Consumer Heterogeneity, Free Trade, and the Welfare Impact of Income Redistribution

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Abstract

Demographic differences, like young and elderly, and healthy and disabled, are summarized as consumers' heterogeneity in expenditure shares, and introduced into an otherwise standard HO model, together with income distribution in this paper. We prove that free trade may hurt consumers who spend more on the exporting good if the volume of trade is small, while redistributing more income to consumers who spend more on the exporting good may make everyone in the country better off. By contrast, redistributing more income to consumers who spend more on the importing good may make everyone in the country worse off.

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Contents

1 Introduction

It is well known that income redistribution could make a *potential Pareto improvement:* the gain to consumers whose income is increased compensates more than the loss to consumers whose income is reduced. In this paper we show a much stronger result in an open economy when consumers are heterogeneous: redistributing more income to consumers who spend more on the exporting good could be strictly *Pareto-improving* to all consumers. By contrast, redistributing more income to consumers who spend more on the importing good may make everyone in the country worse off.

We introduce consumers' heterogeneity into the standard two goods, two factors, and two countries Heckscher-Ohlin model. There are two groups of consumers. Group 1, like the exporting good relatively more (spending more on the exporting good), while group 2, like the importing good relatively more (spending more on the importing good). The effect of income redistribution can be decomposed into two components: the *wealth effect* (direct effect, more (less) income makes consumers better (worse) off), and an indirect effect – the *terms of trade effect.* For example, if more income is redistributed to group 1 consumers, who spend more on the exporting good, this will raise the price of the exporting good but lower the price of the importing good, and therefore will improve the *terms of trade.* An improvement in the terms of trade (the *terms of trade effect*) increases the real GNP of the country and decreases the relative price of the importing good, both of which benefit consumers in group 2. If the *terms of trade effect* is sufficiently strong and dominates the *wealth effect,* then group 2 consumers will be better off after the income redistribution. If the volume of trade is sufficiently large, the *terms of trade effect* will also benefit consumers in group 1 so their welfare is improved as well. On the other hand, the same mechanism implies that if the *terms of trade effect* is sufficiently strong and the volume of trade is sufficiently large, redistributing more income to consumers who spend more on the importing good will make consumers in both groups worse off.

On the welfare impact of free trade, in addition to the classic gains from trade, we also document a *terms of trade effect* which differs across consumer groups. Specifically free trade increases (decreases) the price of the exporting (importing) good, hurting (benefiting) the consumer group who like the exporting (importing) good relatively more. We show that the consumer group who like the importing good more will always benefit from free trade. The consumer group who like exporting good more, however, may be worse off after trade if the volume of trade is small.

Leading by Melitz (2003) and Eaton and Kortum (2002), firms' heterogeneity has been a central theme in a recent development of the "New New Trade" theory. While consumers' heterogeneity in demand side is equally important in determining the market equilibrium in practice, very little demand-side considerations in heterogeneity are in the theory of international trade. The bias stems, in our view, from the difficulty in describing systematically about what consumers' heterogeneity is, and how it affects trade patterns and welfare, while keeping the model tractable. In this paper we parameterize consumers' heterogeneity within a country into two dimensions: income distribution and differences in expenditure shares. Most studies in the literature of international trade assume that consumers' preferences are identical. Yet, in the real world young and elderly, and healthy and disabled all have different expenditure shares on goods at given level of income.

Models of nonhomothetic preferences which assume that wealthier people spend more on luxury goods can be viewed as a special case of our model. We depart from the connection between the income level and the expenditure share, and the focus of income elasticities in this literature, but formulate a more general and a much simpler framework for issues related to demographic differences across consumers. In our view, differences in expenditure shares catch an essential heterogeneity in different demographic groups, and therefore provide a channel to study the interaction between international trade and demographic differences, which has been largely left aside in the literature.

Our paper is related to the theoretical literature of nonhomothetic preferences and international trade. Nonhomothetic preferences were first introduced by Linder (1961), who used the demand-side considerations to explain the large volume of intra-industry trade between developed countries. Markusan (1986) combines nonhomothetic preferences with scale economies and differences in endowments in explaining the volume of trade. Flam and Helpman (1987), Stokey (1991), and Matsuyama (2000) introduce nonhomothetic preferences into Ricardian models with a continuum of goods. Mitra and Trindade (2004) focus on the role of inequality in the determination of trade flows and patterns, while Dutt and Mitra (2005) consider ideology and inequality within HO framework. Fieler (2007) introduces nonhomothetic preferences into Eaton-Kortum model to explain the positive relationship between trade share and income per capita. The *terms of trade effect* is one of the driving forces for nontrivial effects in this literature, as well as in our paper. Matsuyama (2000) notices that South's domestic policy to redistribute income from rich, who buy foreign imports, to the poor, who cannot afford to buy them, may make all households in South better off. However, there is a fundamental difference between this paper and the existing literature. In Matsuyama (2000), the result relies on the income effect that makes luxury goods complement to necessary goods. In our paper, the Cobb-Douglas utility function implies that two goods are neither substitute nor complement. Our result is also more general. The policy can be taken in any country (not only in South), and the consumers who buy more foreign imports are not required to be rich. Furthermore, the opposite result in our paper that redistributing income to consumers who spend more on the importing good may make everyone worse off is not presented in Matsuyama (2000).

