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WHEN DOES TRADE HURT? MARKET, TRANSITION AND DEVELOPING ECONOMIES

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ABSTRACT

This paper argues that labor market distortions in transition and developing economies help explain differential impacts of trade liberalization. We assume that workers differ in ability. In a market economy their earnings depend on their ability. However, earnings are independent of ability due to a common wage set in manufacturing in a transition economy and because of family farms in a developing economy.

Our work suggests that trade liberalization without structural reform can have serious adverse effects in transition and developing economies: there can even be mutual losses from trade.

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1 Introduction

The past half century has seen dramatic transformations in many parts of the world. Trade has been seen as a major factor in allowing remarkable rates of growth in South East Asia. At the same time, large parts of the world had stagnant real incomes. There was also a significant deterioration in the standard of living in most former socialist countries which liberalized trade. Why has the pattern of transformation been so uneven? Are there unexplored economic factors that can help explain this? We argue that labor market distortions present in transition and developing economies may provide an answer.

We develop a simple competitive general equilibrium model with two final goods, one of which is indivisible,[1] and labor which differs in productivity. We consider three kinds of economies: market, transition, and developing, with different institutional arrangements in the labor market. Trade can only improve social welfare in a market economy. In transition and developing economies social welfare may fall due to trade.

In market economies, workers earn their marginal product. In transition economies, workers in indivisibles earn a common market clearing wage unrelated to their ability. This is meant to capture the idea that workers get a common wage, especially in state owned sectors which make indivisible consumer goods. As a result, low productivity workers who cannot earn more in divisibles are attracted to indivisibles. These workers are paid more than their marginal product in *divisibles* which makes the cost of producing *indivisibles* higher than that in a market economy with the same technology. On the other hand, the higher incomes earned by less able workers increases the potential market size for indivisibles. Trade can reduce social welfare in such an economy when it involves importing the indivisible good. Such trade has adverse effects as it lowers production of indivisibles, which reduces wages, and hence the ability to afford the indivisible good.[2] Loosely speaking, before opening up to trade, socialist economies had a relatively equal distribution of income, which, although not as high as in capitalist countries, allowed most citizens access to simple consumer durables like ranges and refrigerators, though maybe not cars. Opening up to trade resulted in such goods being imported rather than produced domestically. As a result, labor allocated to manufacturing fell, as did real wages there, so that few could afford such goods! Liberalization and welfare reduction went hand in hand.

In developing economies, family farming in agriculture is the norm. This results in workers earning their average rather than marginal product in agriculture. In a developing economy workers in the divisible good sector, interpreted as agriculture, work in family farms and obtain the average product of labor in the farm. When workers have diminishing marginal product in agri-

[1] Indivisibility refers to either zero or one unit of the good being purchased by a consumer. As a result, the marginal rates of substitution between goods need not equal their price ratio.

[2] It also reduces price of indivisibles, which is beneficial. If the transition economy importing indivisibles is large, there is no price effect and trade is, in fact, weakly Pareto inferior to autarky!

culture, their average product exceeds their marginal product so that too many workers remain in agriculture. In the development literature this distortion has been linked with the concept of "Disguised Unemployment", see Sen (1960). However, when labor is of differential productivity, as in our model, only lower quality labor remains in agriculture. As a result, the marginal worker produces more than the average product of labor in agriculture, so that too few workers remain in agriculture rather than too many.

Low productivity workers who cannot earn more in indivisibles are attracted to divisibles. These workers are paid more than their marginal product in *indivisibles* which makes the cost of producing *indivisibles* lower than that in a market economy with the same technology. Also, the higher incomes earned by less able workers increases the potential market size for indivisibles. Trade can reduce social welfare in such an economy when it involves importing the divisible good. Increased output of the indivisible good reduces the labor force and average quality of labor in agriculture, thereby reducing the earnings of those in agriculture, and hence their ability to afford the indivisible good.

Our work suggests that trade liberalization without structural reform can have serious adverse effects in transition and developing economies. An unusual possibility is mutual losses from trade which occurs when a developing country exports the indivisible good to a transition economy.

We proceed as follows. In Section 2 we develop the demand side of the model. In Section 3 we solve for the autarky equilibrium. Free trade equilibrium is analyzed in Section 4. Section 5 discusses the effects of land constraints, while Section 6 contains some concluding remarks and directions for future work.

2 Demand

There are a continuum of individuals differentiated by their productivity, $\gamma \in [0,1]$, and γ is uniformly distributed on the unit interval. There are two goods in the economy, indivisible and divisible, and both goods are produced under competitive conditions. The indivisibility assumption reflects the idea that the good must be of a minimum size.[3] We assume in the body of this paper that the indivisible good is highly valued, i.e., all consumers who can afford to buy the good do so. We drop this assumption in the Appendix and show that the basic results remain.

It takes one unit of effective labor to make a unit of the divisible good which is taken as the numeraire, and it takes $\frac{1}{\alpha}$ units of effective labor to make a unit of the indivisible good. Consumers obtain utility V if they purchase the

[3] At low income levels, even clothing could be seen as indivisible good. One of the most successful projects undertaken by the World Bank involved subsidizing purchases of wood stoves. The initial cost of such stoves, around 10 to 25 dollars, prohibited their widespread usage although they are more efficient than native stoves made of mud. Although such goods can be made divisible by renting or sharing, to the extent that it is more costly to rent than buy and because of moral hazard problems involved in sharing, an essential indivisibility remains.

indivisible good, and obtain $U(n)$ if they buy n units of the divisible good which has a price of unity.

As indivisibles are highly valued all consumers with income exceeding P, the price of the indivisible good, purchase it.[4] In this manner, demand for the indivisible good depends on the level and distribution of income. If there are no factor market distortions, income is uniformly distributed over the unit interval and the demand curve, depicted in Figure $1(a)$ by the line AB, is given by

$$Q^* = 1 - P. \tag{1}$$

Note that indirect utility jumps up at $I = P$ from $U(P)$ to $U(I - P) + V$. As a result, any change which involves raising the consumption of indivisibles increases our utilitarian social welfare function.[5]

3 Autarky Equilibrium

In this section we outline the equilibrium in autarky for a market economy, a transition economy, and a developing economy. In what follows the superscripts M, T, and D denote values associated with market, transition, and developing economies, respectively.

3.1 The Market Economy in Autarky

A worker with productivity γ makes γ units of the divisible good, which is the numeraire, or $\alpha\gamma$ units of the indivisible good. In a market economy, workers in both sectors are paid according to their marginal productivity. Hence, If P^M is greater (less) than $\frac{1}{\alpha}$, then only the indivisible (divisible) good sector attracts workers. For both goods to be produced, as must be the case in autarky equilibrium,

$$P^M = c^M = \frac{1}{\alpha}.$$

If $\alpha < 1$ then even the most productive worker cannot afford the good when it is priced at cost, so the indivisible sector is not viable. Given viability, equilibrium output is just the demand at $c^M$and since some workers have an income above c^M, they demand some of the divisible good so that both goods must be produced.

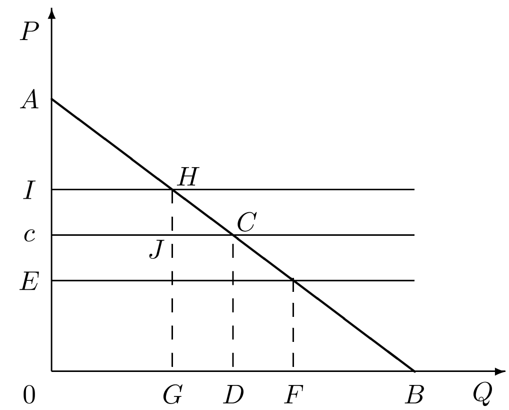
Lemma 1 *In a market economy, output is given by*

$$Q^M(\alpha) \quad = \quad 1 - \frac{1}{\alpha} \qquad\qquad for\ \alpha > 1,$$

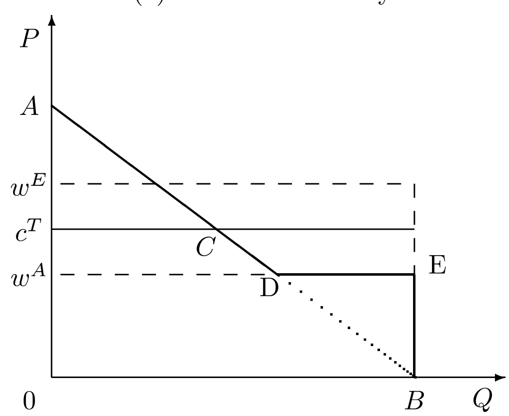
[4] This simple way of allowing income distribution to play a role is an advantage of our model. Standard utility specifications tend to either eliminate the role of income distribution or become intractable as pointed out in the conclusion.

