



# Trade Pattern and Economic Development when Endogenous and Exogenous Comparative Advantages Coexist

The Harvard community has made this  
article openly available. [Please share](#) how  
this access benefits you. Your story matters

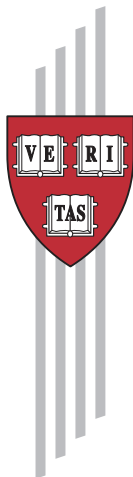
Citation	Sachs, Jeffrey D., Xiaokai Yang, and Dingsheng Zhang. "Trade Pattern and Economic Development when Endogenous and Exogenous Comparative Advantages Coexist." CID Working Paper Series 1999.03, Harvard University, Cambridge, MA, March 1999.
Citable link	<a href="http://nrs.harvard.edu/urn-3:HUL.InstRepos:39297759">http://nrs.harvard.edu/urn-3:HUL.InstRepos:39297759</a>
Terms of Use	This article was downloaded from Harvard University's DASH repository, and is made available under the terms and conditions applicable to Other Posted Material, as set forth at <a href="http://nrs.harvard.edu/urn-3:HUL.InstRepos:dash.current.terms-of-use#LAA">http://nrs.harvard.edu/urn-3:HUL.InstRepos:dash.current.terms-of-use#LAA</a>

**Trade Pattern and Economic  
Development when Endogenous  
and Exogenous Comparative  
Advantages Coexist**

Jeffrey D. Sachs, Xiaokai Yang,  
and Dingsheng Zhang

CID Working Paper No. 3  
March 1999

© Copyright 1999 Jeffrey D. Sachs, Xiaokai Yang, Dingsheng Zhang,  
and the President and Fellows of Harvard College



**Working Papers**

**Center for International Development  
at Harvard University**

## **Trade Pattern and Economic Development when Endogenous and Exogenous Comparative Advantages Coexist**

Jeffrey Sachs, Xiaokai Yang, and Dingsheng Zhang

### **Abstract**

This paper applies the infra-marginal analysis, which is a combination of marginal and total cost-benefit analysis, to a model with both constant returns and increasing returns in production and with exogenous and endogenous comparative advantages. It demonstrates that as transaction conditions are improved, the general equilibrium discontinuously jumps from autarky to partial division of labor with a dual structure, then to the complete division of labor where dual structure disappears. Two types of dual structure may occur in the transitional stage of economic development and globalization. One of them involves the division of labor in the developed economy and autarky in the less developed economy, generating increasing disparity of per capita real income between the two types of economies. The other involves a domestic dual structure in the less developed economy, where the population is divided between commercialized sector which trades with foreign country and self-sufficient sector which is not involved in trade. All gains from trade go to the developed economy. This paper shows that deterioration of a country's terms of trade may concur with an increase of gains that this country receives from trade provided productivity progress from an expanded network of division of labor outpaces the deterioration of terms of trade. In the model with both endogenous and exogenous comparative advantages, a country may exports a good with exogenous comparative disadvantage if endogenous comparative advantage dominates this exogenous comparative disadvantage.

**Keywords:** Trade pattern, dual economy, endogenous comparative advantage, endogenous specialization, division of labor

**JEL codes:** F1, O1

---

**Jeffrey D. Sachs** is the Director of the Center for International Development and the Harvard Institute for International Development, and the Galen L. Stone Professor of International Trade in the Department of Economics. His current research interests include emerging markets, global competitiveness, economic growth and development, transition to a market economy, international financial markets, international macroeconomic policy coordination and macroeconomic policies in developing and developed countries.

**Xiaokai Yang** is a Research Fellow at the Center for International Development. His research interests include equilibrium network of division of labor, endogenous comparative advantages, inframarginal analysis of patterns of trade and economic development.

**Dingsheng Zhang** is Professor of Research Center of Economics, Wuhan University. His current research interests include dual structure in economic development, economic development and income distribution, equilibrium models of monopolistic competition, trade pattern and development strategies.

## **Trade Pattern and Economic Development when Endogenous and Exogenous Comparative Advantages Coexist**

Jeffrey Sachs, Xiaokai Yang, and Dingsheng Zhang

### **1. Introduction**

The purpose of this paper is threefold. First we introduce endogenous comparative advantage into the Ricardo model with exogenous comparative advantage to show that a dual structure with underemployment in a less developed economy can occur as a general equilibrium phenomenon in the transitional stage of economic development. Here, dual economy implies not only unequal distribution of gains from trade between the developed and less developed economies, but also a dual structure of commercialized sector and self-sufficient sector in the less developed economy. Those self-sufficient individuals look like in underemployment. They have low productivity and cannot find jobs to work for the market.

Second, we use inframarginal analysis, which is total cost-benefit analysis across corner solutions in addition to marginal analysis of each corner solution, to show that deteriorated terms of trade for a country may be associated with increasing gains from trade that this country receives if productivity gains generated by expanding network of division of labor more than compensate the deteriorated terms of trade.<sup>1</sup>

---

<sup>1</sup> The essence of the infra-marginal approach can be found in Coase (1946, 1960). Coase (1946) noted “a consumer does not only have to decide whether to consume additional units of a product; he has also to decide whether it is worth his while to consume the product at all rather than spend his money in some other direction” (p.173). Hence, marginal cost pricing is not applicable to a good with increasing returns in production. Buchanan and Stubblebine (1962) introduced the concept of infra-marginal externality which is an early application of the infra-marginal analysis in welfare economics. Formally, the infra-marginal analysis is associated with non-linear or linear programming, while marginal analysis is associated with classical mathematical programming. Other applications of the infra-marginal analysis can be found in Becker (1981), Dixit (1987, 1989), Grossman and Hart (1986), Rosen (1977, 1983) and Yang and Ng (1998).

