# Import Prices, Importer Income and Importer Income Inequality: Comparing Competing Theories

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ABSTRACT: Empirical research shows that importer income per capita has a strong positive effect on unit values of trade. In this paper three theoretical models are proposed to explain this empirical finding. The effect of importer income inequality on unit values is used to discriminate between the three different models. The prediction of only one of the three models is in accordance with empirical findings. In a first model the demand for quality rises in income with utility expanding both in quantity and quality. A second model features a hierarchic demand system where agents having an increased willingness to pay for necessary goods as more commodities enter the consumption set and can thus be charged higher markups. In a third model, drawing on existing work on the ideal variety model, higher incomes are more finicky to consume their ideal variety and will thus face higher markups. Both in the quality model and the ideal variety model unit values of trade rise with income inequality, whereas in the hierarchic demand model unit values decline in income inequality. Based on a large COMTRADE dataset with HS6 level data from more than 200 countries between 2000 and 2004, we find a highly significant negative effect of income inequality on unit values, thus providing support for the hierarchic demand model.

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# 1 Introduction

It is a well established fact that unit values of trade vary systematically with various exporter characteristics, like the income and factor abundance of exporting countries (Schott (2004)). But unit values also vary with importer characteristics. Hummels and Lugovskyy (2009) study the effect of market size and income per capita on unit values in an ideal variety model. Market crowding as a consequence of a larger market size leads to lower prices. And as people become richer they are more eager (finicky) to consume their ideal variety and therefore the price elasticity goes down and the market price goes up.

In this paper we focus on the effect of income per capita in the importing country on unit values of trade. We compare three different theoretical channels to explain rising unit values in importer income per capita and offer a way to discriminate between them by considering the effect of income inequality on unit values of trade. Along a first channel higher incomes demand a larger quality in a model with utility expanding both in quantity and quality. Along a second channel a higher income reduces price elasticity as goods become more necessary in the consumption bundle in a hierarchic demand model. The third channel features the increased finickyness to consume an ideal variety, as modeled by Hummels and Lugovskyy (2009).

In the theoretical models income inequality increases unit values through an aggregate increase in demand for quality and through a decrease in the price elasticity of demand in the ideal variety model and income inequality reduces unit values through an increase in the price elasticity of demand in the hierarchic demand model.

Empirically, we confirm the findings of Hummels and Lugovskyy (2009) that a higher GDP per capita raises importer unit values with a much broader dataset. The empirical analysis shows that unit values decline in income inequality, thereby rejecting the quality channel and the finickyness channel of Hummels and Lugovskyy (2009) and providing support for the price elasticity channel in the hierarchic demand model.

We model the three different channels separately. Catching the three channels in one model would become unduly complicated and has little to add.[1] In the first model with demand for quality rising in income there is a utility function that expands both in quality and quantity consumed. Production is constant returns to scale, the market structure perfect competition and marginal costs rise in quality of a commodity. A higher income raises demand for quality and with marginal costs rising in quality this increases prices.

In the second model we work with the hierarchical demand system proposed by Jackson (1982), which is a variant of Stone-Geary preferences with negative instead of positive

[1] Still, we show in Appendix A that both models are a nested case of a more general model that is however not analytically solvable.

vertical intercepts. As such, agents expand their consumption set as they become richer. As the set of consumed goods becomes larger, the price sensitivity on goods lower in the hierarchy shrinks. The intuition is that goods lower in the hierarchy become more necessary and therefore their price elasticity declines. In a setting with market power this leads to higher prices. We model market power with small group monopolistic competition between firms within each sector. Hence, within each set of consumed goods (sector), there are various differentiated goods.[2]

The third model features increased finickyness of consumers to consume their ideal variety as they get richer. When income goes up consumers become less price sensitive and firms can thus charge higher markups. We use an adapted version of the ideal variety model proposed by Hummels and Lugovskyy (2009). In their model the welfare costs of distance rise with the amount consumed of the specific good, in our model they rise with income. In this way we get rid of the restriction in Hummels and Lugovskyy (2009) that agents on aggregate consume only one good.[3]

To focus on the demand side explanation for differences in unit values, we sterilize the influence of supply side factors in the three models. There is only one factor of production. We model the open economy as a 2-country world.[4] Countries differ only in labor productivity in a uniform way across sectors. There are no trade costs. Hence, both countries produce all goods and charge different prices in the 2 different markets, either because of

[2] In this model we can impose a free entry condition to address the long run. The implication is that an increasing income per capita might lead to a higher price elasticity if the amount of resources spent in a certain sector rises strongly. This leads to an increasing number of firms in the market possibly outweighing the direct effect reducing the price elasticity. However, in the open economy we assume the importing country to be small relative to the other country, interpreted as the rest of the world. This implies that a higher income in the importing country has hardly an effect on resources allocated to the sector and thus on competitive pressure in the sector. As such, also in the long run a higher income per capita will increase importer unit values.

[3] In our model consumption also rises with the amount consumed, but the amount consumed of all goods. With only one good consumed as in Hummels and Lugovskyy (2009).our model collapses to their model.

[4] One country can be interpreted as the importing country with varying income and income inequality and the other country as the rest of the world.

differences in demand for quality or because of differences in their price sensitivity.

We discriminate between the three models by considering the effect of income inequality on import prices. We model income inequality by means of the Atkinson index of inequality allowing for an arbitrary number of income groups in the economy. To build intuition we also derive the effects of income inequality in a model with two income groups, exploring the effect of a change in the mean preserving spread. We find that income inequality increases average trade prices through the quality and the ideal variety channel, whereas it reduces average trade prices through the hierarchic demand channel.

When income inequality rises in the quality model, there is a shift in demand towards goods with higher quality and higher prices, i.e. the weight of high income goods in total consumption rises. Besides that, the price of the good consumed by the high incomes rises and the price of the good consumed by the low incomes declines, with the first effect dominating and therefore also raising the average price. These effects are similar to the increased aggregate demand for high quality goods at higher income levels in a model with non-homothetic preferences like Francois and Kaplan (1996).

In the hierarchical demand model an increase in income inequality raises the price elasticity and thus reduces the market price. The mechanism behind this effect is as follows. Higher income inequality implies that the demand of the high income groups for each product rises and the demand of the low income groups for each product declines. Also, the high income group extends the set of products consumed, whereas the low income group reduces the set of products consumed. On net total demand for each good declines, leading to an increase in the price elasticity. The result in this model is conditional on all income groups consuming a certain product and can be reversed if the low incomes would not consume a specific good. An increase in inequality would then simply raise relevant income (of the high income group) and thereby reduce the price elasticity.

In the ideal variety model a higher income inequality decreases the price elasticity and thus raises the market price like in the quality model. This effect is driven by the following mechanism. The overall price elasticity is a weighted average of the price elasticities of the different income groups. When inequality rises the price elasticity of the high income group declines and the price elasticity of the low income group rises. Also, the price elasticity of the high income group gets more weight and the price elasticity of the low income group gets less weight. Overall, this weighting effect dominates the effect on the price elasticities of the different groups, leading to a decreasing price elasticity. To summarize, two models predict that unit values rise in income inequality and one model predicts that they decline in income inequality.

In the empirical part we proxy prices with import unit values using data from the BACI database at the 6-digit level. This database is based on COMTRADE covering more than 200 countries and 5,000 products between 1995 and 2004. In the empirical analysis we include importer-exporter fixed effects and exporter-time fixed effects eliminating as much omitted variable bias as possible.

The empirical analysis shows that unit values rise with income, which is support for all three theories. However, in the empirical analysis we also find a clear and significant negative effect of income inequality on unit values. This supports the hierarchical demand model and contradicts the predictions of the effect of income inequality in the quality expansion model and the finickyness circle model of Hummels and Lugovskyy (2009). The finding on income inequality does not falsify the quality expansion model and the finickyness circle model. It is likely that all models provide part of the explanation for the positive effect of income per capita on unit values. But the empirical results on the effect of income inequality suggest that the price elasticity channel of the hierarchic demand model is an indispensable channel to account for the empirical findings.

The fact that differences in prices related to income levels are not only driven by different demand for quality, but also by differences in markups has two interesting implications. First, it implies that the pricing to the market is possibly not optimal from a welfare perspective. If differences would be only driven by a different demand for quality, there would be no welfare distortions, as firms just provide different qualities to different markets. The fact that price differences are also driven by different markups, implies the use of market power and thus possibly welfare distortions. It is an open question what the welfare implications are of pricing to the market and the use of market power, because positive markups also generate resources to develop welfare increasing additional varieties. This question requires more research.

A second implication of the importance of differences in markups is that regulation on parallel imports does affect real world outcomes. If differential demand for quality would drive price differences, there would be no incentive for parallel imports, as it does not pay off to resell a product with an optimal quality level in another market, where consumers demand a different quality level. With differences in optimal markups, there is an incentive to resell identical products sold in a market with high markups at a lower price in a market with lower markups. The welfare effects of the possibility of pricing to the market driven by differences in markups and thus the effects of regulation on parallel imports are an interesting avenue for future research, as pointed out in the previous paragraph.

This paper fits in the literature explaining price differences across markets. The early literature on Harrod-Balassa-Samuelson effects focuses on the role of non-traded goods in these price differences. A more recent literature explores pricing to the market, with firms charging different prices for identical goods across different markets due to differences in market conditions, see Goldberg and Knetter (1997) for a review. The papers closest to our paper are Hummels and Lugovskyy (2009) and Simonovska (2009). Hummels and

Lugovskyy (2009) relate price differences in tradable goods to importer country characteristics, in particular income and income per capita. They propose a model where the price elasticity also declines with income. In this paper we limit ourselves to exploring the importance of income per capita differences in explaining price differences and propose two alternative mechanisms to the mechanism proposed by Hummels and Lugovskyy (2009). Also we extend the analysis beyond income per capita by examining the effect of income inequality to discriminate between the different theories.

