

INEQUALITY AND TRADE*

Devashish Mitra[†] Vitor Trindade[‡]
Syracuse University & NBER Syracuse University

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Abstract

We incorporate demand-side considerations in trade in a systematic but straightforward way. We do so by focusing on the role of inequality in the determination of trade flows and patterns. With nonhomothetic preferences, when countries are similar in all respects but asset inequality, we find that trade is driven by specialization in *consumption*, not production. These assumptions allow us to generate some interesting international spillover effects of redistributive policies. We also look at the effects of combining inequality and endowment differences on trade flows, and see that this has implications for “the mystery of the missing trade.” We then study a model of monopolistic competition, and find a novel V-shaped relationship between the ratio of inter-industry to intra-industry trade and a country’s inequality. Finally, we look at how international differences in factor endowments affect this relationship between the ratio of inter- to intra-industry trade and inequality. Our theory formalizes as well as modifies Linder’s conjecture about the relationship between intra-industry trade and the extent of similarity between trading partners.

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[†]Department of Economics, The Maxwell School, Syracuse University, 133 Eggers Hall, Syracuse, NY 13244-1090, Email: dmitra@maxwell.syr.edu

[‡]Department of Economics, The Maxwell School, Syracuse University, 117 Eggers Hall, Syracuse, NY 13244-1090, Email: vmtrinda@maxwell.syr.edu

1 Introduction

International trade thinking has been dominated in the past few decades by supply-side theories, which place their focus squarely on differences in factor endowments or differences in production technologies across countries.¹ This theoretical bias stands in contrast to a number of empirical studies, which find that demand differences also matter for the determination of trade. The reason for the theoretical bias stems, in our view, from the difficulty in saying something *systematic* about how differences in consumption impact trade. For instance, assuming at the very outset differences in tastes across countries may make the analysis trivial, and a formal model redundant.

In this paper, we incorporate demand-side considerations in a systematic but straightforward way, by focusing on the role of inequality in the determination of trade flows and patterns. As we shall see, inequality has intuitive consequences for international trade that provide empirically verifiable hypotheses. Another reason to concentrate on the impact of inequality on trade is its virtual absence from previous theoretical work.

The intuition for our model can be simply explained. When preferences are assumed to be nonhomothetic (in such a way that income expansion paths are actually curved), aggregate demand for each good depends not only on aggregate income, but also on the *distribution* of that income.² But if income distribution is a determinant of aggregate demand, then it must

¹ The few exceptions to this rule only seem to confirm it. See the paper by Markusen (1986), in which he considers nonhomothetic tastes as part of the explanation for the volume of trade, but calls his approach “eclectic.”

² With linear income expansion paths, preferences are nonhomothetic if the expansion paths do not pass through the origin. An example of this case (in which preferences are called quasi-homothetic) can be found in the aforementioned paper by Markusen (1986). The linearity of the income-expansion path excludes a role for income distribution. For our purposes, then, we assume that the income-expansion paths are *strictly* curved.

be a determinant of trade, which is nothing but the excess demand vector for the economy. More specifically, consider a model with two goods: manufactures are a “luxury,” and food is a “necessity,” in the sense that, as consumers become richer, they allocate larger shares of their budgets to manufactures. There are two countries: the East and the West, with the East having a more equitable distribution of income than the West. The two countries are assumed to have the same factor endowments and technology, and therefore their supply schedules are identical. However, the *demand* for food is lower in the West, because the rich are richer in the West and therefore they demand disproportionately less food. When the two countries open to trade, the world price lies between the two autarky prices, which causes the East to import food and to export manufactures.

Note that in this simple inter-industry model we get the exact opposite of the standard reason for trade. Given common world prices and identical technology and endowments, the two countries (assumed for simplicity to be the same size) produce the *same* quantities of food and manufactures. But given their different inequality levels, they consume the two goods in *different* proportions. Therefore, the gains from trade are due to *specialization in consumption*, not in production.

In this paper, by considering the impact of demand on trade, we also revisit some earlier insights from trade theory - while at the same time extending them and making them more precise. We emphasize especially the work of Linder (1961), who used demand-side considerations to explain the large volume of intra-industry trade between developed countries. Linder began by assuming that consumers earning similar incomes have similar demands. If firms respond first to consumers in their own country, firms in each of the developed countries

end up producing goods adapted to the tastes not only of their own consumers, but also of the consumers in *all* other developed countries, thus enhancing intra-industry trade among such countries.

Of course, Krugman (1979), Helpman (1981) and Helpman and Krugman (1985) also offer an explanation for intra-industry trade, and they do rely on demand-side considerations, in that they assume a taste for variety on the part of consumers. However, as Markusen (1986) in his seminal paper points out, Helpman and Krugman's work omits Linder's important intuition that consumers earning similar incomes consume similar baskets of goods. This intuition, which is sometimes called the Linder hypothesis, can only be understood using a model with nonhomothetic preferences, which is precisely the driving assumption in this paper.

The relevance of using nonhomothetic preferences in trade models can only be evaluated in the context of the existing empirical evidence. Thursby and Thursby (1987) find that countries with similar per capita incomes trade more. They explicitly consider the similarity in per capita incomes to be a measure for similarity in tastes, and therefore to be a test variable for Linder's hypothesis. Hunter and Markusen (1988) estimate a linear expenditure system for aggregate demand across thirty four countries and eleven industries and find that tastes deviate from homotheticity in a statistically significant way. Furthermore, Hunter's (1991) counter-factual exercise suggests that net trade volumes would increase by as much as a quarter if tastes were homothetic. In a different approach, Tchamourliyski (2002) extends Anderson and van Wincoop's (2003) model of gravity and trade costs to allow for nonhomothetic tastes, and estimates it for bilateral trade data in 1996. He rejects at any conventional

significance level the hypothesis that tastes are homothetic. None of the aforementioned papers looks for income distribution as a determinant of trade, the empirical support for which has been provided by Francois and Kaplan (1996) and more recently by Dalgin, Mitra and Trindade (2003).³

We begin our analysis in the next section with a simple Heckscher-Ohlin framework. Contrary to standard trade models, which usually assume “disembodied” capital and labor, we explicitly assume an ownership structure for the factors of production. For given factor rewards, this determines an income distribution, which in turn affects the pattern of consumption in the aggregate. Thus, our paper shares Grossman and Maggi’s (2000) concern with the distribution of factor endowments, while being quite different due to our emphasis on the demand-side consequences of such a distribution. It is interesting to note that, in autarky, two countries with the same aggregate endowments but different asset distribution have different product (and therefore factor) prices. With the additional assumption that the necessity (food) is the labor-intensive good,⁴ we find that trade leads to incomplete convergence in income distribution: it reduces inequality in the more unequal country and increases it in the more equal country.

We also obtain what constitutes to us a novel effect in the literature: the international transmission of redistributive policies. Suppose that one of the countries enacts a policy of asset (or income) redistribution from the poor to the rich, thereby increasing the inequality

³ Using Japanese regional data, Davis et al (1997) lend support to the hypothesis of homothetic tastes. However, as they point out, theirs is only a *consistency* test. Their results can alternatively be explained if income distributions and incomes per capita do not vary sufficiently across Japanese regions to “reveal” the nonhomotheticity in tastes.

⁴ This assumption implies that poorer countries specialize in necessities, a finding that is empirically supported by Dalgin, Mitra and Trindade (2003).

within the country. In the standard model this has no impact on world product or factor prices, and therefore has no impact on the distribution of income in the other country. When we recognize the nonhomothetic nature of preferences, however, we see that the redistributive policy, which raises the demand for manufactures, reduces the world wage rate and raises the return on capital, thereby resulting in a more unequal distribution of income *in all countries*.

Although we begin by allowing no differences in factor proportions across countries, we subsequently ask how their introduction affects the results. If both relative endowments and inequality are different across the two countries, it is possible that the predicted volume of trade is smaller than under a model with homothetic tastes. This outcome arises when the capital abundant country is also more unequal and the impact of nonhomotheticity on demand is not large enough to reverse the pattern of trade.⁵

We study in section 3 a model of *intra*-industry trade. This provides a tighter link between nonhomothetic tastes, demand, and Linder's hypothesis. Holding the West's asset inequality constant, and increasing the East's, we show that the volume of intra-industry trade increases, while the ratio of inter-to intra-industry trade decreases, eventually achieving zero when the East is as unequal as the West. If we increase the inequality in the East beyond that in the West, then both the ratio of inter-to intra-industry trade and the volume of inter-industry trade increase. One of the reasons that this result is interesting is that it formalizes, and at the same time amends, Linder's intuition. While Linder argued that there should be more intra-industry trade between similar countries, we find that it is really the proportion of

⁵ A much more complete analysis of the implications of nonhomothetic tastes for the "missing trade" can be found in Chung (2000). Note that he abstracts from distributional considerations by assuming quasi-homothetic preferences. In our paper, the result on missing trade is a by-product of the overall theory of inequality and trade. However, it is important insofar as it lends further support to the use of inequality in trade theory.

intra-industry in overall trade that is high between similar countries, while the measure of similarity should be not only the similarity of incomes per capita, but also the similarity in distribution. We provide further precision to Linder's conjecture by looking simultaneously at the role of international differences in inequality and factor endowments in the determination of inter- versus intra-industry trade.

A few recent theoretical papers incorporate nonhomothetic preferences into their analysis and, as expected, they are similar to our paper in some respects. There are quite a few important differences as well. We already mentioned Markusen (1986) and Chung (2000), both of whom are mainly interested in explaining the volume of trade, the latter in the context of Treffer's (1995) results on the "missing trade." We also discuss the assumption of homotheticity as a possible cause for over-estimating the predicted volume of trade, but we add income distribution and especially focus on it as a possible determinant of the pattern and volume of trade. Income distribution is excluded by the assumption of quasi-homotheticity in both Markusen and Chung. Ramezzana (2002) also studies the impact of per capita income on world trade, but restricts his analysis to the case where there is perfect equality within each country.

A few theoretical contributions have explored, just as we do here, the link between non-homothetic preferences, income distribution, and aggregate demand. A first strand does so in the context of general equilibrium closed economy models, and is most concerned with the process of industrialization. Examples of this are Murphy, Shleifer and Vishny (1989), and Krishna and Yavas (2001). The second segment deals with open economy models where the income distribution is exogenously given. See for instance Matsuyama's (2000) Ricardian

model. In his framework it is not possible to ask our question of the impact of one country's redistributive policy on another country's distribution. Furthermore, Matsuyama is mainly interested in examining the asymmetric impact of population and productivity growth on the terms of trade between developed and developing countries.⁶

One further difference between our work and all the papers mentioned above is that, to the extent of our knowledge, no other work considers nonhomothetic preferences and asset distribution within a model of monopolistic competition, increasing returns and intra-industry trade.

One additional contribution is that we study the effect of asset inequality on factor prices, both in the presence and in the absence of international trade. Thus, what is really novel in this paper, besides the study of distributional differences as a basis for comparative advantage and trade, is the direct and indirect effects (through the impact on factor prices) of asset inequality on income inequality.

2 A Two by Two Model

A. Production and consumption

There are two goods, food (F) and manufactures (M). There are also two factors of pro-

⁶ Johnson (1959) is another theoretical paper that attempts to capture the impact of inequality on aggregate demand and trade flows. In his model, there are two classes of consumers, namely capitalists and workers, with different marginal propensities to consume any given good, the difference in propensities not being formally modeled. Under these conditions, trade impacts aggregate demand through its impact on factor rewards, which in turn affect the relative weights given to the tastes of the two groups in deriving national demand. Johnson argues that a country's offer curve may as a consequence have backward bending portions, giving rise to possible multiplicity and/or instability of equilibria. Our paper goes beyond Johnson's work in several dimensions: we model the importance of distribution based specifically on nonhomothetic tastes; in the context of the perfectly competitive model (the only one that Johnson studied), we apply the model to missing trade, to the international transmission of redistributive policies, and to the comparative statics of changing the degree of asset inequality (fixed in Johnson); most importantly, we also examine a model with imperfect competition.

duction, capital and labor. In this section, we assume that the production functions for food and manufactures exhibit constant returns to scale. We further assume that manufactures are the capital intensive good and that there are no factor intensity reversals.

Since these are the assumptions of the standard 2x2 model, it is not surprising that we reproduce the results from that model. In particular, we will be interested in how factor prices change with goods prices. We begin with the zero-profit conditions:

$$p_F = c_F(w, r), \quad p_M = c_M(w, r), \quad (1)$$

where c_F and c_M represent the unit costs of food and manufactures, p_F and p_M are their prices, w is the wage, and r is the rental price of capital.

