Trade Liberalization and Welfare Inequality: a Demand-Based Approach *

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Abstract

There is strong evidence suggesting that different income groups consume different bundles of goods. Hence, trade liberalization can affect welfare inequality via changes in the relative prices of goods consumed by different income groups (the price effect). In this paper, I develop a framework that enables us to explore the role of the price effect in determining welfare inequality. I find that trade liberalization does benefit some income classes more than others. In particular, I show that the relative welfare of the rich with respect to that of the poor has a hump shape as a function of trade costs.

Keywords: Nonhomothetic preferences; monopolistic competition

JEL classification: F12

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I Introduction

It is well known that different income classes consume different bundles of goods. This evidence suggests that trade liberalization can affect welfare inequality within a country through at least two effects. First, trade liberalization can lead to changes in income distribution in a country and, thereby, affect the income inequality (*the income effect*). Secondly, trade liberalization can have a different impact on prices of different goods, affecting welfare inequality through changes in the relative prices of goods consumed by different income groups (*the price effect*). While the income effect is intensively explored in the trade literature (see Goldberg and Pavcnik (2007)), the price effect is not paid much attention.

Empirical evidence suggests that the price effect may be essential in determining welfare inequality. For instance, Broda and Romalis (2009) argue that the assumption about a representative agent substantially increases the measured growth of inequality in the United States. They find that if price indexes are calculated for each income class separately, then welfare inequality might even fall between 1994 and 2005 (which is in contrast to the US Census report). This is due to a decrease in the relative price of products consumed by the poor. Porto (2006) empirically explores the impact of Argentinean trade reform (entry into Mercosur) on the distribution of welfare. In particular, he estimates welfare gains and losses for different income classes caused only by changes in prices of traded goods. He finds substantial welfare losses (0.75% of initial expenditure) for the poor and gains (0.5% of expenditure) for the rich. This is explained by the nature of the Mercosur agreements that increase the prices of necessities (Food and Beverages) that are mostly consumed by the poor.

In this paper, I construct a general equilibrium model of trade between symmetric countries that enables us to examine the role of the price effect in determining welfare inequality. The core element of the model is nonhomothetic consumer preferences.[1] Indeed, trade models with homothetic preferences are not appropriate for studying the impact of trade liberalization on welfare inequality through the price effect, as irrespective of their income, consumers purchase identical bundles of goods. In contrast, in the present model, nonhomotheticity of preferences leads to some goods (luxuries) being available only to the rich. Another key element is a

[1] There is strong empirical evidence that consumer preferences are nonhomothetic (see for example Deaton and Muellbauer (1980) and Hunter and Markusen (1988)).

monopolistic competition environment. Imperfect competition induces variable markups and, therefore, allows us to explore the effects of trade liberalization on prices set by firms. In particular, I find that trade liberalization does affect the prices of different goods (necessities and luxuries) differently and, as a result, can benefit some income classes more than others.

The key assumption about consumer preferences is that goods are indivisible and consumers purchase at most one unit of each good (see Murphy et al. (1989) and Matsuyama (2000)). This implies that, given the prices, goods are arranged so that consumers can be considered as moving down a certain list in choosing what to buy. For instance, in developing countries, consumers first buy food, then clothing, then move up the chain of durables from kerosene stoves to refrigerators, to cars. Furthermore, consumers with higher income buy the same bundle of goods as poorer consumers plus some others.[2]

I assume that each good is produced by a distinct firm and goods differ according to the valuations consumers attach to them.[3] Depending on the valuations placed on their goods, firms decide whether to serve both domestic and foreign markets, to serve only the domestic market, or not to produce at all. I limit the analysis in the paper to a two-class society (the rich and the poor).[4] Then, given the preferences, firms serving a certain market face a trade-off between selling to both income classes at a lower price and selling only to the rich at a higher price. Specifically, firms with sufficiently high valuations find it profitable to sell to all consumers, while firms with low valuations decide to sell only to the rich. Hence, available goods in each market are divided into two groups: the necessities include goods that are consumed by both income classes, while the luxuries include goods that are consumed by the rich only.

Since the income distribution in the model is exogenous, I focus only on the price effect and do not explore the impact of trade liberalization on income distribution. I find that the

[2] This structure of consumer preferences has enough flexibility to be applied just as well to the whole economy as to a certain industry where goods differ in quality. On the one hand, each good can be interpreted as a distinct good sold in the market. On the other hand, we might think that firms sell not distinct goods but some characteristics of a good produced in a certain industry. For instance, consider a car industry. Each good can be treated as some characteristic of a car. The poor purchase the main characteristics associated with a car, while the rich buy the same characteristics as the poor plus some additional luxury characteristics. That is, both groups of consumers buy the same good but of different quality.

[3] By the valuation of a good, I mean the utility delivered to consumers from the consumption of one unit of this good.

[4] Income heterogeneity in the model is introduced by assuming that consumers differ according to the efficiency units of labor they are endowed with. That is, the income distribution is exogenous and shaped by the relative income of the rich and the fraction of the rich. Hence, I focus only on the price effect and do not explore the impact of trade liberalization on income distribution.

reduction in trade costs affects the prices of necessities and luxuries differently and, therefore, changes welfare inequality within a country via the price effect. In particular, I show that the relative welfare of the rich with respect to that of the poor has a hump shape as a function of trade costs. If trade costs are sufficiently low, then further trade liberalization benefits the poor more, while if trades costs are high enough, then the rich gain more from the reduction in trade costs.

The intuition behind this model is based on changes in the relative prices of the luxuries (with respect to necessities) caused by changes in trade costs. In particular, if trade costs are sufficiently low, then exporting firms with high valuations of their goods serve all consumers, while exporting firms with lower valuations serve only the rich. In this case, lower trade costs *increase* spendings of the poor on imported necessities (inducing tougher competition among firms serving all consumers), while *decreasing* spendings of the rich on imported luxuries (leading to lower competition among firms serving the rich only). As a result, the prices of the luxuries fall by less than those of the necessities, implying that the rich gain relatively less from a fall in trade costs than the poor do. In contrast, if trade costs are high enough, then exporting firms find it profitable to serve only the rich. In that case, a fall in trade costs does not have a direct impact on the poor and, therefore, the rich gain relatively more.