Simonovska (2009) also addresses the effect of income differences on the price of tradables, using a model that is similar to our hierarchic demand model. Simonovska (2009) works also with Stone Geary preferences with a positive intercept, but this intercept is equal across all varieties. Each variety is produced by only one firm with firms having heteregenous marginal costs. The implication is that the productivity of a variety's producer determines whether a good is in the consumption set or not. Simonovska (2009) finds also a positive relation between income per capita in a market and the markups charged in that market driven by differences in price elasticity. There are two main differences with our model. First, in Simonovska (2009) there is one producer for each variety, whereas in our model each variety is produced by different firms producing different types of each variety. Second, in our model the Stone Geary intercept varies across varieties/sectors, implying a more realistic explanation for which varieties are produced than in Simonovska (2009). In Simonovska (2009) chance determines whether varieties are produced or not. As a result, it might be the case that intuitively 'necessary' varieties are not produced. An advantage of the varying Stone Geary intercept in our model is that the lower price elasticity for goods already in the consumption set when income rises and the consumption set expands has a more natural interpretation: the inframarginal varieties become more necessary goods in the consumption bundle and this drives down their price elasticity.[5]

The current paper is also related to the literature that uses the large datasets on unit values of trade to analyze the relation of unit values with importer and exporter country characteristics. Schott (2004) relates unit values of trade with exporter characteristics, in particular income per capita and factor abundance. Baldwin and Harrigan (2007) analyze the relationship between unit values and distance between trading partners and importer country size in different firm heterogeneity models. Our approach differentiates itself from this literature by focusing on demand side explanations for differences in unit values.

Various authors have addressed the effect of importing country characteristics on trade patterns assuming non-homothetic preferences in determining trade flows. (see for example Hallak (2006)). As we consider explicitly the effect of income inequality on trade, we only discuss the literature on the effect of income inequality in importing countries on trade patterns. Francois and Kaplan (1996) and Dalgin, Mitra and Trindade (2008) examine the effect of income inequality on the type of goods imported finding that a higher income inequality leads to more demand for differentiated goods and for luxury goods, respectively. But these papers do not explore the effect of income inequality on unit values of trade. Choi, Hummels and Xiang (2009) study explicitly the link between income distribution of the importer country and the price distribution of import prices, applying the model of Flam and Helpman (1987). Our approach is distinct from the mentioned paper by focusing on the effect of average income inequality on average unit values to differentiate between different theories explaining differences in unit values as a function of importer characteristics.

[5] The difference in setup of Simonovska (2009) and our model can be explained by what the models are used for. Simonovska (2009) tries to create a model that can account for income varying price elasticities which can also be calibrated with real world data. We want to compare different theories and try to build a theory that can tell a clear intuitive story and therefore focus more on the conceptual soundness of the model and less on possible calibration.

The paper is organized as follows. The next section outlines the two theoretical models, with much derivations relegated to the appendix. Section 3 discusses data and empirical methods. Section 4 contains the empirical results and section 5 concludes with a discussion of the results.

# 2 Theory

## 2.1 Preliminaries

Three channels through which income per capita of an importer country affects trade unit values are explored in this section. Empirically, we focus on the effect of variation of these variables over time on within sector variation in unit values. Hence, we concentrate on within sector variation in unit values.

In the three models all agents have identical preferences and labor is the only production factor. The number of workers is equal to $L$. Each agent has an amount of labor units $i$ at its disposal. Income inequality is modeled such that agents differ in the amount of labor they have with labor still homogeneous. There are $G$ types (groups) of agents, indexed by subscript $g$, differing in the amount of labor $i_g$ at their disposal, hence income of agent $g$ is equal to $i_g$.[6] The number of workers of different types is equal and normalized at 1.

There are 2 countries, indexed by subscripts $k$ and $l$. There are no trade costs, but we exclude parallel imports, for example because regulation forbids parallel imports for differentiated goods. Countries only differ in income and income inequality, i.e. in the average amount of labor units or in the distribution of the labor units across different groups. Both countries produce in all sectors. As countries only differ in the amount of labor units, wages are equal in both countries and can be normalized at 1.

[6] With two income groups, we could interpret high and low income as skilled and unskilled labor with perfect substitutability between the two types of labor.

## 2.2 Demand for Quality Model

### 2.2.1 Open Economy without Income Inequality

We start with a model where all agents have income $i$. To focus on differential demand for quality within sectors as a function of income and market size, we work with Cobb-Douglas preferences across sectors $j$ and within each sector $j$, preferences depend both on quantity $q_j$ and quality $\alpha_j$:

$$U = \prod_{j=1}^{m} u_j^{\beta_j};\ 0 < \beta_j < 1 \text{ for all } j,\ \sum_{j=1}^{m} \beta_j = 1 \tag{1}$$
$$u_j = \left( \alpha_j^{\frac{\rho-1}{\rho}} + q_j^{\frac{\rho-1}{\rho}} \right)^{\frac{\rho}{\rho-1}};\ \rho > 1;\ \text{for all } j$$

$u_j$ is the sectoral utility, $\beta_j$ are the Cobb-Douglas parameters and $\rho$ is the substitution elasticity between quality and quantity. The cost function of a firm in sector $j$ is equal to:

$$c_j\left(q_j, \alpha_j\right) = \alpha_j^{\gamma} a_j q_j;\ 0 < \gamma < 1$$

Hence, marginal costs rise with quality $\alpha_j$, although less than proportional. $a_j$ is a sector specific marginal cost shifter. Given the fact that perfect competition requires price to be equal to marginal cost, we can find the equilibrium amounts of quality $\alpha_j$ and quantity $q_j$ by maximizing utility subject to the following budget constraint with the marginal costs substituted for prices:

$$\sum_{j=1}^{m} \alpha_j^{\gamma} a_j q_j = i \tag{2}$$

Maximizing utility in equation (1) s.t. (2) generates the following equilibrium outcomes for individual demand $q_{lj}$, quality $\alpha_{lj}$ and price $p_{lj}$ in country $l$:[7]

$$q_{lj} = \gamma^{\frac{\rho}{1-\rho}\frac{\gamma}{1+\gamma}} \left(\frac{\beta_j i_l}{a_j}\right)^{\frac{1}{1+\gamma}} \tag{3}$$

$$\alpha_{lj} = \gamma^{\frac{\rho}{\rho-1}\frac{1}{1+\gamma}} \left(\frac{\beta_j i_l}{a_j}\right)^{\frac{1}{1+\gamma}} \tag{4}$$

$$p_{lj} = \gamma^{\frac{\rho}{\rho-1}\frac{\gamma}{1+\gamma}} \left(\beta_j i_l\right)^{\frac{\gamma}{1+\gamma}} a_j^{\frac{1}{1+\gamma}} \tag{5}$$

From equation (4) it is clear that the level of quality varies with income, this implies that firms produce different levels of quality for different markets. As there are no fixed costs in producing quality, this variation of quality across markets is costless for firms. As there are no trade costs, firms in both countries can serve both markets. Assuming that at least one firm from country $k$ exports to country $l$, the price $p_{lj}$ is also the import price $p_{klj}$ for goods going from country $k$ to $l$. Hence, we get the following result:

**Proposition 1** *In a model with utility expanding in both quantity and quality and constant returns to scale production, higher income per capita leads to higher import prices.*

#### 2.2.2 Income Inequality

In this section we introduce inequality. We focus on country $l$ and suppress country indexes in the expressions below. As there are no fixed costs, firms produce different quality for each income group. The expressions for quantity $q_{jg}$, quality $\alpha_{jg}$ and price $p_{jg}$ in sector $j$ and in income group $g$ are given in equations (3), (4) and (5) with a subscript $g$ added to the variables $q_{jg}$, $\alpha_{jg}$ and $p_{jg}$ and income $i_g$.

To address the effect of changes in income inequality, we consider the effect of changes

[7] Derivations available upon request.

in the Atkinson index $I_A$ defined as follows:

$$I_A(\theta) = 1 - \left(\frac{1}{G}\sum_{g=1}^{G}\left(\frac{i_g}{\bar{i}}\right)^{1-\theta}\right)^{\frac{1}{1-\theta}} \text{ with } \bar{i} = \frac{1}{G}\sum_{g=1}^{G} i_g \tag{6}$$

To find the effect of a change in the Atkinson index on unit values, we sum prices across different income groups, weighted by their share of spending on good $j$. We assume that the fraction of firms producing in country $k$ and selling in country $l$ for the different income groups, is proportional to the fraction of firms selling for the two income groups across the entire world economy. With this assumption, we get the following expression for unit values of trade from country $k$ to country $l$ in sector $j$:

$$p_{klj} = \sum_{g=1}^{G} \omega_{ljg} p_{ljg} \tag{7}$$

With $\omega_{ljg}$ the value share of good $j$ consumed by group $g$, defined as:

$$\omega_{ljg} = \frac{p_{ljg} q_{ljg}}{\sum_{g=1}^{G} p_{ljg} q_{ljg}} \tag{8}$$

Substituting equation (8) into (7) leads to:

$$p_{klj} = \gamma^{\frac{\rho}{\rho-1}\frac{\gamma}{1+\gamma}} \beta_j^{\frac{\gamma}{1+\gamma}} a_{lj}^{\frac{1}{1+\gamma}} \sum_{g=1}^{G} \frac{i_{lg}^{\frac{1+2\gamma}{1+\gamma}}}{\sum_{g=1}^{G} i_{lg}} \tag{9}$$

We can rewrite equation (9) as follows:

$$p_{klj} = \gamma^{\frac{\rho}{\rho-1}\frac{\gamma}{1+\gamma}} \beta_j^{\frac{\gamma}{1+\gamma}} a_j^{\frac{1}{1+\gamma}} \left(1 - I_A\left(-\frac{\gamma}{1+\gamma}\right)\right)^{\frac{1+2\gamma}{1+\gamma}} \left(\frac{1}{G}\sum_{g=1}^{G} i_{lg}\right)^{\frac{\gamma}{1+\gamma}} \tag{10}$$

Normally, we impose the restriction that the parameter featuring the Atkinson index is positive. In equation (10) this parameter is negative. This implies that a decrease in inequality leads to an increase in the Atkinson index present in equation (10). Therefore, an increase in inequality corresponds with an increase in the Atkinson index measured with a parameter $\theta > 0$, leading to a decrease in the Atkinson measure with parameter $\theta < 0$ and this leads to a higher average price, as is clear from equation (10), where $p_{klj}$ is negative in $I_A$. We summarize this result in the following proposition:

