPII. Tariffs from WITS. Sales taxes from European Commission and national statistical agencies.

Table 16: Test With Different Consumer Types and Alternative Measure of Income, 29 Countries

Effective price above threshold
(Medium-Valuation Types)

PC Income Measure	$\hat{\beta}_w$ (s.e.)	$\hat{\beta}_\lambda$ (s.e.)	$\hat{\beta}_\kappa$ (s.e.)	$\hat{\beta}_{dhl}$ (s.e.)	$\hat{\beta}_{eur}$ (s.e.)	$\hat{\beta}_g$ (s.e.)
GDP	0.1628***	0.0192	0.4729	0.3363***	-0.0564	0.0438
R^2=0.5417	(0.0390)	(0.0128)	(0.4146)	(0.0945)	(0.0533)	(0.1269)
Consumption	0.1839***	0.0200	0.1717	0.3733***	-0.0572	0.0309
R^2=0.5430	(0.0382)	(0.0121)	(0.3661)	(0.0893)	(0.0497)	(0.1235)
HH Cons.	0.1810***	0.0197	0.1507	0.3550***	-0.0642	-0.0159
R^2=0.5389	(0.0396)	(0.0124)	(0.3902)	(0.0852)	(0.0496)	(0.1245)
GNI Atlas	0.1798***	0.0197	0.4551	0.3681***	-0.0562	0.0665
R^2=0.5370	(0.0405)	(0.0134)	(0.4321)	(0.0990)	(0.0515)	(0.1359)
GNI	0.1875***	0.0241**	0.5694	0.3970***	-0.0542	0.0646
R^2=0.5475	(0.0406)	(0.0119)	(0.4513)	(0.1017)	(0.0515)	(0.1328)
GDP PPP	0.2516***	0.0131	0.5554	0.2887***	-0.0647	-0.0117
R^2=0.5197	(0.0721)	(0.0112)	(0.5293)	(0.0953)	(0.0543)	(0.1320)

Effective price below threshold
(Low-Valuation Types)

PC Income Measure	$\hat{\beta}_w$ (s.e.)	$\hat{\beta}_\lambda$ (s.e.)	$\hat{\beta}_\kappa$ (s.e.)	$\hat{\beta}_{dhl}$ (s.e.)	$\hat{\beta}_{eur}$ (s.e.)	$\hat{\beta}_g$ (s.e.)
GDP	0.1472***	0.0108	0.8965	0.5039***	-0.1033**	0.0872
R^2=0.6759	(0.0278)	(0.0088)	(0.5911)	(0.0874)	(0.0450)	(0.1149)
Consumption	0.1756***	0.0121	0.6832	0.5517***	-0.1011**	0.0878
R^2=0.6877	(0.0312)	(0.0074)	(0.4499)	(0.0812)	(0.0392)	(0.1014)
HH Cons.	0.1822***	0.0119	0.7185*	0.5477***	-0.1052***	0.0533
R^2=0.6928	(0.0341)	(0.0077)	(0.3806)	(0.0764)	(0.0360)	(0.0963)
GNI Atlas	0.1681***	0.0119	0.9263	0.5412***	-0.1013**	0.1162
R^2=0.6790	(0.0311)	(0.0082)	(0.5459)	(0.0915)	(0.0430)	(0.1124)
GNI	0.1770***	0.0160**	1.0467**	0.5710***	-0.0989***	0.1170
R^2=0.6899	(0.0294)	(0.0068)	(0.5159)	(0.0851)	(0.0416)	(0.1047)
GDP PPP	0.1783**	0.0071	0.6869	0.4228***	-0.1205**	-0.0022
R^2=0.6387	(0.0821)	(0.0093)	(0.9309)	(0.1178)	(0.0539)	(0.1554)

* significance at 10% level, ** significance at 5%-level, *** significance at 1%-level

Price regressions: N. Obs 6860, Country clusters 28 (Spain is numéraire), Fixed Effects 244 (relative to good 1)

Data Sources: Prices from Summer 2012 exclusive online catalogue of apparel manufacturer Mango. Exchange rate for April 2012 from ECB. Nominal per-capita GDP, nominal per-capita consumption, nominal per-capita household consumption, and PPP-adjusted GDP per capita for 2010 from WDI. Nominal per-capita GNI and Atlas-method per-capita GNI for 2009 from WDI. Gini coefficient from WIID and CIA. DHL Express shipping quotes from DHL Spain Online. Gravity variables from CEPII. Bilateral trade for 2008 for commodity codes H0-61, 62, and 64 from Comtrade. Gross output for apparel and footwear for 2008 from Stats.OECD, Prodcom, and national statistical agencies. Tariffs from WITS. Sales taxes from European Commission and national statistical agencies.