This paper is closely related to Fajgelbaum et al. (2009), who develop a general equilibrium model with nonhomothetic preferences for studying trade in vertically differentiated products. Their framework also implies that trade liberalization can affect welfare of different income groups differently. However, the mechanism developed in their paper is based on the home market effect (à la Krugman (1980)), while the present paper provides another, possibly complementary, view which is based on the price effect. Ramezzana (2000) and Foellmi et al. (2010) use the similar preference structure in a monopolistic competition framework to examine how similarities in per capita incomes affect trade volumes between countries. In these papers, consumers are assumed identical within a country and the impact of trade on relative welfare is not explored. Mitra and Trindade (2005) also consider a model of monopolistic competition with nonhomothetic preferences. However, they focus on the income effect of trade liberalization rather than on the price effect.

The present paper also complements a broad strand of literature that explores the role of supply-side factors in determining trade patterns. Markusen (1986) extends the Krugman type model of trade with monopolistic competition and differences in endowments by adding nonhomothetic demand. He examines the role of per capita income in interindustry and intra-industry trade. Flam and Helpman (1987), Stokey (1991), and Matsuyama (2000) develop a Ricardian model of North-South trade with nonhomothetic preferences. They examine the impact of technological progress, population growth, and redistribution policy on the patterns of specialization and welfare. Stibora and Vaal (2005) extend the model in Matsuyama (2000) by studying the effects of trade liberalization. They show that the South loses in terms of trade from unilateral trade liberalization, while the North may gain by liberalizing its trade. Fieler (2010) modifies a Ricardian framework à la Eaton and Kortum (2002) by introducing nonhomothetic preferences and technology distribution across sectors. This modification allows her to separate the effects of per capita income and population size on trade volumes.

The rest of the paper is organized as follows. Section 2 introduces the basic concepts of the model. Section 3 explores the effects of trade liberalization on prices, market structure, and consumer welfare. Section 4 concludes.

II Setup of The Model

In this section, I construct a model of trade between two symmetric countries but with non-homothetic preferences. As the countries are symmetric, in my analysis I consider only one economy (the home country).[5]

Consumption

In the model, all consumers have identical preferences that are represented by the following utility function:

$$U = \int_{\omega \in \Omega} b(\omega) x(\omega) d\omega,$$

where Ω is the set of available goods in the economy, $b(\omega)$ is the valuation of good ω, and $x(\omega) \in \{0, 1\}$ is the consumption of good ω. Note that goods are indivisible and consumers can purchase at most one unit of each good. To find the optimal consumption bundle, consumer i

[5] The equilibrium conditions for the foreign country are the same.

maximizes

$$U_i = \int_{\omega \in \Omega} b(\omega) x_i(\omega) d\omega \tag{1}$$

subject to her budget constraint

$$\int_{\omega \in \Omega} p(\omega) x_i(\omega) d\omega \leq w_i, \tag{2}$$

where w_i is the total income of consumer i and $p(\omega)$ is the price of good ω. This maximization problem implies that

$$x_i(\omega) = 1 \iff \frac{b(\omega)}{p(\omega)} \geq Q_i, \tag{3}$$

where Q_i is the Lagrange multiplier associated with the maximization problem and represents the marginal utility of income of consumer i. In other words, consumer i purchases good ω if and only if the valuation to price ratio $b(\omega)/p(\omega)$ of this good is sufficiently high.

I limit the analysis to a framework with two types of consumers indexed by L and H. A consumer of type $i \in \{L, H\}$ is endowed with I_i units of labor where $I_H > I_L$. The fraction of consumers with income I_H in the aggregate mass N of consumers is given by α_H. Then, the total labor supply in the economy is equal to $N(\alpha_H I_H + (1 - \alpha_H) I_L)$. I assume that each consumer owns a balanced portfolio of shares of all firms producing the goods. Since there is free entry into the market (see the next section), the aggregate firm profits are equal to zero in the equilibrium. This implies that the value of any balanced portfolio is equal to zero. Hence, the total income of consumer i, w_i, is equal to her labor income I_i (the wage per unit of labor is normalized to unity).

Using (3), the budget constraint in (2) can be rewritten as follows:

$$\int_{\omega: \frac{b(\omega)}{p(\omega)} \geq Q_i} p(\omega) d\omega = I_i.$$

It is straightforward to see that, given the prices and the valuations, the left hand side of the equation is decreasing in Q_i. This suggests that the marginal utility of income is lower for richer consumers, i.e., $Q_H < Q_L$. Hence, the preferences considered in the paper imply that rich consumers purchase the same goods as the poor plus some others. That is, goods available in the economy can be divided into two groups: the necessities include goods that are purchased by all consumers; the luxuries include goods that are purchased only by the rich. As a result, demand for a certain good ω is given by

$$D(p(\omega)) = \begin{cases} N, & \text{if } \frac{b(\omega)}{p(\omega)} \geq Q_L, \\ \alpha_H N, & \text{if } Q_L > \frac{b(\omega)}{p(\omega)} \geq Q_H, \\ 0, & \text{if } \frac{b(\omega)}{p(\omega)} < Q_L. \end{cases} \quad (4)$$

Production and Exporting

The only factor of production in the economy is labor. There is free entry into the market. Each good ω is produced by a distinct firm. To enter the market, firms have to pay costs f_e that are sunk. If a firm incurs the costs of entry, it obtains a draw b of the valuation of its good from the common distribution $G(b)$ with the support on $[0, B]$. I assume that $G'(b) = g(b)$ exists. This captures the idea that before entry, firms do not know how well they will end up doing due to uncertainty in valuations of their products. Such differences among goods generate ex-post heterogeneity across firms. To simplify the analysis, I assume that marginal cost of production is identical for all firms and equal to c, i.e., it takes c units of labor (which are paid a wage of unity) to produce a unit of any good.

In the model, trade costs take the Samuelson's iceberg form and equal τ. The presence of trade costs implies that some firms find it profitable to serve only the domestic market, as exporting would lead to negative profits.[6] Hence, depending on the valuation drawn, a firm has three options: to exit, to serve only the domestic market, or to serve both domestic and foreign markets. In the paper, I consider *pricing-to-market*. That is, I assume that the markets are segmented and firms are able to price discriminate between domestic and foreign markets. Furthermore, it is not possible for any third party to buy a good in one country and then to resell it in the other to arbitrage price differences.

