Import Prices, Income, and Inequality*

Eddy Bekkers  
*University of Linz*  
Joseph Francois  
*University of Linz & CEPR*  
Miriam Manchin  
*University College London*

ABSTRACT: We compare three theoretical explanations for the positive empirical relationship between importer income per capita and traded goods prices. A first explanation is that consumers with higher incomes demand higher quality goods with higher prices. A second explanation is that wealthier people exhibit an increased willingness to pay for necessary goods as more goods enter the consumption set in a hierarchic demand system, and can thus be charged higher markups. A third explanation is that consumers with higher incomes are more finicky regarding their preferred variety in an ideal variety framework and can thus be charged higher markups. We discriminate between these three theories by focusing on the effect of income inequality on trade prices. Based on a large dataset with bilateral HS6 level data on 1260 final goods categories from more than 100 countries between 2000 and 2004, we find a highly significant negative effect of income inequality on unit values. This contradicts both the demand for quality and finickyness theories, while providing support for the increased willingness to pay theory linked to hierarchic demand. These findings on income inequality do not falsify the quality expansion model and the ideal variety model per se. However, the results do argue for place of importance of hierarchic demand.

*Keywords:* Unit Values, Importer Characteristics, Quality Expansion, Hierarchic Demand, Ideal Variety

*JEL codes:* F12

This version: 25th July 2011

---

*Thanks are due to participants at sessions of the ETSG, Midwest Trade Meetings, and the GTAP conference, and two anonymous Referees. Address for correspondence: Eddy Bekkers, Johannes Kepler University of Linz, Department of Economics, Altenbergerstr. 69, 4040 Linz, Austria. email: eddybekkers@gmail.com*
1 Introduction

The prices of traded goods vary systematically with the characteristics of exporting countries, like the income and factor abundance of exporting countries (Schott 2004). Prices also vary with importer characteristics, like income per capita and market size (Hummels and Lugovskyy 2009, and Simonovska 2010). In this paper we focus on the relationship between import prices, income per capita, and inequality. We compare and test three different theoretical frameworks to explain the documented rise in prices associated with higher importer income per capita. We discriminate between them by examining the effect of income inequality on unit values of trade. Along a first channel, consumers with higher incomes demand greater quality goods in a setup 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 system, similar to the mechanism proposed by Simonovska (2010). The third channel features consumer preference for ideal varieties, similar to Hummels and Lugovskyy (2009).

Our contributions follow from identifying analytical differences between the different theoretical explanations that allow us to collectively confront their predictions with the data. Based on a large dataset with bilateral HS6 level data on 1260 final goods categories from more than 100 countries, we find that unit values rise significantly with importer income per capita, confirming the findings in Hsieh and Klenow (2007), Hummels and Lugovskyy (2009), Simonovska (2010) and Alessandria and Kaboski (2011). Indeed this is consistent with all three theoretical explanations stressed in the literature. However, we also find that trade prices decline with income inequality (measured by the Atkinson index). These results contradict the quality and ideal variety models and provide support for the price elasticity mechanism linked to hierarchic demand. This finding on income inequality does not falsify the quality expansion model and the

---

1 Various authors have addressed the effect of income inequality in importing countries on the patterns of trade. 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. Fajgelbaum, Grossman and Helpman (2009) also study the effect of income inequality on the patterns of trade in a model featuring demand for quality. These papers do not explore the effect of income inequality on unit values of trade. Choi, Hummels and Xiang (2009) examine empirically the link between income distribution of the importer country and the price distribution of import prices, applying the theoretical model of Flam and Helpman (1987). Our approach is distinct from these because we focus on the effect of average income and inequality on average unit values. Lipsey and Swedenborg (1999) and Lipsey and Swedenborg (2007) examine national prices (including non tradables) and give a supply side explanation for a positive effect of income per capita and wage compression on national prices focusing on the services/non tradables component of prices. Our paper is different as we focus on demand side explanations of price differences of tradables.
ideal variety model per se. In our view, it is likely that all three demand-side mechanisms provide part of the explanation for the positive effect of income per capita on trade prices. However, the results do argue for place of importance for the price elasticity channel linked to hierarchic demand.

These results, which link variations in trade prices to differences in markups, have important implications. First, the fact that observed price differences are at least partially driven by variations in markups implies market power and thus possibly welfare distortions. The welfare and policy implications of international price discrimination are unclear, because possible welfare distortions have to be traded off against potentially larger resources to develop more varieties. Second, the importance of the markup channel and pricing to the market implies that regulation of parallel imports has welfare impacts. If differential demand for quality would be the only driver of 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 when they are sold both in a market with high markups and at a lower price in a market with lower markups.

This paper fits in the literature on pricing to the market, with firms charging different prices for identical goods across different markets due to differences in market conditions (Goldberg and Knetter, 1997). It is also related to the literature using large datasets on unit values of trade to analyze the relation of unit values with importer and exporter country characteristics (Schott 2004, Baldwin and Harrigan 2011, Pham 2008). The competing theoretical explanations found in the literature highlight different mechanisms linking trade prices to the income levels of importers (Fajgelbaum, Grossman and Helpman 2009, Simonovska 2010, Hummels and Lugovskyy 2009). To represent the first explanation, with demand for quality rising in income, we examine a utility function that expands both in quality and quantity consumed. Production is constant returns to scale and the market structure involves perfect competition. Higher incomes then raise demand for quality. With marginal costs rising in quality, this increases prices. To represent the second explanation with hierarchic demand, we work with a variant of Stone-Geary preferences with

---

2 See Goldberg and Knetter (1997) for a review of the recent literature exploring pricing to the market.
3 We leave a welfare comparison of the outcomes with and without parallel imports for future work.
negative instead of positive vertical intercepts, similar to Simonovska (2010). 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. Finally, to represent demand based on ideal varieties, wherein consumers become less price sensitive (and firms can thus charge higher markups) with higher incomes, we use an adapted version of the ideal variety model of Hummels and Lugovskyy (2009). In all three cases, in order to focus on the demand side explanations we analytically sterilize the influence of supply side factors.

The effect of inequality operates in all three models through both the direct effect on the demand of different income groups, as well as an indirect effect. The indirect effect involves a shift in the relative importances or weights of low-income and high-income consumers in overall demand (the weights effect). From the weights effect, higher inequality leads to higher prices in all three models. In particular, there will be more weight on the high quality consuming high income consumers in the quality model, and more weight on the low price elasticity high income consumers in the varying markup models. As such, what matters is the relative impact of the weights or consumer composition effect vis-à-vis the direct effect on consumer demand. The direct effects on low and high quality cancel out in the quality model, implying that larger inequality leads to higher prices by the weights effect. In the ideal variety model, the direct effect is dominated by the weights effect, implying as well that prices go up. In the hierarchic demand model, high income consumers extend their budget set besides consuming more in each sector. As a result, the direct effect dominates the weights effect and henceforth prices go down.

We have organized the paper as follows. In Section 2 we outline the three theoretical channels linking inequality to prices, with much derivation relegated to an appendix available upon request. In Section 3 we discuss data and empirical methods. Section 4 contains our empirical results and in Section 5 we conclude.
2 Theory

2.1 Preliminaries

Three channels through which the 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.

Throughout, we assume that all agents have identical preferences and labor is the only production factor. 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 $i_g$. 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 and charge different prices in the 2 different markets, either because of differences in demand for quality or because of differences in their price sensitivity. As countries only differ in the amount of labor units, wages are equal in both countries and can be normalized at 1.

\footnote{With two income groups, we can interpret high and low income as skilled and unskilled labor with perfect substitutability between the two types of labor. In other words, with labor scaled in constant units on an output basis, higher endowments of labor represent higher productivity or skill levels.}

\footnote{All derivations of this section not shown explicitly here are described in an appendix, available upon request.}

\footnote{We could capture wage differences across countries by introducing a country-specific productivity parameter on labor. In all three models, the level of income then would lead to the same prediction related to changes in the level of prices for a given level of inequality. However, as we are interested in the opposite instance where the models diverge – the impact of inequality on prices given mean income, we do not focus explicitly on these mechanisms here.}
2.2 Demand for Quality

2.2.1 Basics

The first channel put forward is an increased demand for quality as agents become richer. As higher quality goods are more expensive to produce, a higher income levels lead to higher priced goods. We start with a specification where all agents have the same 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 $\alpha_j$ as they enter into utility $U$:

$$U = \prod_{j=1}^{m} u_j^{\beta_j}; \ 0 < \beta_j < 1 \text{ for all } j, \sum_{j=1}^{m} \beta_j = 1$$

$$u_j = \left( \frac{\rho^{\frac{1}{\beta_j}}}{\alpha_j^{\frac{1}{\beta_j}} + q_j^{\frac{1}{\beta_j}}} \right)^{\frac{\beta_j}{\rho - 1}} \text{ for all } j$$

In equation (1) $u_j$ 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:

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

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:

$$\sum_{j=1}^{m} \alpha_j^\gamma a_j q_j = i$$
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 $l$.

\[
q_{lj} = \gamma \frac{\beta_{lj}}{a_j} \left( \frac{\beta_{lj}}{a_j} \right)^{\frac{1}{\rho}} \tag{3}
\]
\[
\alpha_{lj} = \gamma \frac{\beta_{lj}}{a_j} \left( \frac{\beta_{lj}}{a_j} \right)^{\frac{1}{\rho}} \tag{4}
\]
\[
p_{lj} = \gamma \frac{\beta_{lj}}{a_j} \left( \beta_{lj} \right)^{\frac{1}{\rho}} a_j^{\frac{1}{\rho}} \tag{5}
\]

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.\(^7\) 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** When utility is expanding in both quantity and quality under constant returns to scale in 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 in the Atkinson index of income inequality, defined as follows:

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

\(^7\)An increase in $\gamma$, reflecting the cost of quality, raises (decreases) quality relative to quantity when $\rho < 1$ ($\rho > 1$).
As defined, the Atkinson index increases with rising inequality. 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 $j$:

$$p_{klj} = \sum_{g=1}^{G} \omega_{ljg} p_{ljg}$$  \hspace{1cm} (7)

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

$$\omega_{ljg} = \frac{q_{ljg}}{\sum_{g=1}^{G} q_{ljg}}$$  \hspace{1cm} (8)

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

$$p_{klj} = \gamma^{\frac{\beta_j}{1+\gamma}} \beta_j^{\frac{\gamma}{1+\gamma}} a_j^{\frac{1}{1+\gamma}} \sum_{g=1}^{G} \frac{i_{lg}}{I_{Al} \left( \frac{\gamma}{1+\gamma} \right)}$$  \hspace{1cm} (9)

We can rewrite equation (9) as follows:

$$p_{klj} = \gamma^{\frac{\beta_j}{1+\gamma}} \beta_j^{\frac{\gamma}{1+\gamma}} a_j^{\frac{1}{1+\gamma}} \frac{i_{lg}}{I_{Al} \left( \frac{\gamma}{1+\gamma} \right)} \left( 1 - I_{Al} \left( \frac{\gamma}{1+\gamma} \right) \right)^{\frac{1}{1+\gamma}}$$  \hspace{1cm} (10)

From equation (10) it follows directly that, for a given average income $\tilde{t}_i$, an increase in the Atkinson index $I_{Al} \left( \frac{\gamma}{1+\gamma} \right)$ implies a larger average price $p_{klj}$. We summarize this result in the following proposition:

**Proposition 2** For a given average income $\tilde{t}$, when utility is expanding in both quantity and quality under constant returns to scale in production, an increase in the Atkinson index of inequality as defined in equation (6), leads to higher average import prices.

---

8Unit values (UV) are defined as value/volume implying that $UV = \sum p_i x_i / \sum x_i = \sum \omega_i p_i$ with $\omega_i = x_i / \sum x_i$
2.2.3 Income Inequality with Two Income Groups

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 $i_l = \frac{i_l H + i_l L}{H + L}$.\(^9\) Log differentiating $p_{klj}$ wrt shares $\omega_{ljG}$ and prices $p_{ljG}$ gives:\(^{10}\)

$$
\bar{p}_{klj} = \frac{\omega_{ljH} p_{ljH} \bar{\omega}_{ljH}}{\omega_{ljH} p_{ljH} + \omega_{ljL} p_{ljL}} + \frac{\omega_{ljH} p_{ljH} \bar{p}_{ljH}}{\omega_{ljH} p_{ljH} + \omega_{ljL} p_{ljL}} + \frac{\omega_{ljL} p_{ljL} \bar{\omega}_{ljL}}{\omega_{ljH} p_{ljH} + \omega_{ljL} p_{ljL}}
$$

(11)

To address the effect of an increase in the mean preserving spread shares $\bar{\omega}_{ljG}$ and prices $p_{ljG}$, we log differentiate with respect to $i_{lH}$ and $i_{lL}$ imposing $\bar{i}_{lL} = -\frac{i_{lH} H + i_{lL} L}{i_{lH} L + i_{lL} H}$, to keep mean income constant. Using equations (3) and (5) with income group subscripts, we can re-write equation (11) as:

$$
\bar{p}_{klj} = (p_{ljH} - p_{ljL}) \frac{1}{\omega_{ljH} p_{ljH} + \omega_{ljL} p_{ljL}} \frac{1}{\bar{i}_{lH}}
$$

(12)

The coefficient of $\bar{i}_{lH}$ in equation (12) represents the first terms in equation (11), i.e. the shift in market share towards higher priced goods. The second term in equation (11), the change in prices of the high and low quality good, is equal to zero. The shift in spending towards the higher quality goods consumed by the high incomes has a positive effect on the average price. There is less consumption of the low quality good and more consumption of the high quality good leading to an increase in the average price, because the price of the high quality good is higher. The effect through the changes in prices themselves, because of changed demand for quality, is zero. 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 and these two effects cancel out.

Although this framework is somewhat stylized, it catches the effect of income inequality on prices through expanded 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

\(^9\)Notice that we include the possibility for different sizes of the two income groups, whereas in the calculation with the dispersion 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.

\(^{10}\)Variables with a hat represent relative changes, $\bar{x} \equiv dx/x$
share of high quality high priced goods increases, whereas the share of low quality low priced goods shrinks.\textsuperscript{11} The implication is that the non-homothetic expansion in demand for quality clearly predicts that more income inequality should drive up average demand for quality and average unit values.

We should comment briefly on the implication of alternative specifications based on other quality models found in the international trade literature.\textsuperscript{12} This includes the model by Flam and Helpman (1987) and an empirical application of this model to unit values and income distribution by Choi, Hummels and Xiang (2009), as well as the model proposed by Hallak (2006). Flam and Helpman (1987) consider a model with preferences over a single unit of a differentiated good of varying quality and a numeraire good. Choi, Hummels and Xiang (2009) find a direct mapping from the income distribution in an economy to the price distribution of the differentiated good. In the framework of Flam and Helpman (1987), we can show that a change in the Atkinson index has no impact on the average traded goods price within a sector. The reason is that demand is unitary implying that the mechanism driving the results in our model, an increase in income inequality raising the share of higher quality goods demanded by the rich consumers, is absent in the model of Flam and Helpman (1987). In contrast, the Hallak (2006) model, which features CES preferences within sectors with taste shifters (CES weights) varying across consumers reflecting higher demand for quality among richer consumers, is not suitable for our analysis. This is because the setup is too reduced form, with a demand system that does not satisfy homogeneity of degree zero in prices and income. Whereas this is not a problem for the empirical application in Hallak (2006), it would be so here as we need homogeneity to be able to determine the impact of income inequality on average prices.

\textsuperscript{11} In an appendix available upon request, we examined alternatives to the basic setup, as a robustness check. We considered a setup where within each sector demand is Cobb Douglas or CES. The setup is as in the current framework, but within a sector each agent consumes all varieties. This setup does not change the main result that an increase in inequality leads to higher average prices within a sector (an average across several varieties for each consumer). The mechanism is the same: an increase in inequality leads to more consumption of high quality goods and less consumption of low quality goods, implying an increase in average prices.

\textsuperscript{12} While not shown here, derivations of the results discussed below are also available upon request.
2.3 Hierarchic Demand

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. We work with the same setup as in the first model. There are two countries identical in all aspects except income and income distribution and there are no trade costs. Country subscripts are omitted in the exposition of the model. We proceed by outlining 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 use the following Linear Hierarchic Expenditure System (LHES) utility function first proposed by Jackson (1982) to model this notion:

\[
U = \int \ln (q_j + \gamma_j) \, dj; \quad \gamma_j > 0
\]

In equation (13), \(q_j\) is the demand for sector \(j\) goods, and \(I\) is the endogenous set of sectors in which agents can consume. As income increases, agents extend the number of sectors from which they consume. Preferences characterized by this utility function are similar to the well-known Stone-Geary utility function, where the \(\gamma_j\)’s have a negative sign. In our framework with positive \(\gamma_j\)’s 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 \(\sigma\). We assume \(\sigma > 1\). 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

\[
C(q_{sj}) = (a_j q_{sj} + f_j)
\]

We assume that \(a_j \gamma_j\) is increasing in \(j\), i.e. when we get higher up in the hierarchy the product of the Stone Geary intercept \(\gamma_j\) and marginal cost \(a_j\) is increasing. The firms can be based in one of the two countries. Important is that the fixed costs \(f_j\) have to paid for sales in each of the two markets. As we work with the assumption of no trade costs, the fixed costs are equal...
for domestic and foreign producers.

Demand within each sector \( q_{sj} \) is equal to:

\[
q_{sj} = \frac{p_j^{\sigma-1}}{p_{s,j}^\sigma} E_j; \quad p_j = \left( \sum_{s=1}^{n} p_{s,j}^{1-\sigma} \right)^{\frac{1}{1-\sigma}}
\]  

(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 \( \int p_j q_j dj = i \) generates the following expression for sectoral demand \( q_j \):

\[
q_j = \frac{1}{p_j} \left( \frac{i + \int \gamma_m p_m dm}{\int \gamma_m p_m dm} \right) - \gamma_j; \quad j \in J
\]  

(15)

\( J \) is the set of goods that are consumed in positive amounts with a corresponding mass \( J \) of goods in the set. The price elasticity of composite \( j \), \( \varepsilon_j \), can be derived easily from equation (15) as:

\[
\varepsilon_j = 1 + \frac{\gamma_j}{q_j}
\]  

(16)

The number of firms within each sector \( j \) is small. This implies that the price elasticity facing an individual firm is non constant. It can be shown that the price elasticity of firm \( s \) in sector \( j \), \( \varepsilon_{sj} \), is equal to:

\[
\varepsilon_{sj} = \sigma \frac{n_j - 1}{n_j} + \frac{1}{n_j} \varepsilon_j
\]  

(17)

Log differentiating this expression, we can show that the price elasticity facing firm \( s \) in sector \( j \) declines in income \( i \) as follows: \(^{13} \)

\[
\tilde{\varepsilon}_{sj} = -\frac{n_j (\varepsilon_j - 1) (\varepsilon_{sj} - 1)}{n_j^2 (\varepsilon_{sj} - 1) \varepsilon_j + \varepsilon_j (\varepsilon_j - 1)} \eta_{q_j,i} \tilde{i} \]  

(18)

With \( \eta_{q_j,i} \) the income elasticity of demand is given by equation (19).

\[
\eta_{q_j,i} = \frac{\beta_i}{\beta_i + \beta_j \int \gamma_m p_m dm - \gamma_j p_j \int \beta_m dm}
\]  

(19)

\(^{13} q_j \) 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.
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 can be shown that this effect is 0. Hence, given markup pricing, higher incomes lead to a smaller price elasticity, a larger markup and a higher price:

$$p_{sj} = \frac{1}{\varepsilon_{sj} - 1} \tilde{\varepsilon}_{sj}$$

$$= \frac{n_j (\varepsilon_j - 1)}{n_j^2 (\varepsilon_{sj} - 1) \varepsilon_{sj} + \varepsilon_j (\varepsilon_j - 1)} \left( \frac{\beta_j i}{\beta_j + \beta_j \int_0^J \gamma_m p_m dm - \gamma_j p_j \int_0^J \beta_m dm} \right) \tilde{i}$$

Like in the quality model, firms from both countries can serve both markets. Assuming that at least one firm exports from one country to the other, the price $p_{sj}$ is also the import price of a country. Hence, we have derived the following result without imposing a free entry condition and thus valid in the short run:

**Proposition 3** With hierarchic demand, a larger income per capita leads in the short run to higher import prices through a decrease in the price elasticity of demand.