[5] Note that indirect utility is not concave in income because both the indirect utility and the marginal utility of income jumps up at $I = P$ making individuals risk lovers in this region as pointed out by Ng (1965).

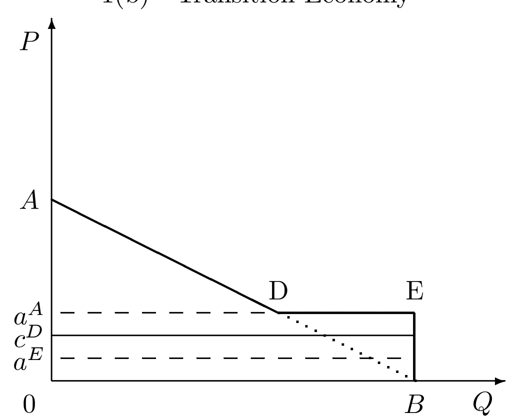
Figure 1: Demand for Indivisibles



1(a) - Market Economy

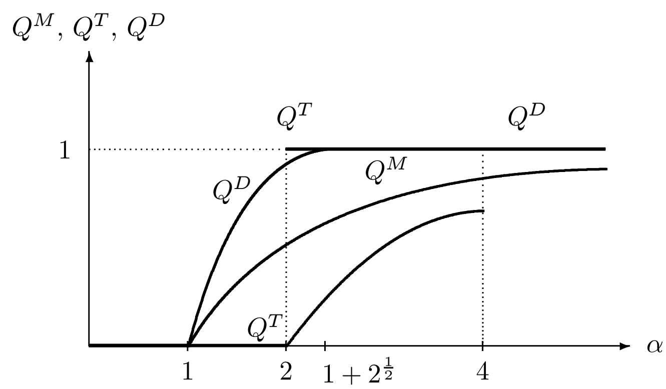


1(b) - Transition Economy



1(c) - Developing Economy

Figure 2: Output of Indivisibles in Three Economies



$$= \quad 0 \qquad\qquad for\ \alpha \leq 1 \tag{2}$$

as depicted in Figure 2.

3.2 The Transition Economy in Autarky

In a transition economy we assume that all workers are paid the going wage, w, independent of their ability[6] in the indivisible good sector while each worker earns the value of his marginal product, γ, in the divisible good sector. At wage w, workers with $\gamma > w$ choose to work in the indivisibles sector, while the others choose to work in the divisible good sector. An increase in the wage rate attracts higher productivity workers into indivisibles and raises the average quality of labor there.

Indivisible good output at wage w is given by

$$Q(w) = \alpha \int_0^w \gamma d\gamma = \frac{\alpha}{2} w^2, \tag{3}$$

while employment is w, and output per worker is $\frac{\alpha w}{2}$. Let $w(Q)$ be the wage in indivisibles needed to attract enough labor to produce Q. Using Equation (3) we find

$$w(Q) = (\frac{2Q}{\alpha})^{1/2} \tag{4}$$

[6]The assumption that wages are equal across workers of different productivities could also be due to a complex technology which prevents piece rates, or other ways of tying earnings to productivity, from being used.

as depicted in Figure 3.

The unit labor requirement (the inverse of output per worker) times the wage gives marginal cost of indivisibles in the transition economy, c^T, to be[7]

$$c^T = \frac{2}{\alpha}$$

which also equals its price. Note that for the indivisible good sector to be viable, we need $c^T \leq 1$, or $\alpha \geq 2$.

The wage distortion in a transition economy affects demand through its effect on incomes. When wages are zero, the demand function for the transition economy is depicted by the line AB in Figure 1(b). If wages are given by $w^A > 0$, workers with productivity below w^A, represented by the segment DE, work in indivisibles. All of them are willing to pay up to w^A for the indivisible good. This causes demand to jump to the right at this price as depicted by the curve $ADEB$ in Figure 1(b).

Let $\bar{w}$ be the wage needed to elicit the labor needed to produce an output of unity, let Q^{*T} be the output level at the intersection of cost and the demand curve AB, and let w^* be the wage needed to elicit Q^{*T}. Using (4) gives

$$\bar{w} = (\frac{2}{\alpha})^{1/2} = \left(c^T\right)^{1/2}, \tag{5}$$

and using (1) and (4) gives

$$Q^{*T} = 1 - c^T, \tag{6}$$

and

$$w^* = \left(\frac{2}{\alpha}\left(1 - c^T\right)\right)^{1/2} = (c^T)^{1/2}(1 - c^T)^{1/2} < \bar{w} \tag{7}$$

as $c^T \leq 1$.

If the wage level weakly exceeds cost, then at a price of c^T everyone is in the market and in equilibrium the whole market can be served. If the wage is less than c^T, then only part of the market can be served.

There are three possibilities depicted in panels (a), (b) and (c) of Figure 3. Either

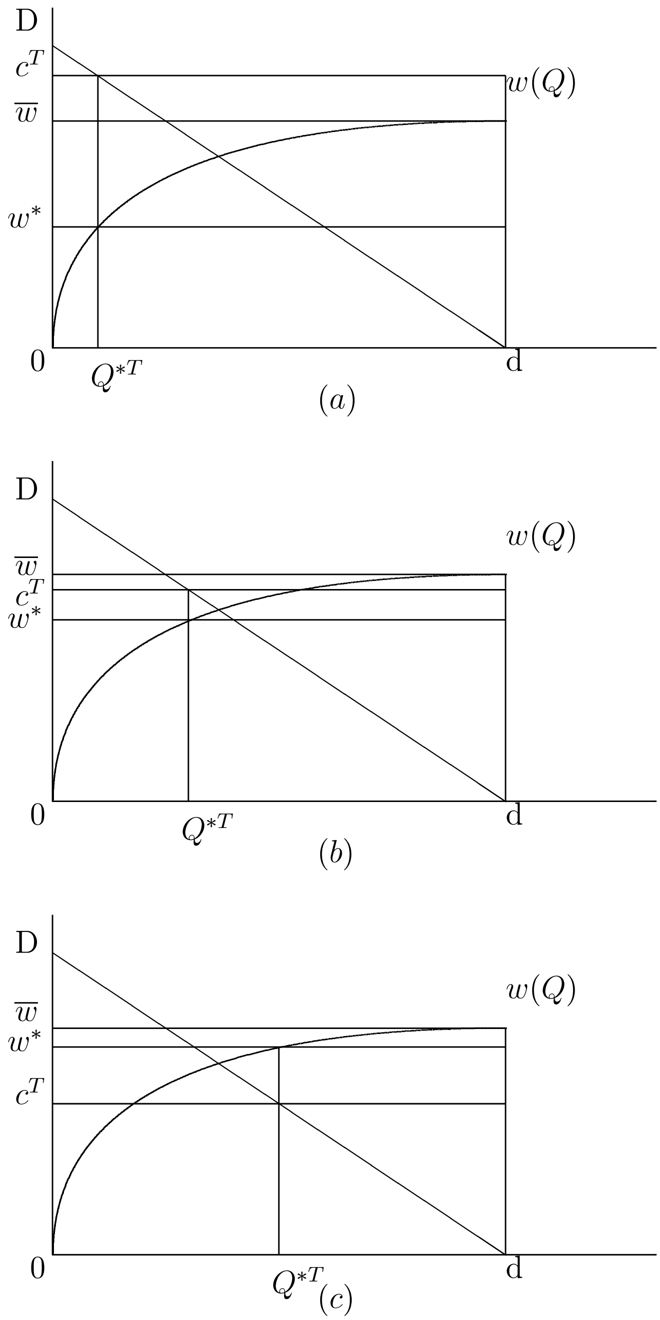
$$(a)\ c^T > \bar{w} > w^*, (b)\ \bar{w} \geq c^T > w^*,\ or\ (c)\ \bar{w} > w^* \geq c^T, \tag{8}$$

or correspondingly,

$$(a)\ c^T > 1,\ (b)\ 1 \geq c^T > \frac{1}{2},\ or\ (c)\ \frac{1}{2} \geq c^T. \tag{9}$$

[7]Note that cost is independent of the wage. Cost is just the wage times the unit labor requirement. As the wage rises, the unit labor requirement falls. In the uniform distribution case, the two effects exactly offset each other to leave marginal costs independent of the wage. At wage w, the total value of the product is $\frac{P\alpha w^2}{2}$ and total wage bill is w^2. The value of the product will not fall short of the total wage bill as long as $P\alpha \geq 2$ or $P \geq \frac{2}{\alpha} = c$. As a firm prices at cost, the value of output equals costs so there are zero profits.