Since the countries are symmetric, it is sufficient to describe the equilibrium only for one economy. Let us denote $\pi_D(\omega)$ and $\pi_F(\omega)$ as the profits of a firm producing good ω from selling

[6] Note that, in the present model, there is no need for fixed costs of trade to have firm selection into exporting.

at home and abroad, respectively. Then, the total profits of the firm are given by

$$\pi(\omega) = \begin{cases} 0, & \text{if the firm exits,} \\ \pi_D(\omega), & \text{if the firm serves only the domestic market,} \\ \pi_D(\omega) + \pi_F(\omega), & \text{if the firm serves both the markets.} \end{cases} \tag{5}$$

By analogy, I denote $p_D(\omega)$ and $p_F(\omega)$ as the price of good ω if it is sold at home and abroad, respectively. The pricing-to-market assumption implies that, taking Q_L and Q_H as given, firms separately maximize their profits in each market. That is, firms maximize

$$\pi_D(\omega) = (p_D(\omega) - c)D(p_D(\omega)), \tag{6}$$

$$\pi_F(\omega) = (p_F(\omega) - \tau c)D(p_F(\omega)) \tag{7}$$

with respect to $p_D(\omega)$ and $p_F(\omega)$, where τ represents the trade costs and $D(\cdot)$ is given by (4).

Tarasov (2009) showed that the optimal domestic price of good ω is given by

$$p_D(\omega) = \begin{cases} \frac{b(\omega)}{Q_L} & \text{if } b(\omega) \geq b_M, \\ \frac{b(\omega)}{Q_H} & \text{if } b(\omega) \in [b_L, b_M), \end{cases}$$

where b_M is such that

$$\left(\frac{b_M}{Q_L} - c\right) N = \left(\frac{b_M}{Q_H} - c\right) \alpha_H N.$$

The idea behind this is that firms face a trade-off. They can sell their products to both income classes at a lower price or sell only to the rich charging a higher price. As a result, if a firm draws $b \geq b_M$, then it is more profitable for the firm to serve both types of consumers (firms with valuation b_M are indifferent between selling to all consumers or only to the rich). Otherwise, the firm serves only the rich or exits (if $b < b_L$). In the same manner, it can be shown that the optimal price of good ω charged abroad is given by

$$p_F(\omega) = \begin{cases} \frac{b(\omega)}{Q_L} & \text{if } b(\omega) \geq \tau b_M, \\ \frac{b(\omega)}{Q_H} & \text{if } b(\omega) \in [\tau b_L, \tau b_M). \end{cases}$$

Figure 1 summarizes the findings above. Thus, firms with $b(\omega) < b_L$ exit, firms with $b(\omega) \in [b_L, \tau b_L)$ serve only the domestic market, while firms with $b(\omega) \geq \tau b_L$ serve both domestic and foreign markets. In addition, as illustrated in Figure 2, domestic goods with valuations $b(\omega) \in [b_M, B]$ and imported goods with $b(\omega) \in [\tau b_M, B]$ are purchased by all consumers and,

Figure 1: Profit Functions

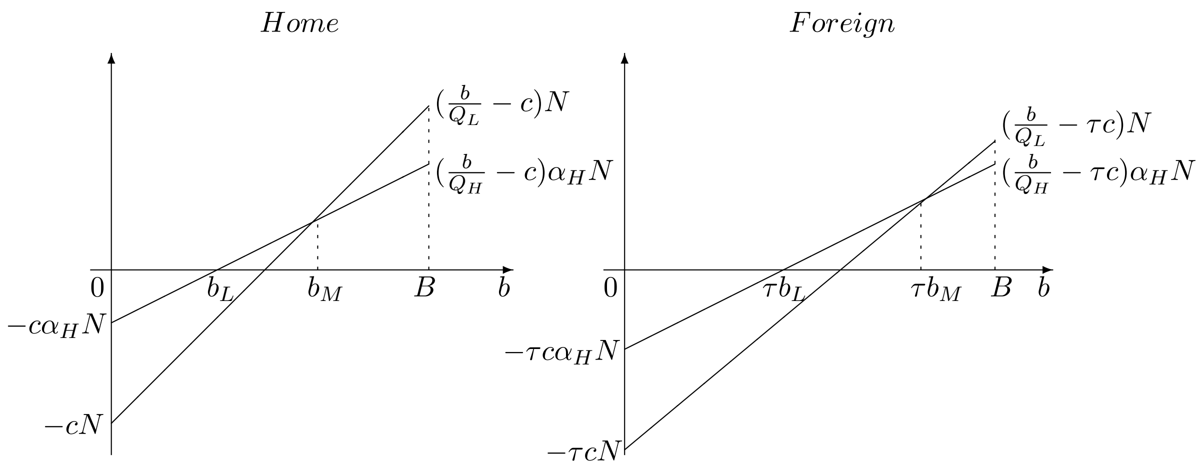
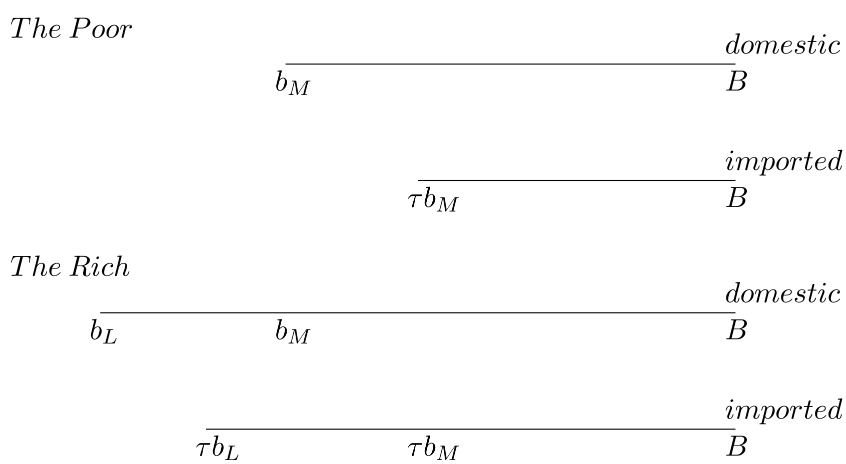


Figure 2: Consumption



thereby, belong to the necessities, while domestic goods with $b(\omega) \in [b_L, b_M)$ and imported goods with $b(\omega) \in [\tau b_L, \tau b_M)$ belong to the luxury group.