**Proposition 2** *For a given average income $\bar{i}$, an increase in the Atkinson index as defined in equation (6) with positive parameter $\theta$ in the importing country, leads to higher average import prices.*

To shed some light on the intuition of this result, we calculate the effect of an increase in income inequality in a setup with only two income groups $H$ and $L$, modeled as an increase in the mean preserving spread of average income $i_l = \frac{i_{lH}H + i_{lL}L}{H+L}$.[8] Log differentiating $p_{klj}$ wrt shares $\omega_{ljG}$ and prices $p_{ljG}$ gives:

$$\widehat{p_{klj}} = \frac{\omega_{ljH}p_{ljH}\widehat{\omega_{ljH}} + \omega_{ljL}p_{ljL}\widehat{\omega_{ljL}}}{\omega_{ljH}p_{ljH} + \omega_{ljL}p_{ljL}} + \frac{\omega_{ljH}p_{ljH}\widehat{p_{ljH}} + \omega_{ljL}p_{ljL}\widehat{p_{ljL}}}{\omega_{ljH}p_{ljH} + \omega_{ljL}p_{ljL}} \tag{11}$$

To address the effect of an increase in the mean preserving spread shares $\omega_{ljG}$ and prices $p_{ljG}$ are log differentiated with respect to $i_{lH}$ and $i_{lL}$ imposing $\widehat{i_{lL}} = -\frac{i_{lH}H}{i_{lL}L}\widehat{i_{lH}}$, to keep mean income constant. Using equations (3) and (5) with income group subscripts, one can

[8] Notice that we include the possibility for different sizes of the two income groups, whereas in the calculation with the Atkinson index, we assumed that all income groups are equal. With a general number of $G$ income groups, we don't need to weight by the size of income groups, as larger income groups can be considered as two separate income groups.

easily write equation (11) as:

$$\widehat{p_{klj}} = \frac{i_{lH}H}{i_{lH}Hi_{lH}^{\frac{1}{1+\gamma}} + i_{lL}Li_{lL}^{\frac{1}{1+\gamma}}}\left(i_{lH}^{\frac{\gamma}{1+\gamma}} - i_{lL}^{\frac{\gamma}{1+\gamma}}\right)\widehat{i_{lH}} + \frac{\gamma}{1+\gamma}\frac{i_{lH}H}{i_{lH}Hi_{lH}^{\frac{1}{1+\gamma}} + i_{lL}Li_{lL}^{\frac{1}{1+\gamma}}}\left(i_{lH}^{\frac{\gamma}{1+\gamma}} - i_{lL}^{\frac{\gamma}{1+\gamma}}\right)\widehat{i_{lH}} \tag{12}$$

The two terms in equation (12) represent the two terms in equation (11), i.e. the shift in market share towards higher priced goods and the change in prices of the high and low quality good. As is clear from equation (12) both effects are positive. The shift in spending towards the higher quality goods consumed by the high incomes is positive. There is less consumption of the low priced good and more consumption of the high priced good leading to an increase in the average price. Also, the effect through the changes in prices themselves, because of changed demand for quality, is positive. The price of high quality goods goes up, as the rich get more income, but the price of low quality goods goes down as the poor get less income. In its effect on average unit values the first effect dominates the second, because the initial price of the high quality good is higher.

Although this model is somewhat stylized, it catches the effect of income inequality on prices through non-homothetic demand for quality which is also present in other models like Francois and Kaplan (1996). More income inequality increases average demand for quality, because the larger demand for quality of the higher incomes dominates the lower demand for quality of the lower incomes due to the fact that demand for quality is non-homothetic. The implication is that the non-homothetic expansion in demand for quality as income rises clearly predicts that more income inequality should drive up average demand for quality and average unit values.

### 2.3 Hierarchic Demand Model

#### 2.3.1 Basics

Next we focus on the effect of income and income inequality on unit values through its effect on the price elasticity and optimal markup of firms. The next section we explore a model of ideal variety in the spirit of Hummels and Lugovskyy (2009). In this section we outline a mechanism where as people become richer, more goods become indispensable in their consumption bundle. This decreases the price elasticity of these goods and thus raises its markup in an imperfect competition setting. We first consider the closed economy version of this model. We use the following Linear Hierarchic Expenditure System (LHES) utility function first proposed by Jackson (1982) to model this notion:[9]

$$
\begin{aligned}
U &= \sum_{j \in I} \beta_j \ln \left( q_j + \gamma_j \right) dj \\
q_j &= \left( \sum_{s=1}^{n_j} q_{sj}^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}}
\end{aligned}
\tag{13}
$$

$q_j$ is the demand for sector $j$ goods, $I$ is the endogenous set of sectors in which agents can consume. As income increases, agents extend this set. Preferences characterized by this utility function are similar to the more well-known Stone-Geary preferences, where the intercept terms $\gamma_j$ have a negative sign. Hence, in this model the intercept of the income expansion line with the vertical axis is negative. Therefore, as income rises, consumers extend their set of goods consumed. Lower tier utility is CES with substitution elasticity $\sigma$. There is monopolistic competition between a small group of identical firms $n_j$ producing each $q_{sj}$. Firm $s$ in sector $j$ has the following cost function

$$C\left(q_{sj}\right) = \left(a_j q_{sj} + f_j\right)$$

[9] There are again $L$ identical agents with each an amount of labor units $i$ as in the previous section.

As the upper tier utility function is separable and the lower tier utility function is homothetic, we can first optimize within each nest, construct a price index and maximize the upper tier utility using this price index (see Blackorby et al. (1998)). Demand within each sector is equal to:

$$q_{sj} = \frac{p_j^{\sigma-1}}{p_{sj}^{\sigma}} E_j;\; p_j = \left(\sum_{s=1}^{n_j} p_{sj}^{1-\sigma}\right)^{\frac{1}{1-\sigma}} \tag{14}$$

$p_j$ is the price index of composite $j$ and $E_j$ income spent on composite $j$, $E_j = p_j q_j$. Maximizing utility in (13) s.t. the budget constraint $\sum_j p_j q_j = i$ using Kuhn-Tucker, generates the following expression for demand $q_j$:[10]

$$q_j = \frac{\frac{\beta_j}{\sum_{j\in J}\beta_j}\left(i + \sum_{j\in J}\gamma_j p_j\right)}{p_j} - \gamma_j;\; j \in J \tag{15}$$

$J$ is the set of sectors in which agents consume positive amounts. The price elasticity of composite $j$, $\varepsilon_j$, can be derived easily from equation (15) as:

$$\varepsilon_j = 1 + \frac{\gamma_j}{q_j}\left(1 - \frac{\beta_j}{\sum_{j\in J}\beta_j}\right) \tag{16}$$

The number of firms within each sector $j$ is small. This implies that the price elasticity facing an individual firm is non constant. In Appendix B it is shown that the price elasticity of firm $s$ in sector $j$, $\varepsilon_{sj}$, is equal to:

$$\varepsilon_{sj} = \sigma\frac{n_j - 1}{n_j} + \frac{1}{n_j}\varepsilon_j \tag{17}$$

[10] See for derivation Appendix B .

Log differentiating this expression, we can show that the price elasticity facing firm $s$ in sector $j$ declines in income $i$ as follows (derivation in Appendix B):[11][12]

$$\widehat{\varepsilon_{sj}} = -\frac{n_j\left(\varepsilon_j - 1\right)\left(\varepsilon_{sj} - 1\right)}{n_j^2\left(\varepsilon_{sj} - 1\right)\varepsilon_{sj} + \varepsilon_j\left(\varepsilon_j - 1\right)}\eta_{q_j,i}\widehat{i} \tag{18}$$

With $\eta_{q_j,i}$ the income elasticity of demand, given by:

$$\eta_{q_j,i} = \frac{\beta_j i}{\beta_j i + \beta_j \sum\limits_{j\in J}\gamma_j p_j - \gamma_j p_j \sum\limits_{j\in J}\beta_j} \tag{19}$$

There is also an indirect effect of $i$ on $q_j$, when the budget set is extended which should be a part of the income elasticity. It is straightforward to show that this effect is 0 (derivation in Appendix B). Hence, given markup pricing, a higher income leads to a smaller price elasticity, a larger markup and a higher price:

$$\begin{aligned}\widehat{p_{sj}} &= -\frac{1}{\varepsilon_{sj} - 1}\widehat{\varepsilon_{sj}} \\ &= \frac{n_j\left(\varepsilon_j - 1\right)}{n_j^2\left(\varepsilon_{sj} - 1\right)\varepsilon_{sj} + \varepsilon_j\left(\varepsilon_j - 1\right)}\left(\frac{\beta_j i}{\beta_j i + \beta_j \sum\limits_{j\in J}\gamma_j p_j - \sum\limits_{j\in J}\beta_j\gamma_j p_j}\right)\widehat{i}\end{aligned}$$

Hence, we have derived the following result without imposing a free entry condition and thus valid in the short run:

**Proposition 3** *A larger income per capita leads to higher prices through a decrease in the*

[11] We do not take into account the effect of a change in income on the price elasticity through the possible change in the budget set and therefore in $\sum\limits_{j\in J}\beta_j$, as this effect only occurs in the border case that the consumption set changes. If there would be a continuum of sectors, this term would vanish, because $\varepsilon_j$ would be equal to $1 + \gamma_j/q_j$.

[12] $q_j$ is a function of the price $p_j$ and therefore a function of the price elasticity. We have to take this endogenous effect of a larger income into account: a larger income reduces the price elasticity which raises the price of individual firms, reducing sales and thus raising the price elasticity. This indirect effect reduces the effect of a higher income on the price elasticity.