Figure 3: Equilibria in a Transition Economy



Equivalently, in terms of α this gives

$$(a)\ \alpha < 2, (b)\ 2 \leq \alpha < 4,\ or\ (c)\ \alpha \geq 4. \tag{10}$$

In case (a) the economy is not viable.[8] In case (c), demand is unity even at a wage of w^*, and hence serving the entire market is the unique equilibrium. In case (b) there are two equilibria: serving the whole market at the wage $\bar{w}$, or serving part of the market by producing Q^* with the wage w^*.

Lemma 2 *In a transition economy, output is given by*

$$\begin{aligned} Q^T(\alpha) &= 0 && for\ \alpha < 2 \\ &= 1 - \frac{2}{\alpha} && for\ 2 \leq \alpha < 4 \\ &= 1 && for\ \alpha \geq 2. \end{aligned} \tag{11}$$

as depicted in Figure 2.

Proof. For $\alpha < 2$, costs of production in indivisibles exceed unity, the indivisible goods sector is not viable, and hence $Q^T(\alpha) = 0$. For $\alpha \geq 4$, serving everyone is the unique equilibrium, so $Q^T(\alpha) = 1$. For $2 \leq \alpha < 4$, $Q^T(\alpha)$ takes two values: $Q^{*T}(\alpha)$ and $Q = 1$. Note that $Q^{*T}(\alpha)$ lies below $Q^M(\alpha)$ (the analogous curve for a market economy). ■

3.3 The Developing Economy in Autarky

In a developing economy the traditional sector, agriculture, is organized on the basis of family farms where workers share output equally.[9] Thus, workers in divisibles earn the average product there.[10] As a result, more able workers work in indivisibles while the less able remain in divisibles.[11] Let $\tilde{\gamma}$ denote the marginal worker's productivity. Workers with productivities less than $\tilde{\gamma}$ work in divisibles earning $\frac{\tilde{\gamma}}{2}$. A worker of type γ earns $P^D\alpha\gamma$ in the indivisible good sector. For both goods to be produced in equilibrium, as must be the case in autarky, the marginal worker has to be indifferent between the two sectors, i.e.,

$$P^D = \frac{1}{2\alpha} = c^D. \tag{12}$$

[8] It is possible to have a part served equilibrium if only part of the population demands indivisibles, while all of it is active in the labor force. See Krishna and Yavas (2000) for details.

[9] We assume that the agricultural sector is one big family farm that produces the divisible good. This allows us to abstract from asymmetries and integer problems in family size, farm size, and member ability. An alternative interpretation would involve identical family farms, each with a continuum of members.

[10] Note that the developing economy differs from a transition economy by wage equality in indivisibles rather than divisibles. In both cases, the sector with wage equality attracts the least able.

[11] Unlike the usual assumption in the disguised unemployment literature, the average product of labor in agriculture *falls* as less people work on it. This is a consequence of constant returns to scale and effective labor being the only factor of production. This does not need to be the case with a land constraint in agriculture as explained in Section 5.

As in the transition economy the marginal worker in divisibles is determined by the demand side. If demand for indivisibles is Q, then $\tilde{\gamma}$ should satisfy

$$Q = \alpha \int_{\tilde{\gamma}}^{1} \gamma d\gamma = \frac{\alpha}{2}(1 - \tilde{\gamma}^2). \tag{13}$$

Rewriting (13) gives

$$\tilde{\gamma}(Q) = (1 - \frac{2}{\alpha}Q)^{1/2}. \tag{14}$$

The average product, $a(Q)$, in the divisible good sector is hence given by

$$a(Q) = \frac{\tilde{\gamma}}{2} = \frac{1}{2}(1 - \frac{2}{\alpha}Q)^{1/2}. \tag{15}$$

As the output of indivisibles rises so does its demand for labor, and so $\tilde{\gamma}$ falls reducing the average product in the divisible good sector. The family farm distortion affects demand through its effect on earnings. The earnings of a worker with productivity γ are:

$$\omega^D(\gamma) = \max(\frac{\tilde{\gamma}}{2}, \frac{\gamma}{2}). \tag{16}$$

If $a(Q) = 0$, then the demand curve, depicted by the line AB in Figure 1(c), is given by

$$Q^{*D}(c^D, 0) = 1 - 2c^D.$$

If some workers are employed in divisibles, their average product is positive and these workers are willing to pay up to $a(Q)$ for the indivisible good. This causes demand to jump to the right at this price as depicted by the curve $ADEB$ in Figure 1(c). The position of the jump depends on the value of $a(Q)$, which in turn depends on the output of indivisibles. As output in indivisibles rises, the average product of labor in divisibles falls, so that this jump occurs at a lower price. Thus greater output of indivisibles affects its demand adversely!

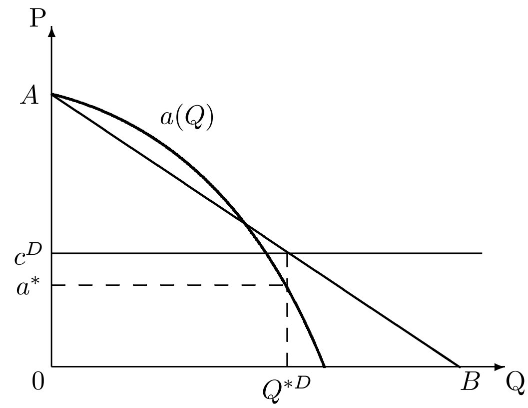
Let $\bar{a} = a(1)$, or the income level in divisibles when the output of indivisibles is unity. Let Q^{*D} denote the output level at the intersection of the cost line and the demand curve AB, and let a^* denote the average productivity in divisibles when output in indivisibles is Q^{*D}. From (15) it is easy to verify that $a(Q)$ is downward sloping and concave. Moreover, that $a(Q) \geq 0$ at $Q = 1$ if $\alpha \geq 2$. If $\alpha < 2$, then $a(Q)$ intersects the horizontal axis below unity. At $Q = 0$, $a(Q) = \frac{1}{2}$ and $a'(Q) = -\frac{1}{2\alpha}$. Hence, the $a(Q)$ curve at $Q = 0$ intersects the inverse demand curve but it is flatter. Figure 4 respects these properties.