Note that, due to the presence of trade costs, there are goods that are available to consumers of type i at home but not available to consumers of the same type abroad. In particular, goods with valuations $b(\omega) \in [b_M, \tau b_M)$ are sold to all consumers at home, but exported only to the rich in a foreign country. Hence, the model provides a natural explanation of why some imported goods are available to the rich and not available to the poor. Moreover, as it can be seen, if transport costs τ are sufficiently high ($\tau b_M \geq B$ in the equilibrium), then imported goods are so expensive that only the rich can afford purchasing them.

Prices and Arbitrage Opportunities

In the equilibrium, the price of good ω depends only on $b(\omega)$. Therefore, hereafter I omit the notation of ω and consider all variables as a function of b. From the analysis above, the prices of goods at home and abroad are given by

$$p_D(b) = \begin{cases} \frac{b}{Q_L} = cb\left(\frac{\alpha_H}{b_L} + \frac{(1-\alpha_H)}{b_M}\right), & \text{if } b \geq b_M, \\ \\ \frac{b}{Q_H} = \frac{cb}{b_L}, & \text{if } b \in [b_L, b_M), \end{cases} \tag{8}$$

$$p_F(b) = \begin{cases} \frac{b}{Q_L} = cb\left(\frac{\alpha_H}{b_L} + \frac{(1-\alpha_H)}{b_M}\right), & \text{if } b \geq \tau b_M, \\ \\ \frac{b}{Q_H} = \frac{cb}{b_L}, & \text{if } b \in [\tau b_L, \tau b_M). \end{cases} \tag{9}$$

Hence, the prices of goods with sufficiently high and low valuations are the same at home and abroad, i.e., $p_D(b) = p_F(b)$, implying that the f.o.b. export prices of those goods (given by $p_F(b)/\tau$) are strictly less than the prices in the domestic market.[7] This is reminiscent of reciprocal dumping in Melitz and Ottaviano (2008).

Note that the assumption about the infeasibility of arbitrage is a necessary ingredient of the model. In particular, for goods with $b \in [b_M, \tau b_M)$, $p_D(b)$ and $p_F(b)$ are different with $p_F(b) > p_D(b)$ and, therefore, it can be profitable for a third party to ship those goods from one country to the other to arbitrage the price difference. Namely, the absence of arbitrage opportunities is equivalent to

$$\tau p_F(b) \geq p_D(b) \geq \frac{p_F(b)}{\tau}. \tag{10}$$

In our case, inequality (10) holds for goods with $b \in [\tau b_L, b_M) \cup [\tau b_M, B]$ and does not necessarily hold for goods with $b \in [b_M, \tau b_M)$. Specifically, for any $b \in [b_M, \tau b_M)$,

$$\frac{p_D(b)}{p_F(b)} = \alpha_H + \frac{b_L(1-\alpha_H)}{b_M}.$$

[7] In the model, the prices are not directly affected by the trade costs. The impact of τ on the equilibrium prices goes through the effects on b_L and b_M only.

Hence, the no-arbitrage condition means that

$$\alpha_H + \frac{b_L(1-\alpha_H)}{b_M} \geq \frac{1}{\tau} \iff \frac{b_L}{b_M} \geq \frac{1-\alpha_H\tau}{(1-\alpha_H)\,\tau}. \tag{11}$$

Later in the paper, I show that the ratio b_L/b_M is increasing in τ in the equilibrium. As $(1-\alpha_H\tau)\,/\,((1-\alpha_H)\,\tau)$ is decreasing in τ, this implies that there exists τ^* such that for any $\tau \geq \tau^*$, inequality (11) holds. Hence, arbitrage opportunities are ruled out in the equilibrium if and only if the transport costs are sufficiently high.[8]

The Equilibrium

In the equilibrium, two conditions should be satisfied. First, due to free entry, the expected profits of firms have to be equal to zero. Secondly, the goods market clears. Next, I derive the equations that are sufficient to describe the equilibrium in the model.

The free entry condition means that in the equilibrium, the ex-ante profits of firms are equal to zero. That is,

$$f_e = \int_0^B \pi(t)dG(t),$$

where the function $\pi(t)$ is given by (5). It is straightforward to show that the profits from selling at home and abroad are given by

$$\pi_D(b) = \begin{cases} \left(\frac{b}{Q_L} - c\right)N = \left(b\left(\frac{\alpha_H}{b_L} + \frac{(1-\alpha_H)}{b_M}\right) - 1\right)cN, & \text{if } b \geq b_M, \\ \left(\frac{b}{Q_H} - c\right)\alpha_H N = \left(\frac{b}{b_L} - 1\right)c\alpha_H N, & \text{if } b \in [b_L, b_M). \end{cases} \tag{12}$$

and

$$\pi_F(b) = \begin{cases} \left(\frac{b}{Q_L} - \tau c\right)N = \left(b\left(\frac{\alpha_H}{b_L} + \frac{(1-\alpha_H)}{b_M}\right) - \tau\right)cN, & \text{if } b \geq \tau b_M, \\ \left(\frac{b}{Q_H} - \tau c\right)\alpha_H N = \left(\frac{b}{b_L} - \tau\right)c\alpha_H N, & \text{if } b \in [\tau b_L, \tau b_M). \end{cases} \tag{13}$$

Using the latter expressions for $\pi_D(b)$ and $\pi_F(b)$, the free entry condition can be rewritten as follows:

$$\frac{f_e}{cN} + 1 + \tau = \alpha_H\left(H(b_L) + \tau H(\tau b_L)\right) + (1-\alpha_H)\left(H(b_M) + \tau H(\tau b_M)\right),$$

[8] Notice that τ^* lies in the interval $(1, 1/\alpha_H)$.

