Price Discrimination, Income Inequality, and Trade*

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Abstract

I study the effect of income inequality on trade flows. I document that higher income inequality increases the value and quantity, but lowers the average price, of differentiated goods but has little effect for homogeneous goods. Given the importance of firms pricing power for this result, I introduce non-homothetic preferences into a monopolistic competition model of trade to generate income-group specific mark-ups and consumption patterns. The model can explain about 30% of the observed relationship between inequality and trade value, quantity, and unit value of traded goods. Additionally, the trade model implies the high income consumers pay a 5.5% mark-up on identical goods that are sold to all income groups, consistent with estimates derived from USA grocery data.

JEL Classification: F12, F16, F61 L11

Keywords: inequality, variable mark-ups, nonhomothetic preferences, heterogeneous firms

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1 Introduction

How does trade affect inequality within a country? The classic approach within the trade literature examines the effect of trade on the wages of income groups, and then maps those changes to changes in relative consumption. This approach implies that if trade doesn’t change relative earnings then relative consumption doesn’t change either. However, recent trade literature has established that cross country price levels of traded goods are systematically positively correlated with per capita income: firms charge higher prices in countries with higher GDP per capita, and that this effect is particularly strong in tradeable consumption goods. As traded goods are part of the consumers consumption bundle, these pricing practices can exacerbate or alleviate the consumption inequality - the difference in aggregate consumption of different income groups - even if income inequality is unchanged. In order to understand how trade changes consumption inequality, it is therefore important to include this underlying price mechanism in a model of trade: that is the goal of this paper.

I introduce two income groups into a general equilibrium trade model with nonhomothetic preferences. The non-homothetic utility in this model results in bounded marginal utility for goods so that there exists a choke price above which consumers are unwilling to buy a good even if they have access to it on the market. Consumers therefore endogenously choose not only the quantity but also the variety of goods to consume. Firms are heterogeneous in productivity and monopolistic price setters, as per Melitz [2003] and Chaney [2008], but cannot perfectly price discriminate between income groups and must therefore choose whether to make their good available at a low price (such that both consumers can afford the good), or a high price (such that it is exclusively affordable to wealthy consumers).

Previous trade models use homothetic preferences, which limits both income groups to consume the same variety of goods, and consumers of lower income groups consume a constant fraction of the high income group’s consumption. This means that the price indices faced by both consumer groups are identical, and that real income co-move exactly. Therefore, unless trade liberalization affects relative incomes, relative consumption inequality is unaffected. With per-capita and inequality dependent mark-ups that exist in the data and in my model, I show that this is no longer true;

\footnote{For example, see Fieler [2011], Hummels and Lugovskyy [2009], Simonovska [2010]}

\footnote{Hsieh and Klenow [2007]}

\footnote{Unless explicit assumptions are made that restrict market access of certain income groups, a case I ignore.}
even if incomes are unaffected by a trade liberalization it is still possible that real income inequality is changed due to the different behaviour in prices faced by the two income groups. A decrease in the cost of trade changes the firms optimal price, and may change which income group market they serve (high income, or both type). This changes the variety and quantity of goods consumers buy. I find that the effect of trade on consumption inequality depends crucially on the characteristics on the trade partner.

The resurgence of nonhomothetic demand in trade has resulted in various possible specifications of demand structures. The interested reader should refer to Markusen [2013] for a comprehensive discussion of the usefulness non-homothetic preferences in trade. Bekkers et al. [2012] compares the predictions of hierarchic demand, demand for quality and demand finickyness, all of which have been used in the trade literature to explain the positive correlation between prices and income, and find that only models with hierarchic demand systems can explain the negative correlation between prices and inequality. Simonovska [2010] compares hierarchic demand structures with models of search costs and find that these models fail to capture the negative relationship between prices and market size that can be matched by hierarchic demand. Conversely, she finds that the nonhomothetic demand presented by Feenstra [2003] and Melitz and Ottaviano [2008] capture the negative relationship between prices and market size but do not capture per-capita income effects on prices. With these results in mind, I use a hierarchic demand structure as specified in Simonovska [2010] to generate nonhomotheticity in my demand function.

To summarize, in this paper I present a heterogenous-firm model of international trade with two income groups with identical nonhomothetic demand residing in each country. I find that even if trade does not change relative incomes, the optimal pricing strategies of firms change as a result of trade liberalization which in turns changes relative consumption inequality. The layout of the paper is as follows: In section 2, I present evidence that, in addition to average income and market size, a country’s income inequality affects trade flows. In section 3 I introduce the model, in section 4 I show that the predictions of the model can match those found in the data, and in section 5 I examine the consequences of trade liberalization for inequality between income groups even if relative wages remain unchanged.
2 Trade and Inequality

2.1 Data

I collect the 2011 trade value, $TV_{sd}$, and trade quantity, $TQ_{sd}$, for goods at the 6-digit Harmonized System level (HS6) exported from the USA to all trading partners from COMTRADE (Commodities Trade Statistics database). The price of traded goods will be proxied by unit value, $UV_{sd}$, generated by dividing trade flow value by quantity of goods traded, $UV_{sd} = TV_{sd}/TQ_{sd}$. To ensure that observations are comparable, I keep only observations that report a quantity value in kilograms.

I collect 2011 data on population and GDP per capita, as a proxy for income, and measures of income inequality from the WDI (World Development Indicators). I augment the data to include inequality data sourced from 2009-2013 giving preference to years closest to 2011 and using the average value if two observations are equidistant. For ease of mapping to the model, my measure of inequality is the income share of the upper 40%. As this number increases, more of the aggregate income is held by the upper 40%, representing increasing inequality, or decreasing equality. Next, I discard any observations which reports a unit value of less than 1% or more than 100 times the median unit value of that HS product line. As my regression exploits differences in income inequality across destinations, I drop any product line the USA exports to fewer than five destinations.

Equation (1) summarizes my regression framework; $x_{id}$ is the variable of interest (either trade value, $i=v$, quantity, $i=q$ or unit value, $i=p$), $\beta_{ci}$ is the elasticity of the $x_{id}$ with respect to income per capita, $\beta_{mi}$ is the elasticity with respect to market size (as proxied by population), and $\beta_{si}$ is elasticity with respect to inequality, measured by the share of income held by the upper 40% of income earners.

$$
\log(x_{id}) = \alpha + \beta_{ci} \log(CGDP_d) + \beta_{mi} \log(Pop_d) + \beta_{si} \log(Inequality_d) + \epsilon_{di} + \text{controls}
$$

I use additional controls for (the log of) distance and an indicator for a common official language obtained from the CEPII GeoDist database (Mayer and Zignago [2011]), and an indicator for 20011 EU, NAFTA, ASEAN, or MERCOSUR membership. I employ HS-fixed effects and bootstrap errors.

I first examine the difference in behaviour between goods over which firms have pricing power -
differentiated goods - and goods for which they don’t - homogeneous goods. I use the 2007 revision of Rauch [1999] production differentiation index to identify the different types.

<table>
<thead>
<tr>
<th></th>
<th>Trade Value</th>
<th>Trade Quantity</th>
<th>Unit Value</th>
<th>Trade Value</th>
<th>Trade Quantity</th>
<th>Unit Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>log(CGDP)</td>
<td>1.089*</td>
<td>1.105*</td>
<td>-0.016*</td>
<td>0.564*</td>
<td>-0.003</td>
<td>0.004</td>
</tr>
<tr>
<td></td>
<td>(0.018)</td>
<td>(0.019)</td>
<td>(0.006)</td>
<td>(0.118)</td>
<td>(0.035)</td>
<td>(0.038)</td>
</tr>
<tr>
<td>log(Pop)</td>
<td>0.496*</td>
<td>0.503*</td>
<td>-0.007*</td>
<td>0.329*</td>
<td>-0.002</td>
<td>-0.002</td>
</tr>
<tr>
<td></td>
<td>(0.008)</td>
<td>(0.008)</td>
<td>(0.002)</td>
<td>(0.052)</td>
<td>(0.013)</td>
<td>(0.012)</td>
</tr>
<tr>
<td>Inequality</td>
<td>-</td>
<td>-</td>
<td>-0.813*</td>
<td>-</td>
<td>-</td>
<td>-0.009</td>
</tr>
<tr>
<td></td>
<td>(0.247)</td>
<td>(0.236)</td>
<td>(0.082)</td>
<td>(1.391)</td>
<td>(1.882)</td>
<td>(0.436)</td>
</tr>
<tr>
<td>Product FE</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Adj. R²</td>
<td>0.53</td>
<td>0.64</td>
<td>0.85</td>
<td>0.45</td>
<td>0.63</td>
<td>0.92</td>
</tr>
<tr>
<td>Observations</td>
<td>51,874</td>
<td>51,874</td>
<td>51,874</td>
<td>2,297</td>
<td>2,297</td>
<td>2,297</td>
</tr>
<tr>
<td># of Importers</td>
<td>54</td>
<td>54</td>
<td>54</td>
<td>52</td>
<td>52</td>
<td>52</td>
</tr>
<tr>
<td># of Products</td>
<td>2,561</td>
<td>2,561</td>
<td>2,561</td>
<td>201</td>
<td>201</td>
<td>201</td>
</tr>
</tbody>
</table>

Table 1: Regression Results: Trade and Inequality
*p<0.01; **p<0.05; ***p<0.10

Table (1) summarizes the regression results for differentiated goods and homogenous goods. The distinction between homogeneous goods and differentiated goods clearly matter: inequality has no effect for homogenous goods, but does matter for differentiated goods. This leads credence to the idea, pursued in this paper, that monopoly pricing power is important for trade effects of inequality.