Total differentiation of equation (1), use of Shepard's lemma, and some transformation, yield:⁷

$$\begin{bmatrix} \hat{w} \\ \hat{r} \end{bmatrix} = \frac{1}{|\theta|} \begin{bmatrix} \theta_{MK} & -\theta_{FK} \\ -\theta_{ML} & \theta_{FL} \end{bmatrix} \begin{bmatrix} \hat{p}_F \\ \hat{p}_M \end{bmatrix}, \quad (2)$$

where the caret denotes the usual Jones proportional change (for example: $\hat{w} = \frac{dw}{w}$). Letting K_i and L_i ($i = F, M$) be the amount of capital and labor used in the production of one unit of good i , then $\theta_{iL} \equiv \frac{wL_i}{c_i}$ is the cost share of labor in good i , with an analogous definition for θ_{iK} . In the expression above, $|\theta| = \theta_{FL} - \theta_{ML} = \theta_{MK} - \theta_{FK} > 0$, the last inequality following from the assumption that manufactures are capital-intensive. We now assume that food is the numeraire good (and therefore $\hat{p}_F = 0$). Denoting the price of manufactures by p , for $\hat{p} > 0$, equation (2) implies:

⁷ Here, we follow Feenstra's (2003) textbook.

$$\hat{w} = -\frac{\theta_{FK}}{\theta_{MK} - \theta_{FK}}\hat{p} < 0, \quad \hat{r} = \frac{\theta_{FL}}{\theta_{FL} - \theta_{ML}}\hat{p} > \hat{p}, \quad (3)$$

which is the Stolper-Samuelson effect.

We model any individual j 's consumption of food and manufactures, respectively, in the following way:

$$C_F^j(p, I^j) = [1 - \phi(p, I^j)]I^j, \quad C_M^j(p, I^j) = \frac{\phi(p, I^j) I^j}{p},$$

where I^j is her income and $\phi(p, I^j)$ is the share of income that she spends on manufactures. We model the nonhomotheticity in tastes explicitly by assuming that this share is a function of income. The central case in our analysis will be the one in which the capital-intensive good (manufactures) is also the luxury. That is, we assume that ϕ is an increasing function of I^j . Figure 1 depicts a typical income expansion path, in the case where $\partial\phi/\partial I^j > 0$, for all $I^j > 0$. The reverse case can easily be analyzed without any difficulty.

The economy consists of two groups of people, each of mass one: the rich (\mathcal{R}) and the poor (\mathcal{P}). Both groups possess equal amounts of labor, $\frac{L}{2}$ each, but the shares of \mathcal{R} and \mathcal{P} in the economy's capital stock are σ and $1 - \sigma$ respectively, with $\frac{1}{2} \leq \sigma \leq 1$. Thus asset inequality increases with σ . If $\sigma = \frac{1}{2}$ ($\sigma = 1$), there is perfect asset equality (inequality). Incomes of groups \mathcal{R} and \mathcal{P} are given by:

$$I^{\mathcal{R}} = r\sigma K + \frac{wL}{2}, \quad I^{\mathcal{P}} = r(1 - \sigma)K + \frac{wL}{2}. \quad (4)$$

Total consumption of manufactures can be written as $C_M = C_M^{\mathcal{R}} + C_M^{\mathcal{P}}$, where $C_i^{\mathcal{J}} \equiv C_i(p, I^{\mathcal{J}})$ denotes consumption of good i by group $\mathcal{J} = \mathcal{R}, \mathcal{P}$. Total consumption of food is written as $C_F = C_F^{\mathcal{R}} + C_F^{\mathcal{P}}$.

B. Changes in income caused by changes in price

Given this paper's focus on inequality, a natural question to pose is how the incomes of the rich and of the poor change, as goods prices change. Differentiating equation (4), we obtain:

$$\widehat{I}^{\mathcal{R}} = \eta_K^{\mathcal{R}} \widehat{r} + \eta_L^{\mathcal{R}} \widehat{w},$$

where $\eta_K^{\mathcal{R}} = \frac{r\sigma_K}{I^{\mathcal{R}}}$ is the share of capital income in the total income of the rich, and $\eta_L^{\mathcal{R}} = \frac{wL/2}{I^{\mathcal{R}}}$ is the share of labor income (analogous definitions apply to the poor). Substituting from equation (3), and using $\theta_{FL} = 1 - \theta_{FK}$ and $\eta_K^{\mathcal{R}} + \eta_L^{\mathcal{R}} = 1$ (and repeating the procedure for $I^{\mathcal{P}}$), we get:

$$\widehat{I}^{\mathcal{R}} = \frac{\eta_K^{\mathcal{R}} - \theta_{FK}}{\theta_{MK} - \theta_{FK}} \widehat{p}, \quad \widehat{I}^{\mathcal{P}} = \frac{\eta_K^{\mathcal{P}} - \theta_{FK}}{\theta_{MK} - \theta_{FK}} \widehat{p}. \quad (5)$$

Consider now a shock to prices, such that $\widehat{p} > 0$. The following Lemma shows what happens to the incomes of the two groups.

Lemma 1. *Suppose that $\widehat{p} > 0$. Then there are two cutoff values for σ , defined*

as:

$$\sigma^{\mathcal{R}} = \frac{1}{2} \frac{K_M/L_M}{K/L}, \quad \sigma^{\mathcal{P}} = 1 - \frac{1}{2} \frac{K_F/L_F}{K/L}.$$

The assumption that manufactures is the capital intensive good immediately implies that $\sigma^{\mathcal{R}} > \frac{1}{2}$, $\sigma^{\mathcal{P}} > \frac{1}{2}$. The following implications hold:

(i) $\frac{1}{2} < \sigma < \sigma^{\mathcal{R}} \Rightarrow 0 < \widehat{I}^{\mathcal{R}} < \widehat{p}$.

$$(ii) \sigma^{\mathcal{R}} < \sigma < 1 \Rightarrow 0 < \hat{p} < \hat{I}^{\mathcal{R}}.$$

$$(iii) \frac{1}{2} < \sigma < \sigma^{\mathcal{P}} \Rightarrow 0 < \hat{I}^{\mathcal{P}} < \hat{p}.$$

$$(iv) \sigma^{\mathcal{P}} < \sigma < 1 \Leftrightarrow \hat{I}^{\mathcal{P}} < 0 < \hat{p}.$$

$$(v) \hat{I}^{\mathcal{R}} > \hat{I}^{\mathcal{P}}.$$

Proof. We shall only show the first two conditions, as the remaining ones are analogously proved. First note that equation (5) implies that the condition $\hat{I}^{\mathcal{R}} > 0$ is equivalent to $\eta_K^{\mathcal{R}} > \theta_{FK}$, given that $\theta_{MK} - \theta_{FK} > 0$. After substituting from the definitions of $\eta_K^{\mathcal{R}}$ and θ_{FK} this is equivalent to $\frac{r\sigma K}{r\sigma K + wL/2} > \frac{rK_F}{rK_F + wL_F}$. Further manipulation yields $\sigma KL_F > K_F \frac{L}{2}$, or $\sigma > \frac{1}{2} \frac{K_F/L_F}{K/L}$, which is always true, because (assuming both goods are produced in equilibrium) $\frac{K_F/L_F}{K/L} < 1$ and $\sigma > \frac{1}{2}$. Therefore, $\hat{I}^{\mathcal{R}} > 0$ is true always. The condition $\hat{I}^{\mathcal{R}} > \hat{p}$, in turn, is equivalent to $\eta_K^{\mathcal{R}} > \theta_{MK}$. This yields $\sigma KL_M > K_M \frac{L}{2}$, or $\sigma > \sigma^{\mathcal{R}}$. which completes the proof of conditions (i) and (ii) above.

In words, Lemma 1 says that as inequality increases (σ goes up), the rich become more identified with capital, while the poor become more identified with labor (see equation 4). Therefore a “Stolper-Samuelson-like” result obtains for high levels of inequality: $\hat{I}^{\mathcal{P}} < 0 < \hat{p} < \hat{I}^{\mathcal{R}}$. For lower levels of inequality, the real incomes of both groups measured in food units rise, while they fall when measured in units of manufactures. Thus, a sufficient amount of inequality is required for the two groups to have different preference orderings over goods prices or terms of trade, a conclusion that may have applications for political economy.

C. Closed economy equilibrium

We begin our analysis of the equilibrium in a closed economy by showing two properties of the total consumption of manufactures. First, assume that inequality increases, through a redistribution of assets from the poor to the rich. All else equal, it is intuitive that aggregate demand for manufactures should increase. The rich increase their demand, and the poor decrease it, but the former dominates, because the rich's marginal demand for manufactures is higher than the poor's.

Next, consider an increase in the price of manufactures. Note that, besides the normal substitution and income effects, price impacts consumption in two additional ways: first, through the extra income effect of the income redistribution itself (since I changes with p); and second, through the separate impact of income on consumers' consumption mixes. The first effect is due to our assumption of an ownership structure for the factors of production. The second effect is due to our assumption of nonhomothetic tastes. It can be shown that a sufficient condition for total consumption in manufactures to go down with its price is that these two effects be sufficiently small. In other words, we require that our assumptions do not overturn the standard results from trade theory, but simply add to them. Lemma 2 establishes the two properties of the demand for manufactures.

Lemma 2. *At any given price, total consumption of manufactures increases with an increase in the inequality, that is, $\frac{\partial C_M}{\partial \sigma} > 0$. Furthermore, suppose that the following condition holds: $\frac{p}{\phi} \frac{d\phi}{dp} + \frac{p}{I^{\mathcal{J}}} \frac{dI^{\mathcal{J}}}{dp} < 1$ ($\mathcal{J} = \mathcal{R}, \mathcal{P}$), for any price p and income $I^{\mathcal{J}}$, where $\frac{dI^{\mathcal{J}}}{dp}$ and $\frac{d\phi}{dp}$ ($= \frac{\partial \phi}{\partial p} + \frac{\partial \phi}{\partial I^{\mathcal{J}}} \frac{dI^{\mathcal{J}}}{dp}$) are total derivatives with respect to p . Then, total consumption in manufactures decreases with the price*

of manufactures, that is, $\frac{dC_M}{dp} < 0$.

Proof: We can use Figure 1 to show that $\frac{\partial C_M}{\partial \sigma} > 0$. Note that for both groups ($\mathcal{J} = \mathcal{R}, \mathcal{P}$), as income goes up, relative consumption of manufactures must increase. More formally,

$$\frac{\partial}{\partial I^{\mathcal{J}}} \frac{C_M^{\mathcal{J}}}{C_F^{\mathcal{J}}} = \frac{\partial}{\partial I^{\mathcal{J}}} \left[\frac{\phi(p, I^{\mathcal{J}})}{p(1 - \phi(p, I^{\mathcal{J}}))} \right] > 0,$$

because $\frac{\partial \phi}{\partial I^{\mathcal{J}}} > 0$, by assumption that manufactures are the luxury good. This implies that the income expansion path is convex. We assume that it is strictly convex, as shown in the figure. When σ increases by $\Delta\sigma$, the changes in the incomes of the rich and the poor are: $\Delta I^{\mathcal{R}} = -\Delta I^{\mathcal{P}} = rK\Delta\sigma$. The figure depicts the initial budget constraints for the rich (the solid line marked $I^{\mathcal{R}}$) and for the poor (the solid line marked $I^{\mathcal{P}}$). The dashed lines are the budget constraints after the increase in σ . It is then geometrically obvious that $\Delta C_M^{\mathcal{R}} + \Delta C_M^{\mathcal{P}} > 0$, therefore $\frac{\partial C_M}{\partial \sigma} > 0$. This leaves out the possibility of an income expansion path that is not strictly convex, that is, that has some linear sections. In that case, all that we need to assume is that the budget lines of the rich and the poor cross *different* linear sections of the income expansion path, and the result follows.⁸

Suppose now that the sufficient condition holds. It is straightforward to show that

it implies $d \left(\frac{\phi(p, I^{\mathcal{J}}) I^{\mathcal{J}}}{p} \right) / dp < 0$, for any income and price, thereby guaranteeing

⁸ The case of quasi-homothetic preferences that dominates the previous literature happens for example if there is a minimum subsistence level of food, with Cobb-Douglas preferences above that minimum. Consumers have consumption expansion paths with the shape of “launching ramps”: horizontal from the origin, thereafter a straight line at some slope up. If all consumers are in the inclined portion, a small income redistribution does not change aggregate consumption, and inequality does not play a role. We exclude such a possibility here.

that an increase in price makes *all* consumers decrease their consumption of manufactures. Thus aggregate consumption goes down.⁹

The sufficient condition in lemma 2 *can* be violated, if the effects studied in this model are “too” strong, a theoretical possibility on which we do not focus.¹⁰

Figure 2 depicts the markets for manufactures in two countries: the East and the West. The East has a more equal asset distribution than the West ($\sigma^E < \sigma^W$), the two countries being otherwise identical. The curve labeled C_W (Y_W) represents total demand (supply) for manufactures in the West, with analogous curves for the East.¹¹

The two countries have identical factor endowments, therefore, if there is trade, it cannot be due to Heckscher-Ohlin effects. In particular, the two supply curves are identical. The C_W curves take into account both the direct effect of a change in p on consumption, as well as the impact of p on nominal income. From now on we assume the sufficient condition of lemma 2, and draw the demand curves as downward sloping.