where

$$H(x) = G(x) + \frac{\int_x^B tdG(t)}{x}.$$

The goods market clearing condition implies that for any $i \in \{L, H\}$,

$$\int_{\omega \in \Omega} p(\omega) x_i(\omega) d\omega = I_i.$$

Let us denote M_e as the mass of firms entering the market. One can think of M_e in terms of there being $M_e g(b)$ different firms with a certain valuation b. Then, the goods market clearing conditions are equivalent to

$$\begin{cases} I_L = M_e \left(\int_{b_M}^B p_D(t) dG(t) + \int_{\tau b_M}^B p_F(t) dG(t) \right), \\ I_H - I_L = M_e \left(\int_{b_L}^{b_M} p_D(t) dG(t) + \int_{\tau b_L}^{\tau b_M} p_F(t) dG(t) \right). \end{cases} \tag{14}$$

Using the expressions for the domestic and export prices derived in the previous section and dividing the second line by the first one, we obtain

$$\frac{\int_{b_L}^{b_M} tdG(t) + \int_{\tau b_L}^{\tau b_M} tdG(t)}{\int_{b_M}^B tdG(t) + \int_{\tau b_M}^B tdG(t)} = \left(\frac{I_H}{I_L} - 1 \right) \left(\alpha_H + \frac{b_L(1-\alpha_H)}{b_M} \right).$$

Hence, given parameters I_H, I_L, α_H, f_e, c, N, and the distribution of draws $G(\cdot)$, we can find the equilibrium values of b_M and b_L from the following system of equations:[9]

$$\begin{cases} \frac{\int_{b_L}^{b_M} tdG(t) + \int_{\tau b_L}^{\tau b_M} tdG(t)}{\int_{b_M}^B tdG(t) + \int_{\tau b_M}^B tdG(t)} = \left(\frac{I_H}{I_L} - 1 \right) \left(\alpha_H + \frac{b_L(1-\alpha_H)}{b_M} \right), \\ \frac{f_e}{cN} + 1 + \tau = \alpha_H \left(H(b_L) + \tau H(\tau b_L) \right) + (1-\alpha_H) \left(H(b_M) + \tau H(\tau b_M) \right). \end{cases} \tag{15}$$

Finally, the mass of entrants into the market can be found from (14).

[9] Existence and uniqueness of the solution can be shown in the same manner as in the closed economy case (see Tarasov (2009) for details).

III Nonhomotheticity and Consumer Welfare

Before analyzing some properties of the equilibrium, I will first focus on consumer welfare. Recall that welfare of consumer i is given by

$$U_i = \int_{\omega \in \Omega} b(\omega) x_i(\omega) d\omega.$$

Thus, welfare of consumers with income I_L is equal to

$$U_L = M_e \left(\int_{b_M}^{B} t dG(t) + \int_{\tau b_M}^{B} t dG(t) \right).$$

Meanwhile, the market clearing conditions in (14) imply that

$$M_e = \frac{I_L}{\int_{b_M}^{B} p_D(t) dG(t) + \int_{\tau b_M}^{B} p_F(t) dG(t)}.$$

Therefore, using the expressions for the prices (see (8) and (9)), we obtain that

$$U_L = I_L Q_L. \tag{16}$$

Welfare of the poor naturally rises with an increase in either their income or the valuation to price ratio of goods they consume.

Note that the latter expression can be rewritten in the following way:

$$U_L = \frac{I_L}{1/Q_L},$$

where $1/Q_L$ can be interpreted as the price index of necessities.[10] Thus, welfare of a poor consumer is given by her real income in terms of goods she consumes, i.e., in terms of the necessities. This is reminiscent of the expression for consumer welfare in models with constant elasticity of substitution (CES) preferences, where welfare of a certain consumer depends on her nominal income divided by the CES price index.

Similarly, welfare of the rich is given by

$$U_H = I_L Q_L + (I_H - I_L) Q_H. \tag{17}$$

[10] Remember that the price of a certain product (with valuation b) from the necessity group is equal to b/Q_L. Hence, $1/Q_L$ seems to be a natural measure of the price level of goods consumed by the poor.

As the rich consume the same bundle of goods as the poor plus some others, welfare of the rich is equal to welfare of the poor plus additional welfare from the consumption of the luxury goods, which is in turn equal to income spent on those goods multiplied by their valuation to price ratio. Again, the latter expression can be rewritten as follows:

$$U_H = \frac{I_L}{1/Q_L} + \frac{(I_H - I_L)}{1/Q_H},$$

where one can think of $1/Q_H$ as the price index of the luxuries.[11] Hence, welfare of a rich consumer is given by her real income spent on necessities plus real income spent on luxuries.

The findings above suggest that, in the model, changes in the welfare of a certain income class are interpreted as changes in the real income spent on products this income class consumes. As mentioned previously, this interpretation of welfare changes is similar to that in models with CES consumer preferences. The only key difference is that, in the present model, different income classes consume different products and, as a result, face different price indexes. In models with homothetic preferences, all income classes buy the same bundle of products and, thereby, the price effect discussed in the introduction is assumed away.

Finally, the relative welfare of the rich with respect to the poor is given by

$$\frac{U_H}{U_L} = 1 + \left(\frac{I_H}{I_L} - 1\right)\frac{Q_H}{Q_L}.$$

Hence, all changes in the relative welfare are due to two effects: the price and income effects. The price effect is determined by changes in the relative price index Q_H/Q_L, while the income effect is determined by changes in the relative income I_H/I_L.

Trade Liberalization and Relative Welfare

This section focuses on the effects of changes in trade costs on the relative welfare of the rich. To simplify the analysis and to avoid some ambiguity in the results, I assume that the aggregate

[11] Alternatively, welfare of the rich can be expressed in the following way:

$$U_H = \frac{I_H}{1/\left(\frac{I_L}{I_H}Q_L + \left(1 - \frac{I_L}{I_H}\right)Q_H\right)},$$

where $1/\left(Q_L I_L/I_H + (1 - I_L/I_H)\,Q_H\right)$ can be interpreted as the aggregate price index of the goods consumed by the rich.

utility from the consumption of goods with a certain valuation b given by $M_e b g(b)$ does not decrease too fast in b. Specifically, I limit the analysis to the case when the distribution of draws $G(b)$ is such that $b^2 g(b)$ is increasing and convex in b.[12] This assumption also guarantees that the probability of getting higher values of b does not decrease too fast with b.