Across differentiated goods income inequality increases trade value and quantity, but decreases unit value, most significantly impacting the effect of average income. These results are due to two inter-tangled effects: firstly, more inequality means that high income earners earn higher incomes than their equivalents in a more equal economy, which increases their demand and the prices they can pay. Simultaneously however, the low income consumers in a less equal country demand fewer goods and can pay lower prices. The data shows that the effects of the low income group dominates in unit value, while high income group dominates for value and quantity.

The focus of this paper is the impact of income distribution on trade of consumption goods, therefore I need to identify which HS6 product lines consist of consumption goods, as opposed to intermediate or capital goods, and, of those lines, which represented differentiated goods. To accomplish this I use World Bank WITS concordance to map the HS6 categories into the BEC (Broad Economic Classification) categories. Table (2) presents the regression coefficient of inequality for the regression for differentiated goods, broken down by BEC category. BEC categories 61 to 63 represent

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4Differentiated goods constitute 53% of the trade value in the sample, homogenous goods 12%, and goods that cannot be classified the remaining 35%.

represent goods of different durability, and that the coefficients have the same sign and similar significance so the observed relationship is not driven by durable goods behaviour. Most goods within the consumption category exhibit similar behaviour as observed in the aggregate - value and quantity increase with inequality, and unit value decrease - with the exception of “food” goods BEC 112 and 122. This may be because food represents a fundamentally different type of consumption good, or it may reflect the small observation size, as all values are insignificant. Excluding food consumptions goods increases the effect of inequality.

The unit value relationship is the most precarious one with only 9 statistically significant results - of which two take the opposite sign. This implies that the aggregate result of inequality on trade unit values will be sensitive to the goods composition of trade flows. This explains why Flach and Janeba [2013], using Brazilian firm level data, finds a positive relationship between inequality and export unit values: they examine the exports of all differentiated goods but do not control for good-type, therefore their result could be driven by a different composition of goods. Bekkers et al. [2012] also studies the effects of inequality on unit values, taking care to only use consumption

The regression results for homogenous goods are provided in the appendix.

<table>
<thead>
<tr>
<th>BEC</th>
<th>Category Description</th>
<th># HS-product lines (# of obs)</th>
<th>Regression Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Value</td>
<td>Quantity</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Consumption goods</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>112</td>
<td>Food and beverages, primary, mainly for household consumption</td>
<td>14 (86)</td>
<td>8.232</td>
</tr>
<tr>
<td>122</td>
<td>Food and Beverages, processed, mainly for household consumption</td>
<td>109 (1,639)</td>
<td>2.304</td>
</tr>
<tr>
<td>522</td>
<td>Transport equipment, non-industrial</td>
<td>17 (539)</td>
<td>14.306*</td>
</tr>
<tr>
<td>61</td>
<td>Consumer goods not elsewhere specified, durable</td>
<td>102 (2,255)</td>
<td>8.557</td>
</tr>
<tr>
<td>62</td>
<td>Consumer goods not elsewhere specified, semi-durable</td>
<td>325 (5,724)</td>
<td>8.557</td>
</tr>
<tr>
<td>63</td>
<td>Consumer goods not elsewhere specified, non-durable</td>
<td>165 (3,292)</td>
<td>8.356</td>
</tr>
<tr>
<td><strong>Intermediate goods</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>111</td>
<td>Food and beverages, primary, mainly for industry</td>
<td>4 (34)</td>
<td>11.655**</td>
</tr>
<tr>
<td>121</td>
<td>Food and beverages, processed mainly for industry</td>
<td>17 (263)</td>
<td>8.893*</td>
</tr>
<tr>
<td>21</td>
<td>Industrial supplies not elsewhere specified, primary</td>
<td>65 (891)</td>
<td>6.322*</td>
</tr>
<tr>
<td>22</td>
<td>Industrial supplies not elsewhere specified, processed</td>
<td>946 (15,402)</td>
<td>11.404*</td>
</tr>
<tr>
<td>31</td>
<td>Fuel and lubricants, primary</td>
<td>3 (35)</td>
<td>18.316*</td>
</tr>
<tr>
<td>322</td>
<td>Fuel and lubricants, processed (other than motor spirits)</td>
<td>4 (88)</td>
<td>7.361</td>
</tr>
<tr>
<td>42</td>
<td>Parts and accessories of capital goods (except transport equipment)</td>
<td>173 (5,155)</td>
<td>14.081*</td>
</tr>
<tr>
<td>53</td>
<td>Parts and accessories of transport equipment</td>
<td>76 (2,049)</td>
<td>14.414*</td>
</tr>
<tr>
<td><strong>Capital goods</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>41</td>
<td>Capital goods (except transport equipment)</td>
<td>499 (13,353)</td>
<td>10.899*</td>
</tr>
<tr>
<td>521</td>
<td>Transport equipment, industrial</td>
<td>24 (527)</td>
<td>6.447*</td>
</tr>
<tr>
<td><strong>Mixed End Use</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>321</td>
<td>Fuel and lubricants, motor spirits</td>
<td>18 (342)</td>
<td>5.978*</td>
</tr>
<tr>
<td>51</td>
<td>Passenger motor cars</td>
<td>8 (207)</td>
<td>4.255*</td>
</tr>
<tr>
<td>7</td>
<td>Goods not elsewhere specified</td>
<td>10 (245)</td>
<td>8.606**</td>
</tr>
<tr>
<td><strong>All Differentiated Goods</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>All Food Consumption Goods</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>All Non-Food Consumption Goods</strong></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>
goods, and finds similar results to those presented using the Atkinson index instead of the income share.  

2.2 Predictions of the CES preferences monopolistic competition model

The predictions of the monopolistic competition model with symmetric CES preferences are at stark odds with these results.\(^7\) Consider the standard model where a consumer of income-type \(k\) in country \(d\) is trying to maximize her utility over all goods \(g\) from all countries \(s\)

\[
U^k_d = \max_{c_{sd}^k(i)} \left( \sum_s \int_0^{G_s} \left( \frac{c_{sd}(i)}{x_{sd}(z)} \right)^{\frac{1}{1-\sigma}} \right)^{\frac{1}{\sigma}} 
\]  

subject to a budget constraint. A series of monopolistic firms, each with a firm-specific productivity \(z\) drawn from a Pareto distribution, face a fixed cost of exporting, \(f_x\) and aggregate demand \(x_{sd}(z)\) solve the following profit maximization problem

\[
\pi_{sd} = \max_{p_{sd}} p_{sd} x_{sd} - \frac{\tau_{sd} w_s}{z} x_{sd} - w_s f_x
\]

In these models, prices take the form of a constant mark-up over the firms marginal cost of serving the market

\[
p_{sd}(z) = \frac{\sigma}{1-\sigma} \frac{\tau_{sd} w_s}{b_s z}
\]

Unless low- and high-income consumers have fixed and fundamentally different preferences (captured by the \(\sigma\) term in the mark-up) prices of individual goods will be unresponsive to income inequality. Furthermore, exports cutoffs are determined by aggregate income (GDP) levels, so all countries with the same GDP will have an identical composition of identically priced goods - and therefore trade values, quantities, and unit values will not depend on income inequality.

The alternative model I propose in the next section endogenously creates different preferences for different income groups by making their willingness to buy a good a function of their income - a

\(^6\)The best known study of inequality and unit values, Choi et al. [2009], studies the role of income distributions on import price distributions, not levels, and therefore is not directly relatable.  

\(^7\)The full derivation of these results are provided in the appendix.
higher income will result in a higher mark-up tolerance.

3 Model

I consider a static environment with a finite number of countries, \( i \in \{1, \ldots, I\} \), trading varieties of final goods to be purchased by consumers. Let \( s \) denote the exporter (“source”) and \( d \) the importer (“destination”).

3.1 Consumer’s Problem

Country \( d \in \{1, \ldots, I\} \) has two consumer types, \( k = \{H, L\} \), each of population size \( M^k_d \) such that \( \sum_k M^k_d = M_d \), where \( M_d \) denotes the total population. Consumers types differ only by their effective labor, \( \theta^k_d \). Both consumer types supply 1 unit of labor inelastically, so that the total effective labor supply is \( L_d = M^H_d \theta^H_d + M^L_d \theta^L_d \). Let \( w_d \) denote income per unit of effective labor, then income for type \( k \) is given by \( w^k_d = \theta^k_d w_d \). As \( w^H_d = \frac{\partial H}{\partial d} w^H_d \), \( \theta^H_d > \theta^L_d \) is sufficient to ensure that H-type has higher income than L-type. All consumers have the identical utility function over the available goods, \( G_s \), from countries \( s = \{1, \ldots, I\} \).

\[
U^k_d = \max_{c^k_{sd}(i)} \sum_s \int_0^{G_s} \log(c^k_{sd}(i) + q) di
\] (5)

where \( q > 0 \) and is assumed to be the same across all goods and countries.