Our result that free trade may make the consumer who spends more on the exporting good worse off provides an alternative channel for conflict interests in free trade, different from traditional Stopler-Samuelson explanation in conflict of interests between labor and capital. We actually prove a more general result: as long as the ratio of the consumers' expenditure share for a good in a group to the average expenditure share in a country is larger than the ratio of the country's output of the good to the consumption, then a policy resulting in an increase in the relative price of the good will hurt the consumers in that group. The present model, therefore, will be appropriate to address issues of political support among different demographic groups.

The rest of the paper is organized as follows. Section 2 develops the basic model. A general equilibrium analysis is conducted in Section 3. Trade patterns and the welfare effect of free trade are discussed in Section 4, while the welfare impact of income redistribution is discussed in Section 5. Section 6 then concludes.

2 The Model

In an otherwise standard two goods, two factors, and two countries Heckscher-Ohlin framework, we introduce income distribution and the consumers' heterogeneity in expenditure shares into the model. Focusing now on a single country, let the labor endowment (population) be L and the capital endowment be K in the country. There are two groups of consumers. The size of group $h (h = 1, 2)$ is $\lambda_h L$ where $\lambda_1 + \lambda_2 = 1$ and $0 < \lambda_h < 1$. The utility function for consumers in group h is $U_h(x_{h1}, x_{h2}) = x_{h1}^{a_h} x_{h2}^{1-a_h}$ where a_h is the consumer's expenditure share of good 1 in group h. We assume that $a_1 > a_2$ so that a consumer in group 1 spends more on good 1 than a consumer in group 2. The income share of group h is denoted as σ_h where $\sigma_1 + \sigma_2 = 1$. The aggregate income in the country is denoted by, $I = wL + rK$, where w and r are the wage rate and the interest rate, respectively. Therefore, the individual consumer's income in group h, I_h, is given by

$$I_h = \frac{\sigma_h I}{\lambda_h L} \tag{1}$$

If $\sigma_h = \lambda_h$, the income distribution exhibits a perfect equality.

Let p_i be the price of good i. The consumer's utility maximization problem in group h is

$$\begin{aligned} \max\ U_h(x_{h1}, x_{h2}) &= x_{h1}^{a_h} x_{h2}^{1-a_h} \\ \text{s.t. } p_1 x_{h1} + p_2 x_{h2} &= I_h \end{aligned} \tag{2}$$

which solves for the individual demand of good i in group h :

$$x_{h1} = \frac{a_h I_h}{p_1} \text{ and } x_{h2} = \frac{(1-a_h)\, I_h}{p_2} \tag{3}$$

Therefore, the total demands for good 1 and 2 are:

$$X_1 = (\lambda_1 x_{11} + \lambda_2 x_{21})\, L = \frac{IA_1}{p_1} \tag{4}$$

$$X_2 = (\lambda_1 x_{12} + \lambda_2 x_{22})\, L = \frac{IA_2}{p_2} \tag{5}$$

where

$$A_1 = \sigma_1 a_1 + (1-\sigma_1) a_2 \tag{6}$$

$$A_2 = \sigma_1 (1-a_1) + (1-\sigma_1)(1-a_2) = 1 - A_1 \tag{7}$$

are average expenditure shares of goods 1 and 2 in the country, respectively. Since $a_1 > a_2$,, it is immediately seen that that a rise in σ_1 raises X_1 but lowers X_2. If more income is distributed among consumers who spend more on good 1, the total demand for good 1 increases, while the total demand for good 2 declines.

3 The Equilibrium Analysis

The market is perfectly competitive. The technology exhibits constant returns to scale. The first set of equilibrium conditions for the two-by-two economy is given by zero profit conditions:

$$p_1 = c_1(w,r) \text{ and } p_2 = c_2(w,r) \tag{8}$$

where $c_i(w,r)(i = 1,2)$ is the unit cost function.