There are three possibilities as depicted in panels (a), (b), and (c) of Figure 4:

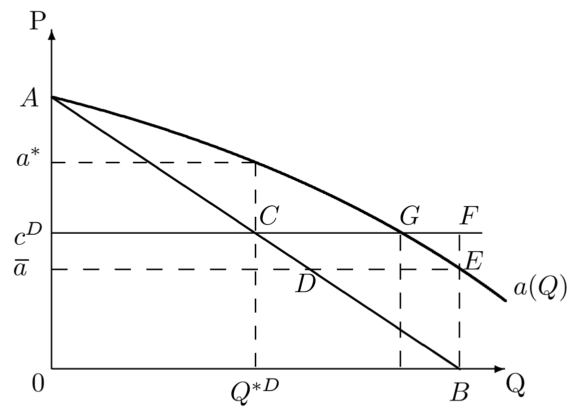
$$a)\ c^D \geq a^* > \bar{a},\ b)\ a^* > c^D > \bar{a},\ c)\ a^* > \bar{a} \geq c^D \tag{17}$$

In case c), $a(.)$ lies above c^D for all feasible consumption levels as depicted in Figure 4(c). In this case serving everyone is an equilibrium. If $Q = 1$, the

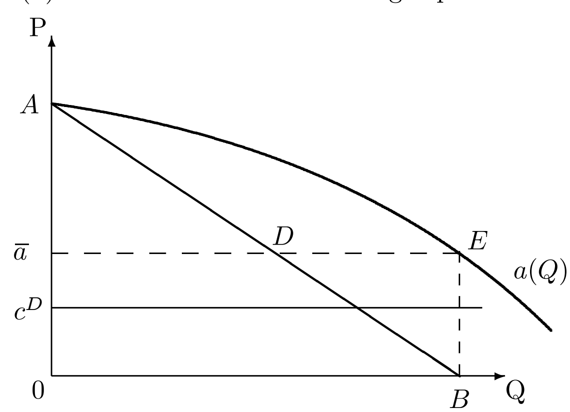
Figure 4: Autarky Equilibrium in a Developing Economy



4(a) - Part Served Equilibrium



4(b) - Part Served with Rationing Equilibrium



4(c) - All Served Equilibrium

demand curve facing each firm is given by $ADEB$ and when firms price at cost, all consumers purchase the good. It is also unique since at lower output levels, $a(Q)$ is even higher than $\bar{a}$ and at a price equal to cost, all consumers can still afford to buy their indivisible good.

In case b), depicted in Figure 4(b), serving everyone cannot be an equilibrium. If everyone is served then the average product in agriculture is $\bar{a}$ which falls short of c^D. As a result all consumers cannot afford to buy the indivisible good and this cannot be an equilibrium. If, on the other hand, output is at the intersection of AB and cost at Q^{*D}, then the average product of labor in agriculture is a^* which exceeds c^D, so everyone can afford the indivisible and this cannot be an equilibrium. Since price must be c^D, the only other possibility is that the equilibrium output level is where $a(Q)$ intersects c^D, that is the output at G, and some consumers are rationed. At this output level demand facing each firm is $ACFB$. Some consumers (namely those with an income of c^D) are rationed, and a fraction GF/CF in Figure 4(b) cannot obtain the good. Since they cannot afford to bid up the price, this is an equilibrium.

In case a) only part of the market would be served as workers in divisibles cannot afford the indivisible when the indivisible output is Q^*. However, it turns out that this case is never realized in our model.[12]

Since $c^D = P^D = \frac{1}{2\alpha}$ and the highest income is $\frac{1}{2}$, $\alpha > 1$ is needed for the indivisible good market to be viable in autarky. By using (15) and (12) we find that serving everyone is an equilibrium, i.e., $\bar{a} \geq c^D$ for

$$\alpha \geq 1 + \sqrt{2}.$$

Otherwise, serving everyone is not an equilibrium and consumers are rationed. In this event, output is implicitly defined by

$$c^D = a(Q).$$

Substituting for c^D in terms of α and using (15), this gives

$$Q = \frac{\alpha}{2}(1 - \frac{1}{\alpha^2}). \tag{18}$$

[12] As shown below, a^* is always greater than c^D, and hence in our model we will never have a part served equilibrium without rationing.

$$\begin{aligned}
a^* &> c^D \Longrightarrow \\
\frac{1}{2}\left\{1 - 4c^D Q^*\right\}^{\frac{1}{2}} &> c^D \Longrightarrow \\
\frac{1}{2}\left\{1 - 4c^D\left(1 - 2c^D\right)\right\}^{\frac{1}{2}} &> c^D \Longrightarrow \\
1 - 4c^D + 8\left(c^D\right)^2 &> 4\left(c^D\right)^2 \Longrightarrow \\
\left\{1 - 4c^D + 4\left(c^D\right)^2\right\} &> 0 \Longrightarrow \\
\left\{1 - 2c^D\right\}^2 &> 0.
\end{aligned}$$

Lemma 3 *In a developing economy, the output level is given by*

$$\begin{aligned} Q^D(\alpha) &= 0 \qquad\qquad for\ \alpha \leq 1 \\ &= \frac{\alpha}{2}(1-\frac{1}{\alpha^2}) \quad for\ 1 < \alpha \leq 1+\sqrt{2} \\ &= 1 \qquad\qquad for\ 1+\sqrt{2} \leq \alpha. \end{aligned} \tag{19}$$

3.4 Comparing Autarky Outcomes

Since there is full employment in our model, output lies on the production possibility frontier. However, due to indivisibilities, the usual tangency between indifference curves and budget sets need not occur. In addition both the transition and developing economies have factor market distortions which affect income distribution and hence demand for indivisibles as well as the cost of producing indivisibles.

The factor market distortion in a transition economy results in an increase in the cost of producing the indivisible. It also raises the productivity level needed in the indivisibles for the market to be viable, and can increase market size through its effect on income distribution. Thus, the net effect of the factor market distortion in a transition economy could be an increase or decrease in indivisible good output depending on productivity and the type of equilibrium realized. The factor market distortion in a developing economy results in a decrease in the cost of producing the indivisible and can increase market size through its effect on income distribution. As a result, in a developing economy, indivisible good output is always higher than that of a market economy at any given productivity level.[13]

Proposition 1 *Output levels in three types of economies are defined in Lemmas* $1-3$ *and depicted in Figure* 2*. The output of indivisibles in a developing economy exceeds that in a market economy for all levels of* α*. Whether the output of indivisibles in a transition economy is higher or lower than that in a developing or market economy depends on* α*.*

4 Trade

We now consider the effects of trade between economies with different institutions and productivity levels.

4.1 Pattern of Trade

Recall that costs are given by $c^M = \frac{1}{\alpha}$, $c^T = \frac{2}{\alpha}$, and $c^D = \frac{1}{2\alpha}$ for the market, transition and developing economies respectively. Note that

$$c^T > c^M > c^D$$

[13]Also note that the returns to ability rise fastest in a market economy suggesting that the incentives to invest in ability improvements, like education, might be higher in market economies.

at any given α. The reason for this ranking is that in a transition economy, workers in indivisibles are paid more than their marginal product in *divisibles* which makes the cost of producing *indivisibles* higher than that in a market economy with the same technology. In a developing economy, workers in divisibles are paid more than their marginal product in *indivisibles* which makes the cost of producing *indivisibles* lower than that in a market economy with the same technology.

Given constant costs and perfect competition, the country with the lowest cost exports the indivisible. Note that both technology and institutions determine this. The country with the best technology in indivisibles, i.e. with the highest α, need not export indivisibles! For example, a developing economy will export to a transition economy as long as $\frac{1}{2\alpha^D} < \frac{2}{\alpha^T}$, or $4\alpha^D > \alpha^T$, even if $\alpha^D < \alpha^T$.

4.2 Welfare Effects of Trade

The effects of trade on welfare are illustrated in Figure 1. In the market economy trade results in a Pareto improvement as in the standard Ricardian model. In Figure 1(a) the autarky price of indivisibles equals Oc. If trade causes the market price to fall to OE, the economy specializes in divisibles and consumption of both divisibles and indivisibles rises and welfare rises. Conversely, if trade causes the price to rise to OI, wages rise in the same proportion as price in order to keep price equal to cost as the market economy specializes completely in indivisibles. As a result, the curve AB anchored at B swings out in the same proportion as price so that all those who could afford the indivisible good earlier can still do, and all agents (except the former marginal agent) can afford more of the divisible as well. The presence of indivisibilities augments the standard consumer surplus changes as additional consumption of the indivisible causes a jump in indirect utility.