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:

$$p_{sj} = \frac{\varepsilon_{sj}}{\varepsilon_{sj} - 1} a_{sj}$$

$$p_{sj} q_{sj} = (a_{sj} q_{sj} + f_{sj})$$

$$q_{sj} = (\varepsilon_{sj} - 1) \frac{f_{sj}}{a_{sj}}$$

(20)

In standard monopolistic competition models the system is closed by combining equation (20) with labor market equilibrium. As there is more than one sector and the upper-tier 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:

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

(21)

With $\theta_j$ the share of labor used in sector $j$, being a function of prices in the different sectors and income.
In an economy with non-constant budget shares across sectors (as with our Stone Geary
upper nest preferences) and with love for variety in each sector (as with our CES lower nest
preferences), there are in general multiple equilibria. The reason for multiple equilibria is that
there are increasing returns to variety within each sector (Francois and Nelson, 2002). We can
find the equilibria by combining a demand equation and 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)

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

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

$$\varepsilon_{xj} = A_j B_j \eta_{qj,i} \hat{\epsilon}_{i}$$  \hspace{1cm} (23)

$$A_j = \frac{n_j (\varepsilon_{xj} - 1)}{(n_j^2 \sigma (\sigma - 1) + (n_j - 1) \sigma \varepsilon_j - \sigma (n_j \sigma - 1) + 2 \varepsilon_j (\varepsilon_j - 1))}$$  \hspace{1cm} (24)

$$B_j = \sigma - \varepsilon_j - \frac{\varepsilon_j (\varepsilon_j - 1)}{(\sigma - \varepsilon_j)}$$  \hspace{1cm} (25)

As $n_j \geq 1$, $A_j$ is positive. Hence, the effect of income on the price elasticity depends upon the
relative size of $\sigma$ and $\varepsilon_j$ in $B_j$. The following can be shown:

$$B_j < 0 \iff \frac{\sigma^2}{2\sigma - 1} < \varepsilon_j < \sigma$$  \hspace{1cm} (26)

Hence, we find that $B_j$ is negative for intermediate values of $\sigma$, i.e. when $\sigma$ is large enough to exceed $\varepsilon_j$, but not so large that $\sigma^2/(2\sigma - 1)$ exceeds $\varepsilon_j$. Otherwise $B_j$ is positive.

There are two effects of a higher income. First, there is a direct effect of a higher income
on the sectoral price elasticity. Higher incomes mean higher quantity consumed in sector $j$
and thereby a lower price elasticity facing the sector. This also reduces the price elasticity of
individual firms. Second, there is an indirect resources effect with a higher income increasing
the amount of resources allocated to sector \( j \). This raises the number of firms in the sector and therefore increases the price elasticity. The direct effect dominates the resources effect if \( B_j \) is positive, implying that a higher income increases the price elasticity and thus reduces the price.

We summarize our findings in the following proposition:

**Proposition 4** If \( \sigma^2 / (\sigma - 1) > \varepsilon_j < \sigma \), with hierarchic demand a higher income per capita \( i \) leads to lower import prices in the long-run through an increase in the price elasticity. Otherwise, this leads to higher prices.

In the first part of proposition 4 we refer to the case where the direct effect dominates the resources effect: the price elasticity goes up and prices go down with a higher income. The direct effect dominates if \( \sigma \) is large enough to satisfy the condition \( \sigma^2 / (\sigma - 1) > \varepsilon_j \). A large \( \sigma \) means that the resource effect is relatively small. A higher income does not generate a lot of entry, as profit margins are small. And a relatively small \( \varepsilon_j \) means that the impact of a change in income \( i \) on the sectoral price elasticity \( \varepsilon_j \), the direct effect, becomes larger.

### 2.3.2 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 start with the effect in the short run.

Suppressing again the country subscript \( l \), total demand for sector \( j \) goods in country \( l \) is equal to:

\[
q_j = \sum_{g=1}^{G} q_{jg} = \sum_{g=1}^{G} i_g \left( \gamma_g \int_0^{m_p} \gammamdp \right) - \gamma_j p_j
\]

Hence, \( q_{jg} \) denotes individual demand in group \( g \). Notice from equation (27) that there is only one price for the different 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 (27) wrt the market price \( p_j \) generates the following expression for the aggregate price elasticity \( \varepsilon_j \):

\[
\varepsilon_j = 1 + \frac{\gamma_j G}{q_j}
\]
To derive the effect of the Atkinson index on the price elasticity in equation (31), we first rewrite the expression for $q_j$ in equation (27) as follows:

$$ q_j = \frac{1}{p_j} \sum_{g=1}^{G} f(i_g) - \gamma_j $$  \hfill (29)

$$ f(i_g) = \frac{1}{J_g} \left( i_g + \int_0^{J_g} \gamma_m p_m dm \right) $$  \hfill (30)

Therefore, substituting equation (29) into equation (28), we can write the price elasticity as follows.

$$ \varepsilon_j = 1 + \frac{p_j \gamma_j G}{\sum_{g=1}^{G} f(i_g) - \gamma_j p_j} $$  \hfill (31)

Log differentiating equations (28) and (31) with $p_j$ treated as an endogenous variable gives:

$$ \hat{\varepsilon}_j = -\frac{\varepsilon_j - 1}{\hat{\varepsilon}_j} \hat{q}_j = -\frac{\varepsilon_j - 1}{\varepsilon_j} \left( -\varepsilon_j \hat{p}_j + \frac{q_j + \gamma_j}{q_j} \sum_{g=1}^{G} f(i_g) \right) $$  \hfill (32)

Like in the subsection without inequality we can solve for the relative change of $\varepsilon_{sj}$ treating $p_j$ as endogenous:

$$ \varepsilon_{sj} = -\frac{n_j (\varepsilon_{sj} - 1) (\varepsilon_j - 1)}{\varepsilon_j n_j (\varepsilon_{sj} - 1) + \varepsilon_j (\varepsilon_j - 1)} - \frac{q_j + \gamma_j}{q_j} \sum_{g=1}^{G} f(i_g) $$  \hfill (33)

The final step is to show that the Atkinson index is monotonic in $\sum_{g=1}^{G} f(i_g)$ for given average income. We prove this in two steps. First, we show that $f(i_g)$ is strictly concave in $i_g$. Differentiating $f(i_g)$ in equation (30) with respect to income $i_g$ gives:

$$ \frac{\partial f(i_g)}{\partial i_g} = \frac{1}{J_g} $$

We have used that the change in $J_g$ does not effect $f(i_g)$, as discussed below equation (19).

The second derivative of $f(i_g)$ is given by:

$$ \frac{\partial^2 f(i_g)}{\partial i_g^2} = -\frac{1}{J_g^2} \frac{\partial J_g}{\partial i_g} $$

$J_g$ strictly increases in $i_g$ (shown in appendix). Therefore, the second derivative is strictly
negative.

Second, the strict concavity of \( f(i_g) \) implies that \( \sum_{g=1}^{G} f(i_g) \) decreases monotonically in the Atkinson index for given average income. The fact that both \( f(i_g) \) and the function \( i_g^{1-\theta} \) appearing in the Atkinson index rise strictly concave in \( i_g \) implies that the sum \( \sum_{g=1}^{G} f(i_g) \) is monotonically increasing in the sum \( \sum_{g=1}^{G} i_g^{1-\theta} \) for given average income and thus monotonically decreasing in the Atkinson index \( I_A = 1 - \left( \frac{1}{\theta} \sum_{g=1}^{G} \left( \frac{i_g}{\bar{i}} \right)^{1-\theta} \right)^{1/\theta} \) for given average income \( \bar{i} \).

From equation (33) the price elasticity thus rises in the Atkinson index. Therefore, we have proved the following result:

**Proposition 5** In the short-run, for a given level of average income under hierarchic demand, higher income inequality as measured by the Atkinson index means a greater price elasticity and hence reduced import prices for goods consumed by all income groups.

This 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 with two income groups.

In the long run we add a free entry condition, endogenizing the number of firms \( n_j \). To find the effect of a change in the Atkinson index, we log differentiate the same equations as in the basic model without inequality, replacing equation (15) by (29). With some manipulation, the price elasticity can be expressed as follows:

\[
\tilde{\varepsilon}_{x_j} = A_j B_j \frac{q_j + \gamma_j}{q_j} \sum_{g=1}^{G} f(i_g) \tag{34}
\]

\( A_j \) and \( B_j \) are defined in equations (24) and (25). From the short run analysis we know that the Atkinson index is monotonic in \( \sum_{g=1}^{G} f(i_g) \) for given average income. Therefore, we have the following result (analogous to the basic model):

**Proposition 6** In the long-run, for a given level of average income under hierarchic demand, higher income inequality as measured by the Atkinson index leads to a greater price elasticity and hence reduced import prices for goods consumed by all income groups if \( \sigma^2/\left(\sigma - 1\right) > \varepsilon_j > \sigma \). Otherwise it means higher import prices.
Again, there are two effects: a direct effect on the sectoral price elasticity and an indirect resources effect through the number of firms. The direct effect of an increase in the Atkinson index is that spending on sector $j$, $q_j$, drops, leading to a higher price elasticity. By the resources effect the number of firms falls raising the price elasticity. As before, the direct effect dominates if $\sigma^2/(\sigma - 1) > \varepsilon_j > \sigma$.

### 2.3.3 Income Inequality with Two Income Groups

Again, we turn to the case of 2 income groups. These 2 income groups have 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. This means we examine the effect of a change in $i_H$ with the corresponding change in $i_L$ equal to $\hat{i}_L = -\frac{i_H}{i_L} \hat{i}_H$. We focus on effects in the short run.

As the 2 income groups case does not provide additional intuition on long run effects with the same effects appearing as in the $G$ income groups case, we do not present the long run effects of inequality with 2 income groups.

Log differentiating (28) wrt $i_H$ imposing $\hat{i}_L = -\frac{i_H}{i_L} \hat{i}_H$, we find the following effect of an increase in the mean preserving income spread on the price elasticity:

$$\hat{\varepsilon}_j = -\frac{\varepsilon_j - 1}{\varepsilon_j} \left( \frac{1}{J_H} - \frac{1}{J_L} \right) \frac{\beta_j i_H}{p_j q_j} \hat{i}_H$$

Equation (35) can be rewritten as follows:

$$\hat{\varepsilon}_j = -\frac{\varepsilon_j - 1}{\varepsilon_j} \left( \frac{1}{J_H} - \frac{1}{J_L} \right) \frac{\beta_j i_H}{p_j q_j} \hat{i}_H$$

Equation (36) shows that the price elasticity rises with income inequality, because $J_H > J_L$. Hence, the price declines in income inequality. This result can be explained as follows. From equation (28) the price elasticity of good $j$ is a function of the amount 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, the set of goods consumed rises and the amount consumed of each variety goes down. As a result the price elasticity goes up and the markup firms can charge goes down.

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:\(^{14}\)

**Proposition 7** With hierarchic demand and two income groups, for goods consumed exclusively 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.

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 Varieties

#### 2.4.1 Basics

Hummels and Lugovskyy (2009) propose a different framework linking higher income per capita in an importing country to a lower price elasticity and thus to higher unit values. In their framework, 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

\(^{14}\)This effect is similar to what Markusen (2010) finds in a two good model with Stone Geary preferences and with two income groups, where only one of the income groups consumes the luxury good. In the general case of many groups, how inequality impacts on prices when a good is exclusive to a subset of income groups cannot be determined analytically, and one must resort to numerical simulation.
the other theories in this paper, we expand their framework to address not only the role of income levels, but also the effect of income inequality for a given level of income. We show that the price elasticity declines and the market price rises with income inequality. This result means the effect of income inequality on the market price (and unit values) has the same sign as in the quality specification but the opposite sign from the hierarchic demand specification.

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. Basically, 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. When people consume only one variety, the results from this framework collapse to the same results as in the original model of Hummels and Lugovskyy (2009).

We again start with 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 frameworks. In the exposition below country subscripts are omitted. We have the following preferences for consumption across sectors $j$:

$$U = \sum_{j=1}^{J} \beta_j \ln u_j$$  \hspace{1cm} (37)

$$u_j = \int_{\omega_j} \frac{q_j}{h_j(\delta(\omega, \tilde{\omega}))}$$

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:

$$h_j(\delta, i) = 1 + v^{\psi}\delta^\psi; \; v < 1; \; \psi > 1$$  \hspace{1cm} (38)
It can be shown that an increase in income leads to a higher indirect utility as long as \( v < 1 \). Therefore we impose this restriction. There are \( G \) different income groups with group \( g \) having income \( i_g \), like in the other two frameworks. All income groups are distributed uniformly across the circle. The cost function for production of a variety \( j \) is equal to:

\[
C(q_j) = a_j q_j + f_j
\]

It can be shown 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:

\[
q_j = d_j \sum_{g=1}^{G} i_g \frac{\beta_j}{p_j}
\]

(39)

In equation (39), \( d_j \) is the equal distance between any two varieties. The price elasticity facing a firm consists 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:

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

(40)

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

\[
\varepsilon_j = 1 + \frac{1}{2\psi} \left( 1 - \frac{1}{I_A(v)} \right)^{1-v}
\]

(41)

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 (41):

\[
\hat{\varepsilon}_j = -\frac{\varepsilon_j - 1}{\varepsilon_j} \left( \psi \hat{d}_j + (1 - v) \frac{I_A}{1 - I_A} \hat{\psi} \right)
\]

(42)

---

\(^{15}\)As there are no trade costs and technologies are identical, firms are indifferent about production location.

\(^{16}\)Derivations are analogue to the derivation in Hummels and Lugovskyy (2009) and in Helpman and Krugman (1985).
In the long run, when \( n_j \) is endogenous, we add the following zero profit condition:

\[
d_j = \frac{f_j}{\sum_{g=1}^{G} \epsilon_g \beta_j}
\]  

(43)

Log differentiating equation (43) and substituting into 42, yields the long run change in the price elasticity:

\[
\hat{\varepsilon}_j = \frac{\varepsilon_j - 1 - \frac{1}{2v}}{(\psi + 1) \varepsilon_j - \psi - \frac{1}{2}} \left( \psi \tilde{G} - \left(1 - v \right) \frac{I_A}{1 - I_A} \tilde{I} - \tilde{v} \right)
\]  

(44)

In equation (44), \( \tilde{G} \) is total income, i.e. the number of agents times average income. Equation (44) shows the same effects as in Hummels and Lugovskyy (2009), i.e. a larger market \( \tilde{G} \) raises the price elasticity and a larger income per capita \( \tilde{i} \) reduces the price elasticity. However there is also an additional determinant of the price elasticity. 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** With ideal varieties as in 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.

### 2.4.2 Income Inequality with Two Income Groups

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 (40) with two income groups wrt \( i_H \) and \( i_L \) with the condition \( \tilde{i}_L = -i_H H/i_L L \tilde{i}_H \) and keeping the number of firms \( n_j \) and hence distance \( d_j \) fixed, generating the following result:

\[
\hat{\varepsilon}_j = \frac{\varepsilon_j - 1}{\varepsilon_j} \frac{i_H H}{ \left( 1 + \frac{1}{i_H \left( \frac{H}{L} \right)^v} \right) + i_L L \left( 1 + \frac{1}{i_L \left( \frac{H}{L} \right)^v} \right) } \tilde{v}_H
\]  

(45)
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 (43), we find that also in the long run the price elasticity decreases when the mean preserving spread rises:

\[
\hat{\varepsilon}_j = \frac{i_H}{\hat{c}_{i_H}} \left(\frac{1}{i_H} \right)^v \left(1 - v \right) \left(\frac{1}{i_H} \right)^v - \left(\frac{1}{i_L} \right)^v + \frac{i_H}{\hat{c}_{i_H}} \left(1 + \frac{1}{i_H} \right)^v \left(1 + \frac{1}{i_L} \right)^v + \frac{i_L}{\hat{c}_{i_L}} \left(1 + \frac{1}{i_L} \right)^v \left(1 + \frac{1}{i_H} \right)^v + \frac{i_L}{\hat{c}_{i_L}} \left(1 + \frac{1}{i_L} \right)^v \left(1 + \frac{1}{i_H} \right)^v + \frac{i_H}{\hat{c}_{i_H}} \left(1 + \frac{1}{i_H} \right)^v \left(1 + \frac{1}{i_L} \right)^v + \frac{i_L}{\hat{c}_{i_L}} \left(1 + \frac{1}{i_L} \right)^v \left(1 + \frac{1}{i_H} \right)^v
\]  

(46)

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 of each group in total demand 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 if \( v < 1 \). We assumed \( v < 1 \) to guarantee that indirect utility rises in income. \( v \) measures the effect of income on the cost of distance in the compensation function and thus on the price elasticity. A smaller \( v \) means that the price elasticity decreases less in response to a higher income. This makes clear that the assumption \( v < 1 \) puts a cap on the second effect through the changes in the price elasticity of the different income groups.

The finickyness of consumers to get closer to their ideal variety rises with income in the theory of this subsection. This finickyness cannot rise by so much that utility would be decreasing in income. This implies that the price elasticity cannot drop too much as income goes up. Therefore, the weights effect of an increase in inequality giving more weight to the low elasticity of the high incomes dominates the direct effect on the price elasticities of the different groups.
3 Data and Estimation Method

Having mapped the impact of inequality on import prices in theory, we now turn to an empirical analysis of the impact of income and income inequality on import prices. More precisely, we examine how the unit value of imported disaggregated product categories changes 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 used for unit values come from the BACI database \(^{17}\) which contains quantity and the value of bilateral imports in 6-digit Harmonized System (HS) classification. The database is constructed from COMTRADE (Commodities Trade Statistics database) and it covers more than 200 countries and 5,000 products. We use data for the period between 2000-2004. We deflate our unit value data by the 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.

We work with those HS product categories which are clearly used for final consumption. This has required a mapping of our HS6 product level data according to intermediate vs final use, based on a classification scheme developed for the ongoing update to the EU-KLEMS database, known as the World Input Output Database or WIOD (Francois et al, 2010). This is a large scale, multi-year database construction project funded by the European Commission, Research Directorate General as part of the 7th Framework Programme.\(^{18}\) While the WIOD mapping starts with a reclassification of the HS6-BEC (UN) mapping at HS6 level, it is somewhat different from the original HS6-BEC scheme. This is because more emphasis is placed under the BEC scheme on whether goods are durables or not, while some products that clearly need processing before final consumption are classified under BEC as consumption goods. For example, televisions are classified as capital goods at HS6 level. Also, meat carcasses are classified as consumption goods at HS6 level under the BEC, though they are in fact bought by industry. There are further problems due to revisions to the HS classification scheme since the original mapping from BEC

---

\(^{17}\) [http://www.cepii.fr/anglaisgraph/bdd/baci/baciwp.pdf](http://www.cepii.fr/anglaisgraph/bdd/baci/baciwp.pdf)

\(^{18}\) The WIOD consortium includes a number of European research centers and universities, as well as the OECD and UNCTAD.
to HS was developed. As such, at the end of the day, the mapping we work from WIOD better reflects both the most current HS-combined product lines, and our need for a breakdown of products by use. The result is 1260 HS6 product lines classified as final consumption goods out of a total 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 further distinguish between luxuries and necessities within final goods using the same methodology as Dalgin, Mitra and Trindade (2008). To do this, first data from Eurostat’s Household Budget Surveys were obtained. This dataset provides information on EU member states’ households expenditures by five income quintiles. It contains the average expenditure share for each quintile. This allowed the classification of goods into luxuries and necessities based on whether the expenditure shares across the different quintiles were rising or falling. If the expenditure shares were weakly rising, we classified goods as luxuries, if weakly falling, as necessities. These data were provided in COICOP classification which then we mapped into the Harmonised System classification in which our trade data were recorded, to be able to classify our unit value data into luxuries and necessities.