Since $\frac{dC_M}{d\sigma} > 0$, the demand curve for the East lies below that of the West. In autarky,

⁹ The relationship between consumption of manufactures (and food) and the distribution of either assets or income is not specific to our simple modeling of inequality. For example, our model generalizes to a uniform discrete distribution of assets, and therefore of income. In such a case, arrange the N individuals in an economy in ascending order of their incomes. We can increase inequality (holding the mean and therefore aggregate income constant) by redistributing equal amounts from individual 1 to individual N , 2 to $N - 1$, 3 to $N - 2$ and so on. Given the assumed curvature of the income expansion path, as described above, we obtain the same relationship between consumption of manufactures and inequality as in lemma 2.

¹⁰ Assume utility $U = (F - F_0)^\beta M^{1-\beta}$. It is Cobb-Douglas, except for the minimum subsistence level F_0 in food. Assume that $I^R > F_0 > I^P$, so that the poor consume only food. The demand functions for the rich are: $F - F_0 = \beta (I^R - F_0)$ and $M = (1 - \beta) (I^R - F_0) / p$. Therefore, $\phi = (1 - \beta) (1 - F_0 / I^R)$ and $(p/\phi) d\phi/dp + (p/I^R) dI^R/dp = (\hat{I}^R / \hat{p}) I^R / (I^R - F_0)$. Suppose that $\sigma^R < \sigma < 1$. Lemma 1 implies that $(\hat{I}^R / \hat{p}) I^R / (I^R - F_0) > 1$ (which violates our sufficient condition), meaning that the rich increase their demand of manufactures as p increases. Since the poor cannot decrease their consumption of manufactures below zero, this implies that aggregate consumption of manufactures goes up with price.

¹¹ C_W is the same as C_M , but for one country (the West) only. To avoid clutter, we omit the subscript M , but do write the subscripts W and E to denote the West and the East, respectively.

therefore, $p_W > p_E$ and $C_W > C_E$. Since r increases and w decreases with p (see equation 3), we have $w_W < w_E$ and $r_W > r_E$. In other words, the wage is higher in the more equal country, while the rental price is higher in the more unequal country. If we think of capital to be human capital, then a more unequal asset distribution leads to a higher ratio of skilled to unskilled wages, i.e., to higher wage inequality.

Let us define *income inequality*, σ_I , as the share of the income of the rich in total income:

$\sigma_I = \frac{r\sigma K + w(L/2)}{rK + wL}$.¹² It is easy to see that:

$$\frac{d\sigma_I}{d\sigma} = \frac{rK}{rK + wL} + \left[\frac{\partial\sigma_I}{\partial w} \begin{matrix} w'(p) \\ (-) \end{matrix} + \frac{\partial\sigma_I}{\partial r} \begin{matrix} r'(p) \\ (+) \end{matrix} \right] \frac{dp}{d\sigma} > 0.$$

The first term, $\frac{rK}{rK + wL}$, is the standard effect of an increase in asset inequality on income inequality, which is also present under homothetic preferences. The second term is a consequence of nonhomotheticity, and it represents the additional adverse effect on income inequality of the increase in the rental price and the reduction in wages, when asset inequality goes up.¹³ Thus, we have the following proposition:

Proposition 1 *With nonhomothetic preferences, if the luxury good is capital intensive, the autarky wage rate decreases with asset inequality, while the rental price increases. This implies that the effect of an increase in asset inequality on income inequality is magnified by the change in the relative factor rewards.*

D. Open economy equilibrium

Suppose now that the two countries open up to free trade in goods. In figure 2, define the curve Y as the *average supply* (that is, $Y = \frac{Y_W + Y_E}{2}$) and curve C as the average demand

¹² This measure relates in a monotonic way to more conventional measures of inequality. For example, it is straightforward to show that the Gini index equals $\sigma_I - 1/2$, and that the ratio of the incomes of the top income quintile to the bottom income quintile equals $\sigma_I/(1 - \sigma_I)$.

¹³ The inequalities $\frac{\partial\sigma_I}{\partial r} \geq 0$ and $\frac{\partial\sigma_I}{\partial w} \leq 0$ can be seen by writing $\sigma_I = \frac{1}{2} + \frac{\sigma - 1/2}{1 + wL/rK}$, and by recalling that $\sigma \geq 1/2$.

($C = \frac{C_W + C_E}{2}$). Since the the two countries' supply curves coincide, they coincide with the average supply. Free trade price and quantity are given by the intersection of the world average supply with the world average demand: p_{FT} and C_{FT} .¹⁴ After opening up to trade, manufactures become cheaper in the more unequal country (the West), and more expensive in the more equal country (the East). At the common world price p_{FT} , the West exports the labor intensive good (food) and imports the capital intensive good (manufactures). Thus, the West becomes a net importer of capital services and a net exporter of labor services. Moreover, since the wage rate decreases and the rental rate increases with the relative price of manufactures, the wage rate rises (falls), while the rental rate falls (rises), in the West (East) to converge to common world levels. Income inequality goes down in the more unequal country and rises in the more equal country. Thus, there is convergence in income inequality, although it is only partial, since asset inequality differs across the two countries. This gives us the following proposition:

Proposition 2 *With nonhomothetic preferences, if the luxury good is capital intensive, free trade between two countries that differ only in their asset inequality results in an increase (decrease) in the wage rate, a reduction (increase) in the rental and a reduction (increase) in income inequality in the more (less) unequal country. The more (less) unequal country is an importer of the luxury good (necessity) and a net importer of capital (labor) services.*

Again, we emphasize that the *only* reason to trade (and for there to be gains from trade) is the difference in the asset inequalities of the two countries, since everything else (factor endowments, technology, and tastes) is the same.

¹⁴ Equilibrium in the market for manufactures insures equilibrium in the market for food, through Walras' law and the fact that all prices are strictly positive.

E. Transmission of inequality under free trade

Suppose that one of the two countries implements a redistributive tax policy. For instance, a tax cut that effectively redistributes income from the poor to the rich will shift that country's (and therefore the world's) C curve to the right. p_{FT} goes up and so w falls and r rises. Therefore, income inequality rises in the whole world, while in the country with the tax cut it rises more than what it would in the presence of constant factor prices (as would be the case under homothetic preferences). Similarly, an exogenous increase in asset inequality in one country will increase income inequality in both countries. Thus income inequality in the two countries is positively correlated.

We see then that fiscal policy can have an impact on trade patterns and can have terms of trade effects, something that is clearly absent under homothetic preferences. This leads to the interesting conclusion that fiscal policy can be a way of protecting one of the two industries. We summarize this discussion in the following proposition.

Proposition 3 *With nonhomothetic preferences, if the luxury good is capital intensive, free trade between two countries results in the international transmission of shocks to income inequality that happen through changes in asset inequality in one country.*

F. Different factor proportions

The focus so far has been on the impact of income inequality on trade, abstracting from supply determinants of comparative advantage. Thus, we defined a generalized comparative advantage, determined by differences in income distribution.

However, it turns out to be instructive to consider the interaction between our model and the standard Heckscher-Ohlin model. To that purpose, we now assume that the two countries have different factor proportions. As we shall see, we obtain surprising results,

with a bearing on factor content studies. In particular, the next proposition shows that an economist that does not take demand effects into account must make one of two possible mistakes: either she will get the direction of trade wrong; or she will over- or under-predict the volume of trade, leading her in the first case to conclude that there is “missing trade.”

Proposition 4 *When the difference in demand due to nonhomothetic tastes is not taken into account, and the world average demand (in terms of expenditure share) is assumed to be each country’s demand schedule, then:*

I. If the more unequal country is the capital abundant country (the “Northern” case), either of two errors will occur:

- (i) The predicted direction of trade is the reverse of the actual direction of trade.*
- (ii) The predicted volume of trade is larger than the actual volume of trade.*

II. If the more unequal country is also the labor abundant country (the “Southern” case), the following error will occur, if the difference in per-capita incomes between the two countries is sufficiently small:

- (iii) The predicted volume of trade is smaller than the actual volume of trade.¹⁵*

Figure 3 illustrates what we call the “Northern” case of proposition 4, in which the more unequal country (the West) is also the capital abundant country (compare, say, the US with Europe).¹⁶ Here, we draw the supply and demand curves in terms of GDP shares. In other words, while the demand curve shows the share in GDP of consumption expenditure on manufactures (and is denoted by s_i^C , $i = E, W$), the supply curve shows the share of manufacture output in overall GDP (and is denoted by s_i^P , $i = E, W$). Note that the s_W^C must lie to the right of s_E^C : the West’s share of consumption in manufactures must be higher, given its higher inequality and higher GDP per capita. Given that the West is more capital abundant, its production of manufactures as a share (s_W^P) of its GDP must also lie to the

¹⁵ *The reason why this “case of excessive trade” is not quite as well-known as its cousin, the “case of the missing trade,” may have to do with the fact that labor abundant countries that are very unequal tend to be less developed countries, and they trade relatively little.*

¹⁶ Note that in this section we allow for differences in the sizes of the overall population of the two countries and assume aggregate capital and labor endowments in two countries to be such that the West is more capital-abundant and has a higher per-capita GDP than the East.

right of the East's (s_E^P).

Consider panel 3a. The world value of the output of manufactures as a share of world GDP is s^P . It is a GDP-weighted average of s_W^P and s_E^P and so lies between the two. We denote the world price by P_{FT} , as before. Given the world price, the volumes and directions of trade are uniquely determined (shown as $t_W GDP_W/p = -t_E GDP_E/p$).¹⁷ Note also that the GDP of each country, given its factor endowments, is only a function of the world relative price of manufactures. To show the direction of trade, each vector points from production to consumption, such that a vector pointing to the right indicates imports. Compare the direction of trade with a prediction based on homothetic tastes. An empiricist who assumes homothetic preferences constrains the world and country-specific expenditure shares on manufactures to be identical when countries face the same world price. This is precisely what factor content studies do: they assume that all countries' consumption levels of each good are proportional to world consumption (the constant of proportionality being the ratio of country GDP to world GDP) and predict trade based solely on differences in factor endowments. But if that is the case, our empiricist would assume curve s^C for both countries' shares of consumption in manufactures. Thus, she would predict a reverse pattern of trade (shown as $\tau_W GDP_W/p = -\tau_E GDP_E/p$, where Greek letters will denote the predictions based on homothetic tastes), thereby committing error (i). Note that we are assuming that the empiricist can only observe the current level of world production of each of the two goods (assumed to be equal to world consumption) and the current world price.

In sum, when the difference in the supply schedules of the two countries is minimal,

¹⁷ Note that the formula above clearly means that, generally, t_W will not equal t_E (and τ_W and τ_E , defined later, will not equal each other) in absolute value unless the two countries have the same aggregate GDP.

predicating the pattern of trade on supply alone leads to a wrong ranking of the autarky prices of the two countries, and thus to the wrong direction of trade. The true autarky prices are marked p_W and p_E , for the West and the East respectively, while the prices based on homothetic tastes are marked π_W and π_E , respectively.

The opposite situation is considered in panel 3b, where the difference in the two countries' supplies dominates the difference in demand. Here, the correct ranking of the autarky prices obtains. However, the reader can easily convince himself that forcing each country's demand schedule to coincide with the world demand (in terms of GDP shares) will *always* result in an overestimate of the volume of trade: thus, while t_W and t_E point in the same direction as τ_W and τ_E , it must be that $|\tau_W| > |t_W|$ and $|\tau_E| > |t_E|$. Therefore, a researcher would in this case avoid error (i) only at the cost of incurring error (ii).

Similarly, we can analyze error (iii) in case (II) mentioned in proposition 4 above.

3 A Model with Inter- and Intra-Industry Trade

A. Model set-up and autarkic equilibrium

We now modify the model from the previous section to introduce monopolistic competition, product differentiation and increasing returns to scale. As we shall see, this will provide precision to Linder's hypothesis about the link between demand similarities and intra-industry trade.