*price elasticity of demand in the short run.*

To address the effects in the long run, we have to impose a free entry condition. This will endogenize the number of firms $n_j$. To solve for equilibrium sales $q_{sj}$ and number of firms $n_j$ in sector $j$, we start by combining markup pricing and zero profit to get to the following expression:

$$\left.\begin{array}{r} p_{sj} = \frac{\varepsilon_{sj}}{\varepsilon_{sj}-1} a_{sj} \\ p_{sj} q_{sj} = (a_{sj} q_{sj} + f_{sj}) \end{array}\right\} q_{sj} = (\varepsilon_{sj} - 1) \frac{f_{sj}}{a_{sj}} \tag{20}$$

In standard monopolistic competition models the model is closed by combining equation (20) with labor market equilibrium. As there is more than one sector and the uppertier utility function is non-homothetic, we have to take into account that the budget share of sector $j$ is not constant. Labor market equilibrium in sector $j$ is given by:

$$(a_{sj} q_{sj} + f_{sj}) n_j = \theta_j (i, p_1, ..., p_I) iL \tag{21}$$

With $\theta_j$ the share of labor used in sector $j$, being a function of prices in the different sectors and income, as demand is non-homothetic.

In an economy with non-constant budget shares across sectors (as with our Stone Geary upper nest preferences) with love for variety in each sector (as with our CES lower nest preferences), there are in general multiple equilibria (Francois and Nelson (2002)). The reason for multiple equilibria is that there are increasing returns to variety within each sector. We can find the equilibria by combining a demand equation, a supply equation with the expression for the price elasticity. Define the following supply equation from the definition of the sectoral price $p_j$, substituting equations (20) and (21)

$$p_j = n_j^{\frac{1}{1-\sigma}} p_{sj} = \left( \frac{\varepsilon_{sj} f_{sj}}{p_j q_j} \right)^{\frac{1}{\sigma-1}} a_{sj} \frac{\varepsilon_{sj}}{\varepsilon_{sj} - 1} \tag{22}$$

Combining equations (15)-(17) and (22) we can find a solution for $p_j$, $q_j$, $\varepsilon_j$ and $\varepsilon_{sj}$. To address the effect of a higher income on the price elasticity, we can log differentiate the same set of equations and solve the relative change in the price elasticity $\varepsilon_{sj}$ as a function of the relative change in income $i$. This exercise leads to the following result:[13]

$$\begin{aligned} \widehat{\varepsilon_{sj}} &= A \left( \sigma - \varepsilon_j - \frac{\varepsilon_j (\varepsilon_j - 1)}{(\sigma - \varepsilon_j)} \right) \eta_{q_j, i} \widehat{i} \\ A &= \frac{n_j (\varepsilon_{sj} - 1)}{\left( n_j^2 \sigma (\sigma - 1) + (n_j - 1) \sigma \varepsilon_j - \sigma (n_j \sigma - 1) + 2\varepsilon_j (\varepsilon_j - 1) \right)} \end{aligned} \tag{23}$$

As $n_j \geq 1$, $A$ is positive. The effect of income on the price elasticity depends upon the relative size of $\sigma$ and $\varepsilon_j$. There are two effects of a higher income. First, a direct effect of a higher income on the sectoral price elasticity. A higher income raises the quantity consumed in sector $j$ and thereby reduces the price elasticity facing the sector. This also reduces the price elasticity of individual firms. Second, a higher income increases the amount of resources allocated to sector $j$. This raises the number of firms in the sector and therefore increases the price elasticity. When $\sigma > \varepsilon_j$, the first effect seems to dominate the second effect. We can summarize our findings in the following proposition:

**Proposition 4** *In the long run the price elasticity of a good either rises or declines in income per capita $i$.*

[13] Derivations available upon request.

### 2.3.2 Open Economy

We assume like in the quality model that there are 2 countries that can trade freely. In this section we abstract from income inequality. Within each country agents are equal and countries only differ in the amount of labor units $i$ agents have in the two countries.

The demands facing firm $s$ (either producing in country $k$ or $l$) in sector $j$ in country $l$, $q_{sjl}$, is equal to:

$$q_{slj} = \frac{p_{lj}^{\sigma}}{p_{slj}^{\sigma}} q_{lj};\ p_{lj} = \left( \sum_{s=1}^{n_j} p_{slj}^{1-\sigma} \right)^{\frac{1}{1-\sigma}}$$

Firms are indifferent about production location, because of the absence of trade costs. There are henceforth no home market effects. As the price elasticity varies with income, firms will charge a different price in each market. The set of consumed goods is also country dependent. The price elasticity facing a firm selling in country $l$, $\varepsilon_{slj}$, is given by:

$$\varepsilon_{slj} = \sigma \frac{n_j - 1}{n_j} + \frac{1}{n_j} \varepsilon_{lj} = \sigma \frac{n_j - 1}{n_j} + \frac{1}{n_j} \left( 1 + \frac{\gamma_j}{q_{lj}} \right) \tag{24}$$

Log differentiating $\varepsilon_{slj}$ wrt the wage in country $l$, $w_l$ , we find like in the closed economy that the elasticity declines with the wage $w_l$:

$$\widehat{\varepsilon_{slj}} = -\frac{n_j \left( \varepsilon_{lj} - 1 \right) \left( \varepsilon_{slj} - 1 \right)}{n_j^2 \left( \varepsilon_{slj} - 1 \right) \varepsilon_{slj} + \varepsilon_{lj} \left( \varepsilon_{lj} - 1 \right)} \frac{\beta_j i_l}{\beta_j i_l + \beta_j \sum_{j \in J_l} \gamma_j p_{lj} - \gamma_j p_{lj} \sum_{j \in J_l} \beta_j} \widehat{i_l} \tag{25}$$

As a next step we can introduce free entry and impose a zero profit condition like in the closed economy. This will endogenize the number of firms $n_j$. The equilibrium conditions are derived in Appendix B. Using these equilibrium conditions, we could do comparative statics on the effect of an increase in income per capita $i_l$ in the importing country. Like in the closed economy, the effect of a larger income per capita in the importing country will generate two effects on the price in sector $j$: a direct effect through the uppernest price elasticity driving down the price elasticity and an indirect effect through the change in the amount of resources allocated to sector $j$ driving up the number of firms and thereby increasing the price elasticity. However, we can interpret the importing country as a small country if the exporting country is seen as the rest of the world. This will imply that the resource allocation effect is negligible and only the direct effect remains. This implies that $n_j$ in equation (B.17) does not change in response to a change in $i_l$. Hence, the change in price elasticity $\varepsilon_{sjl}$ is in the long run also given by equation (25). Therefore, we get the following result:

**Proposition 5** *An increase in income per capita $i_l$ in country $l$ that is small relative to the rest of the world leads to a lower price elasticity and a higher markup on imported goods.*

#### 2.3.3 Income Inequality

We now address the effect of changes in income inequality. There are $G$ income groups of equal group size with income $i_g$. Like above we consider the effect on importer unit values of country $l$, assuming that country $l$ is small. This implies that the long run effect is equal to the short run effect for the same reason as above in response to a change in income. Another way to interpret this assumption in terms of the empirical analysis performed is that we assume that total income is fixed and hence the amount of resources for sector $j$ does not change. As we control for total GDP in the empirical analysis, we can make that assumption that the amount of resources going to sector $j$ is fixed.[14]

Suppressing the country subscript $l$, total demand for sector $j$ goods in country $l$ is

[14] In the third model using the ideal variety approach, discussed below, we can theoretically express the separate effects of a change in total income, income per capita and income inequality on the price in a sector in one equation. Unfortunately this is not possible in the model of this section. We have to limit ourselves to calculating the effect of a change in income inequality on the price in a sector by holding the amount of resources going to the sector and income per capita fixed.

equal to:

$$q_j = \sum_{g=1}^{G} q_{jg} = \sum_{g=1}^{G} \frac{\frac{\beta_j}{\sum\limits_{j \in J_g} \beta_j} \left( i_g + \sum\limits_{j \in J_g} \gamma_j p_j \right) - \gamma_j p_j}{p_j} \tag{26}$$

Hence, $q_{jg}$ denotes individual demand in group $g$. Notice from equation (26) that there is only one price for the two income groups, as the product is identical and the market cannot be segmented between income groups. The price elasticity is a weighted sum of the price elasticities of the different income groups. Log differentiating equation (26) wrt the market price $p_j$ generates the following expression for the aggregate price elasticity $\varepsilon_j$:

$$\varepsilon_j = 1 + \frac{\gamma_j \sum\limits_{g=1}^{G} \left( 1 - \frac{\beta_j}{\sum\limits_{j \in J_g} \beta_j} \right)}{q_j} \tag{27}$$

To derive the effect of the Atkinson index on the price elasticity in equation (30), we first rewrite the expression for $q_j$ in equation (26) as follows:

$$q_j = \frac{1}{p_j} \sum_{g=1}^{G} f(i_g) - \gamma_j \tag{28}$$

$$f(i_g) = \frac{\beta_j}{\sum\limits_{j \in J_g} \beta_j} \left( w i_g + \sum_{j \in J_g} \gamma_j p_j \right) \tag{29}$$

Therefore, substituting the expression for the price elasticity, equation (27), can be written as:

$$\varepsilon_j = 1 + \frac{p_j \gamma_j \sum\limits_{g=1}^{G} \left( 1 - \frac{\beta_j}{\sum\limits_{j \in J_g} \beta_j} \right)}{\sum\limits_{g=1}^{G} f(i_g) - \gamma_j p_j} \tag{30}$$

We assume that changes through $\sum\limits_{j \in J_g} \beta_j$ in the denominator, the result of shifts in the set of goods consumed, can be neglected. As discussed above, with a continuum of sectors this assumption would be valid, as the terms $\frac{\beta_j}{\sum\limits_{j \in J_g} \beta_j}$ would vanish from the expression for the price elasticity. With this assumption, log differentiating equation (27), with $p_j$ treated as endogenous variable, gives:

$$\widehat{\varepsilon_j} = -\frac{\varepsilon_j - 1}{\varepsilon_j}\widehat{q_j} = -\frac{\varepsilon_j - 1}{\varepsilon_j}\left(-\varepsilon_j \widehat{p_j} + \frac{q_j + \gamma_j}{q_j}\widehat{\sum_{g=1}^{G} f\left(i_g\right)}\right) \tag{31}$$

Like in the subsection without inequality we can solve for the relative change of $\varepsilon_{ij}$ treating $p_j$ as endogenous (derivation in Appendix B):

$$\widehat{\varepsilon_{ij}} = -\frac{n_j\left(\varepsilon_{ij} - 1\right)\left(\varepsilon_j - 1\right)}{n_j^2 \varepsilon_{ij}\left(\varepsilon_{ij} - 1\right) + \varepsilon_j\left(\varepsilon_j - 1\right)} \frac{q_j + \gamma_j}{q_j}\widehat{\sum_{g=1}^{G} f\left(i_g\right)} \tag{32}$$

The final step is to show that the Atkinson index is monotone in $\sum\limits_{g=1}^{G} f\left(i_g\right)$ for given average income. To prove this we first observe that we have shown above that the indirect effect of changes in $i_g$ on $f\left(i_g\right)$ are zero, i.e. changes in $f\left(i_g\right)$ through changes in the other variables than $i_g$ featuring the expression for $f\left(i_g\right)$ are zero. See the discussion below equation (19) and the formal proof in Appendix B. With only the direct effect remaining, it is easy to see from equation (29) that $f\left(i_g\right)$ rises strictly concave in $i_g$. This implies that $\sum\limits_{g=1}^{G} f\left(i_g\right)$ decreases monotonically in the Atkinson index for given average income and the price elasticity thus rises in the Atkinson index. Therefore, we have proved the following result:[15]

[15] In a derivation available upon request, we address the effect of income inequality in the model of Simonovska (2009), that is similar to the model in this section, and we find that the effect of an increase in income inequality on markups is equal to the effect derived in our model: income inequality increases the average price elasticity and reduces markups and prices.