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 as a measure of income and income per capita. 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 database. As for some of the EU countries data were not available for certain years, we supplemented this data with data from Eurostat for EU member countries. Furthermore, for some countries the Luxembourg Income Study had a better coverage for the Atkinson index thus we supplemented our dataset with data from the Luxembourg Income

---

19 This classification scheme can be downloaded from this link: http://www.i4ide.org/people/francois/data.htm.
20 Further information about the dataset can be found on Eurostat’s website.
21 We used the expenditure shares provided for the EU aggregate to group products into luxuries and necessities which we then used for the full sample.
22 In order to be able to merge the COICOP classification with the unit value data, which are constructed and reported in different product classifications, we have mapped the HS classified unit value data into the CPCv.1.0 classification and then mapped this classification into the COICOP classification in which the expenditure shares on different goods are provided.
23 The base year for the constant GDP and GDP per capita variables is 2000.
24 The Atkinson index is calculated according to equation (6) using five income groups with the parameter θ equal to 1 implying $I_A = 1 - \frac{1}{5} \left( \prod_{i=1}^{5} IS_i \right)$ as Atkinson index with $IS_i$ the income share of the $i$-th income group.
We employ a fixed effects estimation based upon the theoretical discussion above. 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. Following our analytical results, we also include income per capita and income inequality as explanatory variables of import prices. As a control variable we add total income, based upon the theoretical and empirical analysis in Hummels and Lugovskyy (2009). Given the theoretical results above, the explanatory variables affect unit values non-linearly. Therefore, we have the following equation to be estimated:

\[ p_{kltj} = e_{ktj}b_{klj}f(Y_{lt}, Y_{lt}/L_{lt}, A_{lt})e_{kltj} \] (47)

In equation (47) the subscript \( k \) stands for exporter, \( t \) 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 frameworks explored above, 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 specification). 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:

\[ \ln p_{kltj} = \ln e_{ktj} + \ln b_{klj} + \beta_1 \ln Y_{lt} + \beta_2 \ln Y_{lt}/L_{lt} + \beta_3 \ln A_{lt} + \ln e_{kltj} \] (48)

The quality expansion and ideal variety models predict that inequality has a different impact on import prices of necessity and luxury goods. On the other hand, according to the hierarchic

---

25 More information on the Luxembourg Income Study can be found on the following website: http://www.lisproject.org/. We also interpolated the data to reduce the number of missing values. As a robustness check we run our regressions using only non-imputed data and obtained very similar results. As a further robustness check, we also run our regressions using the atkinson index obtained only from the World Bank’s dataset and we again obtained very similar results.
demand model, this would only be the case if luxuries are only consumed by rich, and necessities
are only consumed by poor people. Thus we first run equation (48) on a sample with all final
good products, and then we also provide results of estimates distinguishing the impact of the
atkinson index on import prices in the case of necessity and luxury goods.

We estimate equation (48) over the period 2000-2004. Given the high dimensionality of these
fixed effects we could not include dummies in the OLS regressions directly. Furthermore, as our
panel is unbalanced, we also could not include these fixed effects implicitly by calculating
the appropriate deviations from means. Thus we employ the Stata program ‘gpreg’, developed by Jo-
hannes F. Schmiedera, which is based on the linear regression procedure developed by Guimaraes
and Portugal (2009). The procedure allows to implement a full Gauss-Seidel algorithm to es-
timate linear regression models with high-dimensional fixed-effects, providing correct standard
errors.

As a robustness check we also estimate a second order logarithmic approximation, i.e. in-
cluding squares of logs and interaction terms in equation (48).

4 Results

Table 1 presents the results of estimation of equation (48) on a sample containing only goods
destined for final consumption. The specification includes exporter-product-time and importer-
exporter-product fixed effect. Since our main variables of interest are importer-time-product
specific we do not include fixed effects for this dimension.

Column 1 of Table 1 displays the results of estimating the log linear equation on a sample
containing all goods destined for final consumption. The results provide support for the three
frameworks in this paper. Unit values rise in the importer country’s 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 somewhat higher, 1.06, than the coefficient found by Hummels and
Lugovskyy (2009). We also find a somewhat higher impact of total income on unit values than
found by Hummels and Lugovskyy (2009). While our coefficient is around -1.38, Hummels and
Lugovskyy (2009) obtained a weighted average coefficient which is larger, -0.5. This difference
### Table 1: Estimation Results for all final goods

<table>
<thead>
<tr>
<th></th>
<th>Sample with all final goods</th>
<th>Quadratic Equation, all final goods</th>
<th>Marginal effects, all final goods</th>
</tr>
</thead>
<tbody>
<tr>
<td>ln GDP</td>
<td>-1.388</td>
<td>-2.623</td>
<td>-1.187</td>
</tr>
<tr>
<td></td>
<td>(0.051)***</td>
<td>(0.513)***</td>
<td>(0.055)***</td>
</tr>
<tr>
<td>ln GDP/capita</td>
<td>1.058</td>
<td>2.705</td>
<td>1.256</td>
</tr>
<tr>
<td></td>
<td>(0.049)***</td>
<td>(0.546)***</td>
<td>(0.051)***</td>
</tr>
<tr>
<td>ln Atkinson</td>
<td>-0.151</td>
<td>1.793</td>
<td>-0.219</td>
</tr>
<tr>
<td></td>
<td>(0.008)***</td>
<td>(0.125)***</td>
<td>(0.011)***</td>
</tr>
<tr>
<td>(ln(GDP/Capita))^2</td>
<td>0.224</td>
<td>0.019</td>
<td>0.001</td>
</tr>
<tr>
<td></td>
<td>(0.019)***</td>
<td>(0.015)***</td>
<td></td>
</tr>
<tr>
<td>(ln(GDP))^2</td>
<td>0.036</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.015)***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(ln(Atkinsonindex))^2</td>
<td>-0.103</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.012)***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ln(GDP/Capita) * ln(GDP)</td>
<td>-0.104</td>
<td>(0.032)***</td>
<td></td>
</tr>
<tr>
<td>ln(GDP/Capita) * ln(Atkinsonindex)</td>
<td>-0.147</td>
<td>(0.007)***</td>
<td></td>
</tr>
<tr>
<td>ln(GDP) * ln(Atkinsonindex)</td>
<td>0.204</td>
<td>0.012</td>
<td></td>
</tr>
<tr>
<td>R-sq</td>
<td>0.001</td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td>4959542</td>
<td>4959542</td>
<td></td>
</tr>
</tbody>
</table>

Robust standard errors in parentheses.
R-squared does not account for the fixed effects included in the regression.
Exporter-year-product, importer-exporter-product fixed effects are included in the regressions.
Column 3 presents the marginal effects for the results presented in Column 2.
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 1: Estimation Results for all final goods
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 data used by Hummels and Lugovskyy (2009) come from the Eurostat’s Trade Database and contains data of 11 EU exporters and 200 importers worldwide. We also have limited our sample to goods clearly destined for final consumption.

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 as measured by the Atkinson index on unit values. This finding provides support for the hierarchic demand specification, that predicts a lower import price in response to higher inequality for goods consumed by all income groups. The quality specification with utility rising in quality and the ideal variety specification both predict a positive effect of inequality on import prices. Our interpretation is that these empirical findings do not falsify the quality and ideal variety framework but they do indicate that hierarchic demand model deserves a place as well.

Column 2 of Table 1 contains the results of the estimation with (log) square and interaction terms included. The marginal effects are presented in Column 3 of Table 1. The findings support the estimation outcomes of the log linear model. The size of the country has a negative impact on import prices, GDP per capita on the other hand has a price increasing effect. Income inequality is again found to be negatively influencing prices. The coefficient of GDP and GDP per capita is similar to the non-quadratic specification, while the coefficient of the atkinson index is somewhat larger.

Next, we distinguished luxury and necessity products, and limited the sample only to these goods. In order to test whether income inequality has a different impact on import prices in the case of luxury and necessity goods, the atkinson variable can now take different values in the case of necessities and luxuries. These results are presented in Column 1 of Table 2. The results confirm the hierarchic demand model. According to the predictions of the model, the impact of inequality on import prices of luxury goods would be higher only if luxuries are only consumed by the rich and necessities by the poor. Luxuries and necessities were defined by the share of income spent on them, and thus based on our classification, rich and poor consume both

\[\text{\textsuperscript{26}}\text{In other words, the 'Atkinson necessity' variable is the atkinson index interacted with a dummy for necessity products; while the 'Atkinson luxury' variable was constructed by interacting the atkinson index with a dummy for luxuries.}\]
necessities and luxuries. Thus we do not expect a higher coefficient of the atkinson variable in the case of luxuries, and we cannot reject the hierarchic model. Furthermore, the coefficients of GDP and GDP per capita variables are similar to those using the full sample.

Classifying goods into luxuries and necessities using household budget surveys can only provide very broad classification given data limitations. Household budget surveys usually provide data at aggregate product categories. For example, the Eurostat’s Household Budget Survey, which is used in this analysis, uses COICOP classification at level 2. This implies that the most detailed product categories are still very aggregate. For example, at the most disaggregated level, it contains product categories such as food products, or clothing products, which are the finest aggregations we can obtain to define products being luxuries or necessities. Based on Eurostat’s Household Budget Surveys using the same methodology as Dalgin, Mitra and Trindade (2008), for example, food products are necessities, while clothing products are luxuries. This might lead to classifying luxury products, such as sparkling wine, or truffles, into necessities. In order to test the robustness of our results, we "handpicked" roughly 40 products which are most likely luxuries (these include for example silk, fur clothing products, sparkling wine, truffles, caviar, lobsters, certain jewelry products, etc.) As a robustness check we restrict luxuries to only these product categories. The results are presented in Column 2 of Table 2. These results confirm the previous findings. The coefficients of the atkinson variable are not

\[ \text{Table 2: Estimation Results for luxuries and necessities} \]

<table>
<thead>
<tr>
<th></th>
<th>Sample with necessities and luxuries</th>
<th>Sample with necessities and strict luxuries</th>
</tr>
</thead>
<tbody>
<tr>
<td>ln GDP</td>
<td>-1.063</td>
<td>-2.741</td>
</tr>
<tr>
<td>(0.058)**</td>
<td>(-0.077)**</td>
<td></td>
</tr>
<tr>
<td>ln GDP/capita</td>
<td>0.920</td>
<td>2.286</td>
</tr>
<tr>
<td>(0.056)**</td>
<td>(0.075)**</td>
<td></td>
</tr>
<tr>
<td>ln Atkinson necessities</td>
<td>-0.115</td>
<td>-0.085</td>
</tr>
<tr>
<td>(0.015)**</td>
<td>(0.012)**</td>
<td></td>
</tr>
<tr>
<td>ln Atkinson luxuries</td>
<td>-0.215</td>
<td>-0.092</td>
</tr>
<tr>
<td>(0.012)**</td>
<td>(0.036)**</td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td>3212997</td>
<td>1827349</td>
</tr>
</tbody>
</table>

Robust standard errors in parentheses

Exporter-year-product, importer-exporter-product fixed effects are included in the regressions

* significant at 10%; ** significant at 5%; ***significant at 1%

27 A list of these goods is provided in the Annex A.2.
different for luxuries and necessities (we tested this with a t-test and found that the coefficients are not significantly different). Thus these results also provide support for the hierarchic demand model.

5 Summary and Conclusions

In this paper we have examined three theories that help to explain the empirical finding that trade prices (unit values) rise in income per capita in the importing country. We also derived the effect of income inequality on trade prices in each of the three theories. The theoretical predictions were compared with the effect of inequality on import unit values in the data. We find strong empirical support for the theoretical predictions on income levels. An increase in importer income per capita by 1% raises importer unit values by 1.06%. Measuring 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 consistent with hierarchic demand, but inconsistent with quality expansion and ideal variety frameworks.

Our results raise a number of issues beyond the scope of this paper. One is 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 theoretical structure presented in the paper offers a framework to address this question. The answer to this question also has implications for the welfare effects of the regulation of parallel imports. In addition, the hierarchic demand system could be used to study the effect of higher world income per capita and a larger world economy on the worldwide availability of different varieties and the pricing of those different varieties.28

References


28See also Saure (2009) and Simonovska (2010)


## Annex Table A.1: Sample countries

<table>
<thead>
<tr>
<th>Country 1</th>
<th>Country 2</th>
<th>Country 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Albania</td>
<td>Greece</td>
<td>Norway</td>
</tr>
<tr>
<td>Argentina</td>
<td>Guatemala</td>
<td>Nepal</td>
</tr>
<tr>
<td>Armenia</td>
<td>Guyana</td>
<td>New Zealand</td>
</tr>
<tr>
<td>Austria</td>
<td>Hong Kong, China</td>
<td>Pakistan</td>
</tr>
<tr>
<td>Azerbaijan</td>
<td>Honduras</td>
<td>Panama</td>
</tr>
<tr>
<td>Burundi</td>
<td>Croatia</td>
<td>Peru</td>
</tr>
<tr>
<td>Benin</td>
<td>Haiti</td>
<td>Philippines</td>
</tr>
<tr>
<td>Burkina Faso</td>
<td>Hungary</td>
<td>Papua New Guinea</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>Indonesia</td>
<td>Poland</td>
</tr>
<tr>
<td>Bulgaria</td>
<td>India</td>
<td>Portugal</td>
</tr>
<tr>
<td>Bosnia and Herzegovina</td>
<td>Ireland</td>
<td>Paraguay</td>
</tr>
<tr>
<td>Belarus</td>
<td>Iran, Islamic Rep.</td>
<td>Romania</td>
</tr>
<tr>
<td>Belgium-Luxembourg</td>
<td>Israel</td>
<td>Russian Federation</td>
</tr>
<tr>
<td>Bolivia</td>
<td>Italy</td>
<td>Rwanda</td>
</tr>
<tr>
<td>Brazil</td>
<td>Jamaica</td>
<td>Senegal</td>
</tr>
<tr>
<td>Canada</td>
<td>Jordan</td>
<td>Singapore</td>
</tr>
<tr>
<td>Switzerland</td>
<td>Kazakhstan</td>
<td>El Salvador</td>
</tr>
<tr>
<td>Chile</td>
<td>Kenya</td>
<td>Slovak Republic</td>
</tr>
<tr>
<td>China</td>
<td>Kyrgyz Republic</td>
<td>Slovenia</td>
</tr>
<tr>
<td>Cote d'Ivoire</td>
<td>Cambodia</td>
<td>Sweden</td>
</tr>
<tr>
<td>Cameroon</td>
<td>Korea, Rep.</td>
<td>Thailand</td>
</tr>
<tr>
<td>Colombia</td>
<td>Lao PDR</td>
<td>Tajikistan</td>
</tr>
<tr>
<td>Costa Rica</td>
<td>Sri Lanka</td>
<td>Turkmenistan</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>Lithuania</td>
<td>Tunisia</td>
</tr>
<tr>
<td>Germany</td>
<td>Latvia</td>
<td>Turkey</td>
</tr>
<tr>
<td>Denmark</td>
<td>Morocco</td>
<td>Tanzania</td>
</tr>
<tr>
<td>Dominican Republic</td>
<td>Moldova</td>
<td>Uganda</td>
</tr>
<tr>
<td>Ecuador</td>
<td>Madagascar</td>
<td>Ukraine</td>
</tr>
<tr>
<td>Egypt, Arab Rep.</td>
<td>Mexico</td>
<td>Uruguay</td>
</tr>
<tr>
<td>Spain</td>
<td>Macedonia, FYR</td>
<td>United States</td>
</tr>
<tr>
<td>Estonia</td>
<td>Mali</td>
<td>Uzbekistan</td>
</tr>
<tr>
<td>Ethiopia</td>
<td>Mongolia</td>
<td>Venezuela</td>
</tr>
<tr>
<td>Finland</td>
<td>Mozambique</td>
<td>Vietnam</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>Mauritania</td>
<td>Yemen</td>
</tr>
<tr>
<td>Ghana</td>
<td>Malawi</td>
<td>Serbia and Montenegro</td>
</tr>
<tr>
<td>Georgia</td>
<td>Malaysia</td>
<td>South Africa</td>
</tr>
<tr>
<td>Ghana</td>
<td>Nigeria</td>
<td>Zambia</td>
</tr>
<tr>
<td>Guinea</td>
<td>Nicaragua</td>
<td>Zimbabwe</td>
</tr>
<tr>
<td>Gambia</td>
<td>Netherlands</td>
<td></td>
</tr>
</tbody>
</table>
### Annex Table A.2: Narrow list of luxuries

<table>
<thead>
<tr>
<th>HS code</th>
<th>Product description</th>
</tr>
</thead>
<tbody>
<tr>
<td>HS070952</td>
<td>Truffles</td>
</tr>
<tr>
<td>HS200320</td>
<td>Processing and preserving of fruit and vegetables</td>
</tr>
<tr>
<td>HS621310</td>
<td>Manufacture of other wearing apparel and accessories</td>
</tr>
<tr>
<td>HS621410</td>
<td>Manufacture of other wearing apparel and accessories</td>
</tr>
<tr>
<td>HS220410</td>
<td>Sparkling wine</td>
</tr>
<tr>
<td>HS870321</td>
<td>Manufacture of motor vehicles</td>
</tr>
<tr>
<td>HS870322</td>
<td>Manufacture of motor vehicles</td>
</tr>
<tr>
<td>HS870323</td>
<td>Manufacture of motor vehicles</td>
</tr>
<tr>
<td>HS870324</td>
<td>Manufacture of motor vehicles</td>
</tr>
<tr>
<td>HS870331</td>
<td>Manufacture of motor vehicles</td>
</tr>
<tr>
<td>HS870332</td>
<td>Manufacture of motor vehicles</td>
</tr>
<tr>
<td>HS870333</td>
<td>Manufacture of motor vehicles</td>
</tr>
<tr>
<td>HS910112</td>
<td>Manufacture of watches and clocks</td>
</tr>
<tr>
<td>HS910121</td>
<td>Manufacture of watches and clocks</td>
</tr>
<tr>
<td>HS910129</td>
<td>Manufacture of watches and clocks</td>
</tr>
<tr>
<td>HS910139</td>
<td>Manufacture of watches and clocks</td>
</tr>
<tr>
<td>HS910229</td>
<td>Manufacture of watches and clocks</td>
</tr>
<tr>
<td>HS910291</td>
<td>Manufacture of watches and clocks</td>
</tr>
<tr>
<td>HS330300</td>
<td>Manufacture of soap, detergents, perfumes and toilet preparations</td>
</tr>
<tr>
<td>HS650692</td>
<td>Manufacture of other wearing apparel and accessories</td>
</tr>
<tr>
<td>HS420221</td>
<td>Manufacture of luggage, handbags and the like, saddlery and harness</td>
</tr>
<tr>
<td>HS711419</td>
<td>Manufacture of jewellery and related articles 36.21Stri</td>
</tr>
<tr>
<td>HS710391</td>
<td>Manufacture of jewellery and related articles 36.21Stri</td>
</tr>
<tr>
<td>HS950691</td>
<td>Manufacture of optical instruments and photographic equipment</td>
</tr>
<tr>
<td>HS900410</td>
<td>Manufacture of sunglasses</td>
</tr>
<tr>
<td>HS900651</td>
<td>Manufacture of optical instruments and photographic equipment</td>
</tr>
<tr>
<td>HS900652</td>
<td>Manufacture of optical instruments and photographic equipment</td>
</tr>
<tr>
<td>HS900653</td>
<td>Manufacture of optical instruments and photographic equipment</td>
</tr>
<tr>
<td>HS900659</td>
<td>Other</td>
</tr>
<tr>
<td>HS160430</td>
<td>Processing and preserving of fish and fish products</td>
</tr>
<tr>
<td>HS030622</td>
<td>Fishing</td>
</tr>
<tr>
<td>HS710391</td>
<td>Miscellaneous manufacturing n.e.c.</td>
</tr>
<tr>
<td>HS621510</td>
<td>Manufacture of other wearing apparel and accessories</td>
</tr>
<tr>
<td>HS621290</td>
<td>Manufacture of other wearing apparel and accessories</td>
</tr>
<tr>
<td>HS615520</td>
<td>Manufacture of knitted and crocheted articles</td>
</tr>
<tr>
<td>HS220820</td>
<td>Manufacture of beverages</td>
</tr>
<tr>
<td>HS230910</td>
<td>Manufacture of prepared animal feeds</td>
</tr>
</tbody>
</table>
Supplementary Appendices of Derivations