Given income, \( w^k_d \) and prices, \( p_{sd}(i) \), each type of consumer chooses \( c^k_{sd}(z) \) to solve

\[
\max_{c^k_{sd}(i)} \sum_s \int_0^{G_s} \log(c^k_{sd}(i) + q) di
\] (6)

s.t \( \sum_s \int_0^{G_s} p^k_{sd}(i)c^k_{sd}(i) di \leq w^k_d \)

\( c^k_{sd}(i) \geq 0 \)

The solution to the consumer’s problem is

\[
c^k_{sd}(i) = \max\{0, \frac{w^k_d + qP^k_d}{p^k_{sd}(i)N^k_d} - q\}
\] (7)
where the number of products purchased by consumer $k$ is

$$N_d^k = \sum_s \int_0^{G_s^k} 1di$$

(8)

and the pricing aggregator over the goods purchased by consumer $k$ is

$$P_d^k = \sum_s \int_0^{G_s^k} p_{sd}(i)di$$

(9)

Note that the only variety-specific variable in (7) is $p_{sd}(i)$; all the other terms are aggregates. This implies that consumers have a bounded marginal utility for any good $i$: if $p_{sd}(i) > \frac{w_d^k + qP_d^k}{qN_d^k}$ the price for a specific good $i$ is “too high” and the consumer will choose the optimal boundary solution of $c_{sd}^k(i) = 0$. Define the boundary price value or “choke price” where as $Q_d^k = \frac{w_d^k + qP_d^k}{qN_d^k}$, rewriting $c_{sd}^k(i) = \max\{0, q\left(\frac{Q_d^k}{P_d^k} - 1\right)\}$. All else equal, if $w_d^k$ increases, then $Q_d^k$ increases - consumers are willing to tolerate a higher price before choosing a zero quantity. This choke price embodies a key tension that firms face in their pricing decision: As inequality increases low income consumers are less likely to pay higher prices, instead choosing to buy zero goods, while high income consumers are willing to pay higher prices.

### 3.2 Firm Problem

I follow Melitz [2003] and assume a continuum of monopolistic firms in each country using labor-only technology, differentiated by only their productivity. Productivity and country uniquely identifies each firm. Firms pay a tariff cost, $\tau_{sd} \geq 1$, where $\forall s \quad \tau_{dd} = 1$. As each firm sells only one good, and goods from different countries are not substitutable, good $i$ and firm $z$ are equivalent.

I assume that while firms can freely price discriminate between countries, within the borders of country firms may be constrained by the resale opportunities of their good. Specifically, a firm wishing to charge different prices to different income groups faces a resale restriction on prices: $p_d^H < (1 + r)p_d^L$, where $r \in [0, \infty]$ captures the maximum difference in prices that firms can charge the various income groups residing within the borders of a country. Given that consumers exhibit bounded marginal utility, it is possible that it is profit maximizing for a firm to choose a price.

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8 Due to consumers bounded marginal utilities, there is no need to include a fixed cost of export.

9 No price discrimination is captured by $r = 0$, while for $r = \infty$ (“large enough”) firms can perfectly price discriminate between income groups.
such that only one of the consumer groups can afford to purchase its good. A firms problem
is as follows: given the consumers indirect demand functions $x^k(p_{sd}(z); P^k_d, N^k_d, w^k_d) = M^k_d e^k(z)$, abbreviated henceforth $x^k_{sd}(z)$, a firm $z$ in $s$ that sells to consumers in $d$ solves

$$\pi_{sd}(z) = \max_{p^H_{sd}(z), p^L_{sd}(z), \ell_{sd}(z)} p^H_{sd}(z) x^H_{sd}(z) + p^L_{sd}(z) x^L_{sd}(z) - w_s \ell_{sd}(z) \quad \text{s.t.} \quad (10)$$

$$x^H_{sd}(z) + x^L_{sd}(z) = \frac{z}{\tau_{sd}(z)} \ell_{sd}(z)$$

$$p^H_{sd}(z) \leq (1 + r)p^L_{sd}(z)$$

where $\ell_{sd}(z) = \theta^H_s \ell^H_s(z) + \theta^L_s \ell^L_s(z)$ represents the effective labor hired by the firm and market clearing imposes that $\sum_d \int \ell_{sd}(z) dz = M^H_s \theta^H_s + M^L_s \theta^L_s$. The assumption of a linear production technology ensures that firms are indifferent between the two types of labor.

### 3.2.1 Unconstrained Prices and Cutoff's

If firms can perfectly price discriminate then, as I assume a linear production function with only labor and no fixed cost of exporting, I can examine the firms production decision for each destination country and income group separately, and total profit is then simply given by $\pi_{sd}(z) = \pi^H_{sd}(z) + \pi^L_{sd}(z)$. The firms problem for each consumer type becomes

$$\pi^k_{sd}(z) = \max_{p^k_{sd}(z), \ell_{sd}(z)} p^k_{sd}(z) x^k_{sd}(z) - w_s \ell_{sd}(z) \quad \text{s.t.} \quad (11)$$

$$x^k_{sd}(z) = \frac{z}{\tau_{sd}(z)} \ell_{sd}(z)$$

where $p^k_{sd}(z)$ denotes the price a firm charges when selling only to the $k$-type. Solving the firms problem the optimal price is

$$p^k_{sd}(z) = \left[ \frac{\tau_{sd} w_s}{z} \right]^{\frac{1}{2}} Q_d^{\frac{1}{2}} \quad \text{Mark-up}$$

Notice that all firms serving destination $d$ and group $k$ charge the same mark-up, with variations driven by differing marginal costs. This results in a firms profit

$$\pi^k_{sd}(z) = q M^k_d \left[ Q_d^{\frac{1}{2}} - \left( \frac{\tau_{sd} w_s}{z} \right)^{\frac{1}{2}} \right]^2$$

(13)
The minimum productivity required to find it profitable to sell to group k, \( z_{sd}^k \) is found by solving \( \pi_{sd}^k(z_{sd}^k) = 0 \) to obtain

\[
z_{sd}^k = \frac{\tau_{sd}w_s}{Q_d^k}
\] (14)

Unsurprisingly, a higher choke price allows less efficient (lower z) firms entering the market, while a higher trade barrier or cost of production requires firms to be more efficient.

**Lemma 3.1.** If \( Q_d^H \geq Q_d^L \) and firms are not price constrained, then for any firm of productivity z from country s

1. Any firm that sells to a L-type in d will also sell to an H-type in d.

2. \( p_{sd}^H(z) > p_{sd}^L(z) \) - the firm will set a higher mark-up, and therefore higher price, for H-type consumers in d.

This follows trivially from equations (12) and (14). Furthermore, due to the lower productivity cut-off for H-type’s, high income consumers enjoy a larger variety of goods.

### 3.2.2 Constrained Prices and Cutoff’s

Based upon equation (12), a necessary and sufficient condition for the resale constraint to bind is \( Q_d^H \geq (1 + r)^2Q_d^L \). This is independent of firm or source country characteristics, therefore the constraint will bind or not bind for all firms serving a destination.\(^{10}\)

If the resale constraint binds, firms selling to both income groups can no longer perfectly price discriminate and the pricing decision for each income group must be solved jointly. Denote by \( p_{sd}^H \) the price charged to the L-type, so that \((1 + r)p_{sd}^H(z)\) denotes the price charged to the H-type.

\[
\pi_{sd}^k(z) = \max_{p_{sd}(z), \ell_{sd}(z)} p_{sd}^B(z) \left( (1 + r) x_{sd}^H(z) + x_{sd}^L(z) \right) - w_s \ell_{sd}(z) \quad \text{s.t.} \quad (15)
\]

\[
x_{sd}^H(z) + x_{sd}^L(z) = \frac{z}{\tau_{sd}} \ell_{sd}(z)
\] (16)

\(^{10}\)This simplification directly results from the assumption of no fixed cost of exports.
The optimal price for a resale constrained firm selling to both types of consumer is

$$p^{Bsd}(z) = \left[ \frac{\tau_{sd}w_s}{z} \right]^{\frac{1}{2}} \left[ \frac{M_d^H Q_d^H + (1 + r) M_d^L Q_d^L}{(1 + r)(M_d^H + M_d^L)} \right]^{\frac{1}{2}} = \left[ \frac{\tau_{sd}w_s}{z} \right]^{\frac{1}{2}} \left[ \frac{S_d^r}{M_d} \right]^{\frac{1}{2}}$$

(17)

where $S_d^r = \frac{M_d^H Q_d^H}{1 + r} + M_d^L Q_d^L$, the weighted sum of cutoff prices, adjusted by the mark-up constraint.

The greater $r$ is, the closer $S_d^r$ becomes to $M_d^L Q_d^L$, and therefore the closer $p^{Bsd}(z)$ becomes to $p^{Lsd}(z)$. As before, notice that all resale constrained firms serving destination $d$ charge the same mark-up.

Constrained profit is given by

$$\pi^{Bsd}(z) = q M_d^H Q_d^H + q M_d^L Q_d^L + q \frac{M_d w_s \tau_{sd}}{z} - 2q \left( \frac{w_s \tau_{sd}}{z} \right)^{\frac{3}{2}} S_d^r \left[ M_d + r M_d^H \right]^{\frac{1}{2}}$$

(18)

Notice that, all else equal, in the constrained equilibrium a H-type pays less and the L-type pays more than they would in the equivalent unconstrained economy, since $Q_d^H > \frac{S_d^r}{M_d} > Q_d^L$ implies that $p^{Hsd}(z) > (1 + r)p^{Bsd}(z) > p^{Lsd}(z)$. What remains is to determine the relevant productivity cutoffs and their ordering.

Lemma 3.2. $\exists \bar{z} > \tilde{z}$ such that $\forall z > \bar{z}$ firms find it more profitable to sell to both types of consumers and be subject to the constraint than to target only one type of consumer.

Proof: Follows trivially from the continuity of $\pi^{sd}$ and $\lim_{z \to \infty} \pi^{sd} = \pi^{Hsd}$ and $\pi^{sd} > \pi^{Lsd}$. □

Lemma 3.3. Firms will initially sell to only the H-type.