Let y_i be the output of sector i. The second set of equilibrium conditions is full employment for both factors:

$$a_{1L}y_1 + a_{2L}y_2 = L \tag{9}$$

$$a_{1K}y_1 + a_{2K}y_2 = K \tag{10}$$

where $a_{iL} = \frac{\partial c_i}{\partial w}$ is the labor used to produce one unit of good i, and likewise for a_{iK}.

The third set of equilibrium conditions is that the product market clears and can be written as:

$$\frac{y_1}{y_2} = \frac{X_1}{X_2} = \frac{p_2 A_1}{p_1 (1 - A_1)} \tag{11}$$

All these conditions are standard except that the relative demand X_1/X_2 now depends on the parameter of income distribution, σ_1, and the parameter of expenditure share, a_h, other than relative price p_1/p_2.

Suppose sector 1 is labor intensive. That is, $a_{1L}/a_{1K} > a_{2L}/a_{2K}$. The classical *Rybczynski effect* still holds: an increase in capital-labor ratio $k = K/L$ reduces the relative supply of labor intensive good with respect to the capital intensive good, y_1/y_2, and therefore increases the relative price, p_1/p_2. As we have formally proved in the Appendix, the *income distribution effect* now also plays a role in determining equilibrium output levels and prices. As σ_1 increases, more income is distributed to consumers who spend more on labor intensive good, good 1, and this increases the relative demand for the labor intensive good with respect to the capital intensive good, X_1/X_2, and therefore increases p_1/p_2. Consider a case that the country is capital abundant but rich people spends more on capital intensive good, i.e., k is large and σ_1 is small. The larger k increases the relative price of labor intensive good, p_1/p_2, but the smaller σ_1 reduces it. The pattern of production and trade, therefore, is jointly determined by both the *Rybczynski effect* and the *income distribution effect.*

Let $\widehat{x} = dx/x$ denote the percentage change of variable x. Rewrite the equation (37) as

$$A\left(\widehat{p}_1 - \widehat{p}_2\right) = \widehat{k} + B\widehat{\sigma}_1 \tag{12}$$

where $A = |\lambda| + \left(\phi_L + \phi_K\right)/|\theta| > 0$ and $B = |\lambda|\,\xi > 0$. Two extreme cases worth noting: if $\widehat{\sigma}_1 = 0$, the increase in k increases p_1/p_2; if $\widehat{k} = 0$, on the other hand, the increase in σ_1 increases p_1/p_2. We summarize our results as follows:

Proposition 1 *Ceteris paribus, an increase in total capital-labor ratio reduces relative output and increases relative price of the labor intensive good, while distributing more income to people who spends more on the labor intensive good increases both relative output and relative price of the labor intensive good.*

4 Free Trade

We now turn to the equilibrium of free trade between the home country and the foreign country. Variables in the foreign country are denoted by superscript "*". Let good 2 be the numeraire good so that p_2 is normalized as 1. Let p^T be the relative price in free trade equilibrium. All equilibrium conditions derived in the last section still hold except that the domestic market clearing condition (11) needs to be replaced by the world market clearing condition

$$\frac{A_1}{p^T(1-A_1)} - \frac{y_1}{y_2} = E^*(p^T) \tag{13}$$

where $E^*(p^T)$ is the relative supply of exports from the foreign country. If $E^*(p^T) > 0$, home imports good 1 and exports good 2. If $E^*(p^T) < 0$, we have the opposite. We will first discuss trade patterns and then examine the welfare impact of free trade.

4.1 Trade Patterns

Heckscher-Ohlin theorem provides a supply side driver for free trade. The difference in income distribution across countries in our model, on the other hand, provides a demand side driver for free trade. Let the home and foreign countries have the same capital-labor endowment ratio for simplicity, i.e., $\frac{K}{L} = \frac{K^*}{L^*}$. However, $\sigma_1 < \sigma_1^*$. Using Proposition 1, we immediately see that $p^a < p^{a*}$. Hence, in autarky the relative price of good 1 is lower in the country where smaller income is distributed to consumers who spend more on good 1. It must be the case that $p^a \leq p^T \leq p^{a*}$. In free trade equilibrium the home country exports good 1 and imports good 2.

4.2 Welfare

In classical HO model, consumers are all better off in free trade than in autarky. It is interesting to investigate if that result still holds when consumers are heterogeneous. In particular, though specialization in production is still beneficial, the consumer who spends more on the exporting good now suffers more from the increase in the relative price. We will first examine the effect of an increase in relative price of good 1 (due to the change in world market) on consumer's welfare in different groups, and then illustrate why free trade may hurt some consumers in the country.