Appendix A  Nesting the Quality and Hierarchic Demand Model

$L$ consumers have the following identical utility function:

$$ U = \sum_{j=0}^{\infty} \beta_j \ln (c_j + \gamma_j) $$

$$ c_j = \left( \sum c_{s_j} \right)^{\frac{\sigma-1}{\sigma}} $$

$$ c_{s_j} = \left( \delta_q q_{s_j} + \delta_\alpha \alpha_{s_j} \right)^{\frac{1}{\sigma}} $$

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

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

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

$$ c(q_{s_j}, \alpha_{s_j}) = (\alpha_{s_j}^q) a_j q_{s_j} + f_j $$

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, $\alpha_{s_j}$ and $q_{s_j}$. 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:

$$ \delta_q = \delta_\alpha = 1 $$

$$ f_{s_j} = 0 $$

$$ \sigma \to \infty $$

$$ \gamma_j \to \infty; \forall j $$

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

$$ \gamma = 0 $$

$$ \delta_\alpha = 0 $$
Appendix B  Hierarchic Demand Model

Appendix B.1  Basics

Maximize utility in (13) s.t. the budget constraint \( \int_{j \in I} p_j q_j dj = i \) using Kuhn-Tucker. This generates the following (rewritten) first order conditions:

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

\[
\frac{1}{q_j + \gamma_j} = \lambda p_j \quad \begin{cases} \ j \in \tilde{J} \\
q_j \geq 0 
\end{cases} \tag{B.2}
\]

\[
\frac{1}{\gamma_j} < \lambda p_j \quad \begin{cases} \ j \in K \\
q_j = 0 
\end{cases} \tag{B.3}
\]

\( \tilde{J} \) is the set of goods that are consumed in positive amounts with a corresponding mass \( J \) of goods in the set, \( K \) is the set of goods that are not consumed. The set of goods \( J \) consumed in positive amounts is determined by the following condition:

\[
j \in \tilde{J} \text{ if } \exists p_j \text{ s.t. } 1/\gamma_j > \lambda p_j \text{ and } \pi_j (p_j, n_j = 1) \geq 0 \tag{B.4}
\]

With \( \pi_j (p_j, n_j = 1) \) 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 \( \lambda \):

\[
\lambda = \frac{J}{i + \int_0^J \gamma_j p_j dj} \tag{B.5}
\]

Substituting equation (B.5) into equation (B.2), gives the expression for demand \( q_j \), equation (15) in the main text.

Equation (17)

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

\[
q_{sj} = \frac{p_j^s}{p_{sj}^s} q_j
\]

Log differentiating this equation we get:

\[
\hat{q}_{sj} = \sigma (\hat{p}_j - \hat{p}_{sj}) + \varepsilon_j \hat{p}_j \tag{B.6}
\]
Using the expression for the price index $p_j$ in equation (14) we get for $\tilde{p}_j$:

$$\tilde{p}_j = \frac{\hat{p}_{s_j}^{1-\sigma} \hat{p}_{s_j}}{\sum_{s=1}^{n_j} \hat{p}_{s_j}^{1-\sigma}} = \frac{1}{n_j} \hat{p}_{s_j} \quad (B.7)$$

Substituting back in into equation (B.6) gives equation (17) in the main text.

Equation (18)

We start by log differentiating $\varepsilon_{s_j}$ wrt $\varepsilon_j$ from equation (17):

$$\tilde{\varepsilon}_{s_j} = \frac{\varepsilon_j}{n_j \hat{\varepsilon}_{s_j}} \hat{\varepsilon}_j \quad (B.8)$$

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

$$\tilde{\varepsilon}_j = -\frac{\varepsilon_j - 1}{\varepsilon_j} \hat{q}_j \quad (B.9)$$

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

$$\hat{q}_j = -\varepsilon_j \tilde{p}_j + \eta_{q_i,i} \hat{i} \quad (B.10)$$

Log differentiating the markup pricing rule, we get:

$$\tilde{p}_{s_j} = -\frac{1}{\varepsilon_{s_j} - 1} \tilde{\varepsilon}_{s_j} \quad (B.11)$$

Combining equations (B.7)-(B.11) gives:

$$\tilde{\varepsilon}_{s_j} = \frac{\varepsilon_j}{n_j \hat{\varepsilon}_{s_j}} \left( -\frac{\varepsilon_j - 1}{\varepsilon_j} \left( -\varepsilon_j \tilde{p}_j + \eta_{q_i,i} \hat{i} \right) \right)$$

$$= \frac{\varepsilon_j - 1}{n_j \hat{\varepsilon}_{s_j}} \left( \varepsilon_j \hat{p}_j - \eta_{q_i,i} \hat{i} \right)$$

$$= \frac{\varepsilon_j - 1}{n_j \hat{\varepsilon}_{s_j}} \left( \varepsilon_j \frac{1}{n_j} \left( -\frac{1}{\varepsilon_{s_j} - 1} \tilde{\varepsilon}_{s_j} \right) - \eta_{q_i,i} \hat{i} \right)$$

$$= -\frac{\varepsilon_j \left( \varepsilon_j - 1 \right)}{n_j \varepsilon_{s_j} \left( \varepsilon_{s_j} - 1 \right)} \tilde{\varepsilon}_{s_j} - \frac{\varepsilon_j - 1}{n_j \varepsilon_{s_j}} \eta_{q_i,i} \hat{i}$$
The effect of a higher income \( i \) on demand for good \( j \), \( q_j \), through a change in the mass of goods consumed \( J \)

We calculate the effect of income \( i \) on \( q_j \) through a change in the consumption set. Differentiating demand \( q_j \) in equation (15) with respect to \( J \) gives:

\[
\frac{dq_j}{dJ} = -\frac{1}{J^2} \left( \frac{i + \int_0^J \gamma_j p_j dj}{\frac{1}{p_j}} \right) \frac{1}{\frac{1}{p_j}} dJ + \frac{1}{J} \gamma_{jpJ} \frac{1}{p_j} dJ
\]

\[
= -\frac{1}{J} \left( \frac{1}{p_j} \left( i + \int_0^J \gamma_j p_j dj \right) - \gamma_{jpJ} \right) dJ
\]

From equation (B.2) we have \( \gamma_{jpJ} = 1/\lambda \), as the demand for the last good consumed is zero, i.e. \( q_J = 0 \). Substituting as well equation (B.5), we get:

\[
\frac{dq_j}{dJ} = -\frac{1}{J} \left( \frac{1}{p_j} \left( \frac{1}{\lambda} - \frac{1}{\lambda} \right) \right) \] 

Hence, the change in demand \( q_j \) through a change in the budget set is zero, in contrast to what Jackson (1982) claims. Still, \( q_j \) does move in the same direction as \( J \), as an increase in income \( i \) increases both \( q_j \) and \( J \) as we will show now.

**Mass of varieties \( J \) rising in income \( i \)**

We can see that \( J \) rises in \( i \) by combining \( \gamma_{jpJ} = 1/\lambda \) with equation (B.5). This generates:

\[
\frac{1}{J} \left( i + \int_0^J \gamma_j p_j dj \right) = \gamma_{jpJ}
\]

Differentiating this wrt \( J \) and \( i \), using the result in equation (B.13) that the LHS does not vary with \( J \) we get:

\[
\frac{1}{J} \frac{di}{dJ} = \frac{\partial \gamma_{jpJ}}{\partial J} dJ
\]
\(\gamma_J p_J\) is equal to:

\[
\gamma_J \frac{\varepsilon_J}{\varepsilon_J - 1} a_J = \frac{1 + \gamma_J}{\gamma_J} \frac{q_J}{q_J} a_J
\]

\[
= \gamma_J \frac{q_J + \gamma_J}{\gamma_J} a_J
\]

\[
= \gamma_J a_J
\]

We have used once more that \(q_J = 0\). As \(\frac{\partial \gamma_J a_J}{\partial J} > 0\) by assumption, we find that \(J\) is strictly increasing in \(i\).

**Strict concavity of the function \(f(i_g)\) in equation (30)**

Differentiating \(f(i_g)\) in equation (30) with respect to income gives:

\[
\frac{\partial f(i_g)}{\partial i_g} = \frac{1}{J_g}
\]

We have used that the change in \(J_g\) does not effect \(f(i_g)\), as proved in equation (B.13).

The second derivative of \(f(i_g)\) is given by:

\[
\frac{\partial^2 f(i_g)}{\partial i_g^2} = -\frac{1}{J_g^2} \frac{\partial J_g}{\partial i_g}
\]

In equation (B.14) we have shown that \(J_g\) strictly increases in \(i_g\). Therefore, the second derivative is strictly negative.

**Equation (23)**

To derive equation (23), we start from the following supply equation, demand equation and an equation for the price elasticity in the three unknowns, \(\theta_j\), \(p_j\) and \(\varepsilon_{sj}\).

\[
p_j = a_{sj} \frac{\varepsilon_{sj}}{\varepsilon_{sj} - 1} \left( \frac{\varepsilon_{sj} \theta_{sj}}{\theta_{sj}} \right)^{\frac{1}{1+\sigma}} \quad (B.15)
\]

\[
\theta_{ji} = \frac{1}{J} \left( i + \int_0^J \gamma_m p_m dm \right) - \gamma_j p_j \quad (B.16)
\]

\[
\varepsilon_{sj} = \sigma + \frac{\varepsilon_J - \sigma}{n_j}
\]

\[
= \frac{\varepsilon_{sj} \theta_{sj}}{\theta_{sj}} \left( 1 + \frac{\gamma_j p_j}{\theta_{sj} iL} - \sigma \right) \quad (B.17)
\]
Log differentiating (B.15) wrt \( \theta_j, p_j \) and \( \varepsilon_{sj} \) gives us:

\[
\tilde{\theta}_j = -\frac{1}{\varepsilon_{sj} - \varepsilon_j} \tilde{\varepsilon}_{sj} + \frac{1}{\sigma - 1} \tilde{\varepsilon}_{sj} - \frac{1}{\sigma - 1} \hat{\theta}_j - \frac{1}{\sigma - 1} \hat{i}
\]

\[
\tilde{p}_j = -\frac{\varepsilon_{sj} - \sigma}{(\sigma - 1) (\varepsilon_{sj} - 1)} \tilde{\varepsilon}_{sj} - \frac{1}{\sigma - 1} \hat{\theta}_j - \frac{1}{\sigma - 1} \hat{i}
\]

\[
\tilde{p}_j = \frac{\varepsilon_j - \sigma}{n_j (\varepsilon_{sj} - 1) \tilde{\varepsilon}_{sj}} - \frac{1}{\sigma - 1} \hat{\theta}_j - \frac{1}{\sigma - 1} \hat{i}
\]

\[
\hat{\theta}_j = \frac{\varepsilon_j - \sigma}{n_j (\varepsilon_{sj} - 1)} \tilde{\varepsilon}_{sj} - (\sigma - 1) \tilde{p}_j - \hat{i}
\] (B.18)

Log differentiating (B.16):

\[
\tilde{\theta}_j = - (\varepsilon_j - 1) \hat{p}_j + (\eta - 1) \hat{i}
\] (B.19)

And (B.17):

\[
\tilde{\varepsilon}_{sj} = -\frac{\varepsilon_j - \sigma}{n_j \varepsilon_{sj}} - \frac{\varepsilon_j - \sigma}{n_j \varepsilon_{sj}} \tilde{\theta}_j - \frac{\varepsilon_j - \sigma}{n_j \varepsilon_{sj}} \hat{\theta}_j - \frac{\varepsilon_j - \sigma}{n_j \varepsilon_{sj}} \hat{i} + \frac{\varepsilon_j}{n_j \varepsilon_{sj}} \frac{\varepsilon_j}{n_j \varepsilon_{sj}} \hat{\theta}_j - \frac{\varepsilon_j}{n_j \varepsilon_{sj}} \hat{i}
\]

\[
\tilde{\varepsilon}_{sj} = \frac{\varepsilon_j - \sigma}{n_j \varepsilon_{sj}} \tilde{\theta}_j + \frac{\varepsilon_j - \sigma}{n_j \varepsilon_{sj}} \hat{\theta}_j + \frac{\varepsilon_j - \sigma}{n_j \varepsilon_{sj}} \hat{i} + \frac{\varepsilon_j - \sigma}{n_j \varepsilon_{sj}} \hat{\theta}_j - \frac{\varepsilon_j - \sigma}{n_j \varepsilon_{sj}} \hat{i}
\]

\[
\tilde{\varepsilon}_{sj} = \frac{\varepsilon_j - \sigma}{n_j \sigma} \tilde{\theta}_j + \frac{\varepsilon_j - \sigma}{n_j \sigma} \hat{\theta}_j + \frac{\varepsilon_j - \sigma}{n_j \sigma} \hat{i} + \frac{\varepsilon_j - \sigma}{n_j \varepsilon_{sj}} \hat{\theta}_j - \frac{\varepsilon_j - \sigma}{n_j \varepsilon_{sj}} \hat{i}
\] (B.20)

In the last line we used that \( n_j \varepsilon_{sj} + \sigma - \varepsilon_j = n_j (\sigma + \frac{\varepsilon_j - \sigma}{n_j}) + \sigma - \varepsilon_j = n_j \sigma \). Merging equations (B.18) and (B.19) gives us:

\[
\frac{\varepsilon_j - \sigma}{n_j (\varepsilon_{sj} - 1)} \tilde{\varepsilon}_{sj} - (\sigma - 1) \tilde{p}_j - \hat{i} = - (\varepsilon_j - 1) \hat{p}_j + (\eta - 1) \hat{i}
\]

\[
(\sigma - \varepsilon_j) \hat{p}_j = - \frac{\varepsilon_j - \sigma}{n_j (\varepsilon_{sj} - 1)} \tilde{\varepsilon}_{sj} - \eta \hat{i}
\]

\[
\hat{p}_j = -\frac{1}{n_j (\varepsilon_{sj} - 1)} \tilde{\varepsilon}_{sj} - \frac{\eta}{\sigma - \varepsilon_j} \hat{i}
\] (B.21)
Solving from the same equations for $\hat{\theta}_j$ gives us:

$$\frac{\varepsilon_j - \sigma}{n_j (\varepsilon_{sj} - 1) (\sigma - 1)} \hat{\varepsilon}_{sj} - \frac{1}{\sigma - 1} \hat{\theta}_j - \frac{1}{\varepsilon_j - 1} \hat{\gamma} = -\frac{1}{\varepsilon_j - 1} \hat{\theta}_j + \frac{\eta - 1}{\varepsilon_j - 1} \hat{\gamma}$$

$$(\frac{1}{\varepsilon_j - 1} - \frac{1}{\sigma - 1}) \hat{\theta}_j = -\frac{\varepsilon_j - \sigma}{n_j (\varepsilon_{sj} - 1) (\sigma - 1)} \hat{\varepsilon}_{sj} + \left( \frac{\eta - 1}{\varepsilon_j - 1} + \frac{1}{\sigma - 1} \right) \hat{\gamma}$$

$$(\varepsilon_j - 1) (\sigma - 1) \hat{\theta}_j = -\frac{\varepsilon_j - \sigma}{n_j (\varepsilon_{sj} - 1) (\sigma - 1)} \hat{\varepsilon}_{sj} + \left( \frac{\eta - 1}{\varepsilon_j - 1} + \frac{1}{\sigma - 1} \right) \hat{\gamma}$$

$$\hat{\theta}_j = \frac{(\varepsilon_j - 1)}{n_j (\varepsilon_{sj} - 1)} \hat{\varepsilon}_{sj} + \left( \frac{(\varepsilon_j - 1) (\sigma - 1)}{\sigma - \varepsilon_j} \right) \hat{\gamma}$$

$$\hat{\theta}_j = \frac{(\varepsilon_j - 1)}{n_j (\varepsilon_{sj} - 1)} \hat{\varepsilon}_{sj} + \left( \frac{(\eta - 1)(\sigma - 1) + \varepsilon_j - 1}{\sigma - \varepsilon_j} \right) \hat{\gamma}$$

$$\hat{\theta}_j = \frac{(\varepsilon_j - 1)}{n_j (\varepsilon_{sj} - 1)} \hat{\varepsilon}_{sj} + \left( \frac{\eta(\sigma - 1) + \varepsilon_j - \sigma}{\sigma - \varepsilon_j} \right) \hat{\gamma}$$

$$\hat{\theta}_j = \frac{(\varepsilon_j - 1)}{n_j (\varepsilon_{sj} - 1)} \hat{\varepsilon}_{sj} + \left( \frac{\eta(\sigma - 1) - \varepsilon_j}{\sigma - \varepsilon_j} \right) \hat{\gamma}$$

(B.22)

Substituting equations (B.21) and (B.22) into (B.20) gives us:

$$\hat{\varepsilon}_{sj} = \frac{\sigma + 1 - 2\varepsilon_j}{n_j \sigma} \hat{\theta}_j + \frac{\sigma + 1 - 2\varepsilon_j}{n_j \sigma} \hat{\gamma} + \frac{\varepsilon_j - 1}{n_j \sigma} \hat{\gamma}$$

$$= \frac{\sigma + 1 - 2\varepsilon_j}{n_j \sigma} \left( \frac{(\varepsilon_j - 1)}{n_j (\varepsilon_{sj} - 1)} \hat{\varepsilon}_{sj} + \left( \frac{\eta(\sigma - 1) - \varepsilon_j}{\sigma - \varepsilon_j} \right) \hat{\gamma} \right) + \frac{\sigma + 1 - 2\varepsilon_j}{n_j \sigma} \hat{\gamma}$$

Rewriting this expression finally leads to:

$$\hat{\varepsilon}_{sj} \left( \frac{\sigma + 1 - 2\varepsilon_j}{n_j \sigma} \left( \frac{(\varepsilon_j - 1)}{n_j (\varepsilon_{sj} - 1)} + \frac{\varepsilon_j - 1}{n_j (\varepsilon_{sj} - 1)} \right) \right)$$

$$= \frac{\sigma + 1 - 2\varepsilon_j}{n_j \sigma} \left( \frac{(\varepsilon_j - 1)}{n_j (\varepsilon_{sj} - 1)} + \frac{\varepsilon_j - 1}{n_j (\varepsilon_{sj} - 1)} \right) \hat{\gamma} + \frac{\sigma + 1 - 2\varepsilon_j}{n_j \sigma} \hat{\gamma}$$

$$= \frac{\sigma + 1 - 2\varepsilon_j}{n_j \sigma} \left( \frac{(\eta(\sigma - 1) - \varepsilon_j)}{\sigma - \varepsilon_j} \right) \hat{\gamma} + \frac{\sigma + 1 - 2\varepsilon_j}{n_j \sigma} \hat{\gamma}$$

$$= \frac{(\sigma + 1 - 2\varepsilon_j)(\eta(\sigma - 1) - (\varepsilon_j - 1))}{n_j \sigma(\sigma - \varepsilon_j)} \hat{\gamma}$$

$$= \frac{\eta(\sigma - 1) - (\varepsilon_j - 1)}{n_j \sigma(\sigma - \varepsilon_j)} \hat{\gamma}$$
\[
\begin{align*}
\hat{\varepsilon}_{xj} &= \left( \frac{n_j^2 \sigma (\sigma - 1) + n_j \sigma \varepsilon_j - n_j \sigma^2 - \sigma \varepsilon_j + \sigma + 2 \varepsilon_j (\varepsilon_j - 1)}{n_j \sigma n_j (\varepsilon_{xj} - 1)} \right) \\
&= \frac{(\sigma + 1) (\sigma - 1) - 2 \varepsilon_j \sigma + 2 \varepsilon_j - \varepsilon_j + 1}{n_j \sigma (\sigma - \varepsilon_j)} \hat{\eta}_i \\
\hat{\varepsilon}_{xj} &= \left( \frac{n_j^2 \sigma (\sigma - 1) + (n_j - 1) \sigma \varepsilon_j - \sigma (n_j \sigma - 1) + 2 \varepsilon_j (\varepsilon_j - 1)}{n_j \sigma n_j (\varepsilon_{xj} - 1)} \right) \\
&= \frac{\sigma^2 - 2 \varepsilon_j \sigma + \varepsilon_j \hat{\eta}_j}{n_j \sigma (\sigma - \varepsilon_j)} \hat{\eta}_i
\end{align*}
\]

**Sign \(B_j\) in equation (23)**

From equation (16) \(\varepsilon_j > 1\) and we assumed \(\sigma > 1\). \(B_j\) is positive if numerator and denominator have the same sign. The numerator is positive if:

\[
\begin{align*}
\sigma \left( \sigma - \varepsilon_j \left( 2 - \frac{1}{\sigma} \right) \right) &> 0 \\
\sigma &> \varepsilon_j \frac{2\sigma - 1}{\sigma} \\
\frac{\sigma^2}{2\sigma - 1} &> \varepsilon_j
\end{align*}
\]

(B.23)

As \(\sigma > 1\), equation (B.24) implies \(\sigma > \varepsilon_j\), so both numerator and denominator are positive when this condition is satisfied.