Proof: As this is a constrained equilibrium, it follows that for given firm, $\pi^{Hsd}(z) + \pi^{Lsd}(z) > \pi^{Bsd}(z)$ otherwise the constraint would not be binding. Furthermore, within the equivalent unconstrained economy $\forall z \in [z^{Hsd}, z^{Lsd}] \pi^{Hsd}(z) \geq \pi^{Hsd}(z) + \pi^{Lsd}(z)$ and $\pi^{Hsd}(z) > 0$. Therefore there exists a range of productivities such that $\pi^{Hsd}(z) > \pi^{Bsd}(z)$ and $\pi^{Hsd}(z) > 0$. As firms in the constrained economy can choose to sell only to the H-type and earn $\pi^{Hsd}(z)$, if $\max\{\pi^{Hsd}(z), \pi^{Bsd}(z), 0\} = \pi^{Hsd}(z)$, it will chose to do so. Finally, by definition $\forall z < z^{Hsd}, \pi^{Hsd}(z) < 0$. Therefore, firms will initially sell to only the H-type. □

$z^{Bsd}$ is the productivity at which firms are indifferent between selling only to the H-type and selling
to both types at a resale constrained price, found at \( \pi_{sd}^H(z_{sd}^H) = \pi_{sd}^B(z_{sd}^B) \). \(^{11}\)

\[
\left( \frac{w_s \tau_{sd}}{z_{sd}^B} \right)^{\frac{1}{2}} = \left( \frac{M_d + rM_H^d}{M_d^L} \right)^{\frac{1}{2}} \frac{S_d}{M_d^L} - M_H^d \frac{Q_d^H}{M_d^L} \right) + \frac{M_H^d}{M_d^L} \sqrt{\left( S_d^{\frac{1}{2}} - Q_d^H \left[ M_d + rM_L^d \right] \right)^{\frac{1}{2}}} + rM_H^L \left[ Q_d^L - Q_d^H \right] \right. (19)
\]

As there is only one positive solution for \( z_{sd}^B \), and using Lemma’s (3.2)-(3.3) - the firms initially only sell to H-types and sell to both types in the limit - it must be that firms sell to H-type before switching selling to both types for all remaining productivities, implying cutoff configuration in the resale constrained equilibrium is given by \( \{ z_{sd}^H, z_{sd}^B \} \).

### 3.3 Equilibrium of the World Economy

Let the number of firms in \( s \) who have paid the fixed cost to draw a productivity be denoted by \( J_s \), this represents the number of potential firms who could produce goods in the economy if their productivity is high enough. I use the simplification of Chaney [2008] and assume that firms can pay a fixed cost, \( f_c \), to draw a productivity \( z \) from a Pareto distribution with support \([b_s, \infty]\) where \( b_s \) denotes the minimum productivity level of the draw in country \( s \). \(^{12}\) Firms will draw productivities until expected profit from production for firms in \( s \) equal the fixed cost of entry. Expected profit, \( \int \pi_{sd}(z)dz \) has two components, expected revenue, \( R_{sd} \) and expected cost, \( TC_{sd} \).

\[
w_s f_c = \sum_d E(\pi_{sd}) = \sum_{d,N} E(R_{sd}^N) - E(T_{sd}^N) + \sum_{d,R} E(R_{sd}^R) - E(T_{sd}^R) \quad (20)
\]

Where \( x^N \) denotes a variable in a economy with no resale constraint, \( x^R \) denotes the variable in a resale constrained economy. Under the assumption of balanced trade, labour market clearing and zero profit conditions, the number of firms is found to be equal to \(^{13}\)

\[
J_s = \frac{Y_s}{\left( \gamma + 1 \right) \left[ w_s f_c + \gamma q r \sum_{d,R} \left( \frac{b_s}{z_{sd}^B} \right)^\gamma \left( \frac{M_H^d Q_H^d}{M_d^L} - \frac{M_H^d}{M_d^L} \left( M_H^d Q_H^R + M_L^d Q_L^R \right) \right) \right]^{\frac{1}{\gamma}} (21)
\]

\(^{11}\)The squared term in the denominator takes a negative value in this form, as \( S_d < M_d Q_H^d \).

\(^{12}\)The Pareto cdf is \( F(z) = 1 - \left( \frac{b_s}{z} \right)^\gamma \), the pdf is \( f(z) = \frac{\gamma b_s^{\gamma+1}}{z^{\gamma+2}} \), where the shape parameter \( \gamma > 0 \).

\(^{13}\)Details of these calculations can be found in the online appendix.
The summation term in the denominator is unique to this model: the number of firms react to the difference in consumer cut-offs - but only if there are economies bound by the resale constraint, and if imperfect price discrimination is allowed, \( r > 0 \). Whether the number of firms increases or decreases as a result is dependent on their ability to exploit choke price differences (\( r \)) and the relative size of the groups.

Recall that the resale constraint either binds or does not bind for all firms exporting to \( d \), therefore all firms selling in \( d \) either earn \( R_{sd}^N \) or \( R_{sd}^R \). Exploit \( z_{sd}^k = \frac{w_{sd} \tau_{sd} z_{sd}}{w_d} \) and balanced trade to obtain

\[
\gamma_d = \sum_t Y_t \frac{J_d \left( \frac{b_d}{\tau_{sd}} \right)^\gamma}{Y_d \sum_s J_s \left( \frac{b_s}{\tau_{st} w_s} \right)^\gamma}
\]  

such that wages in \( d \) is a function of wages, GDP, and potential firms in all other countries.

**Definition 3.4.** Given trade barriers \( \tau_{sd} \), a fixed cost of entry, \( f_c \), a productivity distribution \( F(z) \) with a lower bound \( b_s \), and income distribution information \( M^k_d \) and \( \theta^k_d \), an equilibrium for \( s, d = 1, \ldots, I \) and \( \forall z \in [b, \infty) \) is given by: a productivity threshold for each consumer type \( k \), \( \hat{z}_{sd}^k \); a measure of entrants in each country, \( \hat{J}_s \), the total measure of firms serving group \( k \) market \( d \), \( \hat{N}_{sd}^k \), a aggregate price statistic for each \( k \)-type, \( \hat{P}_d^k \), wages for each type, \( \hat{w}_d^k \); per consumer consumption, \( \hat{c}_sd^k(z) \); a demand function for each firm \( \hat{x}_{sd}^k(z) \) and firm pricing rules \( \hat{p}_{sd}^k(z) \) such that

- Given \( \hat{P}_d^k \), \( \hat{N}_d^k \), \( \hat{w}_d^k \) and \( \hat{p}_{sd}(z) \), the representative consumer solves her maximization problem (5), by choosing \( \hat{c}_{sd}^k(z) \) according to (7)

- Given the demand function \( \hat{x}_{sd}^k \), firm \( z \) solves its maximization problem (10) by choosing prices \( \hat{p}_{sd}^k(z) \) according to (12)

- The relevant productivity threshold’s for satisfies (14) and (19).

- Goods market clear: \( \hat{x}_{sd}^k(s) = M^k_{sd} \hat{c}_{sd}^k(z) \), Trade is balanced: \( \sum_{d \neq s} R_{sd} = \sum_{s \neq d} \sum_k p_{sd}^k x_{sd}^k \), and labor markets clear: \( \sum_d \int_z \ell_{sd}(z)dz = M^H_s \theta^H_s + M^L_s \theta^L_s \).

- \( N_d^k, P_d^k, J_s, \) and \( w_d^k \), jointly satisfy (8), (9), (21), and (22).
4 Prices and Inequality

4.1 Prices and inequality with perfect price discrimination

I begin by examining the case in which the resale constraint is non-binding in all countries - all firms can engage in perfect price discrimination. The constraint must be non-binding for all countries due to the general equilibrium effects on wages and number of firms if the constraint binds. The number of firms that have paid to take a draw is simplified to

$$J_s = \frac{M_s^H \theta_s^H + M_s^L \theta_s^L}{(\gamma + 1) f_c} = \frac{L_s}{(\gamma + 1) f_c}$$

(23)

where $L_s$ measures the effective labor, $M_s^H \theta_s^H + M_s^L \theta_s^L$. The expression for wages collapses to

$$\frac{w_d^{\gamma + 1}}{b_d^{\gamma}} = \left( \sum_s \frac{w_t L_t}{L_s (w_t \tau^s_{dt})^{\gamma}} \right)^\gamma$$

(24)

such that wages in $d$ is a function of only wages and GDP in all other countries. This has the useful property that if GDP and effective labor remains constant a change in inequality has no effect on wages or on the number of firms, $J_d$. The pricing aggregator for goods sourced from $s$ to $d$ to be sold to the $k$-type, $P_{sd}^k$ is given by

$$P_{sd}^k = \frac{\gamma}{\gamma + 1} c_d^{k,N} N_{sd}^{k,N}$$

(25)

And the number of firms serving $k$ group in destination $d$ from source $s$, $N_{sd}^k$, is equal to the number of firms who have drawn productivities equal to or greater than $z_{sd}^k$. With a Pareto distribution of productivities this is given by

$$N_{sd}^H = J_s b_s^\gamma z_{sd}^{H,N-\gamma} \quad N_{sd}^L = J_s b_s^\gamma z_{sd}^{L-\gamma}$$

(26)

These two equations can be combined to solve for the choke price for the $k$-type

$$Q_{d}^{k,N} = \left[ \frac{(1 + 2\gamma) w_d^k}{(\gamma + 1) f_c} \sum_s L_s b_s^\gamma \tau_{sd}^s (w_s)^{-\gamma} \right]^{\frac{1}{1+\gamma}}$$

(27)
Keeping $L_d$ and $GDP_d$ constant, it is obvious that the prices of goods, varieties consumed, and choke price rises (or falls) with group income.