The GDP function for domestic economy is defined as

$$G(p, L, K) = \max_{y_1, y_2}\{py_1 + y_2 : (y_1, y_2) \text{ are feasible}\} \tag{14}$$

It must be the case that $G(p, L, K) = I = wL + rK$, and $\partial G/\partial p = y_1$ by the envelope theorem. Let $V_h(p, I_h)$ be the indirect utility function of the consumer in group h. That is,

$$V_h(p, I_h) = \max_{x_{h1}, x_{h2}}\{U_h(x_{h1}, x_{h2}) : px_{h1} + x_{h2} \leq \frac{\sigma_h G(.)}{\lambda_h L}\} \tag{15}$$

using the envelope theorem again, we obtain

$$\frac{dV_h(p, I_h)}{dp} = \mu_h \left(\frac{\sigma_h y_1}{\lambda_h L} - x_{h1}\right) \tag{16}$$

where μ_h is the marginal utility of income. Using (3) and (4), we have

$$x_{h1} = \frac{X_1 a_h \sigma_h}{A_1 \lambda_h L} \tag{17}$$

Now substituting (17) into (16) gives

$$\frac{dV_h(p, I_h)}{dp} = \frac{X_1 \mu_h \sigma_h}{\lambda_h L}\left(\frac{y_1}{X_1} - \frac{a_h}{A_1}\right) \tag{18}$$

The expression we just derived proves the following proposition:

Proposition 2 *For a particular good, as long as the ratio of the consumer's expenditure share in a group to the average expenditure share in a country is larger than the ratio of the country's output of the good to the consumption, then a policy resulting in an increase in the relative price of the good will hurt consumers in that group.*

If $\frac{y_1}{X_1} < 1$, the home country imports good 1, and if $\frac{y_1}{X_1} > 1$, the home country exports good 1, while $\frac{y_1}{X_1} = 1$ represents autarky. The welfare effects of the increase in p on both groups are summarized in the following table:

$\frac{y_1}{X_1} < \frac{a_2}{A_1}$	$\frac{a_2}{A_1} \leq \frac{y_1}{X_1} < 1$	$1 \leq \frac{y_1}{X_1} < \frac{a_1}{A_1}$	$\frac{a_1}{A_1} \leq \frac{y_1}{X_1}$
$\frac{dV_1}{dp} < 0$	$\frac{dV_1}{dp} < 0$	$\frac{dV_1}{dp} < 0$	$\frac{dV_1}{dp} > 0$
$\frac{dV_2}{dp} < 0$	$\frac{dV_2}{dp} > 0$	$\frac{dV_2}{dp} > 0$	$\frac{dV_2}{dp} > 0$

When p increases, the consumer gets hurt from the price increase in good 1, but benefits from the price decline in good 2. When $\frac{a_2}{A_1} \leq \frac{y_1}{X_1} < \frac{a_1}{A_1}$, and in particular, when $\frac{y_1}{X_1} = 1$ in autarky, there is a conflict in the interests: the consumer who spends more on good 1 sees a reduction in welfare, while the consumer who spends more on good 2 is better off. If the country imports a large amount of good 1 ($\frac{y_1}{X_1} < \frac{a_2}{A_1}$), the rise in the relative price of the import good hurts both groups of consumers. On the other hand, if the country exports a large amount of good 1 ($\frac{a_1}{A_1} \leq \frac{y_1}{X_1}$), the increase in the relative price of the export good benefits all consumers.

If country exports good 1, moving from autarky to free trade is represented by columns 3 and 4 in the above table. Free trade always benefits consumers in group 2 who spend more on the import good. If the amount of exports is small ($1 \leq \frac{y_1}{X_1} < \frac{a_1}{A_1}$), however, free trade will reduce welfare of the consumer who spends more on the exporting good.

In Figure 1 we modify the classical diagram of the gains from trade to explain why free trade may hurt the consumer in group 1. The home country both produces and consumes at point O_2 in autarky. In free trade the home country produces at D but consumes at E. It exports good 1 and imports good 2. O_1KO_2H is the Edgeworth box in autarky. M is the middle point of O_1O_2 so that income is equally distributed between consumer 1 and consumer 2. The contract curve is represented by O_1AO_2. Consumer 1 consumes bundle A where her indifference curve is tangent to the budget line. In free trade, the Edgeworth box is represented by $O_1K'EH'$. Now M' is the middle point in the line of O_1E. The relative price of good 1, p, is higher in free trade than in autarky. The terms of trade in free trade is represented by line ED (and $M'C$). The contract curve in free trade is O_1CE. Consumer 1 in free trade consumes bundle C where the budget line $M'C$ is tangent to the indifference curve. It is immediately seen that consumer 1 is worse off in free trade than in autarky, due to the *terms of trade effect.*

5 The Welfare Impact of Income Redistribution

Redistributing more income to a consumer in group h increases her utility at given prices, which is denoted as the *wealth effect.* On the other hand, redistributing more income to the consumer who spends more on good i increases the price of good i but decreases the price of good j, which is denoted as the *terms of trade effect.* The *the terms of effect* may reduce or increase consumer h's utility. Applying the envelope theorem to (15) gives

$$\frac{dV_h(p, I_h)}{\mu_h d\sigma_h} = \frac{G(.)}{\lambda_h L} + \left(\frac{\sigma_h y_1}{\lambda_h L} - x_{h1}\right)\frac{\partial p}{\partial \sigma_h} \tag{19}$$

The first term on the right hand side of equation (19) catches the *wealth effect,* which is positive. The second term on the right hand side of equation (19) catches the *terms of trade effect,* which could be negative.