The denominator is negative if \(\sigma < \varepsilon_j\) and given that \(\sigma > 1\), equation (B.23) implies that the numerator is also negative.

The case of a negative numerator and a positive denominator occurs, when the following inequalities are satisfied:

\[\frac{\sigma^2}{2\sigma - 1} < \varepsilon_j < \sigma\]

Hence, we have:

\[B_j < 0 \iff \frac{\sigma^2}{2\sigma - 1} < \varepsilon_j < \sigma\]

(B.25)

Otherwise, we have \(B_j < 0\).
Appendix B.2 Income Inequality

Equation (32)

Log differentiating equation (28), we get:

$$\hat{\varepsilon}_j = -\frac{\varepsilon_j - 1}{\varepsilon_j} \hat{q}_j \quad (B.26)$$

As a next step, we log differentiate the expression for $q_j$ in equation (29) wrt $\sum_{g=1}^{G} f(i_g)$ with $p_j$ treated as an endogenous variable:

$$\hat{q}_j = -\varepsilon_j \hat{p}_j + \frac{\sum_{g=1}^{G} f(i_g)}{\sum_{g=1}^{G} f(i_g) - \hat{\gamma}_j p_j} \sum_{g=1}^{G} f(i_g)$$

$$\hat{q}_j = -\varepsilon_j \hat{p}_j + q_j p_j + \frac{q_j p_j}{q_j} \sum_{g=1}^{G} f(i_g)$$

$$\hat{q}_j = -\varepsilon_j \hat{p}_j + \frac{q_j + \gamma_j}{q_j} \sum_{g=1}^{G} f(i_g) \quad (B.27)$$

Substituting equation (B.26) into equation (B.27), we get equation (32).

Equation (33)

Equation (33) can be derived by starting from equation (32):

$$\tilde{\varepsilon}_j = -\frac{\varepsilon_j - 1}{\varepsilon_j} \left( -\varepsilon_j \hat{p}_j + \frac{q_j + \gamma_j}{q_j} \sum_{g=1}^{G} f(i_g) \right) \quad (B.28)$$

Combining equation (B.28) with (B.7), (B.8), (B.9), (B.11) gives us:

$$\tilde{\varepsilon}_{sj} = \frac{\varepsilon_j}{n_j \tilde{\varepsilon}_{sj}} \left( -\frac{\varepsilon_j - 1}{\varepsilon_j} \left( -\varepsilon_j \hat{p}_j + \frac{q_j + \gamma_j}{q_j} \sum_{g=1}^{G} f(i_g) \right) \right)$$

Going through the same steps as to derive (B.12), we arrive at:

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

Equation (34)

To derive equation (34), we start from the following supply equation, demand equation and an equation for the price elasticity in the three unknowns, $\theta_j$, $p_j$ and $\varepsilon_{sj}$ analogous to the case
without income inequality.

\[
p_j = a_{s,j} \frac{\varepsilon_{s,j}}{\varepsilon_{s,j} - 1} \left( \frac{\varepsilon_{s,j} f_{s,j}}{\theta_j G_i} \right)^\frac{1}{\theta_j} \tag{B.29}
\]

\[
\theta_j G_i = \sum_{g=1}^{G} f_i g - \gamma_j p_j \tag{B.30}
\]

\[
\varepsilon_{s,j} = \sigma + \frac{\varepsilon_j - \sigma}{n_j}
\]
\[
= \sigma + \frac{\varepsilon_{s,j} f_{s,j}}{\theta_j i L} \left( 1 + \frac{\gamma_j p_j}{\theta_j G_i} - \sigma \right) \tag{B.31}
\]

Log differentiating (B.29) wrt \( \theta_j, p_j, \varepsilon_{s,j} \) and \( \sum_{g=1}^{G} f_i g \) gives us: ²⁹

\[
\hat{p}_j = -\frac{1}{\varepsilon_{s,j} - 1} \tilde{\varepsilon}_{s,j} + \frac{1}{\sigma - 1} \tilde{\varepsilon}_{s,j} - \frac{1}{\sigma - 1} \hat{\theta}_j
\]

\[
\hat{\theta}_j = \frac{\varepsilon_{s,j} - \sigma}{n_j (\varepsilon_{s,j} - 1)} \tilde{\varepsilon}_{s,j} - (\sigma - 1) \hat{\theta}_j \tag{B.32}
\]

Log differentiating (B.30):

\[
\hat{\theta}_j = \frac{\varepsilon_j - \sigma}{n_j \varepsilon_{s,j}} \tilde{\varepsilon}_{s,j} - (\sigma - 1) \hat{\theta}_j
\]

And (B.31):

\[
\tilde{\varepsilon}_{s,j} = -\frac{\varepsilon_j - \sigma}{n_j \varepsilon_{s,j}} + \frac{\varepsilon_j}{n_j \varepsilon_{s,j}} \tilde{\varepsilon}_j
\]
\[
= \frac{\varepsilon_j - \sigma}{n_j \varepsilon_{s,j}} \tilde{\varepsilon}_j - \frac{\varepsilon_j - \sigma}{n_j \varepsilon_{s,j}} \hat{\theta}_j + \frac{\varepsilon_j}{n_j \varepsilon_{s,j}} \frac{\gamma_j p_j}{\theta_j i L} \left( \hat{\theta}_j - \hat{\theta}_j \right)
\]
\[
= \frac{\varepsilon_j - \sigma}{n_j \varepsilon_{s,j}} \tilde{\varepsilon}_j - \frac{\varepsilon_j - \sigma}{n_j \varepsilon_{s,j}} \hat{\theta}_j + \frac{\varepsilon_j - 1}{n_j \varepsilon_{s,j}} \left( \hat{\theta}_j - \hat{\theta}_j \right)
\]
\[
\tilde{\varepsilon}_{s,j} \left( \frac{n_j \varepsilon_{s,j} + \sigma - \varepsilon_{s,j}}{n_j \varepsilon_{s,j}} \right) = \frac{\sigma + 1 - 2 \varepsilon_j}{n_j \varepsilon_{s,j}} \hat{\theta}_j + \frac{\varepsilon_j - 1}{n_j \varepsilon_{s,j}} \hat{p}_j
\]
\[
\tilde{\varepsilon}_{s,j} = \frac{\sigma + 1 - 2 \varepsilon_j}{n_j \varepsilon_{s,j} + \sigma - \varepsilon_j} \hat{\theta}_j + \frac{\varepsilon_j - 1}{n_j \varepsilon_{s,j} + \sigma - \varepsilon_j} \hat{p}_j
\]

²⁹ We keep average income constant in this exercise.
\[ \varepsilon_{xj} = \frac{\sigma + 1 - 2\varepsilon_j\hat{\theta}_j}{n_j\sigma} + \frac{\varepsilon_j - 1}{n_j\sigma}\hat{p}_j \]  

(B.34)

In the last line we used that \( n_j\varepsilon_{xj} + \sigma - \varepsilon_j = n_j \left( \sigma + \frac{\varepsilon_j - \sigma}{n_j} \right) + \sigma - \varepsilon_j = n_j\sigma \). Merging equations (B.32) and (B.33) gives us:

\[
\frac{\varepsilon_j - \sigma}{n_j (\varepsilon_{xj} - 1)} \varepsilon_{xj} - (\sigma - 1) \hat{p}_j = - (\varepsilon_j - 1) \hat{p}_j + \frac{q_j + \gamma_j}{q_j} \sum_{g=1}^{G} f(i_g)
\]

\[
(\sigma - \varepsilon_j) \hat{p}_j = \frac{\varepsilon_j - \sigma}{n_j (\varepsilon_{xj} - 1)} \varepsilon_{xj} - \frac{q_j + \gamma_j}{q_j} \sum_{g=1}^{G} f(i_g)
\]

\[
\hat{p}_j = - \frac{1}{n_j (\varepsilon_{xj} - 1)} \varepsilon_{xj} - \frac{1}{\sigma - \varepsilon_j} \frac{q_j + \gamma_j}{q_j} \sum_{g=1}^{G} f(i_g)
\]  

(B.35)

Solving from the same equations for \( \hat{\theta}_j \) gives us:

\[
\frac{\varepsilon_j - \sigma}{n_j (\varepsilon_{xj} - 1)(\sigma - 1)} \varepsilon_{xj} - \frac{1}{\sigma - 1} \hat{\theta}_j = - \frac{1}{\varepsilon_j - 1} \hat{\theta}_j + \frac{1}{\varepsilon_j - 1} \frac{q_j + \gamma_j}{q_j} \sum_{g=1}^{G} f(i_g)
\]

\[
\left( \frac{1}{\varepsilon_j - 1} - \frac{1}{\sigma - 1} \right) \hat{\theta}_j = - \frac{\varepsilon_j - \sigma}{n_j (\varepsilon_{xj} - 1)(\sigma - 1)} \varepsilon_{xj} + \frac{1}{\varepsilon_j - 1} \frac{q_j + \gamma_j}{q_j} \sum_{g=1}^{G} f(i_g)
\]

\[
\frac{\sigma - \varepsilon_j}{(\varepsilon_j - 1)(\sigma - 1)} \hat{\theta}_j = - \frac{\varepsilon_j - \sigma}{n_j (\varepsilon_{xj} - 1)(\sigma - 1)} \varepsilon_{xj} + \frac{1}{\varepsilon_j - 1} \frac{q_j + \gamma_j}{q_j} \sum_{g=1}^{G} f(i_g)
\]

\[
\hat{\theta}_j = \frac{\varepsilon_j - 1}{n_j (\varepsilon_{xj} - 1)} \varepsilon_{xj} + \frac{(\varepsilon_j - 1)(\sigma - 1)}{\sigma - \varepsilon_j} \frac{1}{\varepsilon_j - 1} \frac{q_j + \gamma_j}{q_j} \sum_{g=1}^{G} f(i_g)
\]

\[
\hat{\theta}_j = \frac{\varepsilon_j - 1}{n_j (\varepsilon_{xj} - 1)} \varepsilon_{xj} + \frac{\sigma - 1}{\sigma - \varepsilon_j} \frac{q_j + \gamma_j}{q_j} \sum_{g=1}^{G} f(i_g)
\]

\[
\hat{\theta}_j = \frac{\varepsilon_j - 1}{n_j (\varepsilon_{xj} - 1)} \varepsilon_{xj} + \frac{\sigma - 1}{\sigma - \varepsilon_j} \frac{q_j + \gamma_j}{q_j} \sum_{g=1}^{G} f(i_g)
\]

\[
\hat{\theta}_j = \frac{\varepsilon_j - 1}{n_j (\varepsilon_{xj} - 1)} \varepsilon_{xj} + \frac{\sigma - 1}{\sigma - \varepsilon_j} \frac{q_j + \gamma_j}{q_j} \sum_{g=1}^{G} f(i_g)
\]  

(B.36)
Substituting equations (B.35) and (B.36) into (B.34) gives us:

$$
\tilde{e}_{sj} = \frac{\sigma + 1 - 2\varepsilon_j}{n_j \sigma} \tilde{\theta}_j + \frac{\varepsilon_j - 1}{n_j \sigma} \tilde{\rho}_j
$$

$$
= \frac{\sigma + 1 - 2\varepsilon_j}{n_j \sigma} \left( \frac{\varepsilon_j - 1}{n_j (\tilde{e}_{sj} - 1)} \tilde{e}_{sj} + \frac{\sigma - 1}{\sigma - \varepsilon_j} q_j \frac{\sigma - \varepsilon_j}{q_j} \sum_{g=1}^{G} f(i_g) \right)
$$

$$
+ \frac{\varepsilon_j - 1}{n_j \sigma} \left( -\frac{1}{n_j (\tilde{e}_{sj} - 1)} \tilde{e}_{sj} - \frac{1}{\sigma - \varepsilon_j} q_j \frac{\sigma - \varepsilon_j}{q_j} \sum_{g=1}^{G} f(i_g) \right)
$$

Rewriting this expression finally leads to:

$$
\tilde{e}_{sj} \left( 1 - \frac{\sigma + 1 - 2\varepsilon_j}{n_j \sigma} \frac{\varepsilon_j - 1}{n_j (\tilde{e}_{sj} - 1)} + \frac{\varepsilon_j - 1}{n_j (\tilde{e}_{sj} - 1)} \frac{1}{n_j \sigma} \right)
$$

$$
= \frac{\sigma + 1 - 2\varepsilon_j}{n_j \sigma} \frac{\sigma - 1}{\sigma - \varepsilon_j} q_j + \gamma_j \sum_{g=1}^{G} f(i_g) - \frac{\varepsilon_j - 1}{n_j \sigma} \frac{1}{n_j \sigma} \frac{q_j + \gamma_j}{q_j} \sum_{g=1}^{G} f(i_g)
$$

$$
\tilde{e}_{sj} \left( \frac{n_j \sigma n_j (\varepsilon_{ij} - 1) - (\sigma + 1 - 2\varepsilon_j)(\varepsilon_{ij} - 1) + \varepsilon_{ij} - 1}{n_j \sigma n_j (\varepsilon_{ij} - 1)} \right)
$$

$$
= \frac{\sigma + 1 - 2\varepsilon_j}{n_j \sigma} \frac{\sigma - 1}{\sigma - \varepsilon_j} q_j + \gamma_j \sum_{g=1}^{G} f(i_g) - \frac{\varepsilon_j - 1}{n_j \sigma} \frac{1}{n_j \sigma} \frac{q_j + \gamma_j}{q_j} \sum_{g=1}^{G} f(i_g)
$$

$$
\tilde{e}_{sj} \left( \frac{n_j \sigma (n_j (\sigma - 1) + \varepsilon_{ij} - \sigma) - \sigma \varepsilon_{ij} + \sigma - \varepsilon_{ij} + 1 + 2\varepsilon_j^2 - 2\varepsilon_j + \varepsilon_{ij} - 1}{n_j \sigma n_j (\varepsilon_{ij} - 1)} \right)
$$

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

$$
\tilde{e}_{sj} \left( \frac{n_j^2 \sigma (\sigma - 1) + n_j \sigma \varepsilon_{ij} - n_j \sigma^2 - \sigma \varepsilon_{ij} + \sigma + 2\varepsilon_j (\varepsilon_{ij} - 1)}{n_j \sigma n_j (\varepsilon_{ij} - 1)} \right)
$$

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

$$
\tilde{e}_{sj} \left( \frac{n_j^2 \sigma (\sigma - 1) + (n_j - 1) \sigma \varepsilon_{ij} - \sigma (n_j \sigma - 1) + 2\varepsilon_j (\varepsilon_{ij} - 1)}{n_j \sigma n_j (\varepsilon_{ij} - 1)} \right)
$$

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

12
\[ \hat{\varepsilon}_{sj} = \frac{n_j (\varepsilon_{sj} - 1)}{(n_j^2 \sigma (\sigma - 1) + (n_j - 1) \sigma \varepsilon_j - \sigma (n_j \sigma - 1) + 2 \varepsilon_j (\varepsilon_j - 1))} \]
\[ \times \frac{\sigma^2 - 2 \varepsilon_j \sigma + \varepsilon_j^2 - \varepsilon_j (\varepsilon_j - 1) q_j + \gamma_j \sum_{g=1}^{G} f(i_g)}{\sigma - \varepsilon_j} \]
\[ \hat{\varepsilon}_{sj} = \frac{n_j (\varepsilon_{sj} - 1)}{(n_j^2 \sigma (\sigma - 1) + (n_j - 1) \sigma \varepsilon_j - \sigma (n_j \sigma - 1) + 2 \varepsilon_j (\varepsilon_j - 1))} \]
\[ \times \left( \frac{\sigma - \varepsilon_j - \varepsilon_j (\varepsilon_j - 1)}{\sigma - \varepsilon_j} \right) q_j + \gamma_j \sum_{g=1}^{G} f(i_g) \]

*Equation (36)*

To get to equation (36), we start from equation (35) and log differentiate wrt \( p_j \) and \( i_H \) taking the relation between the changes in \( i_L \) and \( i_H \) into account:

\[ \hat{\varepsilon}_j = -\frac{\varepsilon_j - 1}{\varepsilon_j} \left( -s_j \tilde{p}_j + \frac{q_j, H \eta_{q_j, H, \cdot, i_H} - q_j, L \Lambda \eta_{q_j, L, \cdot, i_L, i_H}^H}{q_j, H + q_j, L, i_H} \right) \]

Going through the same steps as to derive the effect of a change in the Atkinson index, we arrive at:

\[ \hat{\varepsilon}_j = -\frac{n_j (\varepsilon_{sj} - 1) (\varepsilon_j - 1)}{n_j^2 \varepsilon_{sj} (\varepsilon_{sj} - 1) + \varepsilon_j (\varepsilon_j - 1)} \frac{q_j, H \eta_{q_j, H, \cdot, i_H} - q_j, L \eta_{q_j, L, \cdot, i_L, i_H}}{q_j, H + q_j, L, i_H} \]

*Equation (B.37)*

Now, we rewrite the income elasticity \( \eta_{q_j, g, \cdot, i_G} \) as follows:

\[ \eta_{q_j, g, \cdot, i_G} = \frac{i_g}{i_g + \int \gamma_m p_m dm - \gamma_j p_j J_g} \]

\[ \eta_{q_j, g, \cdot, i_G} = \frac{\frac{1}{J_g} i_g}{\frac{1}{J_g} \left( i_g + \int \gamma_m p_m dm \right) - \gamma_j p_j} \]

\[ \eta_{q_j, g, \cdot, i_G} = \frac{\frac{1}{J_g} i_g}{q_j, g, p_j} \]