To build intuition for subsequent results, it is useful to consider the non-resale constrained prices, which can now be solved exactly

$$p_{td}^k(z) = \left[ \frac{\tau_{td} w_d}{z} \right]^{\frac{1}{2}} \left[ \frac{(1 + 2 \gamma) w_d^k}{q} \sum_s L_s b_s^k (\tau_{sd} w_s)^{-\gamma} \right]^{\frac{1}{2(1+\gamma)}} \quad (28)$$

As incomes increase (or decrease) groups face higher (or lower) prices. Additionally, as could be expected in an economy with perfect price discrimination and no fixed export costs, the relative prices and varieties enjoyed by each group is independent of the income the other.\footnote{As a consequence of the differing cut-off for each group across countries, it is also possible that a good could be sold to only the H-type in one country, but to both in the other, or it may even not be sold at all.}

$$\frac{p_{td}^H(z)}{p_{td}^L(z)} = \left( \frac{\theta_{td}^H}{\theta_{td}^L} \right)^{\frac{1}{1+\gamma}} \quad \frac{N_{td}^H(z)}{N_{td}^L(z)} = \left( \frac{\theta_{td}^H}{\theta_{td}^L} \right)^{\frac{1}{1+\gamma}} \quad (29)$$

Consider the prices charged by an exporting firm to two non-resale constrained countries, $d$ and $j$, under the assumption that the good is sold to the $k$-type in both countries.

$$\frac{p_{td}^k(z)}{p_{tj}^k(z)} = \left[ \frac{\tau_{td}}{\tau_{tj}} \right]^{\frac{1}{2}} \left[ \frac{w_d \theta_{td}^k}{w_j \theta_{tj}^k} \sum_s L_s b_s^k (\tau_{sd} w_s)^{-\gamma} \right]^{\frac{1}{2(1+\gamma)}} \quad (30)$$

If I assume identical trade barriers, population $M_d = M_j$, and effective aggregate labor, $L_d = L_j \forall d, j$ the model will generate identical wages, GDP, and GDP per capita across countries.\footnote{Notice that GDP per capita is $w_d \left( \frac{M_d^H \theta_d^H + M_d^L \theta_d^L}{M_d} \right) \neq w_d$}

Even with these identical aggregates, defining $\theta_{td}^H = \frac{L_d - M_d \theta_d^L}{M_d}$ where $\theta_d^H \neq \theta_d^L$ will generate different income inequalities and therefore generate price and variety differences in different destinations

$$\frac{p_{td}^k(z)}{p_{tj}^k(z)} = \left[ \frac{\theta_{td}^k}{\theta_{tj}^k} \right]^{\frac{1}{1+\gamma}} \quad \frac{N_{td}^k(z)}{N_{tj}^k(z)} = \left[ \frac{\theta_{td}^k}{\theta_{tj}^k} \right]^{\frac{1}{1+\gamma}} \quad (31)$$

Countries with identical aggregates but higher inequality (in this case a higher $\theta_d^H$ and lower $\theta_d^L$) will import a larger variety of goods ($N_{td}^H$), and face higher H-prices and lower L-prices. But how is this composition of prices reflected in unit-values?
If none of the countries in the regression experienced a binding resale constraint, then quantity traded would correspond to

\[ C_{sd} = M_d^H \int c^H_{sd}(i) \, di + M_d^L \int c^L_{sd}(i) \, di \]
\[ = \frac{1}{2} \gamma \left( M_d^H N_{sd}^H + M_d^L N_{sd}^L \right) \]  

(32)

(33)

trade value would be given by \( R_{sd}^N \)

\[ R_{sd}^N = \gamma b_s^N \gamma \left[ \int_{z_{sd}^H}^{\infty} M_d^H p^H_{sd}(z) c^H_{sd}(z) z^{-(\gamma+1)} \, dz + \int_{z_{sd}^L}^{\infty} M_d^L p^L_{sd}(z) c^L_{sd}(z) z^{-(\gamma+1)} \, dz \right] \]
\[ = \frac{q}{2} \left( \frac{\gamma}{\gamma + 1} \right) \left[ M_d^H Q_d^H N_{sd}^H + M_d^L Q_d^L N_{sd}^L \right] \]  

(34)

and therefore unit value would be

\[ UV_{sd}^N = \frac{R_{sd}^N}{C_{sd}} = \gamma - \frac{1}{2} \cdot \left[ \frac{M_d^H Q_d^H N_{sd}^H + M_d^L Q_d^L N_{sd}^L}{M_d^H N_{sd}^H + M_d^L N_{sd}^L} \right] \]  

(35)

Under the same assumptions that generate identical aggregates but different inequalities, the comparative unit values across countries is

\[ \frac{UV_{sd}^N}{UV_{sj}^N} = \frac{M_d^H \theta_d^H + M_d^L \theta_d^L}{M_d^H \theta_d^H + M_d^L \theta_d^L} \cdot \frac{M_j^H \theta_j^H + M_j^L \theta_j^L}{M_j^H \theta_j^H + M_j^L \theta_j^L} \]  

(36)

If country \( d \) has more inequality than \( j \) (\( \theta_d^H > \theta_j^H \) while still yielding identical aggregates) this ratio is greater than 1, indicating that the unit value is higher in \( d \) than in \( j \). The effect of increasing prices on the H-type dominates the decrease in price of the L-type leading to the increase of unit value with inequality, an unsurprising result given that the consumption of the H-type represents a larger share of the economy than the consumption of the L-type. This result, however, contradicts the data, indicating that perfect price discrimination, while the most theoretically expedient, is not the best representation.

Conveniently the analytical nature of the solution of the non-restrained case allows for the calculation of the value of \( r \) such that \( \forall r \leq r^{\text{bind}} \) the resale constraint is binding. This is done by finding
the value of $r$ such that $Q_d^H = (1 + r^{\text{bind}})^2 Q_d^L$, which is given by

$$r^{\text{bind}} = \left( \frac{\theta_d^H}{\theta_d^L} \right)^{\frac{1}{\gamma + 1}} - 1$$

(37)

The equation can be solved for each country in the sample using information on income shares, results are provided in the appendix. Unsurprisingly, the country with the highest inequality - South Africa, in which the top 40% hold 72.84% of income- also requires the largest degree of price discrimination to be unconstrained, 16.73%. Therefore, for any $r > 0.1673$ firms in all countries can freely price discriminate, while if $r < 0.1673$ at least one country (South Africa) has a binding resale constraint. Based on the analysis on unit value behaviour we can therefore conclude that it must be that $r < 0.1673$. The elasticity of revenue, quantity and unit value to income inequality can then be calculated as

$$\epsilon_{IR}^{R,N} = \frac{M_d L^{\frac{1}{\gamma + 1}} - M_d H^{\frac{1}{\gamma + 1}} \left( \frac{1}{TR_d} - 1 \right)^{\frac{1}{\gamma + 1}}}{1 + \gamma M_d L^{\frac{1}{\gamma + 1}} + M_d H^{\frac{1}{\gamma + 1}} \left( \frac{1}{TR_d} - 1 \right)^{\frac{1}{\gamma + 1}}} > 0$$

(38)

$$\epsilon_{IR}^{C,N} = \frac{\gamma M_d L^{\frac{1}{\gamma + 1}} - M_d H^{\frac{1}{\gamma + 1}} \left( \frac{1}{TR_d} - 1 \right)^{\frac{1}{\gamma + 1}}}{1 + \gamma M_d L^{\frac{1}{\gamma + 1}} + M_d H^{\frac{1}{\gamma + 1}} \left( \frac{1}{TR_d} - 1 \right)^{\frac{1}{\gamma + 1}}} > 0$$

(39)

$$\epsilon_{IR}^{UV,N} = \frac{-\gamma M_d L^{\frac{1}{\gamma + 1}} - M_d H^{\frac{1}{\gamma + 1}} \left( \frac{1}{TR_d} - 1 \right)^{\frac{1}{\gamma + 1}}}{1 + \gamma M_d L^{\frac{1}{\gamma + 1}} + M_d H^{\frac{1}{\gamma + 1}} \left( \frac{1}{TR_d} - 1 \right)^{\frac{1}{\gamma + 1}}} < 0$$

(40)

where $IR_d = \frac{M_d L w_d^L}{Y_d}$. With perfect price discrimination, the value of traded goods therefore increases with increasing equality, as does the quantity of goods. The price of goods decreases with higher equality.