We consider a policy that increases σ_1. Similar to the discussion in Proposition 1, $\frac{\partial p}{\partial \sigma_1} > 0$, since redistributing more income to consumers who spend more on good 1 increases the total demand for good 1. Substituting (17) into (19) and noting that $d\sigma_2 = -d\sigma_1$, we have

$$\frac{dV_1(p, I_1)}{\mu_1 d\sigma_1} = \frac{G(.)}{\lambda_1 L} + \frac{\sigma_1 X_1}{\lambda_1 L}\left(\frac{y_1}{X_1} - \frac{a_1}{A_1}\right)\frac{\partial p}{\partial \sigma_1} \tag{20}$$

and

$$\frac{dV_2(p, I_1)}{\mu_2 d\sigma_1} = -\frac{G(.)}{\lambda_2 L} + \frac{(1-\sigma_1)\, X_1}{\lambda_2 L}\left(\frac{y_1}{X_1} - \frac{a_2}{A_1}\right)\frac{\partial p}{\partial \sigma_1} \tag{21}$$

We consider three intervals of $\frac{y_1}{X_1}$:

Interval 1, $0 < \frac{y_1}{X_1} \leq a_2/A_1$: The home country imports good 1. The *terms* *of trade effects* for consumers in both groups are negative. Thus, we must have $dV_2/d\sigma_1 < 0$ in this case. Noting that the total expenditure on good 1 in the country, $A_1G(.) = pX_1$, with some computations we obtain that $dV_1/d\sigma_1 > 0$ if and only if $\frac{\widehat{p}}{\widehat{\sigma}_1} < C$ where

$$C = \frac{1}{A_1\left(\frac{a_1}{A_1} - \frac{y_1}{X_1}\right)} \tag{22}$$

Interval 2, $a_2/A_1 < \frac{y_1}{X_1} \leq a_1/A_1$: The home country imports good 1 if $\frac{y_1}{X_1} < 1$ but exports it if $\frac{y_1}{X_1} > 1$. The *terms of trade effect* is negative for Group 1, but positive for Group 2. Again, $dV_1/d\sigma_1 > 0$ if and only if $\frac{\widehat{p}}{\widehat{\sigma}_1} < C$. Now $dV_2/d\sigma_1 > 0$ if and only if $\frac{\widehat{p}}{\widehat{\sigma}_1} > D$ where

$$D = \frac{\sigma_1}{(1-\sigma_1)\, A_1\left(\frac{y_1}{X_1} - \frac{a_2}{A_1}\right)} \tag{23}$$

and we can show that $D > C$ if $\frac{y_1}{X_1} > \frac{a_2}{A_1}$.

Interval 3, $a_1/A_1 < \frac{y_1}{X_1}$: The home country exports good 1. Now, the *terms of trade effect* is positive for consumers in both groups. Thus, $dV_1/d\sigma_1$ must be positive, as both the *wealth effect* and the *terms of trade effect* are positive for consumers in group 1. For consumers in group 2, $dV_2/d\sigma_1 > 0$ if and only if $\frac{\widehat{p}}{\widehat{\sigma}_1} > D$. Our results are summarized in the following table:[1]

	$\frac{\widehat{p}}{\widehat{\sigma}_1} < C$	$C \leq \frac{\widehat{p}}{\widehat{\sigma}_1} < D$	$D \leq \frac{\widehat{p}}{\widehat{\sigma}_1}$
$0 < \frac{y_1}{X_1} \leq a_2/A_1$	$dV_1/d\sigma_1 > 0$ $dV_2/d\sigma_1 < 0$	$dV_1/d\sigma_1 < 0$ $dV_2/d\sigma_1 < 0$	$dV_1/d\sigma_1 < 0$ $dV_2/d\sigma_1 < 0$
$a_2/A_1 < \frac{y_1}{X_1} \leq a_1/A_1$	$dV_1/d\sigma_1 > 0$ $dV_2/d\sigma_1 < 0$	$dV_1/d\sigma_1 < 0$ $dV_2/d\sigma_1 < 0$	$dV_1/d\sigma_1 < 0$ $dV_2/d\sigma_1 > 0$
$a_1/A_1 < \frac{y_1}{X_1}$	$dV_1/d\sigma_1 > 0$ $dV_2/d\sigma_1 < 0$	$dV_1/d\sigma_1 > 0$ $dV_2/d\sigma_1 < 0$	$dV_1/d\sigma_1 > 0$ $dV_2/d\sigma_1 > 0$