We assume that, within the manufacturing sector, a number of varieties are produced and consumers exhibit a "love for variety." More specifically, an individual's utility function is written in the form: $U \left(\left(\sum_{i=1}^n (d_{Mi})^{\frac{\varepsilon-1}{\varepsilon}} \right)^{\frac{\varepsilon}{\varepsilon-1}}, d_F \right)$, where d_{Mi} stands for the individual's consumption of the i th variety of manufactures; n is the number of varieties consumed; ε

is the elasticity of substitution between different varieties; and d_F is consumption of food. Here the sub-utility function pertaining to manufactures, $\left(\sum_{i=1}^n (d_{Mi})^{\frac{\epsilon-1}{\epsilon}}\right)^{\frac{\epsilon}{\epsilon-1}}$ is of the Dixit-Spence-Stiglitz form.

As before, we specify that the individual's budget share of manufactures is an increasing function of income. However, we now write a group's (rich or poor) expenditure on manufactures as share of income as $\phi(P, I^J)$, where the "price index" P is defined as $P = \left(\sum_{i=1}^n p_i^{1-\epsilon}\right)^{\frac{1}{1-\epsilon}}$, p_i being the price of variety i .¹⁸

Let $\mu_M(w, r)$ denote the marginal cost of producing any variety of manufactures. We assume that there is a fixed cost with the same capital intensity as the marginal cost and can thus be denoted by $\alpha\mu_M(w, r)$, for some $\alpha > 0$.¹⁹ We shall as before assume that manufactures are the capital intensive good, and that there are no factor intensity reversals.

From now on, we use the symmetry among varieties to assume the equilibrium result that all varieties have the same price and are produced in identical quantities. The total cost of producing a representative variety equals $\alpha\mu_M(w, r) + \mu_M(w, r)x_M$, where x_M is output. Thus the average cost is given by

$$c_M(w, r, x_M) = \frac{\alpha\mu_M(w, r)}{x_M} + \mu_M(w, r).$$

As before, we denote the average cost of food by $c_F(w, r)$.

¹⁸ That ϕ is a function of the price index only (and not separately of the price of each variety) can be seen from a two-stage optimization. It is a standard result that a consumer with second-stage budget ϕI for manufactures consumes $d_{Mi} = (p_i^{-\epsilon} / \sum_{i=1}^n (p_i)^{1-\epsilon}) \phi I$ of variety i . Introducing these demands into the utility function, yields, after some transformation, $U = U(\phi I/P, (1-\phi)I)$. It is apparent that, when optimizing this indirect utility for ϕ in the first stage, the consumer obtains a solution that is a function of P and I only.

¹⁹ Equivalently, as in Ethier (1982), we could think of this as a two-step technology: first, "factor bundles" are produced using capital and labor with a constant-returns-to-scale technology; second, the factor bundles are used to produce output in a linear fashion. In this version, $\mu_M(w, r)$ is the cost of the marginal factor bundle input. Furthermore, the technology specifies that α times this marginal factor bundle input is used up at the beginning of production, resulting in the fixed cost $\alpha\mu_M(w, r)$. In other words, output is linear in factor bundles, with a positive horizontal intercept and a positive slope.

Profit maximization equates marginal revenue to marginal cost:

$$p \left[1 - \frac{1}{\varepsilon} \right] = \mu_M(w, r),$$

where p stands for the price of a representative variety, and we use the well-known approximation (exact in the limit of infinite varieties) that the elasticity of substitution between varieties (ε) is the elasticity of demand for each one.²⁰

Free entry in manufactures implies that price equals average cost:

$$p = c_M(w, r, x_M). \tag{6}$$

The last three equations imply:

$$\left[1 - \frac{1}{\varepsilon} \right] = \left[\frac{\alpha}{x_M} + 1 \right]^{-1},$$

which in turn gives us:

$$x_M^* = (\varepsilon - 1)\alpha.$$

Thus, the equilibrium output of each variety is completely determined by the parameters ε and α .

There is also a zero-profit condition for food:

$$c_F(w, r) = 1. \tag{7}$$

Note that the zero profit equations (6) and (7) essentially reproduce their counterparts in the previous section (equation 1). In particular, the dependence of equation (6) on x_M can be ignored, since x_M is fixed by the parameters of the model. We can therefore recover

²⁰ This approximation holds in our setting as well due to the separability of the utility function in food and manufactures, which in turn allows for two-stage budgeting.

the derivation of the Stolper-Samuelson results from the previous section (equation 3). The crucial step in that derivation was Shepard's lemma, which does not require constant returns to scale.

We can now write the resource constraints for the economy:

$$\frac{L_M(w(p), r(p))}{L} C_M + \frac{L_F(w(p), r(p))}{L} C_F = 1, \tag{8}$$

$$\frac{K_M(w(p), r(p))}{K} C_M + \frac{K_F(w(p), r(p))}{K} C_F = 1,$$

where we recall that L and K denote the economy's labor and capital endowments; L_F , K_F are unit labor and capital inputs in food; while C_i denotes total consumption (and production) of good i . Here, L_M and K_M are the unit factor inputs in the typical variety of manufactures at $x_M = x_M^*$. As we shall see, equation (8) defines a relationship between p and n .

We obtain another relationship between p and n , based on demand. Noting that, in the symmetric case, $P = \frac{p}{n^{\epsilon-1}}$, we can write:

$$D_M(p, n, \sigma) \equiv \frac{\phi\left(\frac{p}{n^{\epsilon-1}}, I^{\mathcal{R}}\right) I^{\mathcal{R}} + \phi\left(\frac{p}{n^{\epsilon-1}}, I^{\mathcal{P}}\right) I^{\mathcal{P}}}{pn} = x_M^*, \tag{9}$$

where the first equality defines $D_M(p, n, \sigma)$, the total demand for one variety of manufactures.

The next lemma establishes under which circumstances equation (8) defines a direct relation, and equation (9) defines an inverse relation, between p and n .

Lemma 3. *Equation (8) defines an increasing relation between p and n . Equa-*

tion (9) defines a decreasing relation between p and n ²¹ if the following two conditions hold for any $I^{\mathcal{J}}$, p and n :

$$(i) \frac{P}{\phi} \frac{d\phi}{dP} + \frac{P}{I^{\mathcal{J}}} \frac{dI^{\mathcal{J}}}{dP} < 1 \text{ (for fixed } n).$$

$$(ii) -\frac{P}{\phi} \frac{\partial \phi}{\partial P} < \varepsilon - 1.$$

Proof: We first show that, given fixed parameters in the model, equation (8) is a relationship only between p and n . Note that the total consumption of manufactures is given by $C_M = \sum_{i=1}^n D_M = n x_M^*$, where x_M^* is fully determined by α and ε . We assume as before that equations (6) and (7) can be inverted to yield w and r as a function of p . Therefore, the only endogenous variables in equation (8) are p , n and C_F . Using (in principle) one of the equations to substitute C_F out, we would get a relationship between p and n . To show that this is an increasing relationship between p and n , we first write the total derivatives of the unit factor inputs with respect to price:

$$\frac{dL_i}{dp} = \frac{\partial L_i}{\partial w} w'(p) + \frac{\partial L_i}{\partial r} r'(p) > 0,$$

$\begin{matrix} (-) & (-) & (+) & (+) \end{matrix}$

$$\frac{dK_i}{dp} = \frac{\partial K_i}{\partial w} w'(p) + \frac{\partial K_i}{\partial r} r'(p) < 0, \quad i = M, F$$

$\begin{matrix} (+) & (-) & (-) & (+) \end{matrix}$

Suppose that p increases in equation (8). This increases the L_i 's and decreases the K_i 's, forcing C_M and C_F to adjust to recover equality. Note that, in the resource constraint for labor (top line), the weight on C_M is a relatively small number, while the weight on C_F is a relatively large number, compared to the

²¹ This is the same condition in Helpman and Krugman (1985) that says that the combinations of p and n are such that the share of food in spending is equal to its share in gross domestic product.

weights on C_M and C_F in the constraint for capital (bottom line). Therefore, the only way to decrease the top line, while increasing the bottom line, is to increase $C_M = n x_M^*$ and decrease C_F .²² Since x_M^* is determined by α and ε , the increase in p leads to an increase in the number of varieties n .

We can analogously see that equation (9) is a relationship only between the two endogenous variables: p and n . Next, we show that condition (i) implies that the middle term decreases with p , at constant n . A sufficient condition is that it does so for any consumer (rich or poor). Rewrite the demand of the rich as $\frac{\phi(P, I^{\mathcal{R}}) I^{\mathcal{R}}}{P n^{\varepsilon/(\varepsilon-1)}}$, and let us increase p without changing n . We need to show that $\frac{\phi(P, I^{\mathcal{R}}) I^{\mathcal{R}}}{P}$ decreases (and analogously for the poor). This is formally analogous to lemma 2, and therefore it is not surprising that the sufficient condition (whose more rigorous proof is straightforward) also looks formally the same, except that it has P instead of p .

Therefore, to establish that equation (9) defines a decreasing relation between p and n , it suffices to prove that the middle term decreases with n , at constant p . Again, it will be sufficient that it does so for any consumer. For the rich, for example, it is sufficient that $\frac{\partial}{\partial n} \left(\phi \left(\frac{p}{n^{1-\varepsilon}}, I^{\mathcal{R}} \right) / n \right) < 0$. It is straightforward to show that this condition is implied by condition (ii).

The intuition for the sufficient conditions in lemma 3 is as follows. First, we expect that

²² For a more analytical proof, it suffices to multiply the top and bottom line of equations (8) by L and K , respectively, then to total differentiate the resulting expressions with respect to p , which after use of Cramer's rule and simplification yields: $(K_M L_F - K_F L_M) dC_M / dp = -C_F L_F dK_F / dp - C_M L_F dK_M / dp + C_F K_F dL_F / dp + C_M K_F dL_M / dp$, which is a positive expression, given how the K_i 's and L_i 's change with p . Since $K_M L_F - K_F L_M > 0$, by virtue of manufactures being the capital-intensive good, $dC_M / dp > 0$.

when the price of manufactures goes up (at fixed n), demand for them goes down. Condition (i) in the lemma ensures this, and it plays a role analogous to the condition in lemma 2.

On the other hand, if the number of varieties increases (at fixed p), we also expect the demand for each variety to decrease, which is guaranteed by condition (ii). It is possible, however, that consumers *increase* their consumption of each variety as n goes up, if the following two conditions hold. First, consumers' response to the decrease in the price index needs to be very strong, that is, $\frac{\partial \phi}{\partial P}$ needs to be negative and large. Note that P decreases as n increases, which by itself makes consumers increase consumption of all varieties combined. Second, the elasticity of substitution between varieties needs to be very small (ε very close to 1), which makes consumers less inclined to substitute away from the original varieties, as n increases. These conditions would tend to generate the unintuitive result that as n goes up, consumers demand more of each variety. They also tend to violate sufficient condition (ii) in the lemma, which therefore is there simply to rule out this unintuitive possibility.

In sum, as before, the sufficient conditions in the previous lemma ensure that the distributional and demand considerations in this paper are not so strong as to overturn the standard results, but simply add to them.

The relationship established by the resource constraints (equation 8) is captured by the R curve in figure 4, while the D curve depicts the relationship based on demand (equation 9). The point of intersection between the R and the D curves gives us the equilibrium p^* and n^* .

An increase in the inequality parameter σ increases demand for manufactures (that is,

the middle term in equation 9) for given p and n .²³ This means that for a given p , a larger n is needed for markets to clear, shifting the D curve to the right (to D'). As a result of this increase in inequality, the equilibrium p^* and n^* are higher, and Stolper-Samuelson effects lead to an increase in the rental price r and a reduction in the wage w , which as in the previous section further worsens income inequality.

B. Trade when countries differ only in inequality

Next, we look at the effect of the integration of two identical economies with the same factor endowments, preferences *and* inequality. This doubles the size of the economy. Both capital and labor are doubled, which in turn implies that for any given p the number of varieties n consistent with full employment of factors is double of its original value (see equation 8, and recall that $C_M = nx_M^*$). Thus, the R curve shifts to the right in such a way that n doubles for any given p . When preferences are homothetic, and more specifically Cobb-Douglas in manufactures and food, the total expenditure on all varieties for a given price of the representative variety does not depend on the number of varieties. In that case, n corresponding to each p on the new D curve would be double of that on the old D curve. However, with nonhomothetic preferences, we can show that the number of varieties n on the new D curve more than doubles.²⁴

We depict in figure 5 the integrated world economy, in which we again allow only inequal-

²³ With fixed p and n , P is fixed, and the expression $\phi(P, I^{\mathcal{J}}) / [p(1 - \phi(P, I^{\mathcal{J}}))]$, which is the ratio of manufactures to food consumption for type $\mathcal{J} = \mathcal{R}, \mathcal{P}$, can only change as $I^{\mathcal{J}}$ changes with σ . We can use the proof of lemma 2 to show that when σ increases, demand for manufactures increases with σ .