From the previous section, the relative welfare is

$$\frac{U_H}{U_L} = 1 + \left(\frac{I_H}{I_L} - 1\right)\frac{Q_H}{Q_L}. \tag{18}$$

As I_L and I_H are exogenously given, changes in trade costs, τ, affect the relative welfare only through their impact on the relative price index, Q_H/Q_L. To understand better the intuition behind the effects of τ, I explore the impact of higher τ on the prices of both the necessities and the luxuries. To do so, I separately consider two submarkets, the submarket for the necessities and the submarket for the luxury goods.

A rise in τ makes some exporting firms exit from the submarket for the necessities and start selling only to the rich (i.e., τb_M rises). This decreases the number of firms selling to the poor and, thereby, decreases the intensity of competition in the submarket. In particular, if Q_L, Q_H, and M_e are unchanged, then

$$I_L > M_e\left(\int_{b_M}^{B} p_D(t)dG(t) + \int_{\tau b_M}^{B} p_F(t)dG(t)\right). \tag{19}$$

Therefore, as a result of lower competition, the prices of the necessities rise (Q_L falls) and some domestic firms that served only the rich find it profitable start selling to all consumers: i.e., the domestic cutoff, b_M, decreases. These changes in Q_L and b_M (and M_e) are such that the inequality in (19) becomes equality.

Note that we should also take into account changes in the mass of entrants, M_e, and their effects on the cutoffs and the prices. In general, the impact of τ on M_e is unclear. On the one hand, a rise in τ reduces the profits from exporting. On the other hand, higher τ can raise the profits from selling domestically due to lower competition. The overall effect on the expected profits and, therefore, on M_e is ambiguous (see the numerical example in *Section* 3.2). However, I find that the results claimed in the previous paragraph hold irrespective of changes in M_e.

[12] For instance, the family of power distributions with $G(b) = (b/B)^k$, $k > 0$, satisfies this assumption. The convexity of $b^2 g(b)$ is rather a technical condition, which substantially simplifies some proofs.

Thus, the following lemma holds.

Lemma 1 *If τ is such that $\tau b_M < B$ in equilibrium, higher transport costs raise the exporting cutoff τb_M, decrease the domestic cutoff b_M, and lead to higher prices of the necessities (Q_L falls).*

Proof. In the Appendix.[13] ■

What is the impact of trade costs on the prices of the luxuries? In contrast to the effects on the poor, here there are three effects of higher τ on Q_H. First, there is a direct effect associated with changes in the spending of the rich on luxury imports. In particular, it can be shown that given Q_L, Q_H, and M_e, higher τ increases the spending of the rich on luxury imports (given by $\int_{\tau b_L}^{\tau b_M} p_F(t)dG(t)$), implying that[14]

$$I_H - I_L < M_e \left(\int_{b_L}^{b_M} p_D(t)dG(t) + \int_{\tau b_L}^{\tau b_M} p_F(t)dG(t) \right). \tag{20}$$

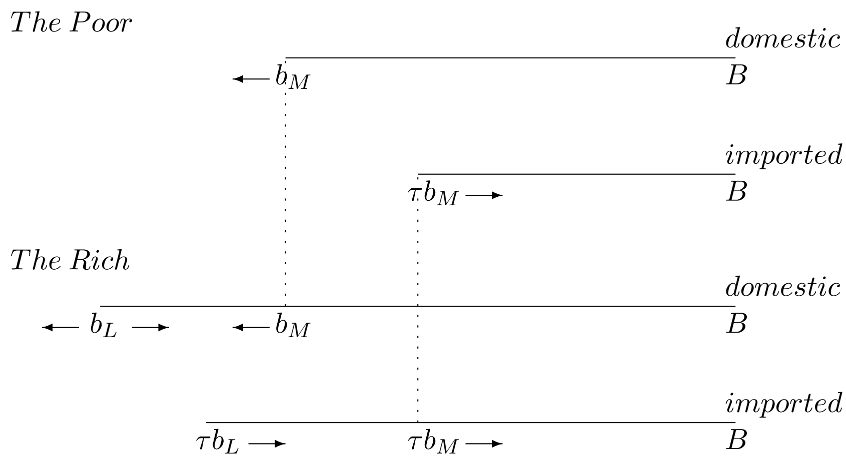
The key idea is that foreign firms that exit from the submarket for the necessities *enter* the submarket for the luxuries (in terms of the model the exporting cutoff τb_M rises). As a result, on average the rich buy relatively more valuable imported luxuries and, therefore, spend a greater fraction of the income on them. This creates tougher competition in the submarket, which in turn leads to lower prices of the luxuries (Q_H rises) and makes some domestic firms exit (b_L rises).

Secondly, there is an indirect effect caused by the changes in the submarket for the necessities. Remember that given a rise in τ, some domestic firms that served only the rich find it profitable to start selling to all consumers: i.e., the domestic cutoff, b_M, falls. This in turn reduces the intensity of competition in the submarket for the luxuries, resulting in higher prices of the luxury goods and, thereby, decreasing the exit cutoff b_L. Hence, we observe two effects on the prices of luxuries that work in opposite directions. Finally, we also need to take into account the effect of changes in M_e (which, as already discussed, is unclear in general).

I find that, in general, the overall impact is unclear. However, in the extreme case when the fraction of the rich is very small and the income difference between the rich and the poor

[13] The Appendix is available on the author's webpage or upon request.
[14] To show this, we need the assumption about the behavior of $b^2 g(b)$.

Figure 3: The Impact of τ on Consumption



is sufficiently high (there is a tiny minority of very rich consumers), the rich may even gain from higher transport costs because of lower prices of the luxuries. In other words, in very unequal societies trade liberalization can even harm the rich. The following lemma summarizes the findings above.