[1] In the case of $0 < \frac{y_1}{X_1} \leq a_2/A_1$, our notation in the table is slightly abused since C can not be less than D in this case. As long as $\frac{\widehat{p}}{\widehat{\sigma}_1} \geq C$, then both $dV_1/d\sigma_1$ and $dV_2/d\sigma_1$ are negative.

In autarky where $\frac{y_1}{X_1} = 1$, we must have $D = C$. It is a special case of Interval 2 ($a_2/A_1 < \frac{y_1}{X_1} \leq a_1/A_1$). Redistributing more income to Group 1 must benefit one group but hurt another. It is interesting to note that Group 1 may be worse off. If the *terms of trade effect* is sufficiently strong ($D \leq \frac{\widehat{p}}{\sigma_1}$), the group whose income is increased will be worse off, and the group whose income is reduced will be better off.

In an open economy, if the *terms of trade effect* is sufficiently strong ($D \leq \frac{\widehat{p}}{\sigma_1}$) and the volume of trade is sufficiently large ($\frac{y_1}{X_1} \leq a_2/A_1$ or $a_1/A_1 < \frac{y_1}{X_1}$), redistributing more income to consumers who spend more on the importing good reduces welfare for all consumers. However, redistributing more income to consumers who spend more on the exporting good makes a Pareto improvement for all consumers in the country.

When the volume of trade is small ($a_2/A_1 < \frac{y_1}{X_1} \leq a_1/A_1$) and the level of the *terms of trade effect* is intermediate ($C \leq \frac{\widehat{p}}{\sigma_1} < D$), the income redistribution makes consumers in both groups worse off, but for different reasons. The *terms of trade effect* dominates the *wealth effect* for consumers in group 1, while it is the opposite for consumers in group 2.

Proposition 3 *In an open economy, if a country's volume of trade is sufficiently large, and the* terms of trade effect *is sufficiently strong, then redistributing more income to consumers who spend more on the exporting good makes a Pareto improvement for all consumers in the country. By contrast, redistributing more income to consumers who spend more on the importing good hurts everyone in the country.*

It is expected that the consumer is better off when her income share is increased. However, it is surprising that the consumer is also better off even if her income share is reduced. We use Figure 2 to further illustrate why that may happen.[2] Let the income distribution be perfectly equal before income redistribution takes

[2] To draw the graph easily, we consider a reduction in σ_1, and assume that the home country exports good 2.

place. The country produces at point F but consumes at point O_2 so that it exports good 2 and imports good 1. O_1KO_2H is the Edgeworth box before the income redistribution. M is the middle point of O_1O_2 so that income is equally distributed between consumer 1 and consumer 2. The contract curve is represented by O_1AO_2. Consumer 1 consumes bundle A where her indifference curve is tangent to the budget line. Consider a policy to redistribute more income to the consumer who spends more on the exporting good, that is, to reduce the income share of consumer 1. The Edgeworth box after the income redistribution is represented by $O_1K'EH'$. Now M' is in the line of O_1E, indicating that consumer 1 has an income share smaller than 1/2. The relative price of the importing good, p, is lower now, and the new terms of trade is represented by line DE (and $M'B$). The new contract curve is O_1BE. Consumer 1 now consumes bundle B where the new budget line $M'B$ is tangent to the indifference curve. It can be immediately seen that consumer 1, whose income share is reduced, is better off, since the strong *terms of trade effect* dominates the *wealth effect.*

6 Conclusion

In this paper, demographic differences, like young and elderly, and healthy and disabled, are summarized as consumers' heterogeneity in expenditure shares, and introduced into an otherwise standard HO model, together with income distribution in this paper. We prove and provide precise conditions for two basic results: a policy resulting an increase in the relative price of a good may hurt consumers who spend more on the good, and redistributing more income to consumers who spend more on the exporting good may make everyone in the country better off. Our model only discusses two groups of consumers, but it can be easily extended to infinite groups of consumers with a continuum of expenditure shares. The median-voter can then be determined by her expenditure share, and that can provide a new framework for policy analysis.