4.2 Prices and Inequality with imperfect price discrimination

With imperfect price discrimination analytical solutions are no longer possible. I will begin by comparing prices within a country:

$$\frac{p_{td}^H(z)}{p_{td}^L(z)} = 1 + r$$

(41)
Since \( p_{sd}^H = (1 + r)p_{sd}^B \), the prices of goods bought by both income groups will jointly increase or decrease with changes in the income or inequality, unlike a constrained economy. The forces at work, however, are the same. With an increase in income of the H-group, firms want to charge higher prices, while a decrease in the income of the L-group pushes firms to charge lower prices. However, now that prices are linked there is a feedback mechanism, complicating the solution. The reason for this can most easily be seen when examining the pricing aggregator for goods sourced from s to d to be sold to the k-type, \( P_{sd}^k \).

\[
P_{sd}^{L,R} = \frac{\gamma}{\gamma + \frac{1}{2}} \left[ \frac{w_d z_{sd}}{z_{dd}} \right]^{\frac{1}{2}} \left[ \frac{S_d^R}{M_d} \right]^{\frac{1}{2}} N_{sd}^{L,R} \tag{42}
\]

\[
P_{sd}^{H,R} = (1 + r)p_{sd}^{L,R} + \frac{\gamma Q_{sd}^{H,R} N_{sd}^{H,R}}{\gamma + \frac{1}{2}} - \frac{\gamma}{\gamma + \frac{1}{2}} \left[ \frac{w_d z_{sd}}{z_{dd}} \right]^{\frac{1}{2}} Q_{sd}^{H,R} N_{sd}^{L,R} \tag{43}
\]

When aggregated, this yields

\[
P_{sd}^{L,R} = \frac{\gamma}{\gamma + \frac{1}{2}} \left[ \frac{w_d z_{dd}}{z_{dd}} \right]^{\frac{1}{2}} \left[ \frac{S_d^R}{M_d} \right]^{\frac{1}{2}} N_{sd}^{L,R} \tag{44}
\]

\[
P_{sd}^{H,R} = 2\gamma w_d H + 2(\gamma + \frac{1}{2})(1 + r)P_{sd}^{L,R} - 2\gamma \left[ \frac{w_d z_{dd}}{z_{dd}} \right]^{\frac{1}{2}} Q_{sd}^{H,R} N_{sd}^{L,R} \tag{44}
\]

Consider a change in L-income that results in a decrease in \( p_{sd}^B(z) \) and a lower variety of goods, \( N_{sd}^{L,R} \). Both changes result in a lower price index for L-type. The decrease in \( P_{sd}^{L,R} \) puts a downward pressure on \( P_{sd}^{H,R} \) as firms charge a lower price for goods that both types buy. However, these changes also put upward pressure on the H-price index as captured in the third term. This is because the decrease in \( p_{sd}^B(z) \) creates the incentive for firms to switch from selling a good to both types to selling the good only to the H-type at a higher prices which is encapsulated in the decrease in variety of goods consumed by L.

Therefore, unlike the economy with perfect price discrimination, both the prices and varieties experienced by the two groups can now change even if the only change in the economy is the income of the other group. The variety of goods for each k-type in a resale constrained economy is given by

\[
N_{sd}^{H,R} = J_s b_s z_{sd}^{H^{-\gamma}} \quad N_{sd}^{L,R} = J_s b_s z_{sd}^{B^{-\gamma}} \tag{45}
\]
where the cutoff prices, $Q^k_d$, are embedded in both productivity cutoff’s. Price comparisons of an exporting firm to two constrained countries, $d$ and $j$, requires comparing the weighted cutoffs, which is not possible without an analytical solution.

$$\frac{p^B_{td}(z)}{p^B_{tj}(z)} = \left[ \frac{\tau_{sd}}{\tau_{sj}} \right] \left[ \frac{S^r_d}{S^r_j} \right]^{\frac{1}{2}}$$

Again, the composition of goods in the economy matter greatly for the unit value, which I calculate by dividing revenue by total quantity $(M^H_d C^H_{sd} + M^L_d C^L_{sd})$, given by

$$R^R_{sd} = q \left[ \frac{M^H_d Q^H_d R^H_{sd}}{2} \frac{N^H_{sd}}{\gamma + \frac{1}{2}} \right] + qM^L_d Q^L_d R^L_{sd} N^L_{sd} + \frac{\gamma N^L_{sd}}{\gamma + \frac{1}{2}} \left( \frac{w_d}{z^R_{sd} z^H_{sd}} \right)^{\frac{1}{2}} \left[ M^H_d Q^H_d R^H_{sd} - (M_d + rM^L_d) \frac{1}{2} S^r_d \right]^{\frac{1}{2}}$$

$$C^H_{sd} = \int c^H_{sd}(i) di = \frac{1}{\gamma - \frac{1}{2}} N^H_{sd} + \frac{\gamma N^L_{sd}}{\gamma - \frac{1}{2}} \left( \frac{z^B_{sd}}{z^H_{sd}} \right)^{\frac{1}{2}} \left[ \left( M_d Q^H_d \right)^{\frac{1}{2}} - 1 \right]$$

$$C^L_{sd} = q N^L_{sd} \left[ \frac{\gamma Q^L_d}{\gamma - \frac{1}{2}} \left( \frac{M_d}{S^r_d} \right)^{\frac{1}{2}} \left( \frac{z^B_{sd}}{w_d} \right)^{\frac{1}{2}} - 1 \right]$$

It is important to remember that $p^B_{td}(z)$ is the price charged when selling to both H- and L- groups. Due to the link between groups if the decrease in L-income is sufficient the price paid for all goods in this productivity range will fall for both groups, not just the L-group as was the case with perfect price discrimination. This increases the downward force on unit values for similar sized changes in inequality in the constrained relative to the unconstrained economy. Firms, however, have a greater incentive to sell only to the H-type, resulting in the higher price for $p^H_{sd}$, in addition to the increase that would have resulted from the increase in their income. Intuitively, as $N^L_{sd}$ represents a large share of the consumption basket, it seems reasonable that the effect of the decrease prices for all goods and quantities sold in this range should outweigh the increase in prices in the smaller H-type exclusive region, as long as the degree of allowable price discrimination, $r$, is small enough.

The simulation presented in the next section corroborates this intuition.
4.3 Simulation

This model contains 6 country-specific parameters: $M_d, M_d^H, M_d^L, b_d, \theta_d^H, \theta_d^L$, 1 bilateral parameter: $\tau_{sd}$, and 5 country-independent parameters: $N, \gamma, f_c, q$, and $r$. The lower bound on the productivity draw is set to be less than the minimum productivity cutoff for all countries. As $b_d$ is the same across countries, any cross country differences in productivity will be induced by differences in labor productivity, $\theta_d^H$ or $\theta_d^L$.

4.3.1 Country Specific Parameters: $M_d^H, M_d^L, \theta_d^H, \theta_d^L, b_d$

I set $M_d$ equal to population reported by WDI, and in keeping with my metric for inequality, choose $M_d^H$ to be 40% of the population, which then defines $M_d^L$ to be 60% of the population. Rearrange the definition of income share and GDP to find that $\theta_d^H = \frac{Y_d IR_d}{w_d M_d^H}$ and $\theta_d^L = \frac{1 - IR_d}{IR_d} - \frac{M_d^H \theta_d^H}{M_d^L}$. I combine these equations with (22) to find parameter values for $\theta_d^H, \theta_d^L$ to simultaneously match GDP and the income shares given the model calculated wages. As income share information for the USA is not available from the WDI, I use USA income share information obtained from the U.S. Census Bureau, table H-2.

4.3.2 Bilateral Parameter, $\tau_{sd}$

To estimate trade barriers I follow the gravity equation methodology of Eaton and Kortum [2002] (EK). The expression for import share of $s$ goods in $d$ expenditures is

$$\lambda_{sd} = \frac{R_{td}}{\sum_s R_{sd}} = \frac{b_d^\gamma J_t (w_t \tau_{td})^{-\gamma}}{\sum_s b_s^\gamma J_s (w_s \tau_{sd})^{-\gamma}} \quad (50)$$
in both types of economies (constrained or unconstrained). This can be manipulated to find that
the relative share of goods imported to goods produced for domestic consumption is given by

\[
\log \left( \frac{\lambda_{sd}}{\lambda_{dd}} \right) = \log \left( b_s^\gamma J_s (w_s \tau_{sd})^{-\gamma} \right) - \log \left( b_d^\gamma J_d (w_d \tau_{dd})^{-\gamma} \right)
\] (51)

Define \( B_s \) and \( B_d \) as exporter- and importer-fixed effects to correspond to \( \log \left( b_s^\gamma J_s w_s^{-\gamma} \right) \) and \( \log \left( b_d^\gamma J_d w_d^{-\gamma} \right) \) respectively, and use \( \tau_{dd} = 1 \) to obtain the standard EK gravity equation

\[
\log \left( \frac{\lambda_{sd}}{\lambda_{dd}} \right) = B_s - B_d - \gamma \log (\tau_{sd})
\] (52)

where I assume the following functional form for trade barriers:

\[
\log(\tau_{sd}) = d_i + b + \delta_{sd}
\] (53)

where country-pair specific subscripts are suppressed for simplification. The distance between \( s \)
and \( d \) resides in the i-th distance interval is captured by \( d_i, i=1,..,6 \).\(^{16}\) A shared border effect is an
indicator variable denoted by \( b \) that takes a value of 1 if \( s \) and \( d \) share a border.\(^{17}\)

For information on distance and shared borders I use CEPII estimates. To construct trade shares
for \( \lambda_{sd} \) I use COMTRADE data on the sum of reported imports between sample countries in BEC
522, 61, 62 and 63. Traditionally, \( \lambda_{dd} \) is calculated as the residual of GDP that is not imported,
and for this purpose of this paper should correspond to the production in categories BEC 522, 61,
62 and 63. As this data does not exist, I instead use the value added in manufacturing (ISIC 15-37)
obtained from the World Bank. This allows me to apply least squares to estimate the trade barriers
for all 55 countries that are consistent with the observed trade flows.