In addition to the price effect which operates as in the market economy, trade affects the level and distribution of income in both the transition and the developing economies. Exporting the indivisible requires more labor to be employed in the indivisible good sector. In the transition economy this raises wages from w^A to w^E in Figure 1(b), while it reduces earnings in divisibles in the developing economy from a^A to a^E in Figure 1(c). These changes in income can change the type of equilibrium in both countries. In a transition economy, exporting the indivisible may enable the economy to switch to an equilibrium where it serves all its consumers from one only some are served if $w^E > c^T > w^A$, as depicted in Figure 1(b). On the other hand, in a developing economy, exporting the indivisible may move the economy from an all served equilibrium to a part served one if $a^E < c^D < a^A$ as depicted in Figure 1(c). Importing the indivisible good will have the opposite effects.

Thus, the effects of trade can be decomposed into two parts in economies with a factor market distortion. The first is the standard price effect which benefits all workers, and the second is via income. Trade unambiguously raises the welfare of the high productivity workers via the price effect, but may reduce the welfare of the workers in the distorted sector via the income effect. If the economy specializes in the distorted sector, the income effect is positive, and trade results in a Pareto improvement over autarky.[14]

4.2.1 Mutual Losses From Trade

It is easy to construct examples of trade between a transition economy and a developing one which results in mutual losses from trade. Suppose that in autarky all consumers are served in both countries. Thus, in the developing country, $\bar{a}$ exceeds marginal cost, c^D, and in the transition economy, $\bar{w}$, exceeds the marginal cost, c^T. Suppose that $c^D < c^T$ but close to it so that price effects are negligible. Since the developing country will export indivisibles, the income effects for both countries will be adverse. As a result, both lose from trade.[15]

5 Land Constraints

So far we have assumed that productivity does not depend on the size of the labor force employed. This is equivalent to assuming that labor is the only scarce factor. This may not be such an unrealistic assumption in land rich countries such as the U.S. or Australia in the past century. However, in most settings, especially in land poor developing countries, having fewer people in agriculture (divisibles) raises the average productivity of labor.

Land constraints can be incorporated into our model simply by assuming that the productivity of type γ in divisibles is $\gamma\lambda(Q)$ where Q is the output in indivisibles. As Q rises, fewer people work in divisibles and $\lambda(Q)$ rises. In other words, there are external diseconomies of scale in the divisible good sector: as labor used in divisibles rises, productivity of labor in divisibles falls. This reduces the opportunity cost of labor and hence the unit cost of indivisibles. Throughout this section we augment our notation using a subscript, L, to denote variables in the presence of land constraints.

In this setting, land constraints, as modelled, leave the output of indivisibles as well as the labor allocation between sectors in all three economies unchanged. For example, an increase in λ swings the line AB in Figure 1 representing productivity in divisibles out from its horizontal intercept at B. It also shifts costs in indivisibles out proportionally since the opportunity cost of labor rises. The average product curve $a(Q)$ in a developing economy and its analogue, the wage curve, $w(Q)$, in a transition economy are similarly affected. This makes nominal variables change proportionally leaving the allocation of labor and output of indivisibles unaffected.

[14] Note that trade may result in a conflict of interests even in a Ricardian setting when workers have different productivities and there are distortions in the factor market.

[15] One such example is $\alpha^D = 3$ and $\alpha^T = 6$.

5.1 The Market Economy Under Land Constraints

A worker with productivity γ earns $\gamma\lambda(Q)$ in the divisible good sector, and $\alpha\gamma P_L^M$ in the indivisible good sector. For both goods to be produced in equilibrium $P_L^M = \frac{\lambda(Q)}{\alpha}$ which is also equal to marginal cost. Therefore both income and cost are affected proportionally leaving the equilibrium output in indivisibles unaffected. Thus,

$$
\begin{aligned}
Q_L^M(\alpha) &= 1 - \frac{P_L^M}{\lambda(Q)} \\
&= 1 - \frac{\frac{\lambda(Q)}{\alpha}}{\lambda(Q)} \\
&= 1 - \frac{1}{\alpha}
\end{aligned} \tag{20}
$$

and (2) still gives the output of indivisibles.

5.2 The Transition Economy With Land Constraints

Total indivisible good output at wage w_L is given by

$$
Q(w) = \alpha \int_0^{\frac{w_L}{\lambda(Q)}} \gamma d\gamma = \frac{\alpha}{2}\left(\frac{w_L}{\lambda(Q)}\right)^2 \tag{21}
$$

which is analogous to (3). The share of the labor force employed in this sector is $\frac{w_L}{\lambda(Q)}$, and output per worker is $\frac{\alpha w_L}{2\lambda(Q)}$. Marginal cost is $c_L^T = \frac{2\lambda(Q)}{\alpha} = \lambda(Q)c^T$.

The equilibrium wage as a function of the aggregate indivisible good production becomes

$$
w_L(Q) = \lambda(Q)(\frac{2Q}{\alpha})^{1/2} = \lambda(Q)w(Q) \tag{22}
$$

which is analogous to (4). Again both the cost and demand variables are multiplied by $\lambda(Q)$ shifting both the demand and price lines proportionally.

Recall that our three cases in a transition economy were determined by comparing c^T to w^* and $\bar{w}$. Since land constraints scale all three variables by $\lambda(Q)$, their relative ranking is unchanged for each α. This, together with the fact that labor allocation is unaffected by land constraints, ensures that indivisible good output is given by (11) as before.

5.3 The Developing Economy with Land Constraints

A worker with productivity γ earns $\alpha\gamma P_L^D$ in the indivisible good sector, and he earns

$$
a_L(Q) = \frac{\tilde{\gamma}_L}{2}\lambda(\tilde{\gamma}_L)
$$

in the divisible good sector, so that analogous to (12)

$$c_L^D(\lambda) = P_L^D = \frac{\lambda(\tilde{\gamma}_L)}{2\alpha} = \lambda(\tilde{\gamma}_L)P^D = \lambda(\tilde{\gamma}_L)c^D.$$

Since land constraints do not affect the technology in the indivisible good sector, the labor needed to make any given output of indivisibles in unchanged so that $\tilde{\gamma}(Q) \equiv \tilde{\gamma}_L(Q)$. However, the average product in the divisible good sector is scaled by $\lambda(Q)$, so that

$$a_L(Q) = \frac{\lambda(Q)\tilde{\gamma}(Q)}{2} = \lambda(Q)a(Q).$$

Recall that equilibrium output in indivisibles in a developing economy in the absence of land constraints depended on the relationship between $a(Q)$ and $c^D(Q)$. Since land constraints scale both $a(Q)$ and $c^D(Q)$ by $\lambda(Q)$, their relative ranking is unchanged for any given α. This, together with the fact that labor allocation is unaffected by land constraints, ensures that indivisible good output is given by (19) as before. Thus we have shown the following:

Proposition 2 *The presence of land constraints in the manner specified does not affect the allocation of labor across sectors and hence does not affect the equilibrium output of indivisibles under autarky.*

5.4 Effects of Trade

Although in autarky, land constraints affect neither the type of equilibrium nor the allocation of labor between the two sectors, they have profound effects in a trading equilibrium. With land constraints, exporting indivisibles becomes more advantageous for all types of economies because producing more of the indivisible good absorbs labor from the divisible good sector raising productivity there, and this raises labor earnings in all three types of economies. If land constraints are severe enough, exporting indivisibles raises social welfare even for a developing economy.

In a developing economy with no land constraints, an increase in aggregate indivisible good production reduces $\tilde{\gamma}$ as the more productive workers go to the indivisible good sector. With land constraints there are two forces at play which determine the behavior of $a(Q)$. As before, an increase in aggregate indivisible good production reduces $\tilde{\gamma}$. On the other hand, it raises $\lambda(\tilde{\gamma})$ as $\lambda'(\tilde{\gamma}) < 0$. The net effect on average productivity in divisibles (and marginal cost in divisibles)

$$\begin{aligned} \frac{da(Q)}{dQ} &= \left[\tilde{\gamma}(Q)\lambda'(\tilde{\gamma}(Q)) + \lambda(\tilde{\gamma}(Q))\right]\frac{\tilde{\gamma}'(Q)}{2} \\ &= [1-\epsilon]\,\frac{\tilde{\gamma}'(Q)\lambda(\tilde{\gamma}(Q))}{2}. \end{aligned}$$

depends on the elasticity of $\lambda(\tilde{\gamma})$, or ϵ, defined to be a positive number. If this elasticity is less than unity then average product of labor in divisibles will fall with increases in Q as before. If this elasticity is more than unity, then average product of labor in divisibles will rise as Q rises. Note that this elasticity depends on the severity of the land constraints, and that in a developing economy with severe land constraints, an increase in indivisible good production *raises* the average productivity in divisibles.