**Proposition 6** *For goods consumed by all income groups, an increase in income inequality as measured by an increase in the Atkinson index raises for given average income the price elasticity of demand and thus reduces the market price.*

As is clear from the proposition the derived result holds only when there is no change in the number of groups that consumes the good under consideration, we postpone a discussion of this point to the derivation of the effect of an increase in the mean preserving spread in the model with two income groups, to which we turn now.

There are 2 income groups with units of labor $i_H$ and $i_L$ and the number of these workers is respectively $H$ and $L$. We address the effect of an increase in the mean preserving spread, hence, we consider the effect of a change in $i_H$ with the corresponding change in $i_L$ equal to $\widehat{i_L} = -\frac{i_H}{i_L}\widehat{i_H}$.

Log differentiating (27) wrt $i_H$ imposing $\widehat{i_L} = -\frac{i_H H}{i_L L}\widehat{i_H}$, we find the following effect of an increase in the mean preserving income spread on the price elasticity:[16]

$$\widehat{\varepsilon_j} = -\frac{\varepsilon_j - 1}{\varepsilon_j}\frac{q_{j,H}H\eta_{q_{j,H},i_H} - q_{j,L}L\eta_{q_{j,L},i_L}\frac{i_H}{i_L}}{q_{j,H}H + q_{j,L}L}\widehat{i^H} \tag{33}$$

Equation (33) can be rewritten as follows:[17]

$$\widehat{\varepsilon_j} = -\frac{\varepsilon_j - 1}{\varepsilon_j}\left(\frac{1}{\sum\limits_{j\in J_H}\beta_j} - \frac{1}{\sum\limits_{j\in J_L}\beta_j}\right)\frac{\beta_j H i_H}{p_j q_j}\widehat{i^H} \tag{34}$$

Equation (34) shows that the price elasticity rises with income inequality, because $\sum\limits_{j\in J_H}\beta_j > \sum\limits_{j\in J_L}\beta_j$. Hence, the price declines in income inequality. This result can be explained as follows: from equation (27) the price elasticity of good $j$ is a function of the amount

[16] We abstract from the effect through the possible change in the budget set $J$, which is valid in the case of a continuum of sectors, see discussion above of this point.

[17] Derivation available upon request.

consumed of good $j$, $q_j$. When inequality goes up the demand by high income groups goes up and the demand by low income groups goes down. Because the income elasticity of low incomes is higher, the decline in demand for $q_j$ as a result of the smaller $i_L$ is larger than the increase in demand as a result of the higher $i_H$. Therefore, demand for $q_j$ goes down leading to a higher price elasticity.

Another way to understand this result is that an increase in income leads both to more consumption of each good $q_j$ and a larger consumption set. When inequality goes up holding constant average income, consumption becomes less comprised: the set of goods consumed rises and the amount consumed of each variety goes down. As a result the price elasticity goes up and firms can charge higher markups.

There is an important qualification to the finding that the market price declines in income inequality. When the low income group does not consume a certain commodity, the only effect of an increase in income inequality is that demand for that good rises as a result of the higher income of the high income group. This reduces the price elasticity and thus raises the market price. We summarize these results in the following proposition:

**Proposition 7** *In the model with only two income groups, for goods consumed only by the high income group, an increase in income inequality as measured by an increase in the mean preserving spread reduces the price elasticity and raises the market price*

How a change in the Atkinson index works out when not all income groups consume a good, cannot be determined analytically. To summarize, we find that for goods lower in the consumption hierarchy the effect of income inequality on market price through the elasticity channel is opposite to the effect of income inequality through the quality channel and for goods high in the consumption hierarchy the effect of income inequality on market price through the price elasticity channel has the same sign as the effect through the quality channel.

## 2.4 Ideal Variety Model

Hummels and Lugovskyy (2009) propose a different explanation for the fact that a higher income per capita in an importing country leads to a lower price elasticity and thus higher unit values. With higher incomes people are willing to pay more to get closer to their ideal variety. This makes them less price sensitive and the price elasticity is thus lower and firms can charge higher markups as people switch less easily between varieties. To differentiate their theory from the other theories in this paper, we adapt their model to address the effect of income inequality. As will be shown the price elasticity rises and the market price declines in income inequality. Hence, the effect of income inequality on the market price (and unit values) has the same sign as in the quality model but the opposite sign from the hierarchic demand model.

Hummels and Lugovskyy (2009) introduce an additional term in the distance compensation function to catch the effect of a higher finickyness (eagerness) to buy the ideal variety as income rises. In concrete, finickyness rises with the amount consumed. In Hummels and Lugovskyy (2009) agents consume only one variety, i.e. there is no upper nest with a Lancaster circle in the lower nest. A model with preferences over more products is not feasible in the model of Hummels and Lugovskyy (2009) as the upper nest optimization depends upon the amount consumed and thus upon the lower nest compensation function. Therefore, we adjust the Hummels and Lugovskyy (2009)-model by creating a Cobb Douglas uppernest and including a finickyness effect in the compensation function that is a function of total consumption, i.e. not only of consumption of the specific variety. In the setup of Hummels and Lugovskyy (2009), where people consume only one variety, our model leads to the same results as the model of Hummels and Lugovskyy (2009).

There are 2 countries identical in all aspects except income and income distribution. There are no trade costs, the setup is identical as in the other two models. In the exposition below country subscripts are omitted. We have the following preferences for consumption across sectors $j$:[18]

$$U = \sum_{j=1}^{J} \beta_j \ln u_j \tag{35}$$

$$u_j = \int\limits_{\omega_j \in \Omega_j} \frac{q_j}{h_j\left(\delta\left(\omega, \tilde{\omega}\right)\right)}$$

We specify the compensation function $h_j$ for the cost of being further away from the ideal variety as rising in total income $i$ and rising in distance $\delta$ from the ideal variety:

$$h_j\left(\delta, w\right) = 1 + i^v \delta^\psi;\ \ v < 1;\ \ \psi > 1 \tag{36}$$

It is easy to show that an increase in income leads to a higher indirect utility as long as $v < 1$ and therefore we impose this restriction on the model. There are $G$ different income groups with group $g$ having income $i_g$, like in the other two models. All income groups are distributed uniformly across the circle. The cost function for production of a variety $j$ is equal to:[19]

$$C\left(q_j\right) = a_j q_j + f_j$$

It is easy to show[20] that with this specification there exists a symmetric zero profit equilibrium like in Hummels and Lugovskyy (2009) with aggregate demand for any produced variety $q_j$ equal to:

$$q_j = d_j \sum_{g=1}^{G} i_g \frac{\beta_j}{p_j} \tag{37}$$

$d_j$ is the equal distance between any two varieties. The price elasticity facing a firm consists

[18] All derivations of this section are described in an annex, available upon request.

[19] As there are no trade costs and technologies are identical, firms are indifferent about production location.

[20] Derivations are analogue to the derivation in Hummels and Lugovskyy (2009) and in Helpman and Krugman (1985) and are available upon request

of two components, one with a direct effect of price on demand and the other with an effect through distance $d_j$, and is equal to:

$$\varepsilon_j = 1 + \frac{\sum_{g=1}^{G} i_g \left(1 + \frac{1}{i_g^v \left(\frac{d_j}{2}\right)^{\psi}}\right)}{2\psi \sum_{g=1}^{G} i_g} \tag{38}$$

This expression can be rewritten as a function of average income $\bar{i}$ and the Atkinson index $I_A(v)$:

$$\varepsilon_j = 1 + \frac{1}{2\psi} + \frac{1}{2\psi \left(\frac{d_j}{2}\right)^{\psi}} \frac{\left(1 - I_A(v)\right)^{1-v}}{\left(\bar{i}\right)^{v}} \tag{39}$$

As $v < 1$, an increase in the inequality as measured by the Atkinson index leads to a lower price elasticity and hence to a higher price for given distance $d_j$, as is clear when we log differentiate equation (39):

$$\widehat{\varepsilon_j} = -\frac{\varepsilon_j - 1 - \frac{1}{2\psi}}{\varepsilon_j} \left(\psi \widehat{d_j} + (1-v) \frac{I_A}{1 - I_A} \widehat{I_A} + v \widehat{\bar{i}}\right) \tag{40}$$

In the long run, when $n_j$ is endogenous, we add the following zero profit condition:

$$d_j = \frac{f \varepsilon_j}{\sum_{g=1}^{G} i_g \beta_j} \tag{41}$$

Log differentiating equation (41) and substituting into 40, we get for the long run change in the price elasticity:

$$\widehat{\varepsilon_j} = \frac{\varepsilon_j - 1 - \frac{1}{2\psi}}{(\psi + 1)\,\varepsilon_j - \psi - \frac{1}{2}} \left(\psi \widehat{G\bar{i}} - (1-v) \frac{I_A}{1 - I_A} \widehat{I_A} - v \widehat{\bar{i}}\right) \tag{42}$$