4.3.3 Non-Specific Parameters: \( N, \gamma, f_c, r, q, b \)

I set \( N \) equal to match the number of countries in my sample plus the USA (55 countries), and
use \( \gamma = 4 \) from Simonovska and Waugh [2011]. What remains is to calibrate the values of the
resale constraint, \( r \), the non-homothetic parameter, \( q \), the cost of a productivity draw, \( f_c \), and the

\(^{16}\)The distance intervals are: \([0, 600), [600, 1200), [1200, 2400), [2400, 4800), [4800, 9600), [9600, \infty] \).

\(^{17}\)Regional Trade agreements are not significant in the gravity equation for this selection of countries, and is
therefore not used.

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lower bound of the productivity draw, $b_d$. Under the assumptions that $b_d$, $f_c$, and $q$ are the same across all countries, and the linearity of log utility and production function, the regression results are independent these three parameters.

I simulate the model over a grid to find the level of price discrimination, $r$ that minimizes the distance between the simulated and measured moments. For robustness I consider 4 variations: (1) Targeting the relationship between inequality and trade value, (2) inequality and quantity, (3) inequality and unit value and finally (4) minimizing the absolute value of the weighted difference of all three moments simultaneously. Graph (1) shows the dependence of the coefficient of trade value and the value of constraint.\textsuperscript{18} Quantity takes a similar inverted-U shape.

4.3.4 Simulation Results

Table (3) presents the result of the regression of inequality on the data obtained from simulating the model. Even though perfect price discrimination yields a negative relationship, it is not significant, although the same is true with imperfect price discrimination. I report the best fit $r$ values for both price and when targeting all 3 moments simultaneously, I will focus only the $r$ values implied by trade value and quantity given the statistical insignificance of the unit value results. The best fit to the data comes with a resale constraint of 5.5%. Which this resale constraint, the model explains 29% of the variation in value, 27% of the variation in quantity, and 20% of the variation in unit values. The degree of price discrimination has almost no effect for the dependence of trade flows

\textsuperscript{18}Smoothed interpolation of 9 points.
on aggregate income statistics (GDP per capita).\textsuperscript{19}

This value for \( r \) implies that the degree of price discrimination between income groups across countries in the sample is 5.5%. Estimating within-country price discrimination by income group is difficult, as most studies have information on prices but not the goods actually purchased. One of the few studies that does is Broda et al. [2009]. They use scanner data from USA households in 2005 and find that high income households pay about 5.1% more than low income households for goods of similar quality, very close to the price discrimination value found in this paper using trade data.

### 5 Liberalization, Trade Partners, and Welfare Gains

#### 5.1 Perfect Price Discrimination

Even though the perfect price discrimination case does not match the data, it is still useful study it to generate intuition for results. The utility of an agent in each group can be solved to give

\[
U_{d}^{k,N} = N_{d}^{k} \left( \log(q) + \frac{1}{2\gamma} \right)
\]

\textsuperscript{19}Even though it is not calibrated for it, the model predicts that 21\% of USA firms would engage in trade activity, close to the 15\% documented by Eaton et al. [2004].
where

\[ N_{d}^k,N = \left( \frac{1 + 2\gamma}{q} w_{d}^k \right)^{\frac{\gamma}{1+\gamma}} \left[ \sum_s \frac{L_s}{(\gamma+1) f_c \left( \frac{b_s}{\tau s d w_s} \right)^\gamma} \right]^{\frac{1}{1+\gamma}} \]  \hspace{1cm} (55)

As expected, an increase in \( w_{d}^k \) or a decrease in trade barriers or wages in foreign countries will result in an increase in utility for both groups, and therefore aggregate utility. It is still worth noting that even in the non-constrained case, the cross-country welfare comparisons of the k-groups is determined entirely by relative variety, which is again determined by relative productivities (wages). Unless the productivities of the k-group in the two countries are identical, k-group welfare in two countries with otherwise identical aggregate data will be different.

Consider the traditional real income index, \( W_{d}^k = \frac{w_{d}^k}{f_d} \). In the unconstrained model, this is

\[ W_{d}^k = \frac{q}{2\gamma} \]  \hspace{1cm} (56)

The real wage, calculated in this traditional way, is clearly not a transformation of the consumer’s utility. It predicts identical values for both types of consumers, and no change with trade liberalization, in contradiction to the true underlying utility function. While the obvious solution is to multiply \( W_{d}^k \) by \( N_{d}^k \), this correction is not sufficient to map the predictions of traditionally calculated real wage onto utility for imperfect price discrimination. As the real wage index does not correctly capture the response of utility inequality to trade, therefore I will instead use the ratio of utilities directly to examine the effect of policy.

Exploiting \( \frac{N_{d}^{H,N}}{N_{d}^{L,N}} = \left( \frac{\theta_{d}^{H}}{\theta_{d}^{L}} \right)^{\frac{\gamma}{1+\gamma}} \) to rewrite relative domestic utility as

\[ \frac{U_{d}^{H,N}}{U_{d}^{L,N}} = \left( \frac{\theta_{d}^{H}}{\theta_{d}^{L}} \right)^{\frac{\gamma}{1+\gamma}} \]  \hspace{1cm} (57)

it is obvious that if firms can freely price discriminate, a change in trade barriers that has no effect on relative wages will have no affect on relative consumption. This result is a consequence of the linearity embedded in the model: the changes in prices (and therefore quantity) are perfectly offset by the changes in varieties of goods each type has access to. Furthermore, there is no effect on relative utility from any characteristic of the source country. Therefore, if firms are free to
price discriminate, then changing trade barriers will no effect on relative utilities of the two income
groups through the channel of prices - a standard result that would allow us to only focus on relative
productivity changes that may result due to labor reallocation. This result does not hold in the
case of imperfect price discrimination.

5.2 Imperfect Price Discrimination

With binding price discrimination of amount $r$, the k-type utility is given by

$$U_d^{H,R} = N_d^{H,R} \left[ \log(q) + \frac{1}{2\gamma} \right] + N_d^{L,R} \log \left( \frac{M_d Q_d^{H,R}}{S_d^r} \right)^{\frac{1}{2}}$$  \hspace{1cm} (58)

$$U_d^{L,R} = N_d^{L,R} \left[ \log(q) + \frac{1}{2\gamma} \right] - N_d^{L,R} \log \left( \frac{S_d^r}{M_d Q_d^{L,R}} \right)^{\frac{1}{2}} - N_d^{L,R} \log \left( \frac{w_d}{z_{sd}^B} \right)^{\frac{1}{2}}$$  \hspace{1cm} (59)

The first term in both utility is identical to the unconstrained case - though again the varieties in
the constrained case behave very differently. Very specifically, a change in the income of one group
can, for the same reasons as discussed previously, change the variety enjoyed by the other, and
through that mechanism the change in the wage of one group can change the utility of the other.
This relationship did not exist in the perfect discrimination case. All of the remaining terms are
positive, so that comparatively H-type consumers enjoy higher utility in the constrained market due
to the $(1 + r)p_{sd}^B(z) < p_{sd}^H(z)$. The utility of the L-type is lower, due the fact that $p_{sd}^B(z) > p_{sd}^L(z)$ -
they face higher prices.

A change in trade barriers, in addition to changing prices through changing marginal cost, also
changes wages and the number of potential firms, $\mathcal{J}_s$ in a non-trivial manner as can be seen in
equations (21) and (22). All else equal, a decreases in trade barriers decreases $z_{sd}^B$ which increases
$\mathcal{J}_s$ if the term in the denominator is positive, or decreases it if the term is negative. A change in
the number of potential firms may change wages, though the direction of the change is a function
of the relative size of potential firms and trade barriers.
5.2.1 Trade Liberalization

I simulate two economies moving from $\tau = 1$ (free trade) to $\tau = 10$, with identical upper income shares of 70% and $r = 0.05$. Removing trade barriers increases the utility of both groups, but as the L-type gains more relative utility inequality decreases.

5.2.2 Trade Partner Inequality

I simulate two economies engaged in trade, with $\text{tau}_{sd} = 1.1$, one with a fixed upper 40% income share of 70%, while the other ranges from 40% (equal) to 90%, while maintaining identical aggregates (GDP and wages) for $r = 0.05$. An increase in income inequality in a trade partner will increase utility inequality in the home country. Both income groups lose utility as the inequality in the partner country increases, but the H-type loses less.

\[ \text{It is positive if } Q_d^H > 3.15Q_d^L, \text{ assuming } r=0.05 - \text{ essentially if inequality is “big enough”}. \]
Figure 3: Change in relative utility with foreign equality

6 Conclusion

In this paper I have studied the effect of inequality on trade flows, using the channel of market and price discrimination. I document that inequality increases the trade value and quantity of goods traded, while decreasing the unit value, for goods in which firms have pricing power. These relationships differ across consumption, intermediate, capital, and mixed end use goods, highlighting the importance of controlling for composition when studying inequality and trade. I show that this behaviour can be explained if consumers have non-homothetic preferences and firms practice price discrimination. Allowing firms to charge a 5.5% mark-up to high income consumers explains approximately one third of the observed relationship between inequality and trade values. Using simulations, I show that income inequality and trade liberalization can result in changes in real wage inequality, even if (nominal) income inequality is unchanged.

References


C. Broda, E. Leibtag, and D. Weinstein. The role of prices in measuring the poor’s living standards.


WDI. World Development Indicators, Data Set, World Bank, Washington, DC. Available at http://web.worldbank.org/data.

A  Sample Country Details

The following lists the income share of the upper 40 percentile (U40) in the aggregate income for each country in the sample.