Lemma 2 *If τ is such that $\tau b_M < B$ in equilibrium, then higher transport costs raise the exporting cutoff τb_L and generally have an ambiguous impact on the exit cutoff b_L and, thereby, on the prices of the luxury goods. However, in very unequal economies, where α_H is close to zero and I_H/I_L is sufficiently high, a rise in τ can reduce the prices of the luxuries and, therefore, benefit the rich.*

Proof. In the Appendix. ■

Figure 3 illustrates the results formulated in *Lemmas 1* and *2*. As it can be seen, the poor unambiguously lose from greater transport costs, while the rich can even gain. Hence, we might expect that a rise in τ hurts the poor relatively more than the rich. Indeed, I show that for any parameters in the model, the ratio Q_H/Q_L is increasing in τ. In other words, greater transport costs increase the relative prices of the necessities with respect to those of the luxuries. The reason behind this is that higher transport costs *increase* spendings of the rich on imported luxuries, while *decreasing* those of the poor on imported necessities. The following proposition holds.

Proposition 1 *If τ is such that $\tau b_M < B$ in equilibrium, then*

$$\left(\frac{U_H}{U_L}\right)'_\tau > 0,$$

implying that the poor lose relatively more from a rise in τ than the rich do.

Proof. In the Appendix. ■

It should be emphasized that the results above are based on two key features of the model: nonhomothetic preferences and monopolistic competition. Nonhomotheticity of preferences implies that different groups of consumers purchase different bundles of goods, while monopolistic competition allows firms to choose what group of consumers to serve and what prices to set.[15] Note that in traditional literature with homothetic preferences, bilateral trade liberalization has the same or no impact on prices set by firms, implying that trade liberalization is beneficial for all consumers, while in the present model, it is not necessarily the case. In very unequal economies, the rich consumers may even lose from trade liberalization due to higher prices of the luxury goods.[16]

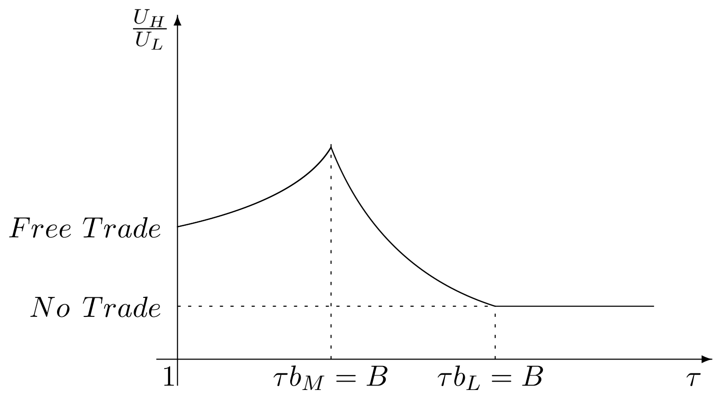
In the analysis above, I assume that imported goods are purchased by both the rich and poor consumers. That is, the transport costs are such that $\tau b_M < B$ in equilibrium. However, it is not necessarily the case. If the transport costs are so high that $\tau b_M > B$, then imported goods are purchased only by the rich. In this case, the equilibrium equations can be written as follows:

$$\begin{cases} \frac{\int_{b_L}^{b_M} tdG(t)+\int_{\tau b_L}^{B} tdG(t)}{\int_{b_M}^{B} tdG(t)} = \left(\frac{I_H}{I_L}-1\right)\left(\alpha_H + \frac{b_L(1-\alpha_H)}{b_M}\right), \\ \frac{f_e}{cN} + 1 + \alpha_H\tau = \alpha_H\left(H(b_L)+\tau H(\tau b_L)\right) + (1-\alpha_H)H(b_M). \end{cases} \tag{21}$$

[15] I also consider a modified model where firms can charge a different price to rich versus poor consumers. I find that the main results do not substantially change. In particular, the rich still lose relatively less from a rise in trade costs than the poor. However, the underlying intuition is different. In that case, higher transport costs decrease spendings of both income classes on imported products (this is different from the present model). This leads to lower competition in both submarkets and, as a result, to higher prices. However, the rich are affected by this less than the poor. This is mainly because the rich buy more products: $b_L < b_M$. As a result, it can be shown that the magnitude of effect of higher τ on the rich is lower than that on the poor. The note is available upon request.

[16] Note that if arbitrage is feasible, the derived results may not hold. On the one hand, the effects considered in the paper still matter. On the other hand, if arbitrage is feasible and τ is low enough, there is an additional *direct* effect of τ on prices of some luxury imports. Specifically, a rise in τ increases prices of imported products with $b \in [b_M, \tau b_M)$ (as for those products arbitrage is feasible). This in turn negatively affects the welfare of the rich. In order to understand the overall impact of τ on relative welfare in that case, further analysis is needed.

Figure 4: Relative Welfare



If we consider this special case, then it is straightforward to see that a rise in transport costs hurts the rich more than the poor. This is explained by the fact that changes in τ do not directly affect the poor consumers, as they purchase only domestic goods. Therefore, the following proposition holds.

Proposition 2 *If τ is such that $\tau b_M > B$ in equilibrium, then*

$$\left(\frac{U_H}{U_L}\right)'_\tau < 0,$$

implying that the poor lose relatively less from a rise in τ than the rich do.

Proof. In the Appendix. ■

Summarizing the findings in *Propositions 1* and *2*, we can see that the relative welfare has a hump shape as a function of transport costs τ. Moreover, if we assume that there are no trade costs, then the trade equilibrium is equivalent to the equilibrium in the closed economy when the mass of consumers is doubled. Meanwhile, Tarasov (2009) shows that in the closed economy, a rise in the mass of consumers benefits the rich more than the poor. Thus, we can conclude that opening a country to costless trade always benefits the rich more than the poor. However, further trade liberalization can reduce welfare inequality. Figure 4 illustrates these findings.

A Numerical Example

This subsection considers a numerical example that illustrates some of the results derived above. For certain values of the parameters, I simulate the relationship between consumer welfare and trade costs in equilibrium. Specifically, I assume that the distribution $G(x)$ is uniform with the support on $[0, 1]$ and $f_e/cN = 1$. In addition, I assume that the rich have an income three times higher than the poor (meaning that $I_H/I_L = 3$) and constitute a quarter of the total population (i.e., $\alpha_H = 0.25$). Given the assumed values of the parameters, I solve for the equilibrium values of b_L and b_M as τ is raised from 1 (free trade) to 12 (no trade).