²⁴ When we integrate two identical economies, $D_M(p, n, \sigma)$ in equation (9) doubles at fixed p and n , as the numerator now has two extra terms identical to the two terms shown. At fixed p , suppose that n doubles. $D_M(p, n, \sigma)$ goes down, as guaranteed by the proof of lemma 3, but by less than one half. (If the numerator were constant, $D_M(p, n, \sigma)$ would decrease in half. However the numerator does go up with n .) Therefore n must increase by more than double, to bring $D_M(p, n, \sigma)$ further down, and equate it with x_M^* .

ity to differ between the two countries. Because of lower inequality in the East, the East's D curve (labeled D(E)) lies to the left of the West's (labeled D(W)). On the other hand, the two countries' R curves (labeled R(E) and R(W), respectively) are the same. Next we draw the D and R curves for an East with twice the size (labeled 2E) and a West with twice the size (labeled 2W). As discussed above, when we double the size of the economies, the D curves more than double, while the R curves are exactly doubled. The combined D and R curves for the integrated world composed of a West and an East are given by D(W+E), which lies between D(2W) and D(2E), and $R(W+E)=R(2W)=R(2E)$, respectively.

In the figure, the number of varieties n^* more than doubles, compared to the autarky level for the East, while it is less than double for the West. It is easy to see that an increase in asset inequality in any one of the two countries shifts the D(W+E) to the right, thereby increasing p . The rental r increases and w decreases, increasing the overall income inequality in both countries, as in the previous section. The number of varieties produced in both countries goes up.

The West exports a volume $D_M^E n^W$ of manufactures, and imports $D_M^W n^E$. We will let the superscripts denote either country. For example, D_M^E is the total demand for one variety, as defined by equation (9), but from consumers in the East only. n^E is the number of varieties produced in the East. Thus, $n = n^E + n^W$, and $D_M^E + D_M^W = x_M^*$. Taking into account that $n^E = n^W = n/2$ (since the two countries' R curves are the same and both countries face the same price of a representative variety), the total flow of trade in manufactures can therefore be written:

$$Mfg = nx_M^*/2.$$

This increases with the inequality of either country (as n increases both with σ^E and σ^W).

When the West is a net importer of manufactures (which is the case when the West is more unequal but has the same factor endowments as the East), inter-industry trade equals $2(D_M^W n^E - D_M^E n^W)$, in units of M . Again taking into account that in this case $n^E = n^W = n/2$, this equals:

$$Inter = (2D_M^W - x_M^*) n.$$

By assumption, $(2D_M^W - x_M^*) \geq 0$, with the equality sign holding when $\sigma^E = \sigma^W$, since in that case the two countries are identical. In the relevant range $\frac{1}{2} \leq \sigma^E \leq \sigma^W \leq 1$, the volume of inter-industry trade increases with σ^W , since D_M^W and n increase with σ^W .²⁵ The relationship between this volume and σ^E is ambiguous, since while n increases with σ^E , D_M^W decreases.

The volume of intra-industry trade is simply twice the West's exports in manufactures and can thus be written as

$$Intra = D_M^E n.$$

This is the part of trade that is balanced within the manufacturing sector. Clearly, both D_M^E and n increase with σ^E . Therefore, the volume of intra-industry trade increases with the inequality of the less unequal country. With respect to σ^W , D_M^E is decreasing but n is increasing, and therefore the impact of the inequality of the more unequal country on intra-industry trade is ambiguous.

²⁵ Recall that $D_M^W + D_M^E = x_M^*$ where x_M^* is already completely determined by α and ε . When we change σ^W , it is best to check the change in D_M^W indirectly, through the change in D_M^E , since in that case inequality does not change in the East. Thus, we can write $\frac{dD_M^W}{d\sigma^W} = -(\partial D_M^E / \partial p) (dp/d\sigma^W) - (\partial D_M^E / \partial n) (dn/d\sigma^W) > 0$.

In other words, demand for one variety in the East goes down because of higher number of varieties and higher prices, while the increase in σ^W insures that demand in the West goes up.

In spite of the ambiguities noted above for both inter- and intra-industry trade, we find that there is no ambiguity in their ratio, which we write as:

$$Inter/Intra = (2D_M^W - x_M^*) / D_M^E = D_M^W / D_M^E - 1. \quad (10)$$

This is clearly increasing with respect to σ^W and is decreasing with σ^E , assuming $\sigma^E < \sigma^W$.

From this analysis, we can describe trade between any two countries A and B that are identical in all respects other than inequality, with the aid of figure 6. Measuring the inequality of country A along the horizontal axis, and holding B's inequality constant, the volume of intra-industry trade is increasing in σ^A until $\sigma^A = \sigma^B$, beyond which the curve can take any shape. The volume of inter-industry trade reaches a minimum of zero when $\sigma^A = \sigma^B$, and increases once σ^A crosses that point. When $\sigma^A < \sigma^B$, we can argue by continuity that inter-industry trade must decrease with σ^A in the neighborhood of σ^B , but outside that neighborhood it can take any shape, as shown. We also see that the ratio of inter-industry to intra-industry trade (and therefore to total trade) has a V-shaped relationship with inequality, reaching a minimum when the two trading partners have the same inequality. Thus intra-industry trade as a proportion of total trade is high when the trading partners are similar in this respect.

The following proposition summarizes the discussion above.

Proposition 5 *Countries that are the same in all respects, but differ in their levels of asset inequality, engage in both inter- and intra-industry trade when they open up. An increase in any country's asset inequality always leads to an increase in the volume of trade in varieties within the manufacturing sector, and to an increase in the relative price of a representative variety (and thus to an increase in the rental price and a reduction in the wage). Inter-industry trade increases with a country's inequality, as long as it is greater than the partner*

country's inequality; while intra-industry trade increases with a country's inequality, as long as it is less than the partner country's inequality. The ratio of inter-industry to intra-industry trade has a V-shaped relationship with respect to a country's inequality, reaching a minimum of zero when it equals its trading partner's inequality, in which case all trade is intra-industry. Intra-industry trade as a proportion of total trade is high when trading partners are very similar in their asset inequality.

C. Trade when countries differ both in factor endowments and inequality

We now look at trade between two countries that differ from each other both in inequality and factor endowments. We assume the West to be more unequal as well as more capital-abundant than the East. Our expressions for inter- and intra-industry trade now become the following:

$$Inter = 2 |D_M^W n^E - D_M^E n^W|, \quad Intra = 2 \text{Min}[D_M^W n^E, D_M^E n^W].$$

Note that depending on the result of the opposing effects of higher inequality and higher capital abundance, the West can be a net exporter or importer of manufactures and therefore, the ratio of inter- to intra-industry trade in this case is given by

$$\begin{aligned} Inter/Intra &= [(D_M^W n^E)/(D_M^E n^W)] - 1 \text{ when } D_M^W n^E \geq D_M^E n^W \\ &= [(D_M^E n^W)/(D_M^W n^E)] - 1 \text{ when } D_M^W n^E < D_M^E n^W. \end{aligned}$$

It is easy to see, as in the case of identical factor endowments, that D_M^W/D_M^E is increasing with respect to σ^W , and decreasing with σ^E . If we assume that the two countries have the same endowments of labor but the West has more capital than the East, it is straightforward to obtain from the solution to the resource-constraint equations that

$$\frac{n^E}{n^W} = \frac{k^E - k_F(p)}{k^W - k_F(p)} < 1,$$

where $k^i (i = E, W)$ is the ratio of capital to labor endowment in country i . k_F is the capital-labor ratio used in the production of food and it is the same for the two countries, due to the common relative price that they face under free trade. Thus, we have

$$\frac{\partial \left(\frac{n^E}{n^W} \right)}{\partial \sigma^i} = \frac{k_F(p)(k^E - k^W)}{(k^W - k_F(p))^2} \frac{\partial p}{\partial \sigma^i} > 0, \text{ for } i = E, W.$$

In words, an increase of inequality anywhere induces an increase in total number of varieties $n = n^E + n^W$. Since $n^E < n^W$, the proportional increase is larger for n^E .

Thus when the West is a net importer of manufactures, i.e., when $D_M^W n^E \geq D_M^E n^W$, the ratio of inter- to intra-industry trade is clearly increasing in the inequality of the West. However, in this case, the effect with respect to the inequality of the East turns out to be ambiguous. If the effect on relative demand per variety (D_M^W/D_M^E) dominates the effect on the relative output of varieties $\left(\frac{n^E}{n^W} \right)$ in the two countries, we clearly recover the V-shaped curve we saw above. Given that the latter effect is zero in the identical factor endowment case, we should expect by continuity that, for sufficiently small relative endowment differences, the former effect dominates and the V-shaped relationship again obtains. This is confirmed by our simulations described below.

We assume for the simulations a utility function given by $U = \left[\left(\sum_{i=1}^n (d_{Mi})^{\frac{\varepsilon-1}{\varepsilon}} \right)^{\frac{\varepsilon}{\varepsilon-1}} \right]^{1/2} + \log d_F$, where we pick $\varepsilon = 3$. Furthermore, we make $\alpha = 2$ in the cost function for manufactures, that is, the first two units produced are thrown away. The average variable cost is constant and is based on a Cobb-Douglas production with output elasticities with respect to capital and labor equal to 0.8 and 0.2, respectively. Food is produced under constant returns to scale using a Cobb-Douglas production function with output elasticities with respect to labor and capital of 0.5 each. The labor endowments in each country are held at 1000 units

throughout.

As seen in figure 7 (lower left panel), the ratio of inter- to intra- industry trade is again V-shaped with respect to country B's inequality, holding constant the capital stocks of the two countries and inequality in country A (whose values are shown). Increasing country B's capital stock shifts the entire curve to the right. This means that if we concentrate just on the downward sloping branch (or exclusively on the upward sloping branch) of the V, a given value of the *inter/intra* ratio for a higher value of country B's capital stock requires a higher level of B's inequality. This can be seen directly by plotting the *inter/intra* ratio as it changes with K_B at fixed values of σ_B , which is shown on the lower right panel. The relationship is again V-shaped and the entire graph shifts to the right as a result of increases in σ_B .

This positive relationship between K_B and σ_B for given *inter/intra* ratio is shown in the top panel of the figure. It plots the level sets corresponding to a three-dimensional plot of the *inter/intra* ratio with respect to σ_B on the horizontal axis and K_B on the vertical axis. Level sets that are further away from the inequality and capital-endowment combination of country A (σ_A, K_A) show increasing amounts of inter-industry trade. Thus, the three-dimensional plot would be a valley stretching from the Southwest to the Northeast. The intuition behind the upward sloping level sets is simple: while consumption of manufactures relative to food increases with inequality (at a given price), production of manufactures relative to food is positively dependent on capital abundance (also at a given price). Moreover, inter-industry trade is positively related to the divergence between the two and therefore to maintain a constant level of intra-industry trade relative to overall trade, some measure of this divergence

should be maintained. This, in turn, requires that as inequality increases, capital abundance must increase. Finally, note that for each value of the *inter/intra* ratio there are two level sets, one to right of the point representing country A and another to its left. In one case, country A is the net exporter of manufactures and in the other case, it is the net importer.

Another interesting aspect of the simulations, which can be easily seen from figure 7, is that a pair of countries with larger differences in factor endowments can have a smaller ratio of inter-industry to overall trade than a country pair which is more similar in factor endowments than the first. Furthermore, in the extreme case at the bottom of the valley (that is, on the level curve that passes through σ_A, K_A), two countries with different factor endowments do not have any inter-industry trade at all.

4 Implications for Trade Theory and Future Research

We incorporate demand-side considerations into the theory of international trade, by focusing on the role of inequality in the determination of trade flows and patterns. This requires a model with nonhomothetic preferences, and we begin this concluding section by summarizing how the standard 2 x 2 model of international trade is amended when preferences are nonhomothetic.

Inequality as a determinant of trade. When all else is equal (namely factor endowments and technology), countries trade, and gain from trading, if their degrees of inequality are different. We get the exact opposite of the standard reason for trade: the gains from trade are due to specialization in *consumption*, not in production.

Heckscher-Ohlin theorem. When all else is the same, the most equal country exports the luxury, and imports the necessity. If the luxury good is capital-intensive, then the most

equal country exports capital services. When there are differences in factor endowments, differences in inequality (and therefore differences in demand) interact with the standard Heckscher-Ohlin differences in supply, to define a generalized comparative advantage.