$G\bar{i}$ is total income, i.e. the number of agents times average income. Equation (42) shows the same effects as in Hummels and Lugovskyy (2009), i.e. a larger market raises $G\bar{i}$ the price elasticity and a larger income per capita $\bar{i}$ reduces the price elasticity. But there is an additional determinant of the price elasticity now: a higher level of inequality as measured by a higher Atkinson index $I_A$ leads to a lower price elasticity. Notice that the effect is stronger in the long run, because of the endogenous response in the number of firms (distance between firms). We summarize our findings in the following proposition:

**Proposition 8** *In the ideal variety model of Hummels and Lugovskyy (2009) an increase in income inequality as measured by an increase in the Atkinson index causes a decrease in the price elasticity of demand and an increase in the market price.*

We also derive the effect of a larger income inequality with two income groups to provide some intuition for our results. We log differentiate equation (38) with two income groups wrt $i_H$ and $i_L$ with the condition $\widehat{i_L} = i_H H / i_L L \widehat{i_H}$ and keeping the number of firms $n_j$ and hence distance $d_j$ fixed, generating the following result:

$$\widehat{\varepsilon_j} = \frac{\varepsilon_j - 1}{\varepsilon_j} \frac{\frac{i_H H}{\left(\frac{d_j}{2}\right)^{\psi}} (1-v) \left( \left(\frac{1}{i_H}\right)^{v} - \left(\frac{1}{i_L}\right)^{v} \right)}{i_H H \left(1 + \frac{1}{i_H^{v} \left(\frac{d_j}{2}\right)^{\psi}}\right) + i_L L \left(1 + \frac{1}{i_L^{v} \left(\frac{d_j}{2}\right)^{\psi}}\right)} \widehat{i_H} \tag{43}$$

As $i_H > i_L$ and $v < 1$, an increase in the mean preserving spread reduces the price elasticity and hence increases the market price. Taking into account equation (41), we find that also in the long run the price elasticity decreases when the mean preserving spread rises:

$$\widehat{\varepsilon_j} = \frac{\frac{i_H H}{\left(\frac{d_j}{2}\right)^{\psi}} (1-v) \left( \left(\frac{1}{i_H}\right)^{v} - \left(\frac{1}{i_L}\right)^{v} \right)}{\frac{\varepsilon_j}{\varepsilon_j - 1} \left( i_H H \left(1 + \frac{1}{i_H^{v} \left(\frac{d_j}{2}\right)^{\psi}}\right) + i_L L \left(1 + \frac{1}{i_L^{v} \left(\frac{d_j}{2}\right)^{\psi}}\right) \right) + \frac{i_L^{1-v} L + i_H^{1-v} H}{\left(\frac{d_j}{2}\right)^{\psi}}} \widehat{i_H} \tag{44}$$

The result that an increase in income inequality reduces the overall price elasticity can be explained as follows. The overall price elasticity is a weighted average of the price elasticity of the high and the low income group. An increase in the mean preserving spread increases the price elasticity of the low income group and decreases the price elasticity of the high income group. On net this leads to a higher price elasticity. But the weights also change: the weight of the low price elasticity of the high income group rises, whereas the weight of the high price elasticity of the low income group drops. This weights effect dominates the effect on the price elasticity of the different groups and as a result the overall elasticity increases. The weights effect dominates the change in the price elasticities of the different income groups when $v < 1$. We assumed that $v < 1$: it guarantees that indirect utility rises in income. $v$ measures the effect of income on the cost of distance in the compensation function. This makes clear that $v < 1$ puts a cap on the second effect through the changes in the price elasticity of the different income groups.

## 3 Data and Estimation Method

We now turn to an empirical analysis of the impact of income and income inequality on unit values. More precisely, we examine how the price of imported disaggregated product categories change with the income, income per capita and income inequality of the importer country.

In our empirical analysis we proxy prices with import unit values. The data we use for unit values come from the BACI database [21] which contains quantity and the value of bilateral imports in 6-digit Harmonized System (HS) classification. The database is based on COMTRADE (Commodities Trade Statistics database) and it covers more than 200 countries and 5,000 products. We select those product categories which are used for final consumption. This is done by going through each HS6 category and choosing those

[21] http://www.cepii.fr/anglaisgraph/bdd/baci/baciwp.pdf

products which are used for final consumption only and not for intermediate consumption. We identify 1260 product lines as final consumption goods out of 5703 product lines (the remaining products are used for intermediate consumption mostly as inputs into further production or could be used both for intermediate and final consumption).We use data for the period between 2000-2004. We deflate unit value data by importer country's gdp deflator. BACI takes advantage of the double information on each trade flow to fill out the matrix of bilateral world trade providing a "reconciled' value for each flow reported at least by one of the partners. Therefore the missing values in BACI are those concerning trade between non reporting countries.

Our income and income per capita data originate from the World Bank's World Development Indicator database. We use constant GDP and GDP per capita data. We also use a measure of income inequality in our regressions. To measure income inequality we constructed an Atkinson index. The data mainly come from the World Banks' World Development Indicator. We supplemented this data with data from Eurostat and from the Luxembourg Income Study.[22]

We employ a fixed effects analysis based upon the theoretical model in this paper, hence including income, income per capita and income inequality as explanatory variables of import prices. We include exporter-time-product specific fixed effects and importer-exporter-product fixed effects to control for unobserved heterogeneity in exporter characteristics like in Schott (2004) and in price measures of different product categories. The importer-exporter-product fixed effect contains an importer time invariant fixed effect. The explanatory variables

$$P_{kltj} = e_{ktj} b_{klj} f(Y_{lt}, Y_{lt}/L_{lt}, A_{lt}) \varepsilon_{kltj} \tag{45}$$

[22]http://www.lisproject.org/ As a robustness check we run our regressions using inequality data only form the World Bank's dataset and we obtained similar results.

In equation (45) the subscript $k$ stands for exporter, $l$ for importer, $j$ for product, and $t$ for time. $e_{ktj}$ captures any exporter-time-product specific effect on prices. $b_{klj}$ captures bilateral country-pair-product specific influences. $f$ is a non-linear function. In the three theoretical models, unit values are a non-linear function of per capita income, $Y/L_{kt}$, income inequality as measured by the Atkinson coefficient, $A_{lt}$, and total income, $Y_{lt}$ (in the ideal variety model) . These variables have their effects through the different channels mentioned in the theory section, so both through exporter destination specific variations in quality and in markups.

We approximate the non-linear function $f$ by a log-linear function which allows us to write log import prices as follows:

$$\ln P_{kltj} = \ln e_{ltj} + \ln b_{klj} + \beta_1 lnY_{lt} + \beta_2 lnY_{lt}/L_{lt} + \beta_3 lnA_{lt} + \ln \varepsilon_{kltj} \tag{46}$$

As a robustness check we also estimate a second order logarithmic approximation, i.e. including squares of logs and interaction terms in equation (46). We estimate equation (46) over the period 2000-2004 and we report estimation results in the next section.[23]

## 4 Empirical Results

Table 1 presents the results of OLS estimation of equation (46) using this sample containing only goods destined for final consumption. The specification includes exporter-product-time and importer-exporter-product fixed effects which we did given the big number of fixed effects by calculating deviations from means. Since our main variables of interest are

[23] The two way fixed effects model is estimated by taking the proper deviation from means, i.e. convert observation $z_{kltj}$ into $\widetilde{z}_{kltj} = z_{kltj} - \frac{1}{N_{ktj}} \sum_{l=1}^{N} z_{kltj} s_{kltj} - \frac{1}{T_{klj}} \sum_{t=1}^{T} z_{kltj} z_{kltj} + \frac{1}{(NT)_{kj}} \sum_{l=1}^{N} \sum_{t=1}^{T} z_{kltj} s_{kltj}$, with $N_{ktj} = \sum_{l=1}^{N} s_{kltj}$ is the number of non-zero observations for exporter $k$, period $t$ and sector $j$ and $T_{klj}$ and $(NT)_{kj}$ are defined accordingly.

importer-time-product specific we are not able to include fixed effects for this dimension instead we cluster by importer-product-time.

| | LUV |
|---|---|
| LGDP | -0.081 |
| | (0.003)*** |
| LGDPcp | 0.481 |
| | (0.004)*** |
| Latkinson | -0.466 |
| | (0.007)*** |
| Observations | 3941179 |
| Chi2 | 44302.32 |
| Prob > Chi2 | 0.000 |

Standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
The specification include exporter-product-time and importer-exporter-product fixed effects

Table 1: Fixed-effects OLS estimates

The empirical results presented in Table 1 provide support for the two models in this paper and the circle model in Hummels and Lugovskyy (2009): unit values rise in importer income per capita. The results also confirm the findings of Hummels and Lugovskyy (2009) that a larger market size of the importer as proxied by total GDP reduces unit values. The size of the effect of income per capita on unit values is very close to the 0.5 coefficient found by Hummels and Lugovskyy (2009). On the other hand we find a smaller impact of total income on unit values than those found by Hummels and Lugovskyy (2009). While our coefficient is around -0.08 Hummels and Lugovskyy (2009) obtained a weighted average coefficient which is larger, -0.5. This difference might partly come from the different sample we use. We have a sample containing a much wider range of exporter countries (we have 115 exporters) which includes not only high-income countries while the dataset used by Hummels and Lugovskyy (2009) come from the Eurostat's Trade Database and contains data of 11 EU exporters and 200 importers worldwide.

To discriminate between the different theories, we also estimated the effect of income inequality in the importer country on unit values. We find a highly significant negative effect of income inequality on unit values. This finding provides support for the hierarchic demand model, that predicts a lower import price in response to higher inequality. The quality model with utility rising in quality and the ideal variety model both predict a positive effect of inequality on import prices. We conclude that the empirical findings do not falsify the quality and ideal variety model but they do indicate that these models have to be combined with a hierarchic demand model, where import price decline in income inequality.