Figure 5 shows the simulated relationship between consumer welfare and trade costs. As can be seen, both types of consumers gain from trade liberalization. Note that the poor are slightly worse off when the economy just starts moving from autarky to costly trade (τ falls from 9.4 to 7.8). This can be explained by the free entry effect. On the one hand, lower transport costs induce tougher competition, as domestic firms have to compete with their foreign counterparts. This positively affects the well-being of consumers in the economy. On the other hand, lower transport costs can reduce the firm's expected profits and, thereby, decrease the mass of firms entering the market (see Figure 6). This in turn negatively affects consumers. It appears that if the poor cannot afford to buy foreign goods (i.e., the trade costs are sufficiently high), then the latter effect can prevail over the former and, as a result, the poor can be worse off from trade liberalization. However, further trade liberalization raises the well-being of the poor.

Figure 6 illustrates the relationship between the relative welfare and the trade costs. As can be inferred from the figure, the relative welfare is first increasing and then decreasing as a function of τ, which is consistent with the theoretical findings obtained in the previous sections (see Figure 4). In particular, moving from the autarky to free trade raises the relative welfare of the rich by 9%. Furthermore, if trade liberalization does not directly affect the poor (when imported goods are purchased only by the rich), then the relative welfare rises by 23%. This suggests that the impact of trade liberalization on relative welfare through the price effect can be of considerable magnitude.

Figure 5: Consumer Welfare and Trade Costs

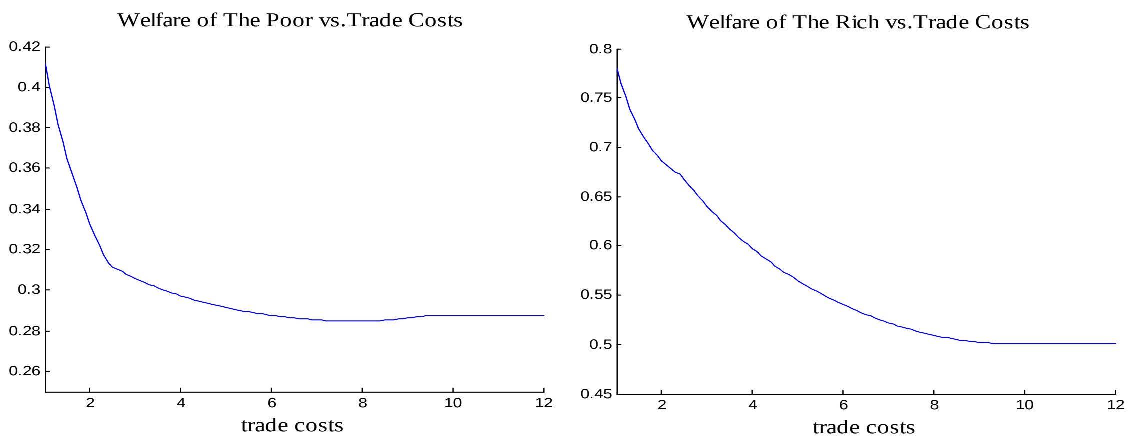
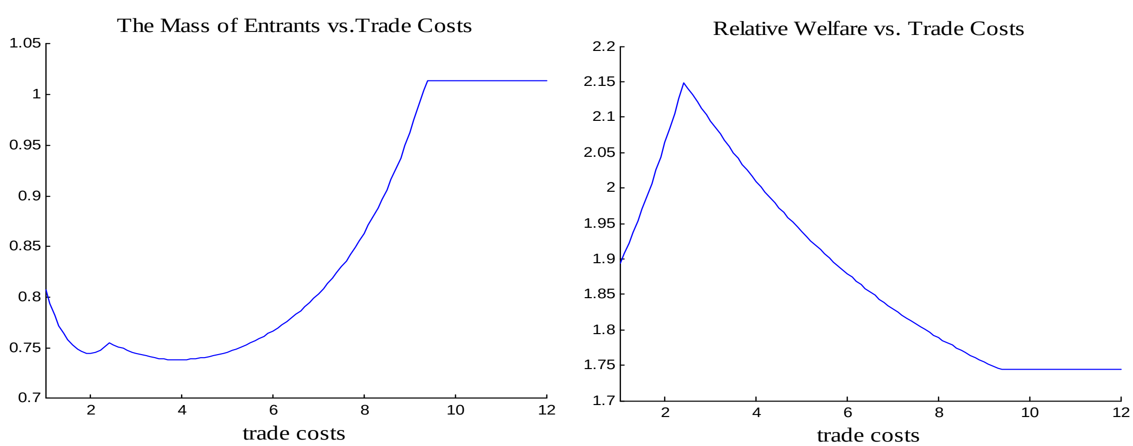


Figure 6: The Mass of Entrants, Relative Welfare, and Trade Costs



IV Concluding Remarks

In this paper, I develop a tractable framework that enables us to analyze the impact of trade on welfare inequality through the price effect. One of the key elements of the model is nonhomothetic preferences that feature discrete choices (among horizontally differentiated goods) made by consumers with heterogeneous income. Such a preference structure implies that consumers first buy goods that are relatively more essential in consumption and then move to less essential goods. Furthermore, the rich consumers buy the same bundle of goods (the necessities) as the poor consumers plus some others (the luxuries).

I then incorporate these preferences in the monopolistic competition model of trade à la Melitz (2003) and Melitz and Ottaviano (2008). The presence of market power leads to prices set by firms being affected by trade costs. Moreover, as the consumer preferences are nonhomothetic, the prices of different goods (necessities and luxuries) are affected differently, implying that trade liberalization can benefit some income classes more than others. In particular, I find that if trade costs are such that some imported goods are available for all consumers, then trade liberalization benefits the poor more than the rich. If trade costs are so high that only the rich can afford to buy imports, then the rich gain relatively more from trade liberalization. In other words, the relative welfare of the rich has a hump shape as a function of trade costs.

The framework developed can be easily extended in at least two directions. First, it would not be difficult to consider a similar model of trade between two countries with different income distributions and to examine how this difference affects trade patterns and relative welfare. Secondly, it would be interesting to explore the case in which income distribution is endogenous. This framework would allow for both the income and price effects and, therefore, could give us an idea about the relative magnitude of the effects. I leave these issues for further work.

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