*Equation (B.38)*

Substituting equation (B.38) into (B.37) gives us:

\[ \hat{\varepsilon}_j = -\frac{n_j (\varepsilon_{sj} - 1) (\varepsilon_j - 1)}{n_j^2 \varepsilon_{sj} (\varepsilon_{sj} - 1) + \varepsilon_j (\varepsilon_j - 1)} \frac{q_j, H \eta_{q_j, H, \cdot, i_H} - q_j, L \eta_{q_j, L, \cdot, i_L, i_H}}{q_j, H + q_j, L, i_H} \]

\[ = -\frac{n_j (\varepsilon_{sj} - 1) (\varepsilon_j - 1)}{n_j^2 \varepsilon_{sj} (\varepsilon_{sj} - 1) + \varepsilon_j (\varepsilon_j - 1)} \frac{\frac{1}{J_H} i_H - \frac{1}{J_L} i_H}{p_j q_j, H + p_j q_j, L, i_H} \]

\[ = -\frac{n_j (\varepsilon_{sj} - 1) (\varepsilon_j - 1)}{n_j^2 \varepsilon_{sj} (\varepsilon_{sj} - 1) + \varepsilon_j (\varepsilon_j - 1)} \left( \frac{1}{J_H} - \frac{1}{J_L} \right) i_H \]

13
Appendix C  Derivations in the Quality Model

Appendix C.1 Derivations \( q_{l,jg}, \alpha_{l,jg} \) and \( p_{l,jg} \)

We derive expressions for \( q_{l,jg}, \alpha_{l,jg} \) and \( p_{l,jg} \), but we suppress country subscripts \( l \) and group subscript \( g \). Maximize utility in equation (1) s.t. the budget constraint in equation (2):

\[
U = \prod_{j=1}^{m} a_j^{\beta_j}; \quad 0 < \beta_j < 1 \text{ for all } j, \quad \sum_{j=1}^{m} \beta_j = 1
\]

\[
u_j = \left( \frac{a_j^{\frac{1}{\beta_j}}}{q_j^{\frac{1}{\beta_j}}} + q_j^{\frac{1}{\beta_j}} \right)^{-\frac{1}{\rho}}; \quad \forall \; j; \; \rho > 0
\]

\[
\sum_{j=1}^{m} \alpha_j^\gamma a_j q_j = i \quad \text{(C.1)}
\]

This leads to the following first order conditions:

\[
\beta_j \frac{U}{u_j} \left( \frac{a_j^{\frac{1}{\beta_j}}}{q_j^{\frac{1}{\beta_j}}} + q_j^{\frac{1}{\beta_j}} \right)^{-\frac{1}{\rho}} \gamma a_j^{-\frac{1}{\beta_j}} - \lambda a_j^\gamma a_j = 0; \quad \forall \; j \quad \text{(C.2)}
\]

\[
\beta_j \frac{U}{u_j} \left( \frac{a_j^{1/\beta_j}}{q_j^{1/\beta_j}} + q_j^{1/\beta_j} \right)^{-\frac{1}{\rho}} \gamma a_j^{-\frac{1}{\beta_j}} - \lambda^\gamma a_j^{\gamma-1} a_j q_j = 0; \quad \forall \; j \quad \text{(C.3)}
\]

Dividing equations (C.2) and (C.3) gives:

\[
\left( \frac{\alpha_j}{q_j} \right)^{\frac{1}{\beta_j}} = \frac{a_j^\gamma a_j}{\gamma a_j^{\gamma-1} a_j q_j}
\]

\[
\left( \frac{\alpha_j}{q_j} \right)^{\frac{1}{\beta_j}} = \frac{a_j}{\gamma q_j}
\]

\[
\frac{\alpha_j}{q_j} = \left( \frac{\alpha_j}{\gamma q_j} \right)^{\rho}
\]

\[
\alpha_j^{1-\rho} = \frac{q_j^{1-\rho}}{\gamma^\rho}
\]

\[
\alpha_j = \gamma^{\frac{\rho}{1-\rho}} q_j
\]

(C.4)
Substituting (C.4) back into (C.2) gives:

\[
\beta_j U \left( \frac{\alpha_j^{1-\gamma}}{\beta_j} + \frac{q_j^{1-\gamma}}{p_j} \right)^{-1} \frac{\gamma^{1-\gamma}}{p_j} q_j^{\frac{1}{\gamma}} - \lambda a_j a_j = 0
\]

\[
\beta_j U \left( \frac{\gamma^{1-\gamma}}{p_j} q_j^{1-\gamma} + \frac{q_j^{1-\gamma}}{p_j} \right)^{-1} \frac{\gamma^{1-\gamma}}{p_j} q_j^{\frac{1}{\gamma}} - \lambda a_j a_j = 0
\]

\[
\beta_j U q_j^{1-\gamma} (1 + \gamma) q_j^{\frac{1}{\gamma}} - \lambda p_j = 0
\]

\[
\beta_j U q_j = \lambda p_j (1 + \gamma) \tag{C.5}
\]

Dividing (C.5) for index \( j \) by the same FOC for the good with index \( k \), one gets:

\[
\frac{\beta_j U_{qj}}{\beta_k U_{qk}} = \frac{p_j (1 + \gamma)}{p_k (1 + \gamma)}
\]

\[
q_k = \frac{\beta_k p_j}{\beta_j p_k} q_j \tag{C.6}
\]

Substituting (C.6) into the budget constraint, equation (2), one gets:

\[
\sum_{k \neq j}^m p_k \frac{\beta_k p_j}{\beta_j p_k} q_j + p_j q_j = i
\]

\[
\sum_{k \neq j}^m p_k \frac{\beta_k p_j}{\beta_j p_k} q_j + \beta_j p_j q_j = i \tag{C.7}
\]

\[
q_j p_j \left( \beta_j + \sum_{k \neq j}^m \beta_k \right) = i
\]

\[
q_j \frac{q_j a_j^{1-\gamma}}{\beta_j} = i \tag{C.8}
\]

\[
q_j \left( \frac{\gamma^{1-\gamma}}{a_j} \right)^\gamma = \frac{i \beta_j}{a_j} \tag{C.9}
\]

\[
q_j = \left( \frac{\gamma^{1-\gamma}}{a_j} \right)^{1-\gamma} \tag{C.10}
\]

Substituting the expression for \( q_j \) in equation (C.9) in into (C.4), we get the following expression:

\[
\alpha_j = \gamma^{\frac{1}{1-\gamma}} q_j
\]

\[
= \gamma^{\frac{1}{1-\gamma}} \left( \frac{\gamma^{1-\gamma} \beta_j i}{a_j} \right)^{1-\gamma}
\]

\[
= \gamma^{\frac{1}{1-\gamma}} (1 - \frac{\gamma}{1-\gamma}) \left( \frac{\beta_j i}{a_j} \right)^{1-\gamma}
\]

\[
= \gamma^{\frac{1}{1-\gamma}} \left( \frac{\beta_j i}{a_j} \right)^{1-\gamma}
\]

15
Price $p_j$ is equal to:

$$
p_j = \gamma^{\frac{j}{\aleph_0}} \beta^j \left( \frac{\beta_j}{a_j} \right)^{\frac{j}{\aleph_0}} a_j
$$

$$
= \gamma^{\frac{j}{\aleph_0}} \beta^j a_j^{\frac{j}{\aleph_0}}
$$

Adding subscripts $l$ and $g$ to income $g$ and quantity $q_j$, quality $\alpha_j$ and price $p_j$ gives the expressions in the main text.

**Appendix C.2 Income Inequality**

*Equation (10)*

We start from equation (9):

$$
p_{klj} = \gamma^{\frac{j}{\aleph_0}} \beta^j a_j^{\frac{j}{\aleph_0}} \left( \frac{G}{\sum_{g=1}^{G} \frac{i_{lg}}{G_{lg}}} \right)
$$

Equation (12)

We can rewrite this equation as follows:

$$
p_{klj} = \gamma^{\frac{j}{\aleph_0}} \beta^j a_j^{\frac{j}{\aleph_0}} \frac{1}{\frac{1}{G} \sum_{g=1}^{G} \frac{i_{lg}}{G_{lg}}} \left( \frac{\sum_{g=1}^{G} \frac{i_{lg}}{G_{lg}}}{G} \right)^{\frac{j}{\aleph_0}}
$$

$$
= \gamma^{\frac{j}{\aleph_0}} \beta^j a_j^{\frac{j}{\aleph_0}} \frac{\left( \frac{1}{G} \sum_{g=1}^{G} \frac{i_{lg}}{G_{lg}} \right)^{\frac{j}{\aleph_0}}}{\left( \frac{\sum_{g=1}^{G} \frac{i_{lg}}{G_{lg}}}{G} \right)^{\frac{j}{\aleph_0}}}
$$

$$
= \gamma^{\frac{j}{\aleph_0}} \beta^j a_j^{\frac{j}{\aleph_0}} \left( \frac{\sum_{g=1}^{G} \frac{i_{lg}}{G_{lg}}}{G} \right)^{\frac{j}{\aleph_0}} \left( \frac{\sum_{g=1}^{G} \frac{i_{lg}}{G_{lg}}}{G} \right)^{1+\frac{j}{\aleph_0}} \left( \frac{\sum_{g=1}^{G} \frac{i_{lg}}{G_{lg}}}{G} \right)^{\frac{j}{\aleph_0}}
$$

$$
= \gamma^{\frac{j}{\aleph_0}} \beta^j a_j^{\frac{j}{\aleph_0}} \left( \frac{\sum_{g=1}^{G} \frac{i_{lg}}{G_{lg}}}{G} \right)^{\frac{j}{\aleph_0}} \left( 1 - I_{Al} \left( \frac{\sum_{g=1}^{G} \frac{i_{lg}}{G_{lg}}}{G} \right) \right)^{\frac{j}{\aleph_0}}
$$

*Equation (12)*

16
We start with equation (11):

\[
d_p \kappa_{ij} = \frac{\omega_{ij} \phi_{ijkl} + \omega_{ij} \phi_{ijkl} \omega_{ijL}}{\omega_{ij} \phi_{ijkl} + \omega_{ij} \phi_{ijkl} \omega_{ijL}} + \frac{\omega_{ij} \phi_{ijkl} \gamma_{ij} H + \omega_{ij} \phi_{ijkl} \gamma_{ij} L}{\omega_{ij} \phi_{ijkl} + \omega_{ij} \phi_{ijkl} \gamma_{ij} L}
\]

(C.13)

First we rewrite \( \omega_{j,i,G} \) as follows:

\[
\omega_{j,i,G} = \frac{q_{j,i,G}}{q_{j,H} + q_{j,L} L}
\]

\[
\omega_{j,i,G} = \frac{\gamma_{i,j}^{H}}{\gamma_{i,j}^{H} + \beta_{j,i} H} \frac{1}{\gamma_{i,j}^{L} + \beta_{j,i} L}
\]

\[
\omega_{j,i,G} = \frac{i_{i,G}}{i_{i,H} H + i_{i,L} L}
\]

(C.14)

Next, calculate \( \omega_{j,i,H}, \omega_{j,i,L} \) as follows from equation (C.14), using that a mean preserving spread requires, \( i_{i,L} = \frac{i_{i,H} H}{i_{i,L} L} i_{i,H} \) as pointed out in the main text:

\[
\tilde{\omega}_{j,i,H} = \frac{1}{1 + \gamma} \left( i_{i,H} - \frac{1}{1 + \gamma} \frac{i_{i,H} H}{i_{i,H} H + i_{i,L} L} i_{i,H} - \frac{1}{1 + \gamma} i_{i,L} L \right)
\]

\[
\tilde{\omega}_{j,i,L} = \frac{1}{1 + \gamma} \left( i_{i,H} - \frac{1}{1 + \gamma} i_{i,L} L \right)
\]

(C.15)

Similarly, we get:

\[
\tilde{\omega}_{j,i,L} = \frac{1}{1 + \gamma} \left( i_{i,H} - \frac{i_{i,L} L}{i_{i,H} H + i_{i,L} L} \right)
\]

\[
= \frac{1}{1 + \gamma} \left( \frac{i_{i,H}}{i_{i,H} H + i_{i,L} L} \right)
\]

(C.16)

\[
= \frac{1}{1 + \gamma} \left( \frac{i_{i,L} L}{i_{i,H} H + i_{i,L} L} \right)
\]

(C.17)

\[
= \frac{1}{1 + \gamma} \left( \frac{i_{i,L} L}{i_{i,L} L} \right)
\]

(C.18)

\[
= \frac{1}{1 + \gamma} \left( \frac{i_{i,L} L}{i_{i,L} L} \right)
\]

(C.19)
Next, calculate \( \tilde{p}_{ijH} \) and \( \tilde{p}_{ijL} \) from equation (5) as follows:

\[
\tilde{p}_{ijH} = \frac{\gamma}{1 + \gamma} \tilde{i}_{iH}
\]

\[
\tilde{p}_{ijL} = -\frac{\gamma}{1 + \gamma} \tilde{i}_{iL} \tilde{L}_{iH}
\]

Substituting equation (5) and (C.14) into equation (11), we can write the relative change of \( p_{klj} \) as follows:

\[
\tilde{p}_{klj} = \frac{\omega_{lj} \rho_{l} \omega_{lj}}{\omega_{lj} \rho_{l} + \omega_{lj} \rho_{l} \omega_{lj}} + \frac{\omega_{lj} \rho_{l} \omega_{lj} + \omega_{lj} \rho_{l} \omega_{lj}}{\omega_{lj} \rho_{l} + \omega_{lj} \rho_{l} \omega_{lj}}
\]

\[
\tilde{p}_{klj} = \frac{\frac{\gamma}{1 + \gamma} \tilde{i}_{iH} \tilde{H}_{iH}}{\frac{\gamma}{1 + \gamma} \tilde{i}_{iH} \tilde{H}_{iH} + \frac{\gamma}{1 + \gamma} \tilde{i}_{iL} \tilde{L}_{iH}} \tilde{p}_{ijH} \tilde{H}_{iH} + \frac{\gamma}{1 + \gamma} \tilde{i}_{iH} \tilde{H}_{iH} \tilde{p}_{ijL} \tilde{H}_{iH}
\]

Next, we use equations (C.15)-(C.21) to get:

\[
\tilde{p}_{klj} = \frac{\frac{\gamma}{1 + \gamma} \tilde{i}_{iH} \tilde{H}_{iH} \tilde{p}_{ijH} \frac{1}{1 + \gamma} \frac{\gamma}{1 + \gamma} \tilde{i}_{iL} \tilde{L}_{iH} \tilde{p}_{ijL} \frac{1}{1 + \gamma} \tilde{i}_{iH} \tilde{H}_{iH} + \frac{\gamma}{1 + \gamma} \tilde{i}_{iL} \tilde{L}_{iH} \tilde{p}_{ijH} + \omega_{lj} \rho_{l} \omega_{lj}}{\omega_{lj} \rho_{l} + \omega_{lj} \rho_{l} \omega_{lj}}
\]

\[
= \frac{\rho_{l} \omega_{lj} \tilde{H}_{iH} \tilde{p}_{ijH} + \omega_{lj} \rho_{l} \omega_{lj} \tilde{H}_{iH} \tilde{p}_{ijL} \tilde{H}_{iH}}{\omega_{lj} \rho_{l} + \omega_{lj} \rho_{l} \omega_{lj}}
\]
Appendix D  Alternative Ways to Model Demand for Quality

Appendix D.1 Cobb Douglas Preferences within Sectors

We assume homothetic preferences across sectors and preferences within a sector $j$ represented by the utility function in equation (1). This implies that the expressions for quantity $q$, quality $\alpha$ and price $p$ stay as in the baseline model, but they now indicate quantity, quality and price of one of the $m$ varieties consumed within a sector. Therefore, to get the average sectoral price we have to take the average across all consumed goods $m$ and all income groups $G$. So, with $G$ income groups all income groups consume every good and we get as average price within a sector:

$$p_{klj} = \frac{\sum_{j=1}^{m} \sum_{g=1}^{G} q_{ijg} p_{ijg}}{\sum_{g=1}^{G} q_{jg}}$$

$$= \sum_{j=1}^{m} \sum_{g=1}^{G} \gamma_{\tau p j} \beta_{jijg} a_{j}^{-\frac{\alpha}{\alpha}} (\beta_{jijg})^{-\frac{1}{\tau}} a_{j}^{\frac{\alpha}{\alpha}}$$

$$= \sum_{j=1}^{m} \sum_{g=1}^{G} \gamma_{\tau p j} \beta_{jijg} a_{j}^{-\frac{\alpha}{\alpha}} (\beta_{jijg})^{-\frac{1}{\tau}} a_{j}^{\frac{\alpha}{\alpha}} A_{ij} i_{lg}$$

$$= \gamma_{\tau p j} \sum_{j=1}^{m} \beta_{jijg} a_{j}^{-\frac{\alpha}{\alpha}} A_{ij} \sum_{g=1}^{G} (i_{lg})^{-\frac{1}{\tau}}$$

(D.1)

In the third line we use that $i_{lg} = A_{lj} i_{lg}$ following from upper nest homothetic preferences. This implies that income spent in sector $j$ is proportional to total income with a proportionality factor $A_{lj}$ equal across income groups. Hence, with equal preferences across different income groups (equal $\beta_{j}$’s) and equal marginal cost shifter $a_{j}$ for products of different quality demanded by the different income groups, which we think is reasonable, our results remain the same. The reason is that $\beta_{j}$ and $a_{j}$ do not interact with the income of different income groups, $i_{lg}$, in equation (D.1). We still find that the average volumes decrease with values staying constant implying that unit values go up. There is less demand for lower priced goods and more demand for higher priced goods, implying that on average prices go up.