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7 Appendix

Proof of Proposition 1

The proof follows closely to the standard approach (Jones 1965). Totally differentiating equations (8) and using "Jones' algebra," we obtain

$$\theta_{1w}\widehat{w} + \theta_{1r}\widehat{r} = \widehat{p}_1 \quad (24)$$

$$\theta_{2w}\widehat{w} + \theta_{2r}\widehat{r} = \widehat{p}_2 \quad (25)$$

where $\widehat{w} = dw/w$ denotes the percentage change in wage rate and likewise for other variables. The θ's refer to the factor shares in each sector. For example,

$\theta_{iw} = a_{iL}w/p_i$, is the labor's share in sector i. Let $|\theta|$ denote the determinant of the 2×2 matrix on the left hand side of the above system. Note that $\theta_{iw} + \theta_{1r} = 1$, and $|\theta| = \theta_{1w} - \theta_{2w} = \theta_{2r} - \theta_{1r} > 0$ since sector 1 is labor intensive. Subtracting (25) from (24), we obtain:

$$\widehat{w} - \widehat{r} = \frac{1}{|\theta|}\left(\widehat{p}_1 - \widehat{p}_2\right) \tag{26}$$

Totally differentiating equations (9) and (10), we obtain

$$\lambda_{1L}\widehat{y}_1 + \lambda_{2L}\widehat{y}_2 = \widehat{L} - \left[\lambda_{1L}\widehat{a}_{1L} + \lambda_{2L}\widehat{a}_{2L}\right] \tag{27}$$
$$\lambda_{1K}\widehat{y}_1 + \lambda_{2K}\widehat{y}_2 = \widehat{K} - \left[\lambda_{1K}\widehat{a}_{1K} + \lambda_{2K}\widehat{a}_{2K}\right] \tag{28}$$

We define $dy_1/y_1 = \widehat{y}_1$, and likewise for all other variables. In addition, we define the *fraction of labor used in industry i*, $\lambda_{iL} = y_i a_{iL}/L$, where $\lambda_{1L} + \lambda_{2L} = 1$. We define λ_{iK} in analogous manner. Let $|\lambda|$ denote the determinant of the 2×2 matrix on the left hand side of (27). $|\lambda| = \lambda_{1L} - \lambda_{1K} = \lambda_{2K} - \lambda_{2L} > 0$.

Note that $c_i(w, r) = wa_{iL} + ra_{iK}$. To minimize the unit cost, the firm takes factor prices as given and varies a_{ij} to set $wda_{iL} + rda_{iK} = 0$. Thus, we have

$$\theta_{1w}\widehat{a}_{1L} + \theta_{1r}\widehat{a}_{1K} = 0 \tag{29}$$
$$\theta_{2w}\widehat{a}_{2L} + \theta_{2r}\widehat{a}_{2K} = 0 \tag{30}$$

We define the elasticities of substitution between factors as $\varepsilon_i = \left(\widehat{a}_{iK} - \widehat{a}_{iL}\right)/\left(\widehat{w} - \widehat{r}\right)$. Then solving for $\widehat{a}_{ij}$ from equations (29) and (30), we have

$$\widehat{a}_{iL} = -\theta_{ir}\varepsilon_i\left(\widehat{w} - \widehat{r}\right) \text{ and } \widehat{a}_{iK} = \theta_{iw}\varepsilon_i\left(\widehat{w} - \widehat{r}\right) \tag{31}$$

Substituting equations (26) and (31) into (27) and (28), we obtain:

$$\lambda_{1L}\widehat{y}_1 + \lambda_{2L}\widehat{y}_2 = \widehat{L} + \frac{\phi_L}{|\theta|}\left(\widehat{p}_1 - \widehat{p}_2\right) \tag{32}$$
$$\lambda_{1K}\widehat{y}_1 + \lambda_{2K}\widehat{y}_2 = \widehat{K} - \frac{\phi_K}{|\theta|}\left(\widehat{p}_1 - \widehat{p}_2\right) \tag{33}$$

where $\phi_L = \lambda_{1L}\theta_{1r}\varepsilon_1 + \lambda_{2L}\theta_{2r}\varepsilon_2$ and $\phi_K = \lambda_{1K}\theta_{1w}\varepsilon_1 + \lambda_{2K}\theta_{2w}\varepsilon_2$.