International transmission of redistributive policies. The Stolper-Samuelson theorem can be used to prove a new result: a redistributive policy in one country has, through demand effects and their impact on factor prices, an effect in the same direction in the other country.

Missing trade. The interaction between demand-effects (the impact of inequality on comparative advantage) and supply-effects (the impact of factor endowments on comparative advantage) may lead to over- or under-predictions in the volume of trade.

In the second model in this paper, we change the nature of “manufactures” to being differentiated and produced under increasing returns and monopolistic competition. Perhaps the most novel result is the V-shaped relationship between the ratio of inter- to intra-industry trade and a country’s inequality. This ratio reaches a minimum of zero when the two countries’ inequality levels are the same (in which case all trade is intra-industry). Thus we can restate Linder’s proposition more precisely and accurately than Linder himself: *Intra-industry trade as a proportion of total trade is increasing in the similarity of trading countries, with “similarity” defined to include similarity in asset distribution.* We provide further precision to Linder’s conjecture by looking simultaneously at the role of international differences in inequality and factor endowments in the determination of inter- versus intra-industry trade.

We mention briefly some implications of this paper for future research.

First, and most obviously, the assertion that inequality is a determinant of trade is an empirically verifiable hypothesis. Such an empirical application is a project already under

way (see Dalgin, Mitra and Trindade 2003). An additional application would be to check the role of inequality more specifically on inter- versus intra-industry trade.

Second, our results may have a bearing on the trade and wages literature, and specifically on the factor content approach. With the assumption that luxuries are the capital-intensive good, the most unequal country (the West) tends to import capital services. If the factor content of trade were perfectly measured, this would not be a problem. However, one needs to realize that what constitutes an “industry” is always the result of the aggregation of more finely-defined industries. Assume complete specialization among these sub-industries, such that some are exportables, and some are importables, in the West. Because the former tend to be more labor-intensive, when one uses the input-output matrix to estimate the labor input for the *aggregate* industry in the West, one over-estimates the labor content of imports, and under-estimates their capital-content.²⁶ A careful empirical analysis of the impact of international trade on wages that takes demand effects into account - of which the story above is only an example - is still lacking.

Third, a dynamic version of our model may generate interesting results. Take Mani’s (2001) paper, which also uses the working assumptions that tastes are nonhomothetic and necessities are (low-skilled) labor intensive. In her model, an initial high level of inequality reduces the demand for (low-skilled) labor, thereby perpetuating the inequality level. Conversely, an initial lower level of inequality may produce a virtuous cycle that further reduces the inequality. In the context of an open economy model, one result is that one country’s redistributive policies may have a permanent impact on the inequality in its trading partner.

²⁶ An analogous, and more detailed, reasoning may be found in Davis and Weinstein (2001), on which this discussion was inspired.

Furthermore, any changes in factor rewards change the relative incentives for factor accumulation, with potentially important consequences for (standard) comparative advantage, and for the composition of trade.²⁷

Fourth, we already noted, based on the results in lemma 1, that the rich and the poor in one country may have the same or different preference orderings over the terms of trade, depending on the level of inequality. This may have implications for political economy. If, for instance, the preference orderings of the rich and the poor in the West are different, but they are the same in the East, the two countries may have different negotiating power in an international setting.

One last application may be for taxation policy.²⁸ When both capital and labor are taxed, there are two ways to enact a regressive distribution policy. The first is the policy assumed in the main text: a transfer of assets from the poor to the rich, or, equivalently, a transfer of income. The second would be a lower tax on capital, and a higher tax on labor, which impacts the relative income of the rich and the poor through factor rewards. The question then is whether the rich or the poor prefer one or the other mechanism. In the open economy, one could ask the same question of the rich and the poor in the other country.

²⁷ We are grateful to Nuno Limao for these suggestions.

²⁸ We are grateful to Mike Conlin for this idea.

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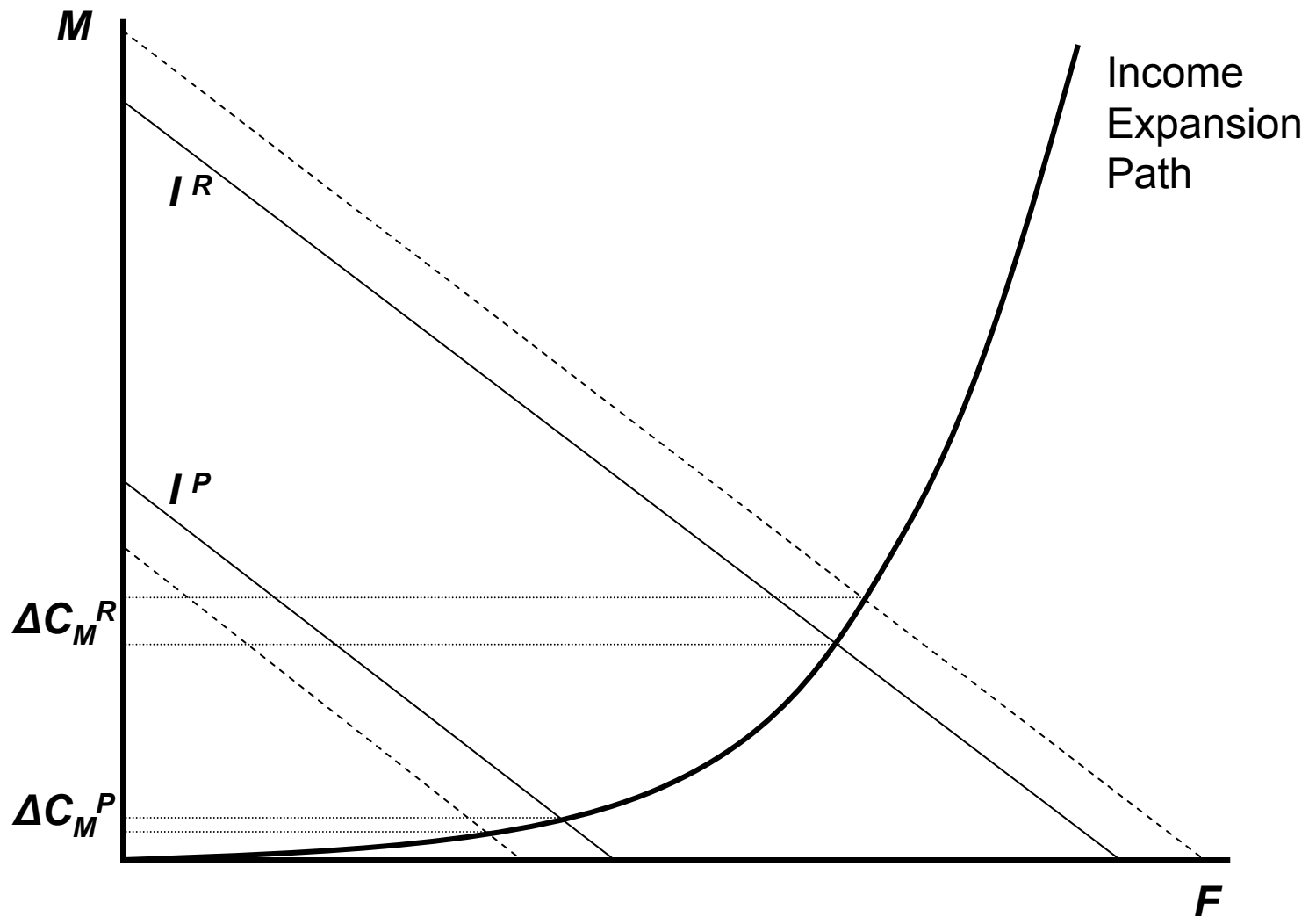