What have we learnt from adding land constraints? They may affect technologically identical economies differently as their output levels of indivisibles may differ, causing differences in the extent of land constraints in equilibrium. For example, a developing economy produces more indivisibles than an otherwise identical market economy in the absence of land constraints, i.e., $Q^D > Q^M$. As a result, less labor works in divisibles in a developing economy. If there were land constraints, then the divisible good sector would be less crowded and more productive in the developing economy, i.e., $\lambda(Q^M) < \lambda(Q^D)$, which in turn increases the cost of producing indivisibles in the developing economy.

As a consequence, land constraints have implications for trade patterns. Although $\frac{1}{\alpha} > \frac{1}{2\alpha}$, it may be that $c_L^M(.) < c_L^D(.)$. If so, the market economy will export indivisibles. Note that as output in the market economy rises and that in the developing economy falls their production costs in divisibles approach one another. In this manner land constraints work against complete specialization.

While a developing economy would gain from importing the indivisible good in the absence of land constraints, it may lose from doing so in their presence due to crowding in agriculture reducing the average product there if land constraints are severe enough. Thus, a land unconstrained developing economy gains from indivisible good imports while a very land constrained one loses.

Proposition 3 *With land constraints, exporting indivisibles becomes more advantageous for all types of economies. Social welfare in a transition or market economy must rise as a result of exporting the indivisible good. In a developing economy with severe land constraints, i.e., one with $\epsilon > 1$, exporting the indivisible good raises social welfare, while in a developing economy without land constraints exporting the indivisible good may reduce social welfare.*

6 Conclusion

In Eastern Europe and the former Soviet Union, industrial output and GDP fell sharply at the onset of liberalization. There have been a number of interesting hypotheses put forward to explain this phenomenon. These include slow adjustment resulting in unemployment, see Gomulka (1992), investment delays caused by the unwillingness to invest till a good match is found since investment is relation specific, see Roland and Verdier (1999), and the disorganization hypothesis of Blanchard and Kremer (1997), where strong complementarities between inputs allows suppliers to exercise their bargaining power and disrupt production chains.

We take a different tack. We argue that the organizational structure of transition economies differs from market economies. In particular, indivisible consumer goods like cars, refrigerators and other appliances are made in the public sector where wages are not dependent on worker productivity. We show that trade, in particular imports of indivisible goods, reduce public sector wages and can result in significant welfare losses in general equilibrium.

Our model also helps explain why some developing economies gain through trade while others do not. There are many reasons put forward to explain such differences, see Krueger (1984) and Ray (1998) for an overview of much of this literature. There is also a substantial literature on trade with factor market distortions. Much of it focuses on minimum wages in manufacturing, see for example Brecher (1974a,b) and Davis (1998). In contrast to this work, we focus on a feature of the organizational structure of developing economies, namely that the divisible good sector, agriculture, is organized on family farm lines. We show that without land constraints, when it involves importing indivisible goods, trade raises welfare due to advantageous wage effects in agriculture. This need not be the case in the presence of land constraints. This suggests why all developing countries with a comparative advantage in agriculture need not gain from trade. Our work suggests that land poor countries may lose from such trade while land rich ones gain.

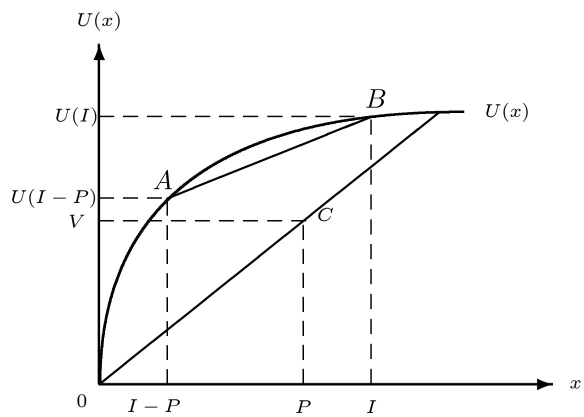
What is the role of indivisibilities in our results? Indivisibilities are not essential in our model. Even without indivisibilities in consumption, trade which involves importing the good made in the sector with the factor market distortion may reduce welfare through its income effects. We use the indivisibility assumption for two reasons.

First, indivisibilities in consumption provide an easy way to characterize demand as a function of income and its distribution.With the standard assumption of identical homothetic preferences, demand depends on aggregate income and is independent of its distribution. Quasi general equilibrium models with an additive linear utility for the numeraire good remove all income effects as they fall on the numeraire good. If preferences are not identical and homothetic then excess demand functions have few restrictions on them in general equilibrium so that this approach is not tractable. Thus, our modelling approach provides a simple way for income distribution to affect aggregate demand.

Second, our model also provides a setting where the location of the factor market distortion, in divisibles or indivisibles, matters. The astute reader will have noticed that the factor market distortion in the developing and transition economy is really the same. In the transition economy, $w(Q)$ is the wage needed to attract enough labor into *indivisibles* to make Q units of output in *indivisibles.* In the developing economy, $a(Q)$ is the average product of a worker in *divisibles*, which equals his earnings, when enough labor is employed in *indivisibles* to make Q units of output there. Without a distinction between the goods in the two sectors, the effects of such a distortion would be the same since the wage in a sector with this distortion is increasing in the output of that sector.

The simple general equilibrium structure developed here also provides a way to study a number of issues in trade and development. In Krishna and Yavas (2000), we argue that technical change in a closed transition economy with product market power may be immiserizing. In Krishna and Yavas (2001),

Figure 5: Choice When V is Small



we assume that the indivisible good is a consumer durable, and show that endogenous business cycles are generically produced and that these cycles have properties consistent with the data. We are currently working in several areas where our set-up may shed new light on old issues. These include the role of multinationals in development, and trade policy with product market power.

7 Appendix: Demand When V is Small

In this section we look at the implications of removing the large V assumption for our results. We first look at the derivation of demand for indivisibles when V is small. We show that while the details differ from the large V case, the manner in which demand is affected by factor market distortions is unchanged. Since costs and hence trade patterns are unchanged, the effects of trade, though less sharp, are of the same form as in the large V case.

A consumer with income I chooses what to buy to maximize his utility subject to his budget constraint. Suppose that $I \geq P$ so that he can afford the indivisible good. Let $U(.)$, depicted in Figure 5, be the utility obtained from consuming the divisible good. If he buys the divisible good only he gets $U(I)$, while if he buys the indivisible good at a price of P, and spends the remainder of his money on the divisible good he gets $V + U(I - P)$. Thus, he is better off buying the indivisible if $V > U(I) - U(I - P)$, or

$$\frac{V}{P} > \frac{U(I) - U(I - P)}{P}. \tag{23}$$

For the worker with productivity and income I, the right hand side of (23) is given by the slope of the line AB in Figure 5. The left hand side of (23) is independent of a worker's income and is given by the slope of the line $0C$. As drawn, this worker is better off buying the indivisible as (23) is met. As income falls, the right hand side of (23) rises due to concavity of $U(.)$, and the analogue to the line AB gets steeper until the two are equal.