Taking log and differentiating the equation (11) give

$$\widehat{y}_1 - \widehat{y}_2 = \widehat{p}_2 - \widehat{p}_1 + \xi\widehat{\sigma}_1 \tag{34}$$

where

$$\xi = \frac{\left(a_1 - a_2\right)\sigma_1}{\left[a_2 + \left(a_1 - a_2\right)\sigma_1\right]\left[1 - a_2 + \left(a_2 - a_1\right)\sigma_1\right]} > 0 \tag{35}$$

Now subtracting (32) from (33) and using (34), we have:

$$\left[|\lambda| + \frac{\phi_L + \phi_K}{|\theta|}\right](\widehat{y}_1 - \widehat{y}_2) = -\widehat{k} + \frac{(\phi_L + \phi_K)\,\xi\widehat{\sigma}_1}{|\theta|} \tag{36}$$

$$\left[|\lambda| + \frac{\phi_L + \phi_K}{|\theta|}\right](\widehat{p}_1 - \widehat{p}_2) = \widehat{k} + |\lambda|\,\xi\widehat{\sigma}_1 \tag{37}$$

Thus, the increase in $k = K/L$ reduces relative equilibrium output y_1/y_2, and increases the relative price p_1/p_2. On the other hand, the increase in σ_1 increases relative equilibrium output y_1/y_2, and increases the relative price p_1/p_2.

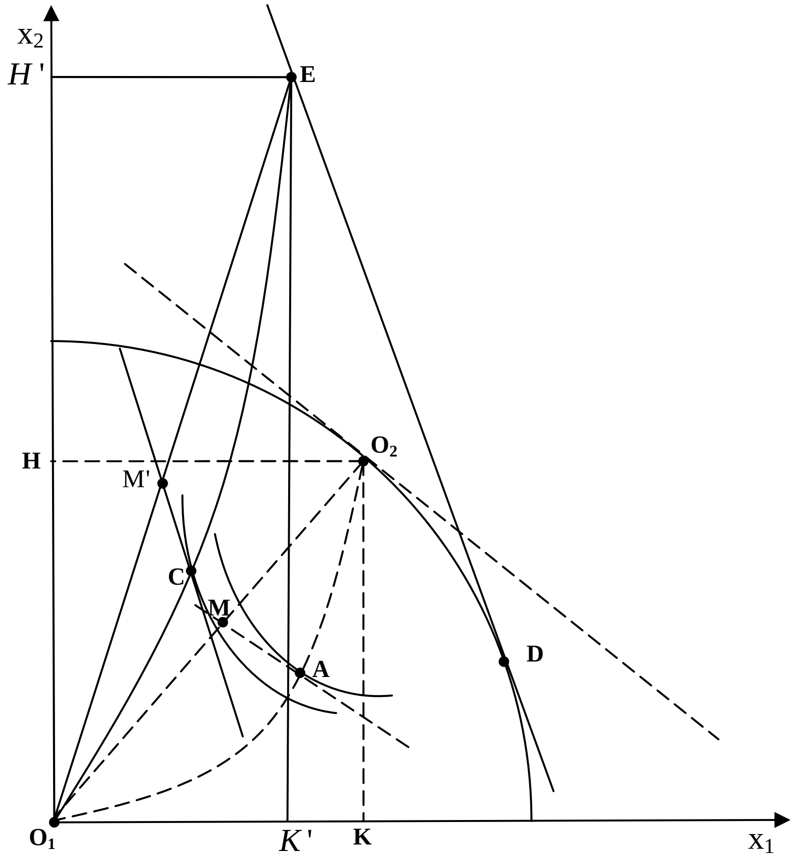

Figure 1

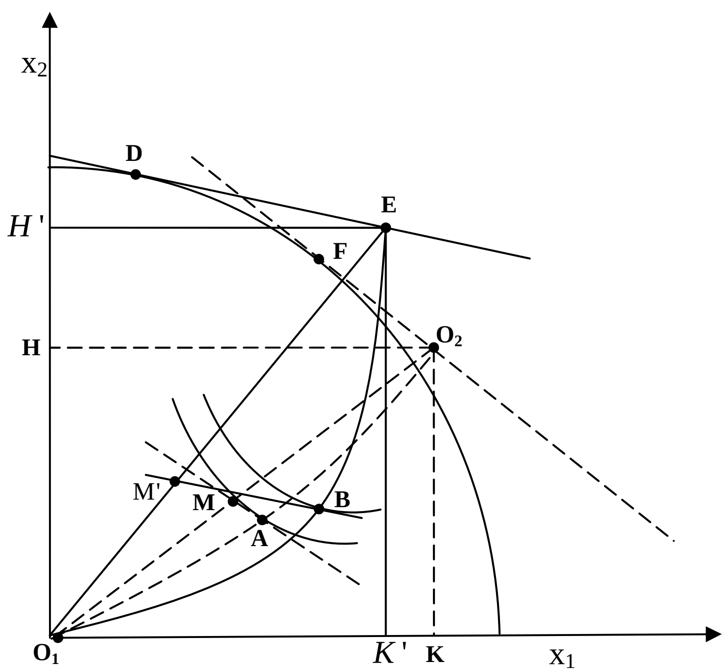

Figure 2