Figure 1

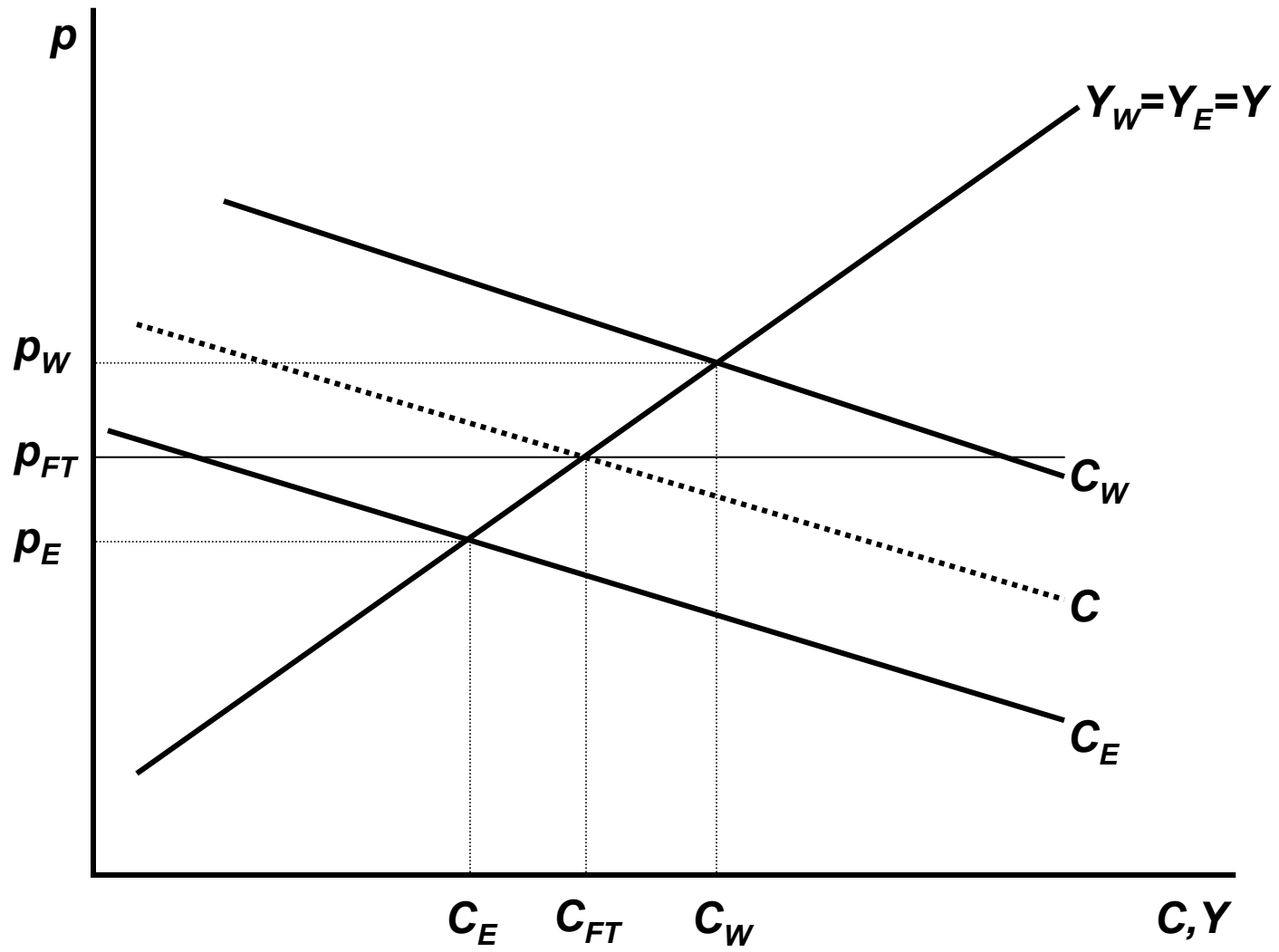


Figure 2

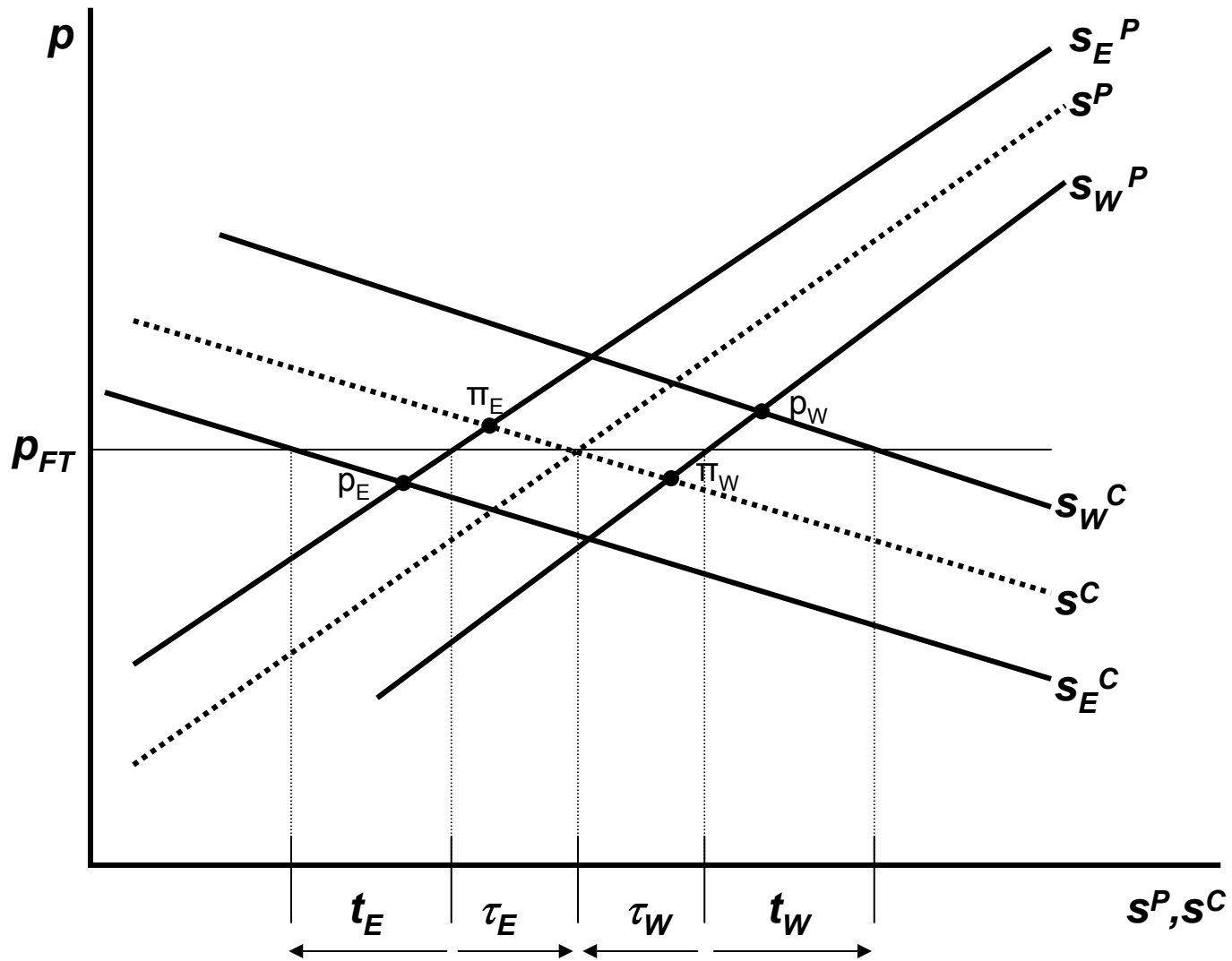


Figure 3a

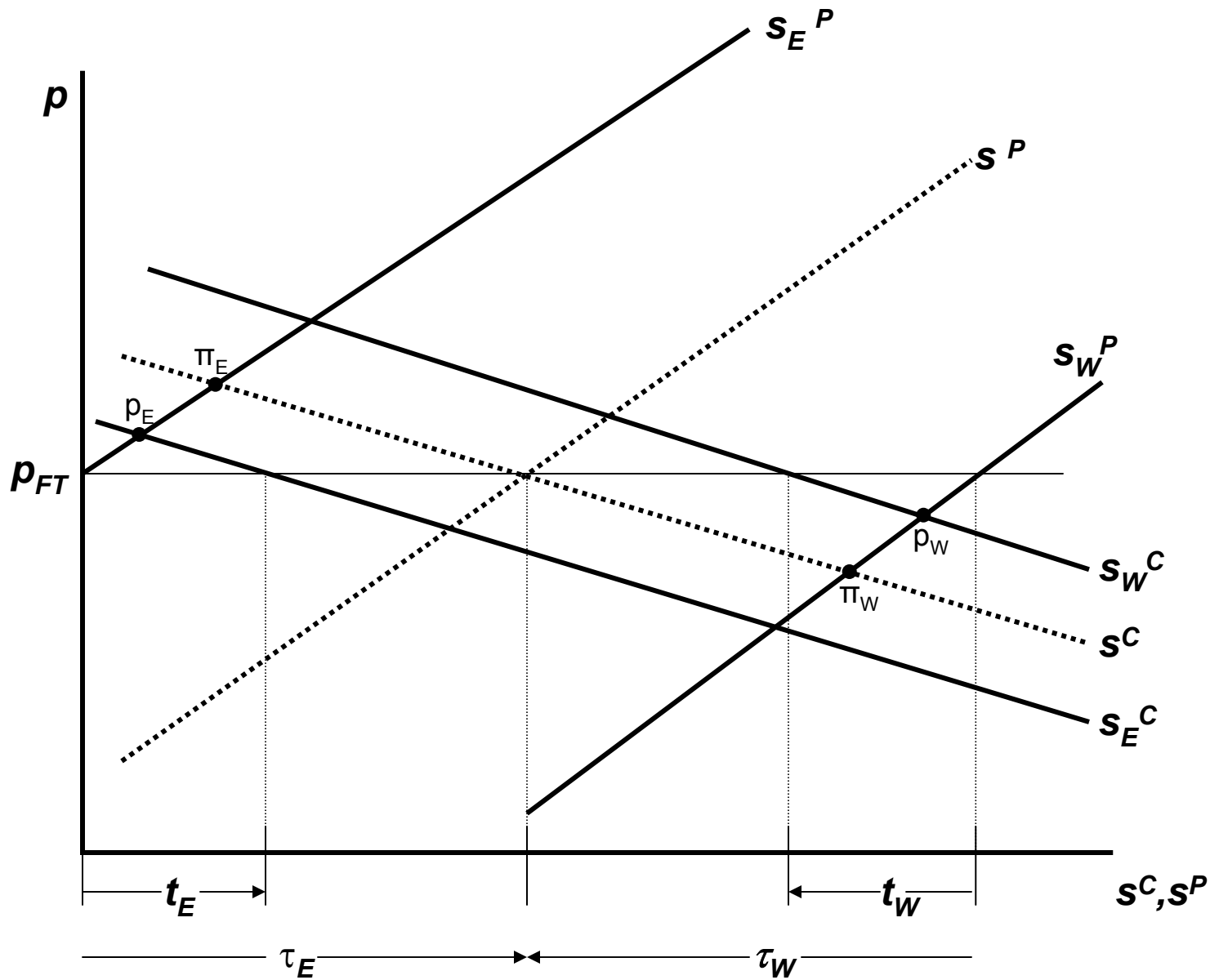


Figure 3b

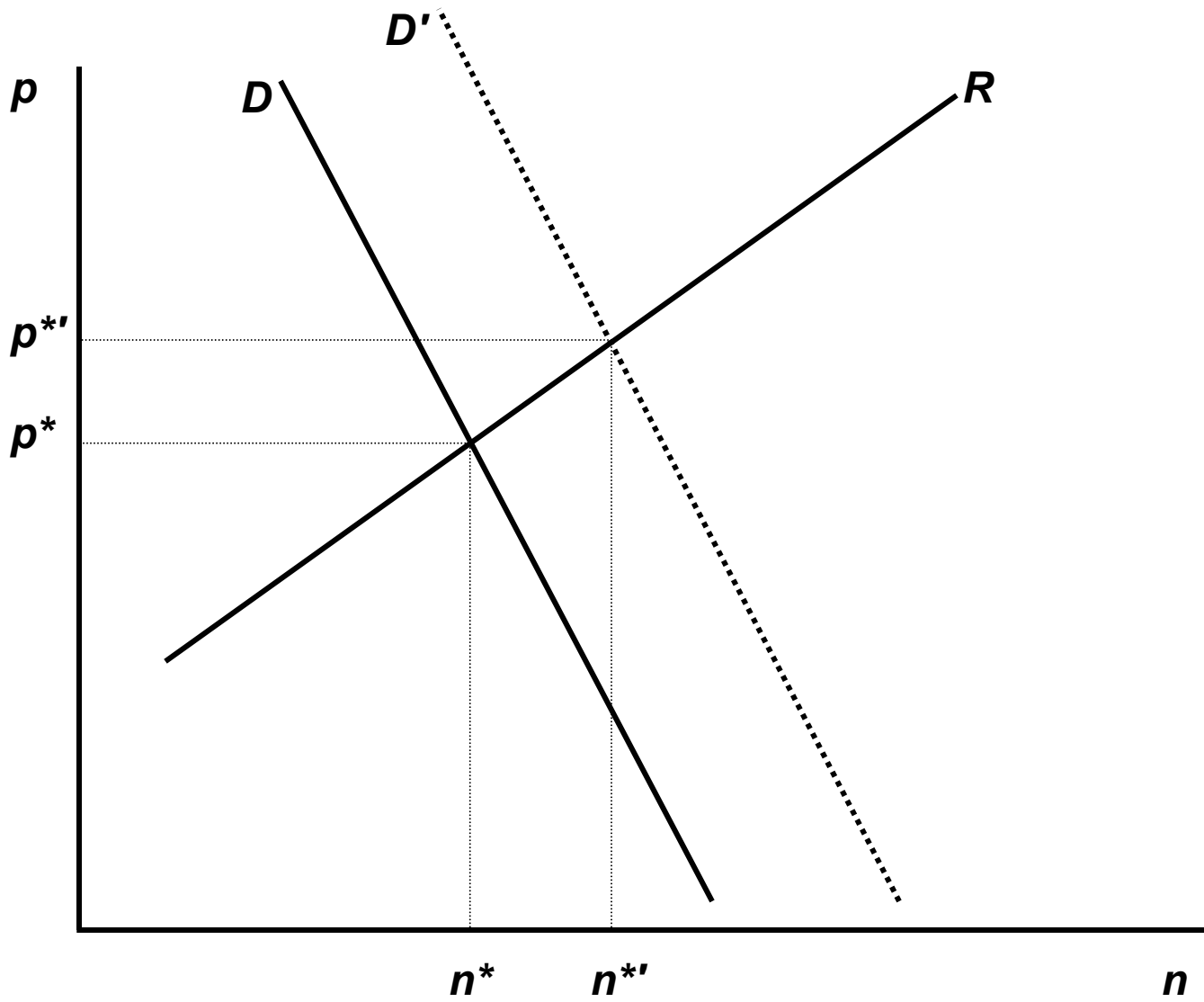


Figure 4