## 5 Concluding Remarks

In this paper we modeled three channels to account for the empirical finding that unit values (trade prices) rise in importer income per capita. On the one hand we modeled the increasing demand for quality at higher levels of income by utility expanding both in quality and quantity. At higher levels of income, consumers demand a higher level of quality and with marginal costs rising in quality this leads to higher prices. On the other hand we modeled the endogenous response of markups on income per capita in two different models. We used a hierarchic demand system to model the notion that with a larger consumption set at higher levels of income, goods lower in the hierarchy become more necessary/indispensable in the consumption set and therefore people are willing to pay a higher price for these goods. We applied the ideal variety model in the spirit of Hummels and Lugovskyy (2009) to model the idea that at higher income levels consumers are more eager to consume their ideal variety (more finicky) and are therefore willing to pay a larger markup.

Empirically, we found strong support for the theoretical predictions: an increase in importer income per capita by 1% raises importer unit values by 0.48%. By addressing the effect of income inequality on unit values, we find a way to discriminate between the different channels. Operationalizing income inequality with the Atkinson index, we find that unit values of trade decline in income inequality of the importer country. This negative effect is predicted by the hierarchic demand model as derived in the theoretical section, whereas it is shown that the quality expansion model and the ideal variety model predict a positive effect of higher income inequality on unit values which is rejected by our regression results.

These findings do not invalidate the ideal variety model and the quality expansion model. They do show the importance of the hierarchic demand model: a larger demand for quality and an increased finickyness with higher levels of income can still be part of the story, but these channels have to be at least accompanied by the channel present in the hierarchic demand model with an increased willingness to pay for necessary goods as consumers become richer.

The research in this paper can be extended in various interesting directions. First, it would be interesting to elaborate on the welfare implications of the finding that price differences across markets are driven partly by differences in markups. Do varying markups across markets raise welfare, because they lead to more resources to develop varieties or do they generate excessive distortionary market power? The models presented in this paper present a framework to address this question. The answer to this question also has implications for the welfare effects of the regulation of parallel imports. Second, we can include in the hierarchic demand model the condition that agents have to consume at least one unit of a good. The implication will be that it might be ideal for a firm to sell a good below its markup price, as otherwise the good will not be consumed at all. This would add further realism to the model, as in the real world for many goods one has to consume at least one unit (laptops, mobile phones). Third, we can use the hierarchic demand system to model the effect of higher world income per capita and a larger world economy on the availability of different varieties and the price of different varieties. In the current model the market size effect is switched off by assuming that the importing country is small relative to the rest of the world.

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**Annex Table A.1: Sample countries**

| | | |
|---|---|---|
| Albania | Guatemala | Nepal |
| Argentina | Guyana | New Zealand |
| Austria | Hong Kong, China | Pakistan |
| Burundi | Honduras | Panama |
| Benin | Croatia | Peru |
| Bangladesh | Haiti | Philippines |
| Bulgaria | Hungary | Papua New Guinea |
| Belgium-Luxembourg | Indonesia | Poland |
| Bolivia | India | Portugal |
| Brazil | Ireland | Paraguay |
| Canada | Iran, Islamic Rep. | Romania |
| Switzerland | Israel | Russian Federation |
| Chile | Italy | Senegal |
| China | Jamaica | Singapore |
| Cote d'Ivoire | Jordan | El Salvador |
| Cameroon | Kenya | Slovak Republic |
| Colombia | Korea, Rep. | Slovenia |
| Costa Rica | Sri Lanka | Sweden |
| Czech Republic | Lithuania | Thailand |
| Germany | Latvia | Tunisia |
| Denmark | Morocco | Turkey |
| Dominican Republic | Madagascar | Tanzania |
| Ecuador | Mexico | Uganda |
| Egypt, Arab Rep. | Mali | Ukraine |
| Spain | Malawi | Uruguay |
| Estonia | Malaysia | United States |
| Finland | Nigeria | Venezuela |
| United Kingdom | Nicaragua | South Africa |
| Ghana | Netherlands | Zambia |
| Greece | Norway | Zimbabwe |

# Appendix A Nesting the Quality and Hierarchic Demand Model

$L$ consumers have the following identical utility function:

$$U = \sum_{j=0}^{\infty} \beta_j \ln\left(c_j + \gamma_j\right)$$
$$c_j = \left(\sum c_{sj}^{\frac{\sigma-1}{\sigma}}\right)^{\frac{\sigma}{\sigma-1}}$$
$$c_{sj} = \left(\delta_q q_{sj}^{\frac{\rho-1}{\rho}} + \delta_\alpha \alpha_{sj}^{\frac{\rho-1}{\rho}}\right)^{\frac{\rho}{\rho-1}}$$

$U$ is maximized subject to the following budget constraint:

$$\sum_{j=1}^{J} \sum_{s_j=1}^{n_j} p_{sj} q_{sj} = i$$

Production is increasing returns to scale with the following identical cost function for all producers within each sector $j$:

$$c\left(q_{sj}, \alpha_{sj}\right) = \left(\alpha_{sj}^{\gamma}\right) a_j q_{sj} + f_j$$

There is monopolistic competition between producers of varieties $j$. To solve the model outlined, one has to determine a zero profit Nash equilibrium that solves for the set of goods in the consumption set, $J$, the number of commodities produced within each set of goods, $n_j$, and the level of quality and quantity produced, $\alpha_{sj}$ and $q_{sj}$. This model is not analytically solvable. Still, the two models discussed in the main text can be seen as nested cases of this more general model. For the quality model, we choose the following parameters:

$$
\begin{aligned}
\delta_q &= \delta_\alpha = 1 \\
f_{sj} &= 0 \\
\sigma &\to \infty \\
\gamma_j &\to \infty; \ \forall j
\end{aligned}
$$

For the hierarchic demand model, we fix the parameters as follows:

$$
\begin{aligned}
\gamma &= 0 \\
\delta_\alpha &= 0
\end{aligned}
$$

# Appendix B Hierarchic Demand Model

Some of the equations below are based upon rather lengthy derivations. A separate document, available upon request, contains the detailed derivations of these equations.

## Appendix B.1 Basics

Maximize utility in (13) s.t. the budget constraint $\sum_j p_j q_j = i$ using Kuhn-Tucker. This generates the following (rewritten) first order conditions:

$$q_j \left( \frac{\beta_j}{q_j + \gamma_j} - \lambda p_j \right) = 0;\ j \in I \tag{B.1}$$

$$\left.\begin{array}{r} \frac{\beta_j}{q_j+\gamma_j} = \lambda p_j \\ q_j \geq 0 \end{array}\right\} j \in J \tag{B.2}$$

$$\left.\begin{array}{r} \frac{\beta_j}{\gamma_j} < \lambda p_j \\ q_j = 0 \end{array}\right\} j \in K \tag{B.3}$$

$J$ is the set of goods that are consumed, $K$ is the set of goods that are not consumed. The set of goods consumed $J$ is determined by the following condition:

$$j \in J \text{ if } \exists p_j \text{ s.t. } \beta_j/\gamma_j > \lambda p_j \text{ and } \pi_j \left(p_j, n_j = 1\right) > 0$$

With $\pi_j \left(p_j, n_j = 1\right)$ the profit of a monopolist in sector $j$ with a price of $p_j$. Hence, the condition for a good to be in the consumption set is that there is a price $p_j$ such that the marginal utility of the good at a consumption level of 0 is larger than this price and that with this price a monopolist can make positive profit.

Rearranging equation (B.2) and substituting back into the budget constraint generates an expression for $\lambda$:

$$\lambda = \frac{\sum\limits_{j \in J} \beta_j}{i + \sum\limits_{j \in J} \gamma_j p_j} \tag{B.4}$$

Substituting equation (B.4) into equation (B.2), gives the expression for demand $q_j$, equation (15) in the main text.

To calculate the price elasticity facing firm $s$ in sector $j$, we rewrite demand facing firm $i$ in sector $j$ substituting $E_j = p_j q_j$:

$$q_{sj} = \frac{p_j^\sigma}{p_{sj}^\sigma} q_j$$

Log differentiating this equation we get:

$$\widehat{q_{ij}} = \sigma \left(\widehat{p_j} - \widehat{p_{sj}}\right) + \varepsilon_j \widehat{p_j} \tag{B.5}$$

Using the expression for the price index $p_j$ in equation (14) we get for $\widehat{p_j}$:

$$\widehat{p_j} = \frac{p_{sj}^{1-\sigma}}{\sum\limits_{s=1}^{n_j} p_{sj}^{1-\sigma}} \widehat{p_{sj}} = \frac{1}{n_j} \widehat{p_{sj}} \tag{B.6}$$

Substituting back in into equation (B.5) gives equation (17) in the main text.

To derive equation (18), we start by log differentiating $\varepsilon_{sj}$ wrt $\varepsilon_j$ from equation (17):

$$\widehat{\varepsilon_{sj}} = \frac{\varepsilon_j}{n_j \varepsilon_{sj}} \widehat{\varepsilon_j} \tag{B.7}$$

Next log differentiate the price index $\varepsilon_j$ with respect to demand $q_j$:

$$\widehat{\varepsilon_j} = -\frac{\varepsilon_j - 1}{\varepsilon_j} \widehat{q_j} \tag{B.8}$$

Log differentiating $q_j$ wrt income $i$ and price $p_j$ gives:

$$\widehat{q_j} = -\varepsilon_j \widehat{p_j} + \eta_{q_j,i} \widehat{i} \tag{B.9}$$

Log differentiating the markup pricing rule, we get:

$$\widehat{p_{sj}} = -\frac{1}{\varepsilon_{sj} - 1}\widehat{\varepsilon_{sj}} \tag{B.10}$$