Let $i(P,V)$, implicitly defined by

$$V = U(i) - U(i-P), \tag{24}$$

denote the income level at which an individual is indifferent between buying and not buying the indivisible. Consumers with an income above this cutoff level strictly prefer buying the indivisible, while those below this cutoff prefer not buying the indivisible. Of course, a consumer may prefer buying the indivisible but be unable to afford to do so. Thus, a consumer will buy the indivisible only if his income exceeds both the price and $i(P,V)$. Let

$$\tilde{\imath}(P,V) = \max\{i(P,V), P\}.$$

Thus, demand for the indivisible is given by

$$D(P) = 1 - G\left(\tilde{\imath}(P,V)\right). \tag{25}$$

Lemma 4 *$i_P(P,V) > 1$, $i_V(P,V) < 0$, $i_{PP}(P,V) < 0$.*

Proof. Totally differentiating (24), gives

$$dV = U'(i)di - U'(i-P)(di - dP)$$

Hence

$$\begin{aligned} i_P(P,V) &= \frac{U'(i-P)}{U'(i-P) - U'(i)} \\ &= 1 + \frac{U'(i)}{U'(i-P) - U'(i)} > 1 \end{aligned}$$

Also,

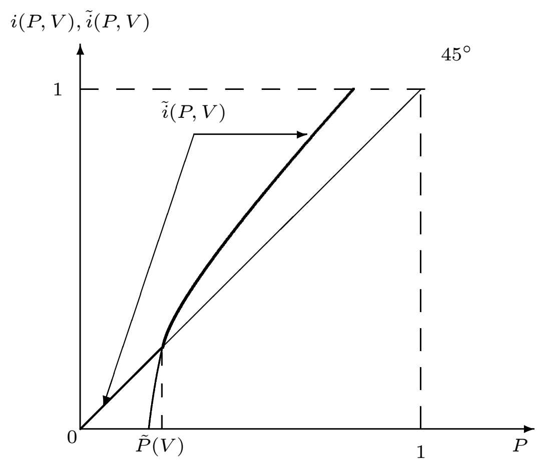
$$\begin{aligned} i_V(P,V) &= \frac{1}{U'(i) - U'(i-P)} < 0 \\ i_{PP}(P,V) &= \frac{U'(i)U''(i-P)}{\left(U'(i) - U'(i-P)\right)^2} < 0. \end{aligned}$$

■

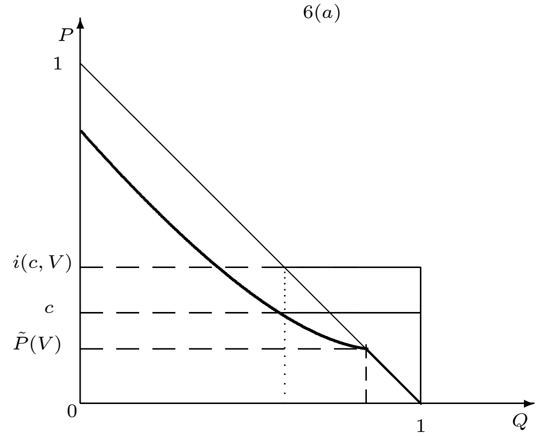
Figure 6(a) depicts the function $\tilde{\imath}(P,V)$. The corresponding demand function is portrayed in Figure 6(b). When P is low enough, all agents prefer buying the indivisible good so that in Figure 6(a), the vertical intercept of $i(P,V)$ is negative. From this fact and from $i_P(P,V) > 1$, it follows that $i(P,V)$ lies below the 45° line for low P and above it for high P. Define $\tilde{P}(V)$ to be where $i(P,V)$ intersects the 45° line. Hence,

$$\begin{aligned} \tilde{\imath}(P,V) &= i(P,V) \quad if\ P \geq \tilde{P}(V) \\ &= P \qquad\quad if\ P \leq \tilde{P}(V) \end{aligned}$$

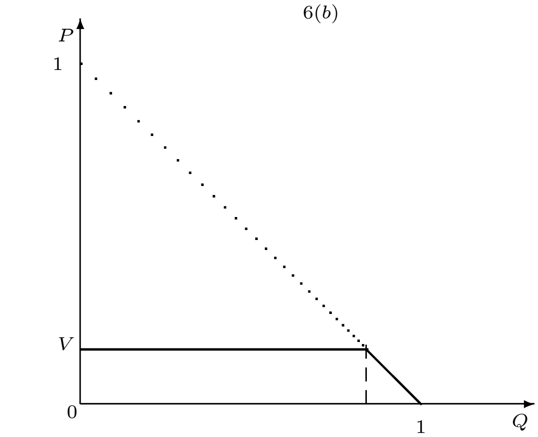
Figure 6: Deriving the Demand Curve



$6(a)$



$6(b)$



$6(c)$

If $G(.)$ represents a uniform distribution as assumed, then

$$D_P(P) = -\tilde{\imath}_P(P,V) < 0. \tag{26}$$

$$\begin{aligned} D_{PP}(P) &= -\tilde{\imath}_{PP}(P,V) > 0 \quad if\ P > \tilde{P}(V) \\ &= 0 \qquad\qquad\qquad\quad if\ P < \tilde{P}(V) \end{aligned}$$

so that the demand curve in Figure 6(b), which represents the demand facing the market economy described above, is convex above $\tilde{P}(V)$ and linear below it.

Since $i(P,V)$ is increasing in P and decreasing in V, an increase in V shifts the $i(P,V)$ curve in Figure 6(a) downwards and raises the intersection with the 45° degree line representing P. As a result, for V high enough, that is, when $\tilde{P}(V) > 1$, $i(P,V)$ never lies above P and we are in the large V case. Since $\tilde{P}(V) > 0$, at a low enough price we are in the large V case. If $P > \tilde{P}(V)$ then we are in the small V case, and from (25) it follows that demand in the small V case at a price P is identical to the demand from the same economy had V been large and the price been $\tilde{\imath}(P,V)$. In other words, $\tilde{\imath}(P,V)$ can be obtained by going vertically up from any point on the demand function in the small V case to the demand function in the large V case. This is depicted in Figure 6(b) for $P = c > \tilde{P}(V)$.

Hence, $i(c,V)$ plays the same role as c did in the large V case analyzed above. The analysis proceeds as earlier with c replaced by $i(c,V)$.

The three possibilities in a transition economy, (a) unique part-served equilibrium, (b) multiple equilibria, and (c) unique all-served equilibrium, are given by the analogue of (8)

$$\begin{aligned} (a')\ \tilde{\imath}(c^T,V) &> \bar{w} > w^*(c^T,V), \\ (b') \qquad\quad \bar{w} &\geq \tilde{\imath}(c^T,V) > w^*(c^T,V),\ or \\ (c') \qquad\quad \bar{w} &> w^*(c^T,V) \geq \tilde{\imath}(c^T,V) \end{aligned} \tag{27}$$

where $w^*(c^T,V)$ is the wage required to elicit the labor needed when the output in indivisibles is

$$Q^*(c^T,V) = 1 - G^T(\tilde{\imath}(c^T,V)). \tag{28}$$

The three possibilities in a developing economy, (a) serving part of the market, (b) part-served equilibrium with rationing, and (c) all-served equilibrium, are given by the analogue of (17)

$$\begin{aligned} (a') \quad \tilde{\imath}(c^D,V) &> a^*(c^D,V) > \bar{a}, \\ (b') \ \ a^*(c^D,V) &\geq \tilde{\imath}(c^D,V) > \bar{a},\ or \\ (c') \ \ a^*(c^D,V) &> \bar{a} \geq \tilde{\imath}(c^D,V) \end{aligned} \tag{29}$$

where $a^*(c^D,V)$ is the average product in divisibles when

$$Q^*(c^D,V) = 1 - 2G^D(\tilde{\imath}(c^D,V)). \tag{30}$$

A special case arises when $U(.)$ is linear. In this case, it follows from (24) that $i(P,V)$ is given by $\frac{U(i)-U(i-P)}{P}=1$. If $\frac{V}{P}>1$ then everyone is better off buying the indivisible than not doing so, and will buy it if they can afford to do so. Thus we are in the large V case. If $\frac{V}{P}<1$, then no one will want to buy the good even if they could afford so that there is no demand for the indivisible. As a result, the demand curve is flat at $P=V$, zero above it and the same as in the large V case for $P<V$ as depicted in Figure $6(c)$[16] by the solid line.