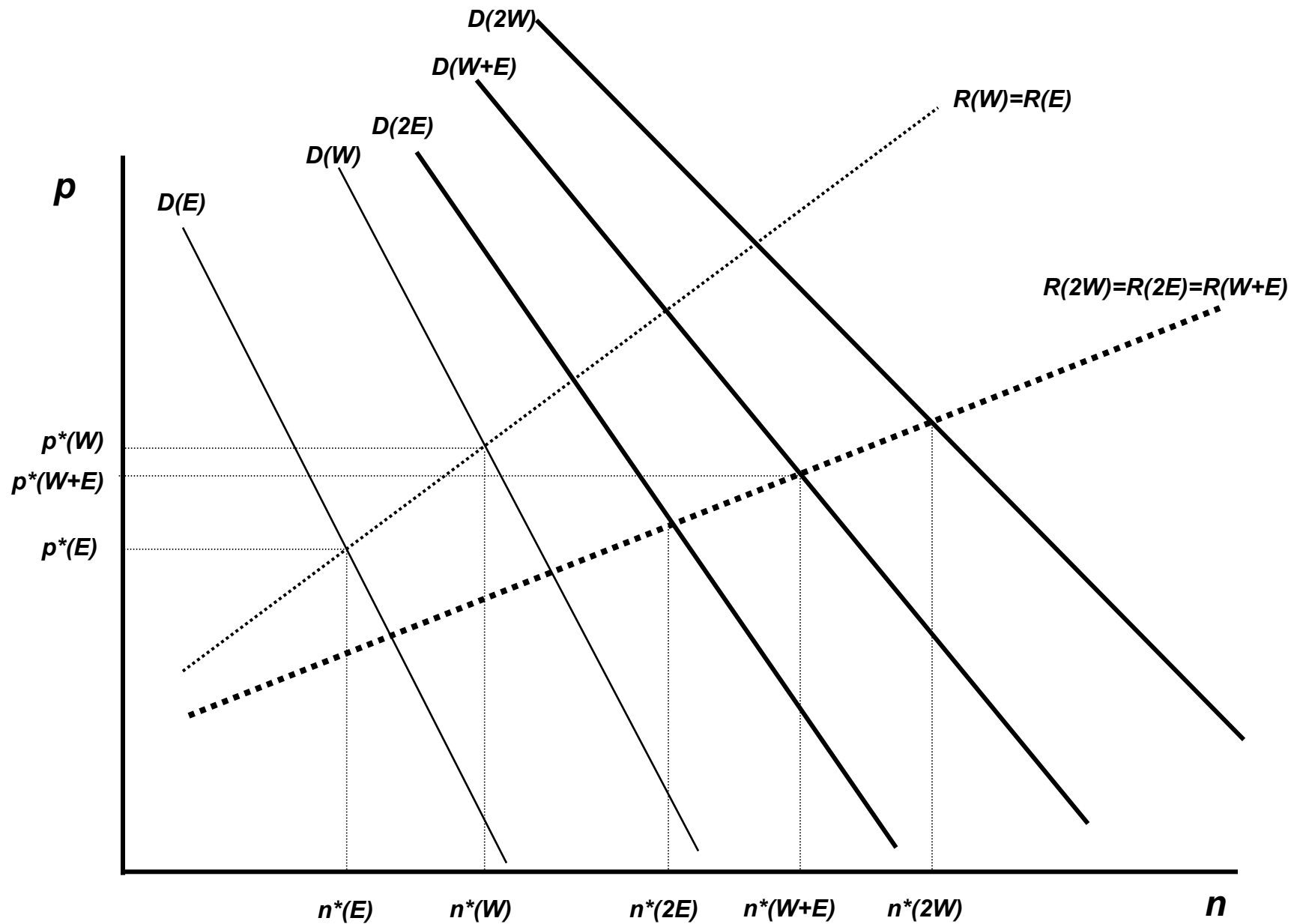


Figure 5

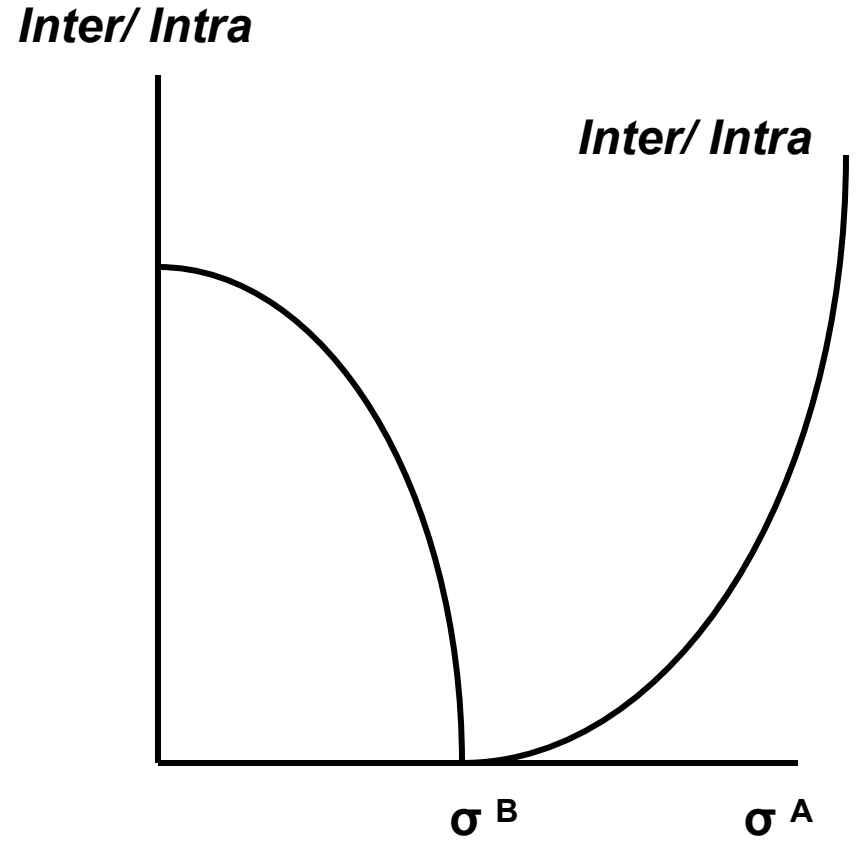
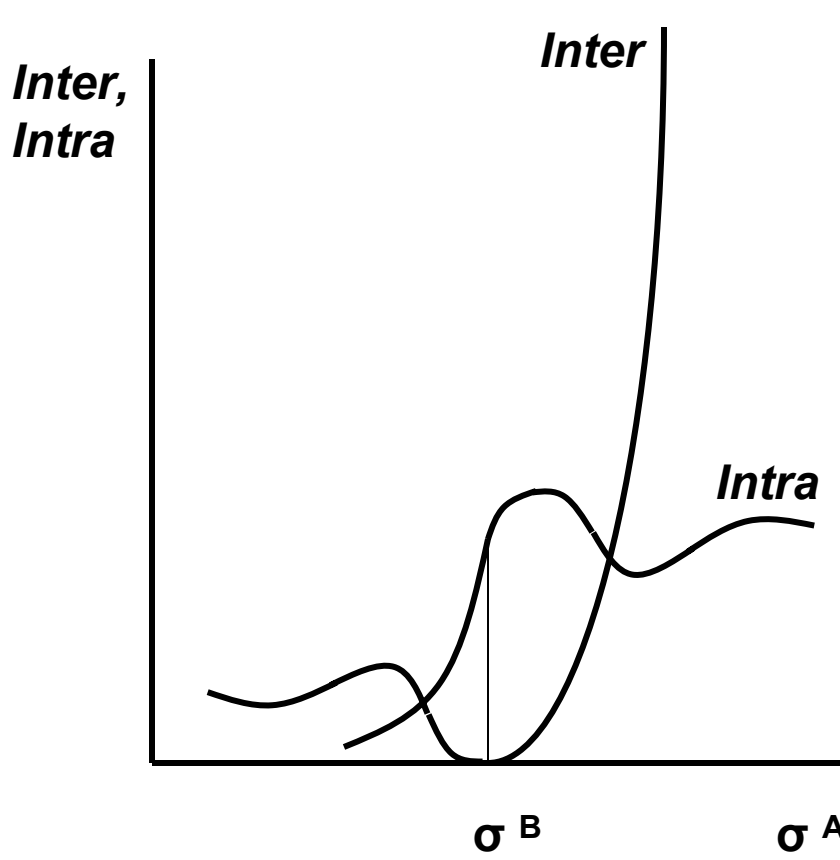


Figure 6

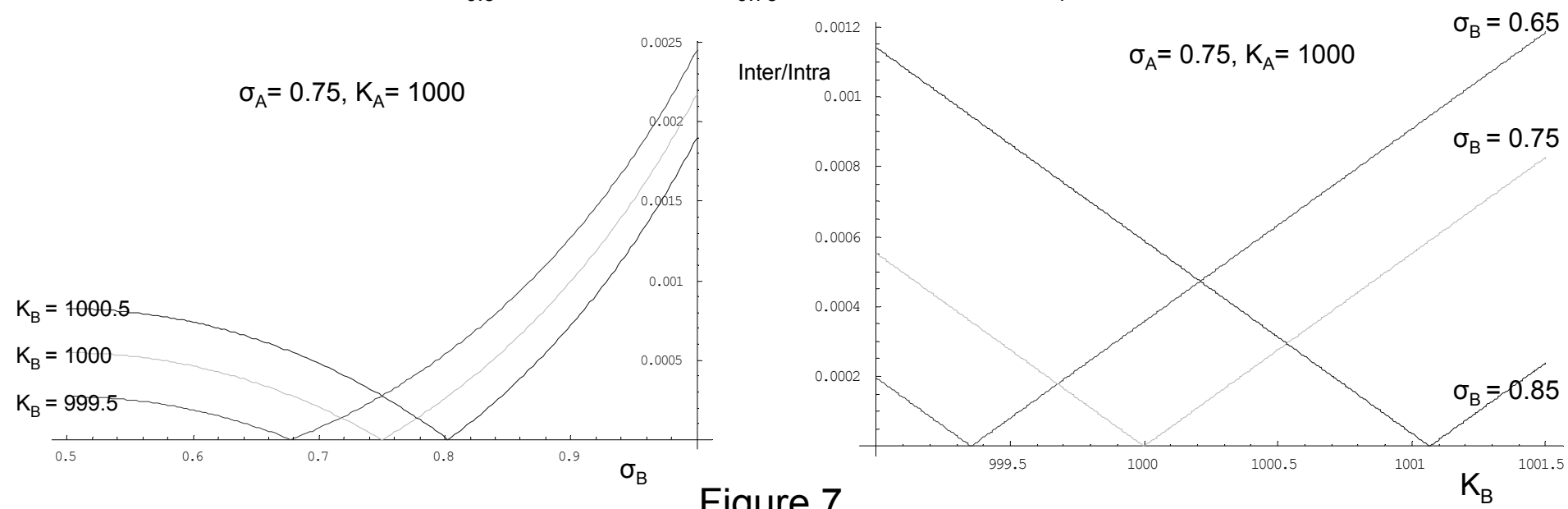
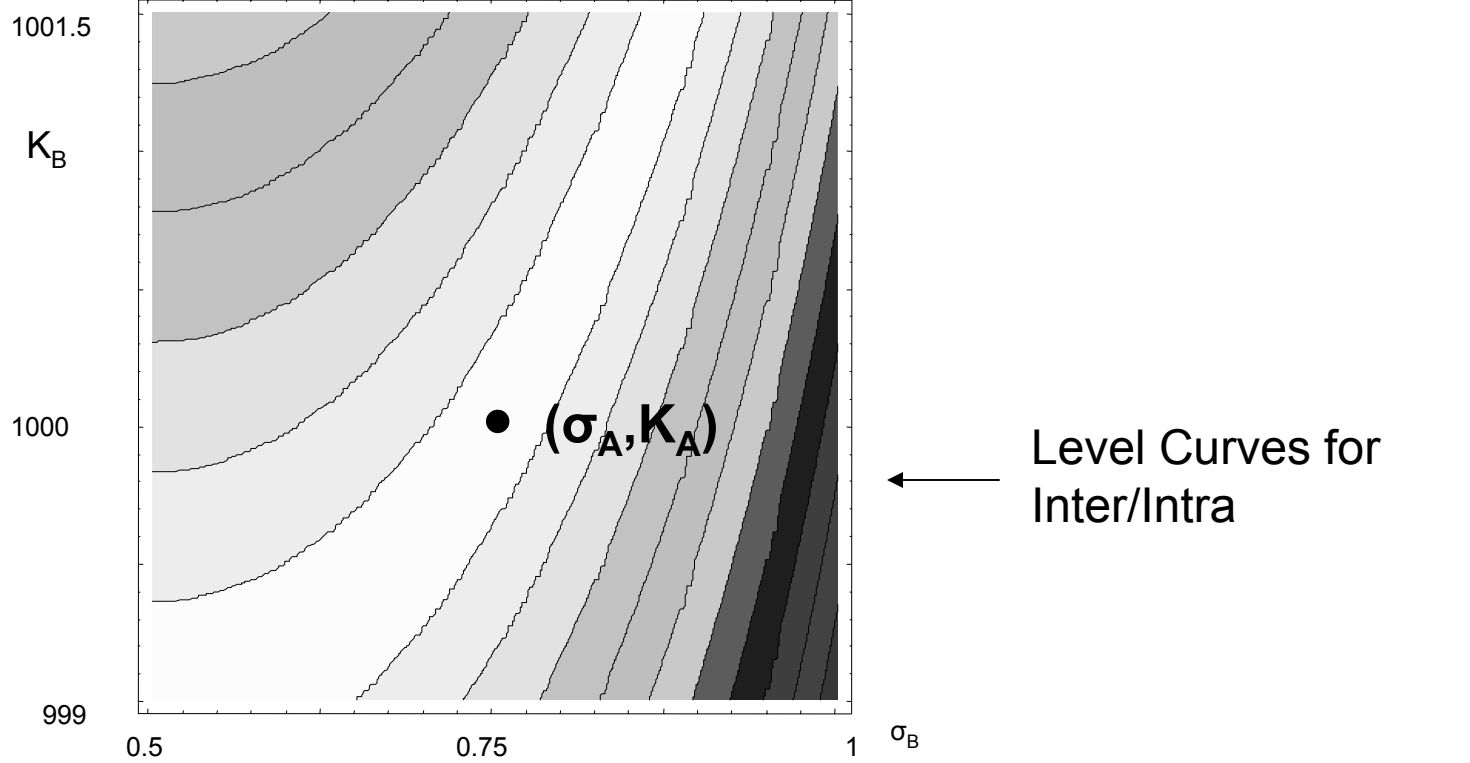


Figure 7