<table>
<thead>
<tr>
<th>Country</th>
<th>U40 Share (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angola</td>
<td>58.27</td>
</tr>
<tr>
<td>Armenia</td>
<td>53.26</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>53.78</td>
</tr>
<tr>
<td>Belarus</td>
<td>49.75</td>
</tr>
<tr>
<td>Bhutan</td>
<td>56.73</td>
</tr>
<tr>
<td>Brazil</td>
<td>65.70</td>
</tr>
<tr>
<td>Burkina Faso</td>
<td>57.62</td>
</tr>
<tr>
<td>Cambodia</td>
<td>55.84</td>
</tr>
<tr>
<td>Chile</td>
<td>65.64</td>
</tr>
<tr>
<td>Colombia</td>
<td>66.98</td>
</tr>
<tr>
<td>Costa Rica</td>
<td>63.87</td>
</tr>
<tr>
<td>Dominican Republic</td>
<td>61.37</td>
</tr>
<tr>
<td>Ecuador</td>
<td>62.02</td>
</tr>
<tr>
<td>El Salvador</td>
<td>61.92</td>
</tr>
<tr>
<td>Ethiopia</td>
<td>54.24</td>
</tr>
<tr>
<td>Fiji</td>
<td>59.46</td>
</tr>
<tr>
<td>Georgia</td>
<td>57.55</td>
</tr>
<tr>
<td>Honduras</td>
<td>66.05</td>
</tr>
<tr>
<td>Indonesia</td>
<td>56.70</td>
</tr>
<tr>
<td>Jordan</td>
<td>53.16</td>
</tr>
<tr>
<td>Kazakhstan</td>
<td>51.56</td>
</tr>
<tr>
<td>Kyrgyz Republic</td>
<td>53.58</td>
</tr>
<tr>
<td>Latvia</td>
<td>53.97</td>
</tr>
<tr>
<td>Macedonia, FYR</td>
<td>58.21</td>
</tr>
<tr>
<td>Madagascar</td>
<td>59.62</td>
</tr>
<tr>
<td>Malawi</td>
<td>59.69</td>
</tr>
<tr>
<td>Malaysia</td>
<td>60.10</td>
</tr>
<tr>
<td>Mali</td>
<td>53.29</td>
</tr>
<tr>
<td>Mexico</td>
<td>61.54</td>
</tr>
<tr>
<td>Moldova</td>
<td>53.34</td>
</tr>
<tr>
<td>Mean</td>
<td>57.76</td>
</tr>
<tr>
<td>Max</td>
<td>74.10</td>
</tr>
<tr>
<td>Min</td>
<td>49.75</td>
</tr>
<tr>
<td>Std. Dev</td>
<td>5.47</td>
</tr>
</tbody>
</table>

B  Homogenous goods: Results by BEC category

The results for homogenous goods presented in table (4) are essentially the opposite of differentiated goods. There are very few statistically significant relationships, one of the obvious is that of food. With homogenous goods, value and quantity falls with inequality and unit value rises, which yields the general result that homogenous consumption goods are correlated with inequality in the opposite way of differentiated goods.
### Table 4: Homogenous Goods, results by BEC categories

<table>
<thead>
<tr>
<th>BEC Description</th>
<th># HS-product lines (# of obs)</th>
<th>Regression Coefficient</th>
<th>Value Quantity</th>
<th>Unit-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Consumption goods</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>112 Food and beverages, primary, mainly for household consumption</td>
<td>27 (326)</td>
<td>-2.850**</td>
<td>-3.821***</td>
<td>0.972**</td>
</tr>
<tr>
<td>122 Food and Beverages, processed, mainly for household consumption</td>
<td>47 (637)</td>
<td>-1.017 -1.822</td>
<td>0.806***</td>
<td></td>
</tr>
<tr>
<td>522 Transport equipment, non-industrial</td>
<td>0 0</td>
<td>N/A N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>61 Consumer goods not elsewhere specified, durable</td>
<td>0 0</td>
<td>N/A N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>62 Consumer goods not elsewhere specified, semi-durable</td>
<td>0 0</td>
<td>N/A N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>63 Consumer goods not elsewhere specified, non-durable</td>
<td>3 (20)</td>
<td>-55.306 -44.891 -10.414</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Intermediate goods</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>111 Food and beverages, primary, mainly for industry</td>
<td>13 (172)</td>
<td>1.749 1.792</td>
<td>-0.043</td>
<td></td>
</tr>
<tr>
<td>121 Food and beverages, processed mainly for industry</td>
<td>14 (121)</td>
<td>-8.358 -7.927</td>
<td>3.103</td>
<td></td>
</tr>
<tr>
<td>21 Industrial supplies not elsewhere specified, primary</td>
<td>48 (202)</td>
<td>7.308 4.206</td>
<td>-1.132</td>
<td></td>
</tr>
<tr>
<td>22 Industrial supplies not elsewhere specified, processed</td>
<td>75 (788)</td>
<td>8.197 9.329</td>
<td></td>
<td></td>
</tr>
<tr>
<td>31 Fuel and lubricants, primary</td>
<td>0 0</td>
<td>N/A N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>322 Fuel and lubricants, (other than motor spirits)</td>
<td>0 0</td>
<td>N/A N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>42 Parts and accessories of capital goods (except transport equipment)</td>
<td>0 0</td>
<td>N/A N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>53 Parts and accessories of transport equipment</td>
<td>0 0</td>
<td>N/A N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Capital goods</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>41 Capital goods (except transport equipment)</td>
<td>2 (17)</td>
<td>-14.980 -14.979</td>
<td>-0.001**</td>
<td></td>
</tr>
<tr>
<td>521 Transport equipment, industrial</td>
<td>0 0</td>
<td>N/A N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Mixed End Use</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>321 Fuel and lubricants, motor spirits</td>
<td>0 0</td>
<td>N/A N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>51 Passenger motor cars</td>
<td>0 0</td>
<td>N/A N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>7 Goods not elsewhere specified</td>
<td>0 0</td>
<td>N/A N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>All Non-Differentiated Goods</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All Food Consumption Goods</td>
<td>201 (2,297)</td>
<td>1.391 1.082</td>
<td>0.309</td>
<td></td>
</tr>
<tr>
<td>All Non-food Consumption Goods</td>
<td>74 (963)</td>
<td>-2.591 -3.619</td>
<td>1.024**</td>
<td></td>
</tr>
<tr>
<td>All Non-Differentiated Goods</td>
<td>3 (20)</td>
<td>-55.306 -44.891 -10.414</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### C Monopolistic competition model with CES preferences

A consumer of income type $k$ in country $d$ is trying to maximize her utility over all goods $g$ from all countries $s$ subject to a budget constraint

$$U_d^k = \max_{c^{sd}(i)} \left( \sum_s \int_0^{G_s} (c^{sd}(i))^{\frac{\sigma-1}{\sigma}} di \right)^{\frac{\sigma}{\sigma-1}} \text{ s.t } \sum_s \int_0^{G_s} p^{sd}(i)c^{sd}(i)di \leq w^k_d$$

The solution to this problem is

$$c^{sd}(z) = w^k_d P^{sd}(z)^{-\sigma} \frac{P^k_d}{P_d}$$

(60)

where $P^k_d = \sum_s \int_0^{G_s} p^{sd}_k(g)dg = \sum_s J_s b^s_k \int_{\gamma}^{\infty} p^{k-\sigma}_s (z)\gamma z^{-(\gamma+1)}dz$

A firm, using the same production technology as in the body of the paper, has a given productivity $z$ drawn from a Pareto distribution and faces a aggregate demand for its from all type $k$ given by
\[ x_{sd}^k = M_d^k c_{sd}^k \]

\[ \pi_{sd}^k = \max_{p_{sd}^k x_{sd}^k} p_{sd}^k x_{sd}^k - \frac{\tau_{sd} w_s}{z} x_{sd}^k \]

(61)

The profit maximizing price is given by

\[ p_{sd}^k = \frac{\sigma}{\sigma - 1} \frac{\tau_{sd} w_s}{z} \]

(62)

Notice that this price is devoid of any income-specific information: Both income groups would get charged the same price, \( p_H^s = p_L^s = p_{sd} \). This, in addition to \( c_{sd}^k > 0 \) for all possible prices, means that all firms sell to both types of consumers if they enter the market, and therefore \( N_d^H = N_d^L = N_d \) and \( P_d^H = P_d^L = P_d \). This allows country aggregate demand for good \( z \) to be written as

\[ M_d^H c_d^H (z) + M_d^L c_d^L (z) = Y_d p_d^{-\sigma} (z) \]

(63)

which means that as long as GDP, \( Y_d \) is identical in two countries the firm faces identical aggregate demand, regardless of inequality, and each country have feature the same productivity cutoff \( A \) firms aggregate profit is given by

\[ \pi_{sd} = \pi_d^H + \pi_d^L - w_s f_x \]

(64)

\[ = \frac{Y_d}{P_d p_{sd}^{-\sigma}} \left[ p_{sd} - \frac{\tau_{sd} w_s}{z} \right] - w_s f_x \]

(65)

where \( f_x \) represents a fixed cost to export to a given market.\(^{21}\) This can be solved to show that the cutoff productivity, \( \bar{z}_{sd} \), is again a function only of aggregate variables, in particular GDP. Therefore, two countries with identical GDP and trade barriers will have the same number of varieties, \( N_{sd} \) and value price indices, \( P_{sd} \), and therefore, finally, the same trade value, trade quantity, and unit value.

\(^{21}\) Algebraically, this fixed cost is needed to prevent all firms from exporting: With homothetic preferences all firms, no matter how unproductive, can set a high price, sell a small quantity, and export.

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