Appendix D.2 CES Preferences within Sectors

To go one step further, we elaborate now on a model with CES preferences across the different goods $j$ within a sector. We work with a continuum of varieties and suppress country index $l$ and the sectoral index. We have to maximize subutility $U_{s}$ in an arbitrary sector $s$ s.t. the budget
constraint that features spending on sector \( s \), \( i_s \):

\[
U_s = \left( \int_{j \in J} \beta_j u_j^{\frac{\kappa-1}{\kappa}} \, dj\right)^{\frac{1}{\kappa-1}} \quad \left( \alpha_j^{\frac{\kappa-1}{\kappa}} + q_j^{\frac{\kappa-1}{\kappa}} \right)^{\frac{1}{\kappa-1}} u_j^{-\frac{1}{\kappa}} = 1 \quad \forall j; \ \rho > 0
\]

\[
\int_{j \in J} \alpha_j^2 a_j q_j \, dj = i_s \tag{D.2}
\]

This leads to the following first order conditions:

\[
\left( \int_{j \in J} \beta_j u_j^{\frac{\kappa-1}{\kappa}} \, dj\right)^{\frac{1}{\kappa-1}} eta_j u_j^{-\frac{1}{\kappa}} \left( \alpha_j^{\frac{\kappa-1}{\kappa}} + q_j^{\frac{\kappa-1}{\kappa}} \right)^{\frac{1}{\kappa-1}} q_j^{-\frac{1}{\kappa}} - \lambda a_j^2 a_j = 0; \quad \forall j \tag{D.3}
\]

\[
\left( \int_{j \in J} \beta_j u_j^{\frac{\kappa-1}{\kappa}} \, dj\right)^{\frac{1}{\kappa-1}} \beta_j u_j^{-\frac{1}{\kappa}} \left( \alpha_j^{\frac{\kappa-1}{\kappa}} + q_j^{\frac{\kappa-1}{\kappa}} \right)^{\frac{1}{\kappa-1}} \alpha_j^{-\frac{1}{\kappa}} - \lambda \gamma a_j^2 a_j = 0; \quad \forall j \tag{D.4}
\]

Dividing the two first order conditions gives:

\[
\left( \frac{\alpha_j}{q_j} \right)^{\frac{1}{\kappa}} = \frac{a_j^{\gamma^2}}{\gamma a_j^{\gamma^1} a_j q_j}
\]

\[
\left( \frac{\alpha_j}{q_j} \right)^{\frac{1}{\kappa}} = \frac{\alpha_j^{\gamma^1}}{\gamma q_j}
\]

\[
\frac{\alpha_j}{q_j} = \frac{\alpha_j^{\gamma^1}}{\gamma q_j}
\]

\[
\alpha_j^{1-\rho} = \frac{q_j^{1-\rho}}{\gamma^{\rho}}
\]

\[
\alpha_j = \gamma^{\frac{\rho}{\kappa}} q_j
\]

Substituting (D.5) back into (D.3) gives:

\[
\left( \int_{j \in J} \beta_j u_j^{\frac{\kappa-1}{\kappa}} \, dj\right)^{\frac{1}{\kappa-1}} \beta_j u_j^{-\frac{1}{\kappa}} \left( \alpha_j^{\frac{\kappa-1}{\kappa}} + q_j^{\frac{\kappa-1}{\kappa}} \right)^{\frac{1}{\kappa-1}} q_j^{-\frac{1}{\kappa}} - \lambda a_j^2 a_j = 0
\]

\[
U^\sigma u_j^{-\frac{1}{\kappa} + \frac{1}{\kappa} - \frac{1}{\kappa}} q_j^{-\frac{1}{\kappa}} - \lambda a_j^2 a_j = 0
\]

\[
U^\sigma \beta_j \left( \gamma^{\frac{\rho}{\kappa}} q_j^{\frac{\rho}{\kappa}} + q_j^{\frac{\rho}{\kappa}} \right)^{\frac{1}{\kappa-1}} q_j^{-\frac{1}{\kappa}} - \lambda a_j^2 a_j = 0
\]

\[
U^\sigma \beta_j q_j^{\frac{\rho}{\kappa}} \left( \frac{1}{\kappa} + \gamma \right)^{\frac{\rho}{\kappa}} q_j^{-\frac{1}{\kappa}} - \lambda p_j = 0
\]

\[
U^\sigma \beta_j q_j^{-\frac{1}{\kappa} + \frac{1}{\kappa} + \frac{1}{\kappa} - \frac{1}{\kappa}} q_j^{-\frac{1}{\kappa}} - \lambda p_j = 0
\]

\[
U^\sigma \beta_j q_j^{-\frac{1}{\kappa} + \frac{1}{\kappa} + \frac{1}{\kappa} - \frac{1}{\kappa}} q_j^{-\frac{1}{\kappa}} - \lambda p_j = 0
\]

\[
U^\sigma \beta_j q_j^{-\frac{1}{\kappa} + \frac{1}{\kappa} + \frac{1}{\kappa} - \frac{1}{\kappa}} q_j^{-\frac{1}{\kappa}} - \lambda p_j = 0
\]

\[
U^\sigma \beta_j q_j^{-\frac{1}{\kappa} + \frac{1}{\kappa} + \frac{1}{\kappa} - \frac{1}{\kappa}} q_j^{-\frac{1}{\kappa}} - \lambda p_j = 0
\]

\[
U^\sigma \beta_j q_j^{-\frac{1}{\kappa} + \frac{1}{\kappa} + \frac{1}{\kappa} - \frac{1}{\kappa}} q_j^{-\frac{1}{\kappa}} - \lambda p_j = 0
\]

\[
U^\sigma \beta_j q_j^{-\frac{1}{\kappa} + \frac{1}{\kappa} + \frac{1}{\kappa} - \frac{1}{\kappa}} q_j^{-\frac{1}{\kappa}} - \lambda p_j = 0
\]

\[
U^\sigma \beta_j q_j^{-\frac{1}{\kappa} + \frac{1}{\kappa} + \frac{1}{\kappa} - \frac{1}{\kappa}} q_j^{-\frac{1}{\kappa}} - \lambda p_j = 0
\]

\[
U^\sigma \beta_j q_j^{-\frac{1}{\kappa} + \frac{1}{\kappa} + \frac{1}{\kappa} - \frac{1}{\kappa}} q_j^{-\frac{1}{\kappa}} - \lambda p_j = 0
\]
Dividing (D.6) for index $j$ by the same FOC for the good with index $k$, one gets:

$$U^{\frac{1}{\gamma}} \beta_j q_j^{\frac{1}{\gamma}} \left(1 + \gamma\right)^{\frac{\alpha}{1 - \sigma}} \frac{\sigma}{\sigma} = \frac{p_j}{p_k}$$

$$q_k = \left(\frac{\beta_k p_j}{\beta_j p_k}\right)^\sigma q_j$$  \hspace{0.5cm}  \text{(D.7)}

Substituting (D.7) into the budget constraint, equation (D.2), one gets:

$$\int_{k \in J} p_k \left(\frac{\beta_k p_j}{\beta_j p_k}\right)^\sigma q_j dk + p_j q_j = i_s$$

$$q_j = \left(\frac{\beta_j}{p_j}\right)^\sigma \int_{k \in J} \frac{i_s}{p_k^{1 - \sigma} \beta_k^\sigma} dk$$

$$q_j = \left(\frac{\beta_j}{\alpha_j a_j}\right)^\sigma \int_{j \in J} \frac{i_s}{p_j^{1 - \sigma} \beta_j^\sigma} dj$$

$$q_j = \left(\frac{\beta_j}{\gamma^{-\frac{\alpha}{1 - \sigma}} a_j}\right)^\sigma \int_{j \in J} \frac{i_s}{p_j^{1 - \sigma} \beta_j^\sigma} dj$$

$$q_j^{1 + \gamma^\sigma} = \left(\frac{\beta_j}{\gamma^{-\frac{\alpha}{1 - \sigma}} a_j}\right)^\sigma \int_{j \in J} \frac{i_s}{p_j^{1 - \sigma} \beta_j^\sigma} dj$$

$$q_j = \left(\frac{\beta_j}{\gamma^{-\frac{\alpha}{1 - \sigma}} a_j}\right)^\sigma \left(P_s^{\sigma - 1} i_s\right)^{\frac{1}{1 + \gamma^\sigma}}$$  \hspace{0.5cm}  \text{(D.8)}

With

$$P_s = \left(\int_{j \in J} p_j^{1 - \sigma} \beta_j^\sigma dj\right)^{\frac{1}{1 - \sigma}}$$

Substituting the expression for $q_j$ in equation (C.9) in into (D.5), we get the following expression:

$$\alpha_j = \gamma^{-\frac{\alpha}{1 - \sigma}} q_j$$

$$= \gamma^{-\frac{\alpha}{1 - \sigma}} \left(\frac{\beta_j}{\gamma^{-\frac{\alpha}{1 - \sigma}} a_j}\right)^{\frac{1}{1 + \gamma^\sigma}} \left(P_s^{\sigma - 1} i_s\right)^{\frac{1}{1 + \gamma^\sigma}}$$

$$= \gamma^{-\frac{\alpha}{1 - \sigma}} \left(1 - \frac{\alpha}{1 + \gamma^\sigma}\right) \left(\frac{\beta_j}{a_j}\right)^{\frac{1}{1 + \gamma^\sigma}} \left(P_s^{\sigma - 1} i_s\right)^{\frac{1}{1 + \gamma^\sigma}}$$

$$= \gamma^{-\frac{\alpha}{1 - \sigma}} \left(\frac{\beta_j}{a_j}\right)^{\frac{1}{1 + \gamma^\sigma}} \left(P_s^{\sigma - 1} i_s\right)^{\frac{1}{1 + \gamma^\sigma}}$$

21
And price $p_j$ is equal to:

$$
p_j = \left( \frac{\gamma p_j a_j}{P_j^1-i_j} \left( \beta_j \right)^\frac{\gamma}{1-\sigma} (P_j^\sigma-1) \right)^\frac{1}{1-\sigma} a_j
$$

$$
= \gamma \left( \frac{p_j a_j}{P_j^1-i_j} \beta_j \left( P_j^\sigma-1 \right) \right)^\frac{1}{1-\sigma} a_j
$$

Solving for the price index $P$:

$$
P_a = \left( \int_{j \in J} p_j^{1-\sigma} \beta_j^\gamma dj \right)^\frac{1}{1-\sigma}
$$

$$
= \left( \int_{j \in J} \left( \frac{\gamma p_j a_j}{P_j^1-i_j} \beta_j^{\gamma-1} (P_j^\sigma-1) a_j^{\gamma \sigma} \right)^{1-\sigma} \beta_j^\gamma dj \right)^\frac{1}{1-\sigma}
$$

$$
P_a = \gamma \left( \frac{p_j a_j}{P_j^1-i_j} \beta_j^{\gamma-1} \left( P_j^\sigma-1 i_j a_j \right)^{\gamma \sigma} \right)^\frac{1}{1-\sigma}
$$

$$
P_a = \gamma \left( \frac{p_j a_j}{P_j^1-i_j} \beta_j^{\gamma-1} \left( P_j^\sigma-1 i_j a_j \right)^{\gamma \sigma} \right)^\frac{1}{1-\sigma}
$$

(D.9)

With G income groups, all income groups consume every good and we get as average price within a sector an integral across all goods consumed and a sum across all income groups:

$$
p_{klj} = \sum_{j \in J} G_{lg} \frac{q_{lgj}}{\sum_{g=1}^G q_{lgj}} p_{ljg} dj
$$

$$
= \int_{j \in J} G_{lg} \left( \frac{\beta_j}{\gamma p_j a_j} \right)^\frac{1}{1-\sigma} \left( P_j^\sigma-1 i_j a_j \right)^\frac{1}{1-\sigma} \left( P_j^\sigma-1 i_j a_j \right)^\frac{\gamma}{1-\sigma} \beta_j^\gamma dj
$$

$$
= \gamma \left( \frac{p_j a_j}{P_j^1-i_j} \beta_j^{\gamma-1} \left( P_j^\sigma-1 i_j a_j \right)^{\gamma \sigma} \right)^\frac{1}{1-\sigma}
$$

(D.10)
Substituting the expression for the price index, equation (D.9), into equation (D.10), we get:

\[
p_{kj} = \frac{\gamma_j}{\gamma_j} \prod_{g=1}^{G} \left( \frac{1}{\gamma_j} \left( \int a_{jl}^{\frac{1}{1+\sigma}} \beta_j^{\frac{\sigma}{1+\sigma}} dj \right) \right)^{\sigma-1} \frac{1}{1+\sigma} \frac{i_{lg}}{i_{tg}}
\]

Hence, also with CES preferences within sectors imposing equal preferences across different income groups (equal \( \beta_j \)'s) and equal marginal cost shifter \( a_j \) for products of different quality demanded by the different income groups, our results remain the same. We can rewrite this expression like in the main text and in the model with Cobb Douglas preferences within sectors as a function of average income and the Atkinson index.

**Appendix D.3 Flam and Helpman (1987)**

We examine the impact of a change in income inequality on the average traded goods price within a sector in the model of Flam and Helpman (1987). We follow the notation of Choi, Hummels and Xiang (2009). We consider demand in country \( l \) for sectoral \( j \) goods. There are \( G \) income groups indicated by the subscript \( g \). Demand for goods from sector \( j \) by income group \( g \) consists of demand for a numeraire good \( y_{lg} \) and a single unit of a differentiated good with quality level \( z_{l,jg} \). We work with homothetic preferences across sectors. As in Flam and Helpman (1987) and Choi, Hummels and Xiang (2009) sectoral utility of a consumer from income group \( g \) for sectoral \( j \) goods is specified as:

\[
u(y_{lg}, z_{l,jg}) = y_{lg} \exp \{ \alpha z_{l,jg} \}
\]  

(D.11)
The budget constraint is given by:

\[ y_{lg} + p(z_{ljg}) = i_{ljg} = A_{ljg} \]

(D.12)

\( i_{ljg} \) is the amount of income spent on sector \( j \) by income group \( g \). The last equality sign follows from upper nest homothetic preferences, implying that income spent in sector \( j \) is proportional to total income with a proportionality factor equal across income groups.

As we focus on the demand side, we assume that all countries produce with an identical technology. As in Flam and Helpman (1987) and Choi, Hummels and Xiang (2009) marginal cost for producing in country \( k \) is given by:

\[ MC_k(z) = \exp(\gamma z) w_k \]

(D.13)

\( w_k \) is the price of input bundles in country \( k \).

Maximizing utility in equation (D.11) subject to the budget constraint in equation (D.12), using the fact that price is equal to marginal cost, leads to the following demand for quality and price of differentiated good \( j \) produced in country \( k \) and consumed in country \( l \) by income group \( g \):

\[ z_{lkjg} = \frac{1}{\gamma} \left( \ln \frac{\alpha}{\gamma + \alpha} + \ln i_{lg} - \ln w_k \right) \]

\[ p_{lkjg} = \frac{\alpha}{\gamma + \alpha} i_{lg} \]

We assume that the numeraire good is equal across all sectors. Hence, the average traded goods price consists of the average price of the differentiated good across the different income groups. As each agent consumes one unit of the differentiated good, the average price of sectoral good \( j \) is simply given by the arithmetic mean of the prices of the differentiated good:

\[ p_{kj} = \frac{1}{G} \sum p_{lkjg} = \frac{\alpha}{\gamma + \alpha} \frac{1}{G} \sum i_{lg} \]

The average price is only a function of average income and not of higher moments of the income distribution. Therefore, a change in income inequality (as for example a change in the mean preserving spread or the Atkinson index as considered in our paper), keeping average income constant, does not affect the average price. Hence, in the model of Flam and Helpman (1987) changes in income inequality have no impact on the average traded goods price in a sector.

In an extension of the baseline model, exporting countries can have different technologies and different income groups could consume goods from different exporters. The marginal cost
in exporting country \( k \) is then given by:

\[
MC_k (z) = \exp\{\gamma_k z\}w_k
\]

The price of differentiated good \( j \) produced in country \( k \) and consumed in country \( l \) by income group \( g \) is then equal to:

\[
p_{lkjg} = \frac{\alpha}{\gamma_k + \alpha}i_{lg}
\]

The average price of sectoral good \( j \) imported from different exporting countries \( k \) is now given by:

\[
p_{lj} = \frac{1}{G} \sum_{k} p_{lkjg} = \frac{1}{G} \sum_{k} \frac{\alpha}{\gamma_{kijg} + \alpha}i_{lg}
\]

The \( k \) subscript of \( \gamma \) gets a subscript \( i_{lg} \), because the country \( k \) from which income group \( g \) imports sectoral good \( j \) in country \( l \) varies. A change in income inequality can now have a non-zero impact on the average price, because of the interaction between income and the comparative advantage parameter \( \gamma \). Still, in our empirical specification we control for that interaction by including exporter time fixed effects. This means that we identify the impact of income inequality by variation in unit values from the same exporters.

**Appendix D.4 Hallak (2006)**

Hallak (2006) works with a model of CES preferences across varieties within sectors with a taste shifter indicating quality with the taste shifter raised to a parameter that is a function of income. The idea is that richer consumers have a larger desire for quality. Using the notation of Hallak (2006) subutility within sector \( z \) in country \( k \) is given by:

\[
u_z^k = \left( \int_{h \in H_z} \left( \theta_h^{\gamma_z^k} q_h \right)^{\frac{\sigma_z+1}{\sigma_z}} \right)^{\frac{\sigma_z}{\sigma_z+1}}
\]  

(D.14)

Deviating from Hallak (2006), we work with a mass of varieties. \( H_z \) is the mass of varieties in sector \( z \), \( \theta_h \) is the taste shifter indicating quality and \( \gamma_z^k \) is the parameter indicating the desire for quality. Hallak (2006) does not solve for an optimal quality level \( \theta_h \) set by the supplier of variety \( h \), but assumes that this parameter varies across source countries. In his empirical work he proxies for this parameter by unit values of differing export countries to the US. Also, he works with a representative agent. In our model we have heterogeneous agents (with different incomes) and we want to determine the impact of changes in income inequality on average quality from a certain export partner. That means that we have to endogenize the quality parameter \( \theta_h \). This quality parameter will be set optimally by a monopolistic competition seller using the weighted
average of demands from the different income groups in a destination market. Also, there has
to be a cost of producing quality and we can follow the approach in our quality model, which is
also followed by Baldwin and Harrigan (2011), i.e. the cost function of the supplier of a variety
is given by:

\[ C_h (\theta_h, q_h) = a_h \theta_h^q q_h + f_h \]

Before we turn to the optimization problem of the supplier, we have to be sure that the demand
function following from subutility in equation (D.14) satisfies homogeneity of degree 0 in prices
and income. This is not evident, as income enters the utility function directly. We need to
impose this condition to be able to derive a prediction on the impact of inequality, otherwise we
can arrive at any prediction by just varying the specification of the relation between parameter
\( \gamma_z^k \) and income. Demand for variety \( h \) is given by:

\[ q_h^k = \frac{(p_h^k)^{\sigma_z}}{(q_h^k)^{1-\sigma_z}} A_z^k E_z^k \quad (D.15) \]

\( E_z^k \) is spending on sector \( z \) in country \( k \). With upper nest homothetic preferences this is proportional to income \( i^k \), \( E_z^k = A_z^k \lambda^k \). Following Hallak (2006) we specify \( \gamma_z^k \) as a function of income
\( i^k \) as follows:

\[ \gamma_z^k = \gamma_z + \mu_z \ln i^k \quad (D.16) \]

Substituting equation (D.16) into equation (D.15) and multiplying all prices and income by a
factor \( \lambda \) to check homogeneity of degree zero, we get:

\[ q_h^k = \frac{(\lambda p_h^k)^{\sigma_z}}{(q_h^k)^{1-\sigma_z}} A_z^k \lambda^k \]

\[ = \frac{(\lambda p_h^k)^{\sigma_z}}{(q_h^k)^{1-\sigma_z}} \frac{1}{\theta_h^k} \lambda^k \quad (D.17) \]

It is clear that homogeneity of degree 0 in prices and income is only satisfied if the quality level of
all varieties is equal, i.e. \( \theta_h = \theta_r \), \( \forall r \). As varieties from different exporting countries will display
different quality, this model is not useful for our exercise.