Combining equations (B.6)-(B.10) gives:

$$\begin{aligned}
\widehat{\varepsilon_{sj}} &= \frac{\varepsilon_j}{n_j \varepsilon_{sj}} \left( -\frac{\varepsilon_j - 1}{\varepsilon_j} \left( -\varepsilon_j \widehat{p_j} + \eta_{q_j,i} \widehat{i} \right) \right) \\
&= \frac{\varepsilon_j - 1}{n_j \varepsilon_{sj}} \left( \varepsilon_j \widehat{p_j} - \eta_{q_j,i} \widehat{i} \right) \\
&= \frac{\varepsilon_j - 1}{n_j \varepsilon_{sj}} \left( \varepsilon_j \frac{1}{n_j} \left( -\frac{1}{\varepsilon_{sj} - 1} \widehat{\varepsilon_{sj}} \right) - \eta_{q_j,i} \widehat{i} \right) \\
&= -\frac{\varepsilon_j \left( \varepsilon_j - 1 \right)}{n_j^2 \varepsilon_{sj} \left( \varepsilon_{sj} - 1 \right)} \widehat{\varepsilon_{sj}} - \frac{\varepsilon_j - 1}{n_j \varepsilon_{sj}} \eta_{q_j,i} \widehat{i}
\end{aligned}$$

$$\begin{aligned}
\widehat{\varepsilon_{sj}} \left( 1 + \frac{\varepsilon_j \left( \varepsilon_j - 1 \right)}{n_j^2 \varepsilon_{sj} \left( \varepsilon_{sj} - 1 \right)} \right) &= -\frac{\varepsilon_j - 1}{n_j \varepsilon_{sj}} \eta_{q_j,i} \widehat{i} \\
\widehat{\varepsilon_{sj}} \left( \frac{n_j^2 \varepsilon_{sj} \left( \varepsilon_{sj} - 1 \right) + \varepsilon_j \left( \varepsilon_j - 1 \right)}{n_j^2 \varepsilon_{sj} \left( \varepsilon_{sj} - 1 \right)} \right) &= -\frac{\varepsilon_j - 1}{n_j \varepsilon_{sj}} \eta_{q_j,i} \widehat{i} \\
\widehat{\varepsilon_{ij}} &= -\frac{n_j \left( \varepsilon_{sj} - 1 \right) \left( \varepsilon_j - 1 \right)}{n_j^2 \varepsilon_{sj} \left( \varepsilon_{sj} - 1 \right) + \varepsilon_j \left( \varepsilon_j - 1 \right)} \eta_{q_j,i} \widehat{i} \qquad \text{(B.11)}
\end{aligned}$$

*The effect of a higher income $i$ on demand for good $j$, $q_j$, through a change in the consumption set $J$*

We calculate the effect of income $i$ on $q_j$ through a change in the consumption set. $q_j$ is equal to:

$$q_j = \frac{\frac{\beta_j}{\sum\limits_{j \in J} \beta_j} \left( i + \sum\limits_{j \in J} \gamma_j p_j \right)}{p_j} - \gamma_j$$

The change in $q_j$ due to a change in the budget set $J$ is equal to:

$$\begin{aligned}
dq_j &= \frac{\frac{\beta_j}{\sum\limits_{j\in J}\beta_j+\beta_{J+1}}\left(i+\sum\limits_{j\in J}\gamma_j p_j+\gamma_{J+1}p_{J+1}\right)}{p_j}-\frac{\frac{\beta_j}{\sum\limits_{j\in J}\beta_j}\left(i+\sum\limits_{j\in J}\gamma_j p_j\right)}{p_j}\\
&=\frac{\beta_j}{p_j}\left[\frac{\sum\limits_{j\in J}\beta_j}{\sum\limits_{j\in J}\beta_j+\beta_{J+1}}\left(\frac{1}{\sum\limits_{j\in J}\beta_j}\left(i+\sum\limits_{j\in J}\gamma_j p_j+\gamma_{J+1}p_{J+1}\right)\right)-\frac{i+\sum\limits_{j\in J}\gamma_j p_j}{\sum\limits_{j\in J}\beta_j+\beta_{J+1}}\right]\\
&=\frac{\beta_j}{p_j}\left[\frac{i+\sum\limits_{j\in J}\gamma_j p_j}{\sum\limits_{j\in J}\beta_j}\left(\frac{\sum\limits_{j\in J}\beta_j}{\sum\limits_{j\in J}\beta_j+\beta_{J+1}}-1\right)+\frac{\gamma_{J+1}p_{J+1}}{\sum\limits_{j\in J}\beta_j+\beta_{J+1}}\right]\\
&=\frac{\beta_j}{p_j}\left[-\frac{1}{\lambda}\frac{1}{\frac{\sum\limits_{j\in J}\beta_j}{\beta_{J+1}}+1}+\frac{1}{\frac{\sum\limits_{j\in J}\beta_j}{\gamma_{J+1}p_{J+1}}+\frac{\beta_{J+1}}{\gamma_{J+1}p_{J+1}}}\right]\\
&=\frac{\beta_j}{p_j}\left[-\frac{1}{\lambda}\frac{1}{\frac{\sum\limits_{j\in J}\beta_j}{\beta_{J+1}}+1}+\frac{1}{\frac{\sum\limits_{j\in J}\beta_j}{\beta_{J+1}}\lambda+\lambda}\right]\\
&=0
\end{aligned}$$

Hence, the change in demand $q_j$ through a change in the budget set is zero, in contrast to what Jackson (1982) claims.

## Appendix B.2 Open Economy

We derive the equilibrium equations for long run equilibrium in the open economy. As there are no trade costs, one can only determine the total number of firms in sector $j$ and not where the firms are located. To determine equilibrium, we define a supply equation for both countries (as prices are different) and a demand equation for total demand for sector

$j$. The supply equations start from the pricing equations $p_{jk}$ and $p_{jl}$:

$$p_{kj} = n_j^{\frac{1}{1-\sigma}} \frac{\varepsilon_{skj}}{\varepsilon_{skj} - 1} a_{sj} \phi_k w_k \tag{B.12}$$

$$p_{lj} = n_j^{\frac{1}{1-\sigma}} \frac{\varepsilon_{slj}}{\varepsilon_{slj} - 1} a_{sj} \phi_l w_l \tag{B.13}$$

Next, we need to define an equation defining relative demand in the two countries:

$$A_{lkj} = \frac{q_{slj}}{q_{skj}} = \frac{q_{lj}}{q_{kj}} \tag{B.14}$$

The zero profit condition for a firm producing in sector $j$ in country $k$ can be expressed as follows:

$$\frac{q_{skj}}{\varepsilon_{skj} - 1} + \frac{q_{skj} A_{lkj}}{\varepsilon_{slj} - 1} = \frac{f_{sj}}{a_{sj}} \tag{B.15}$$

And labor market equilibrium in sector $j$ (for both countries together) can be written as:

$$\left(a_{sj}\left(q_{skj} + q_{slj}\right) + f_{sj}\right) n_j = \theta_j \left(\phi_k L_k + \phi_l L_l\right) \tag{B.16}$$

$\theta_j$ is the share of income spent in sector $j$. Solving for $n_j$ from equation (B.16) using equation (B.15), we get:

$$n_j = \frac{\theta_j \left(\phi_k L_k + \phi_l L_l\right)}{f_{ij}} \frac{\frac{1}{\varepsilon_{skj}-1} + \frac{A_{lkj}}{\varepsilon_{slj}-1}}{\frac{1}{\varepsilon_{skj}-1} + \frac{A_{lkj}}{\varepsilon_{slj}-1}} \tag{B.17}$$

From the demand side $s_j$ is equal to:

$$s_j = \frac{p_{kj} q_{kj} L_k + p_{lj} q_{lj} L_l}{\phi_k L_k + \phi_l L_l} \tag{B.18}$$

With

$$q_{kj} = \frac{\frac{\beta_j}{\sum\limits_{j \in J_k} \beta_j} \left( w_k + \sum\limits_{j \in J_k} \gamma_j p_{kj} \right)}{p_{kj}} - \gamma_j \tag{B.19}$$

$$q_{lj} = \frac{\frac{\beta_j}{\sum\limits_{j \in J_l} \beta_j} \left( w_l + \sum\limits_{j \in J_l} \gamma_j p_{lj} \right)}{p_{lj}} - \gamma_j \tag{B.20}$$

To complete characterization of equilibrium, we need an equation for the price elasticity of sales in country $k$, similar to the expression for the price elasticity for sales in country $l$, equation (24):

$$\varepsilon_{skj} = \sigma \frac{n_j - 1}{n_j} + \frac{1}{n_j} \varepsilon_{kj} = \sigma \frac{n_j - 1}{n_j} + \frac{1}{n_j} \left( 1 + \frac{\gamma_j}{q_{kj}} \right) \tag{B.21}$$

A solution of the model can be found by combining equations (24), (B.12), (B.13), (B.14), (B.17), (B.18), (B.19), (B.20) and (B.21) to solve for $\varepsilon_{skj}$, $\varepsilon_{slj}$, $p_{jk}$, $p_{jl}$, $A_{lkj}$, $n_j$, $\theta_j$, $q_{kj}$ and $q_{lj}$.

Assuming that the importing country $l$ is small relative the rest of the world (country $k$), corresponds with the technical assumption that $A_{lkj}$ is negligble. Therefore a change in income in country $l$ does not affect the number of firms $n_j$ in equation (B.17).

## Appendix B.3 Income Inequality

Equation (32) can be derived by starting from equation (31):

$$\widehat{\varepsilon_j} = -\frac{\varepsilon_j - 1}{\varepsilon_j} \left( -\varepsilon_j \widehat{p_j} + \frac{q_j + \gamma_j}{q_j} \widehat{\sum_{g=1}^{G} f(i_g)} \right) \tag{B.22}$$

Combining equation (B.22) with (B.6), (B.7), (B.8), (B.10) gives us:

$$\widehat{\varepsilon_{sj}} = \frac{\varepsilon_j}{n_j \varepsilon_{sj}} \left( -\frac{\varepsilon_j - 1}{\varepsilon_j} \left( -\varepsilon_j \widehat{p_j} + \frac{q_j + \gamma_j}{q_j} \widehat{\sum_{g=1}^{G} f\left(i_g\right)} \right) \right)$$

Going through the same steps as to derive (B.11), we arrive at:

$$\widehat{\varepsilon_{sj}} = -\frac{n_j \left(\varepsilon_{sj} - 1\right)\left(\varepsilon_j - 1\right)}{n_j^2 \varepsilon_{sj} \left(\varepsilon_{sj} - 1\right) + \varepsilon_j \left(\varepsilon_j - 1\right)} \frac{q_j + \gamma_j}{q_j} \widehat{\sum_{g=1}^{G} f\left(i_g\right)}$$