Note that in the small V case there is no discontinuity in indirect utility at $I=P$, but there is a kink in indirect utility at $I=i(P,V)$ because the marginal utility of income rises once the indivisible good has been purchased.[17] As a result, indirect utility remains non-concave in income.

7.1 An Example

Suppose that utility from divisibles is given by a quadratic function

$$U(x)=x-\frac{1}{2}x^2.$$

In this case, using (24) gives

$$i(P,V)=1+\frac{P}{2}-\frac{V}{P}. \tag{31}$$

Setting $i(P,V)=P$ in (31) gives

$$\tilde{P}(V)=1\pm(1-2V)^{1/2}.$$

Since $\tilde{P}(V)<1$, we choose the negative root.

Figure 7 illustrates possible cases in a transition economy as a function of V and c^T. The boundary between the large V and the small V regions is given by $\tilde{P}(V)=c^T$, or

$$c^T=1-(1-2V)^{1/2}.$$

For V above this line we have the large V case and for V below this line we have the small V case.

Consider the large V case. From (9) we know that if V is large, $c^T=.5$ is the boundary between the region with a unique all served equilibrium and region with multiple equilibria in a transition economy. Thus, above the line where $\tilde{P}(V)=c^T$ and to the right of $c^T=.5$, we have case b and there are multiple equilbria. To the right of $c^T=.5$,we have case c.

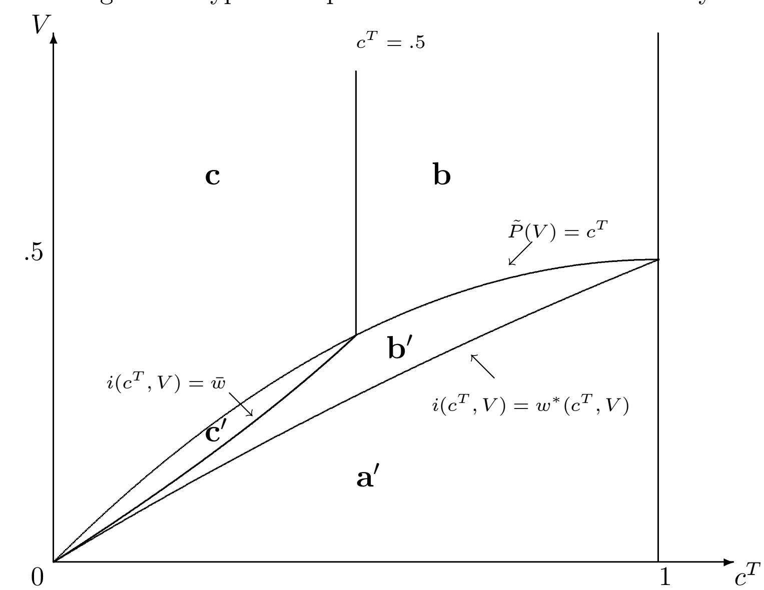
Now consider the small V case. Using (28) and (31) evaluated at $P=c^T$ gives

$$Q^*(c^T,V)=\frac{V}{c^T}-\frac{c^T}{2},$$

[16] A sufficient condition to ensure that we are in the large V case is that $V\geq 1$ since the equilibrium price must always lie below unity.

[17] Ng (1965) argues that such kinks create a rationale for the risk loving behavior by the poor observed in the demand for lottery tickets.

Figure 7: Types of Equilibria in a Transition Economy



and using this and $c^T = \frac{2}{\alpha}$ in (4) gives

$$w^*(c^T, V) = \left(V - \frac{\left(c^T\right)^2}{2} \right)^{1/2}.$$

Using (5) for $\bar{w}$, we can draw the boundaries of the three regions as defined in (27). Setting $i(c^T, V) = \bar{w}$ gives the boundary between the region with a unique all served equilibrium and the region with multiple equilibria. This gives

$$1 + \frac{c^T}{2} - \frac{V}{c^T} = (c^T)^{1/2}.$$

For V above the $i(c^T, V) = \bar{w}$ curve, all of the market is served and this region is denoted by c'.

Similarly, setting $i(c^T, V) = w^*(c^T, V)$ gives the boundary between the region with multiple equilibria and the region with a unique part served equilibrium. This gives

$$1 + \frac{c^T}{2} - \frac{V}{c^T} = (V - \frac{(c^T)^2}{2})^{1/2}.$$

For V below this curve, we are in case a' and only part of the market is served. For V between the $i(c^T, V) = w^*(c^T, V)$ and the the $i(c^T, V) = \bar{w}$ curve, we are in case b'.

Plotting these using MAPLE gives these regions as depicted in Figure 7. Regions labeled b and c correspond to the cases b and c in (9), and regions labeled a', b', and c' to the relevant cases in (27).

Similarly, Figure 8 illustrates possible cases in a developing economy as a function of V and c^D. As before, $\tilde{P}(V) = c^D$ gives the boundary between the large V and the small V regions. Recall that for large V, the boundary between the all served equilibrium and the part served one with rationing is when $c = \frac{1}{2(1+2^{1/2})}$, the vertical line at $c^D = .21$ in Figure 8.

Evaluating (30) and (31) at $P = c^D$ gives

$$Q^*(c^D, V) = \frac{2V}{c^D} - c^D - 1,$$

and using this and $c^D = \frac{1}{2\alpha}$ in (15) gives

$$a^*(c^D, V)) = \frac{1}{2}(1 - 8V + 4\left(c^D\right)^2 + 4c^D)^{1/2}.$$

Evaluating (15) at $Q = 1$ gives

$$\bar{a} = \frac{1}{2}(1 - 4c^D)^{1/2}.$$

Now, we can draw the boundaries of the three regions as defined in (29).

Setting $i(c^D, V) = \bar{a}$ gives the boundary between the region with an all served equilibrium and the region with part served rationing equilibrium. This is given by

$$1 + \frac{c}{2} - \frac{V}{c} = \frac{1}{2}(1 - 4c)^{1/2}.$$

For V above this line, all of the market is served.

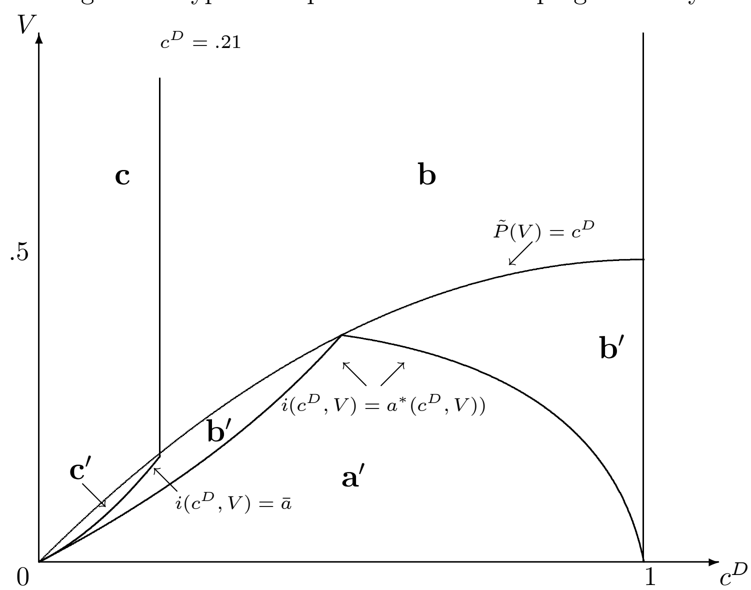
Similarly, setting $i(c^D, V) = a^*(c^D, V))$ gives the boundary between the region with the part served rationing equilibrium and the part served equilibrium without rationing as given by

$$1 + \frac{c}{2} - \frac{V}{c} = \frac{1}{2}\left(1 - 8V + 4c + 4c^2\right)^{1/2}.$$

For V below this boundary there is no rationing.

Note that this boundary is not monotonic because for some V values $i(c^D, V)$ and $a^*(c^D, V))$ intersect twice. Plotting these using MAPLE gives the regions as depicted in Figure 8. Regions labeled b and c correspond to the cases b and c in (17), and regions labeled a', b', and c' to the relevant cases in (29).

Figure 8: Types of Equilibria in a Developing Economy



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