We can derive optimal quality supplied by the producer of variety \( h \) for a general specification
of \( \gamma_z^k \) and check later if we can find a specification that satisfies homogeneity of degree zero in
prices and income. Its profit consists of sales to all income groups \( G \) and these income groups will
have a different \( \gamma_z^k \) but face the same price and the same quality level as producer \( h \) produces
the same variety for all income groups. With the producer using the familiar markup rule (and normalizing the wage in the country where firm \( h \) produces at 1), its profit for sales to country \( k \) is given by:

\[
\pi_h = p^k_h q^k_h - C_h (\theta_h, q_h)
\]

\[
= \sum_{g=1}^{G} \left( \frac{p^k_h}{\theta^g_h} \right)^{1-\sigma_z} \int_{\Gamma \in \Gamma_z} A^{k \cdot k_g}_z \, d\Gamma - a_h \theta^h_h (\theta^h_h)^{-\sigma_z} + f_h
\]

\[
= \sum_{g=1}^{G} \left( \frac{1}{\sigma_z-1} \theta_h \theta^h_h - \gamma^k_g \right) \int_{\Gamma \in \Gamma_z} \left( \frac{p^k_h}{\theta^g_h} \right)^{1-\sigma_z} A^{k \cdot k_g}_z \, d\Gamma - f_h
\]

Taking the FOC wrt \( \theta_h \):

\[
(1 - \sigma_z) \sum_{g=1}^{G} \left( \phi_h - \gamma^k_g \right) \left( \frac{1}{\sigma_z-1} \theta_h \theta^h_h - \gamma^k_g \right) \int_{\Gamma \in \Gamma_z} \left( \frac{p^k_h}{\theta^g_h} \right)^{1-\sigma_z} A^{k \cdot k_g}_z \, d\Gamma = 0
\]

\[
\sum_{g=1}^{G} \left( \phi_h - \gamma^k_g \right) \int_{\Gamma \in \Gamma_z} \left( \frac{p^k_h}{\theta^g_h} \right)^{1-\sigma_z} A^{k \cdot k_g}_z \, d\Gamma = 0
\]

With \( r^g_h \) the revenues from sales to income group \( g \). Hence, we see that this model does not lead to a solution with a representative agent. With \( G \) different income groups, optimal quality will be a function of the willingness to pay of the different income groups in interaction with the revenues. On the low income groups a producer will incur losses at the margin and on the high income groups it will incur marginal gains.
We can try to arrive at a closed form solution with two income groups:

\[
0 = \left( \frac{\phi_h - \gamma_k^L}{\theta_h} \right) r_h^L + \left( \frac{\phi_h - \gamma_k^H}{\theta_h} \right) r_h^H
\]

\[
0 = \left( \frac{\phi_h - \gamma_k^L}{\theta_h} \right) \frac{\sigma_z}{\theta_h^{\sigma_z}(1-\sigma_z)} \left( P_h^L \right)^{\sigma_z-1} \left( \frac{1}{\sigma_z - 1} a_h \theta_h^{\sigma_z} \right)^{1-\sigma_z} A_h^k + \left( \frac{\phi_h - \gamma_k^H}{\theta_h} \right) \frac{\sigma_z}{\theta_h^{\sigma_z}(1-\sigma_z)} \left( P_h^H \right)^{\sigma_z-1} \left( \frac{1}{\sigma_z - 1} a_h \theta_h^{\sigma_z} \right)^{1-\sigma_z} A_h^k
\]

\[
0 = \left( \phi_h - \gamma_k^L \right) \frac{\sigma_z}{\theta_h^{\sigma_z}(1-\sigma_z)} \left( P_h^L \right)^{\sigma_z-1} + \left( \phi_h - \gamma_k^H \right) \frac{\sigma_z}{\theta_h^{\sigma_z}(1-\sigma_z)} \left( P_h^H \right)^{\sigma_z-1}
\]

Analytically we cannot arrive at a solution, unless we impose a very easy specification for the parameter $\gamma_k^g$ as a function of income $h^g$, which will not satisfy homogeneity of degree zero in prices and income. Therefore, we conclude that this model is not suitable for the exercise we want to undertake in this paper, as the model setup is too reduced form.
Appendix E  Derivations in the Ideal Variety Model

We start from the utility function in equation (37). Because the upper tier utility function is separable, we can use decentralization and first calculate the optimal consumption choice within each type of good $j$:

$$
q_j (\omega'_j) = \frac{E_j}{p_j (\omega'_j)} ; q_j (\omega_j) = 0, \forall \omega_j \neq \omega'_j \tag{E.1}
$$

With

$$
\omega'_j = \arg \min \{ p_j (\omega_j) h_j (\delta (\omega_j, \tilde{\omega}_j)) \mid \omega_j \in \Omega_j \} \tag{E.2}
$$

Next we can substitute back into the upper tier utility function the optimal values from the first stage to get the following optimization problem:

$$
U = \sum_{j=1}^{J} \beta_j \ln \tilde{q}_j \tag{E.3}
$$

s.t.:

$$
\sum_{j=1}^{J} \tilde{p}_j (\omega'_j, \tilde{\omega}_j) \tilde{q}_j (\omega'_j) dj \leq i \tag{E.4}
$$

With

$$
\tilde{q}_j (\omega'_j) = \frac{q_j (\omega'_j)}{h_j (\delta (\omega'_j, \tilde{\omega}_j))} \tag{E.5}
$$

and

$$
\tilde{p}_j (\omega'_j, \tilde{\omega}_j) = p_j (\omega'_j) h (\delta (\omega'_j, \tilde{\omega}_j)) \tag{E.6}
$$

Which is the effective price of a unit of ideal variety $\tilde{\omega}_j$, when product $\omega_j$ is actually chosen. We can now maximize with respect to $\tilde{q}_j$ using the effective price $\tilde{p}_j$ given that there is no choice variable in the compensation function.$^{30}$

$$
\tilde{q}_j (\omega'_j) = \frac{\beta_j i}{\tilde{p}_j (\omega'_j, \tilde{\omega}_j)} \tag{E.7}
$$

$$
q_j (\omega'_j) = \frac{\beta_j i}{p_j (\omega'_j, \tilde{\omega}_j)} \tag{E.8}
$$

Next, an explicit expression is specified for the distance function $h_j$. Like in Helpman and Krugman (1985) it is assumed that the distance function increases more than proportionally in distance from the ideal variety $\delta$. Furthermore, the cost of being further away from the ideal variety rises in income $w$:

$$
h_j (\delta, w) = 1 + i^v \delta^\psi ; \; v < 1; \; \psi > 1 \tag{E.9}
$$

It is easy to show that an increase in income leads to a higher utility as long as $v < 1$.

$^{30}$With $D_j$ in the compensation function, the reformulated optimization problem with the effective price and effective demand would lead to the wrong solution. This was the case in the initial model of Hummels and Lugovskyy (2005).
With consumers distributed Next we can aggregate the demand for a variety \( \omega_j \). Individual demand of someone with ideal variety \( \bar{\omega}_j \) is given in equation (E.7). To find demand for variety \( \omega_j \), we have to add (integrate over) all the individual demands of those who do consume type \( j \) and have \( \omega_j \) as their most preferred variety. We assume that consumers are equally distributed on a circle of length 1. There are \( n_j \) producers on this circle. The nearest competitors of producer of variety \( \omega_j \) have variety \( \omega_{j,l} \) and \( \omega_{j,r} \). For the consumers who prefer \( \omega_j \), we have:

\[
p_j(\omega_j) h_j (\delta(\omega_j, \bar{\omega}_j)) \leq \{p_{j,l}(\omega_{j,l}) h_j (\delta(\omega_{j,l}, \bar{\omega}_j)), p_{j,r}(\omega_{j,r}) h_j (\delta(\omega_{j,r}, \bar{\omega}_j))\} \tag{E.10}
\]

Hence we can define the marginal consumers with ideal variety \( \omega_j \) and \( \omega_j \) who are just indifferent respectively between consuming \( \omega_j \) and \( \omega_{j,l} \) and \( \omega_j \) and \( \omega_{j,r} \):

\[
p_j(\omega_{j,l}) h_j (\delta(\omega_{j,l}, \omega_j)) = p_j(\omega_j) h_j (\delta(\omega_j, \omega_j)) \tag{E.11}
\]

\[
p_j(\omega_{j,r}) h_j (\delta(\omega_{j,r}, \omega_j)) = p_j(\omega_j) h_j (\delta(\omega_j, \omega_j)) \tag{E.12}
\]

Next varieties can be defined in terms of their distance on the circle from each other:

\[
d_j = \delta(\omega_{j,l}, \omega_j)
\]

\[
d_j = \delta(\omega_{j,l}, \omega_j)
\]

\[
d_j = \delta(\omega_{j,r}, \omega_j) \implies d_j - d_j = \delta(\omega_{j,l}, \omega_j)
\]

\[
d_j = \delta(\omega_{j,r}, \omega_j) \implies d_j + d_j = \delta(\omega_{j,l}, \omega_j)
\]

Using these definitions, the indifference equations can be rewritten as:

\[
p_j(\omega_{j,l}) h_j (d_j - d_j) = p_j(\omega_j) h_j (d_j) \tag{E.13}
\]

\[
p_j(\omega_{j,r}) h_j (d_j^* - d_j - d_j) = p_j(\omega_j) h_j (d_j^*) \tag{E.14}
\]

By inverting these equations the boundaries of market demand for variety \( \omega_j \) can be found. Implicit differentiation will yield the elasticity of distance wrt price, i.e. how much clientele the producer of \( \omega_j \) loses when the price is raised. Using the explicit expression for \( h_j \) in equation (E.9), total differentiation of equations (E.13) and (E.14) generates:

\[
\frac{dd_j}{dp_j(\omega_j)} = -\frac{1 + i^n d_j^{i^n}}{\psi i^n [p_j(\omega_{j,l}) (d_j - d_j)^{\psi - 1} + p_j(\omega_j) d_j^{\psi - 1}]} \tag{E.15}
\]

\[
\frac{dd_j}{dp_j(\omega_j)} = -\frac{1 + i^n d_j^{i^n}}{\psi i^n [p_j(\omega_{j,r}) (d_j^* - d_j - d_j)^{\psi - 1} + p_j(\omega_j) d_j^*^{\psi - 1}]} \tag{E.16}
\]
Next, aggregate demand for variety $\omega_j$ is defined as:

$$
q_j(\omega_j) = \int_0^1 \beta_j \frac{d\delta}{p_j} + \int_0^1 \beta_j \frac{d\delta}{p_j}
= (d_j + d_j) \frac{\beta_j}{p_j}
$$

(E.17)

A zero profit symmetric equilibrium with all firms charging equal prices and being at equal distance from each other is a Nash equilibrium. We get then that $d_j = d_j = \frac{d_j}{T} = \frac{d_j}{W}$. The symmetric equilibrium expression for market demand is equal to:

$$
q_j(\omega_j) = d_j \frac{\beta_j}{p_j}
$$

(E.18)

The next step is to calculate the price elasticity of aggregate demand for variety $\omega_j$. Differentiating equation (39) wrt $p_j$, we find for the price elasticity:

$$
\frac{\partial q_j(\omega_j)}{\partial p_j} \frac{p_j(\omega_j)}{q_j(\omega_j)} = \left( \frac{\partial d_j}{\partial p_j} + \frac{\partial d_j}{\partial p_j} \right) \frac{\beta_j}{p_j} - (d_j + d_j) \frac{\beta_j}{p_j}
= \left( \frac{\partial d_j}{\partial p_j} + \frac{\partial d_j}{\partial p_j} \right) \frac{\beta_j}{p_j} - (d_j + d_j) \frac{\beta_j}{p_j}
$$

(E.19)

$$
\varepsilon_j(\omega_j) = 1 + \left( \frac{\partial d_j}{\partial p_j} + \frac{\partial d_j}{\partial p_j} \right) \frac{\beta_j}{p_j}
= 1 + 2 \frac{1 + \psi \left( \frac{d_j}{T} \right)^\psi d_j^{\psi-1} \frac{\beta_j}{p_j}}{\psi \psi \psi \left( \frac{d_j}{T} \right)^\psi d_j^{\psi-1} \frac{\beta_j}{p_j}}
= 1 + \frac{1 + \psi \left( \frac{d_j}{T} \right)^\psi \beta_j}{\psi \psi \psi \left( \frac{d_j}{T} \right)^\psi d_j^{\psi-1} \frac{\beta_j}{p_j}}
= 1 + \frac{1 + \psi \left( \frac{d_j}{T} \right)^\psi}{2 \psi \psi \psi \left( \frac{d_j}{T} \right)^\psi}
= 1 + \frac{1}{2 \psi \psi \psi \left( \frac{d_j}{T} \right)^\psi}
$$

With $G$ income groups, aggregate demand for variety $\omega_j$ is equal to:

$$
q_j(\omega_j) = \frac{\beta_j}{p_j} \sum_{g=1}^G (d_j(i_g) + d_j(i_g)) i_g
$$
The price elasticity can in this case be calculated as:

\[ \varepsilon_j (\omega_j) = 1 + \left( \sum_{g=1}^{G} \left( \frac{\partial d_j}{\partial p_j} + \frac{\partial d_j (i_g)}{\partial p_j} \right) \frac{i_g}{p_j} \right) \frac{\beta_j \psi}{p_j} \]

\[ = 1 + \sum_{g=1}^{G} 2i_g \left( \frac{1 + i_g (\frac{d_j}{\psi})}{2 \psi i_g} \right) \frac{1}{\psi} \frac{1}{\sum_{g=1}^{G} i_g} \]

\[ = 1 + \sum_{g=1}^{G} i_g \left( 1 + \frac{1}{\psi (\frac{d_j}{\psi})} \right) \frac{1}{2 \psi \sum_{g=1}^{G} i_g} \]

\[ = 1 + \frac{\sum_{g=1}^{G} i_g \left( 1 + \frac{1}{\psi (\frac{d_j}{\psi})} \right)}{2 \psi \sum_{g=1}^{G} i_g} \quad (E.21) \]

Rewriting gives:

\[ \varepsilon_j = 1 + \frac{\sum_{g=1}^{G} i_g \left( 1 + \frac{1}{\psi (\frac{d_j}{\psi})} \right)}{2 \psi \sum_{g=1}^{G} i_g} \]

\[ = 1 + \frac{1}{2 \psi} + \frac{1}{\psi \left( \frac{d_j}{\psi} \right)} \frac{1}{\sum_{g=1}^{G} i_g} \frac{\sum_{g=1}^{G} i_g^{1-v}}{\frac{1}{\psi} \sum_{g=1}^{G} i_g} \]

\[ = 1 + \frac{1}{2 \psi} + \frac{1}{\psi \left( \frac{d_j}{\psi} \right)} \frac{1}{\sum_{g=1}^{G} \left( \frac{d_j}{\psi} \right)^{1-v}} \frac{1}{(\frac{d_j}{\psi})^{1-v}} \]

\[ = 1 + \frac{1}{2 \psi} + \frac{1}{2 \psi} \left( 1 - I_A (v) \right)^{1-v} \]

\[ (E.22) \]

Log differentiating equation (E.22) gives:

\[ \hat{\varepsilon}_j = - \frac{\varepsilon_j - 1 - \frac{1}{2 \psi}}{\varepsilon_j} \left( \psi \hat{d}_j + (1 - v) \frac{I_A}{1 - I_A} (\hat{I}_A + \hat{v}) \right) \]

\[ (E.23) \]

This expression gives the effect of Atkinson on the price elasticity in the short run, i.e. for given
distance \( d_j \). In the long run we add the free entry condition:

\[
d_j = \frac{f \varepsilon_j}{\sum_{g=1}^{G} \iota_g \beta_j}
\]

(E.24)

Log differentiating equation (E.24), one finds:

\[
\hat{d}_j = \varepsilon_j - \widehat{G_i}
\]

(E.25)

Where \( G_i^T \) is total income, \( G_i^T = \sum_{g=1}^{G} \iota_g \). Substituting equation (E.25) into (E.23), we find:

\[
\hat{\varepsilon}_j = -\frac{\varepsilon_j - 1 - \frac{1}{\varepsilon_j}}{\varepsilon_j} \left( \psi \left( \varepsilon_j - \widehat{G_i} \right) + (1 - v) \frac{I_A}{1 - \overline{I_A}} - \overline{v_i} \right)
\]

\[
\hat{\varepsilon}_j \left( 1 + \psi \frac{\varepsilon_j - 1 - \frac{1}{\varepsilon_j}}{\varepsilon_j} \right) = \frac{\varepsilon_j - 1 - \frac{1}{\varepsilon_j}}{\varepsilon_j} \left( \psi \widehat{G_i} - (1 - v) \frac{I_A}{1 - \overline{I_A}} - \overline{v_i} \right)
\]

\[
\hat{\varepsilon}_j \left( \frac{1 + \psi \varepsilon_j - \psi - \frac{1}{\varepsilon_j}}{\varepsilon_j} \right) = \frac{\varepsilon_j - 1 - \frac{1}{\varepsilon_j}}{\varepsilon_j} \left( \psi \widehat{G_i} - (1 - v) \frac{I_A}{1 - \overline{I_A}} - \overline{v_i} \right)
\]

(E.26)

With two income groups, we proceed as follows. Log differentiating equation (E.21) with only two income groups wrt \( \varepsilon_j, d_j, i_H \) and \( i_L \) with the condition \( i_L = H/i_L \overline{i_H} \) gives us:

\[
\hat{\varepsilon}_j = \frac{\varepsilon_j - 1}{\varepsilon_j} \left( \frac{i_H H \left( 1 + \frac{1}{\overline{i_H} (\frac{1}{\varepsilon})} \right) - v \frac{i_H H}{\overline{i_H} (\frac{1}{\varepsilon})} \overline{i_H} - \frac{i_H H}{\overline{i_H} (\frac{1}{\varepsilon})} \overline{d}_i}{i_H H \left( 1 + \frac{1}{\overline{i_H} (\frac{1}{\varepsilon})} \right) + i_L L \left( 1 + \frac{1}{\overline{i_L} (\frac{1}{\varepsilon})} \right)} \right)
\]

\[
+ \frac{\varepsilon_j - 1}{\varepsilon_j} \left( \frac{i_L L \left( 1 + \frac{1}{\overline{i_L} (\frac{1}{\varepsilon})} \right) - v \frac{i_L L}{\overline{i_L} (\frac{1}{\varepsilon})} \overline{i_L} - \frac{i_L L}{\overline{i_L} (\frac{1}{\varepsilon})} \overline{d}_j}{i_H H \left( 1 + \frac{1}{\overline{i_H} (\frac{1}{\varepsilon})} \right) + i_L L \left( 1 + \frac{1}{\overline{i_L} (\frac{1}{\varepsilon})} \right)} \right)
\]
Continuing the derivation, we get:

\[
\hat{d}_j = \frac{\varepsilon_j - 1}{\varepsilon_j} \frac{i_H}{i_H}(1 - v) \left( \left( \frac{1}{i_H} \right) - \left( \frac{1}{i_L} \right) \right) \frac{\hat{v}_H}{\hat{v}_H} + \frac{i_H}{i_L}(1 + \frac{1}{v_H}) \frac{\hat{v}_L}{\hat{v}_L} \hat{d}_j
\]

(E.27)

In the short run \( d_j \) is fixed. Hence, in the short run the price elasticity declines in income inequality. In the long run, \( d_j \) is endogenous. Log differentiating equation (E.24) wrt \( \varepsilon_j, d_j \) and \( i_H \) and \( i_L \) imposing \( \hat{i}_L = i_H/i_L \hat{i}_H \) gives:

\[
\hat{d}_j = \hat{\varepsilon}_j
\]

(E.28)

Substituting equation (E.28) into equation (E.27) gives for the long run effect of an increase in
income inequality:

$$\hat{\varepsilon}_j \left( 1 + \frac{\varepsilon_j - 1}{\varepsilon_j} \frac{i_{L,v}^{1-v} L + i_{H,v}^{1-v} H}{i_{H}H \left( 1 + \frac{1}{i_{H}^{(\frac{d}{v})}} \right) + i_{L} L \left( 1 + \frac{1}{i_{L}^{(\frac{d}{v})}} \right)} \right)$$

$$= \frac{\varepsilon_j - 1}{\varepsilon_j} \frac{i_{H}H \left( \frac{d}{v} \right)^v (1 - v) \left( \left( \frac{1}{i_{H}} \right)^v - \left( \frac{1}{i_{L}} \right)^v \right)}{i_{H}H \left( 1 + \frac{1}{i_{H}^{(\frac{d}{v})}} \right) + i_{L} L \left( 1 + \frac{1}{i_{L}^{(\frac{d}{v})}} \right)} \hat{i}_H$$

$$\hat{\varepsilon}_j = \frac{\varepsilon_j}{\varepsilon_j - 1} \left( i_{H}H \left( 1 + \frac{1}{i_{H}^{(\frac{d}{v})}} \right) + i_{L} L \left( 1 + \frac{1}{i_{L}^{(\frac{d}{v})}} \right) \right) + \frac{i_{L,v}^{1-v} L + i_{H,v}^{1-v} H}{i_{H}H \left( \frac{d}{v} \right)^v} \hat{i}_H$$

Hence, also in long run with $n$ endogenous a higher inequality leads to a lower price elasticity and thus to a higher price.