Finally, we will examine effects of the coexistence of exogenous and endogenous comparative advantages on pattern of trade. Let us motivate the three tasks one by one.

Yang (1994) and Yang and Borland (1991) have drawn the distinction between David Ricardo's exogenous comparative advantage (Ricardo, 1817) and Adam Smith's endogenous comparative advantage (Smith, 1776).<sup>2</sup> There is an extensive literature on exogenous comparative advantage in trade theory (see, for instance, Dixit and Norman, 1980). Separately, there are many models of endogenous comparative advantage in the growing literature on endogenous specialization (see Yang and Ng, 1998 for a recent survey on this literature and references there). The current paper develops a general equilibrium model with both endogenous and exogenous comparative advantages. The coexistence of endogenous and exogenous comparative advantage may provide a general equilibrium mechanism for explaining phenomena of underdevelopment and dual structure with underemployment in a transitional stage of economic development.

Early studies of structural changes and dual structure rely on the assumption of disequilibrium in some markets to predict dual structure and structural changes. For instance, Lewis (1955) assumed disequilibrium in labor market caused by institutional wage. Chenery (1979) used market disequilibrium to explain structural changes. This disequilibrium argument used to explain dual economy and structural changes is still quite popular in the literature of development economics (see, for instance, Khandker and Rashid, 1995, Din, 1996, and Ranis, 1988). Recently, general equilibrium models are used to study dual structure. In some of these models, such as in Khandker and Rashid's equilibrium model (1995), dual structure is

---

<sup>2</sup> Endogenous comparative advantage is associated with economies of specialization and referred to by Grossman and Helpman (1991) as acquired comparative advantage, whereas exogenous comparative advantage is associated with constant returns to scale in production, referred to by them as natural comparative advantage.

exogenously assumed.<sup>3</sup> They cannot predict the emergence and evolution of dual structure. In a recent literature of formal equilibrium models of high development economics, evolution of dual structure between the manufacturing sector with economies of scale in production and the agricultural sector with constant returns to scale can be predicted (see Krugman and Venables, 1995, 1996, and Fujita and Krugman, 1995). The equilibrium models with endogenous geographical location of economic activities of Krugman and Venables (1995) and Baldwin and Venables (1995) attribute the emergence of dual structure to the geographical concentration of economic activities in economic development that marginalizes peripheral areas. Kelly (1997), based on Murphy, Shleifer, and Vishny (1989), develops a dynamic general equilibrium model that predicts spontaneous evolution of a dual structure between the modern sector with economies of scale and the traditional sector with constant returns technology. As transaction conditions are sufficiently improved, the level of division of labor increases and dual structure disappears. Our model in this paper is complementary to these general equilibrium models that predict the emergence and evolution of dual structure. We pay more attention to the effects of evolution of individuals' levels of specialization and the coexistence of exogenous and endogenous comparative advantages on the emergence and evolution of dual structure.<sup>4</sup>

In our model endogenous and exogenous comparative advantages generate pecuniary positive network effects of division of labor on aggregate productivity. The trade off between the network effects and transaction costs implies that if a transaction cost coefficient for a unit of

---

<sup>3</sup> Also, in Dixit's dynamic planning model (1968), the existence of labor surplus is exogenously assumed.

<sup>4</sup> Mokyr (1993, pp. 65-66) documents evolution of individuals' level of specialization during the Industrial Revolution in Britain. This evolution is sometimes referred to as "industrious revolution" which implies that self-provided home production is replaced with commercialized production. Yang, Wang, and Wills (1992) find empirical evidence for this evolution from China's data. A difference in empirical implications generated by the Krugman and Venables model and our model is that the former yields scale effects (productivity of the manufacturing firm increases if and only if its size increases), but the latter does not.

goods traded is large, total transaction cost outweighs economies of division of labor, so that autarky, where aggregate productivity is lower than the PPF, is equilibrium. As transaction conditions are improved, the equilibrium network of trade expands. In the transitional stage from a low to a high level of domestic and international division of labor, the country with lower transaction efficiency is partly involved in the division of labor. Some residents trade with foreign country and the rest of the population are in autarky. This underemployed labor looks like labor surplus that forces down terms of trade of this country, so that all gains from international trade go to the developed country that has a better transaction condition and is completely involved in the division of labor. As the transaction condition in the less developed country is further improved, the equilibrium network of division of labor expands further, the equilibrium aggregate productivity reaches the PPF, and gains from trade are shared by all individuals, so that dual structure disappears.<sup>5</sup>

We shall show that in the process of moving to a high level of division of labor, a country may receive more gains from trade even if its terms of trade deteriorate. This is because an expansion of the network size of division of labor can generate productivity gains that outweigh the adverse effect of the terms of trade deterioration. Many economists try to find empirical evidence for or against the claim that terms of trade are worsening for developing economies or to measure adverse effects of worsening terms of trade on economic development (see, for instance, Morgan, 1970 and Kohli and Werner, 1998). Recent empirical evidence provided by Sen (1998) shows that economic development may concur with deteriorated terms of trade. Sen uses a partial equilibrium model with monopolistic competition, where prices in the world

---

<sup>5</sup> The effects of transaction conditions on economic development are verified by historical evidences documented in North (1958) and by empirical evidences provided in Barro (1997), Easton and Walker (1997), Frye and Shleifer (1997), Gallup and Sachs (1998), Sachs and Warner (1995, 1997).

market are exogenously given, to predict this phenomenon. Hence, his model cannot explore feedback loops between the network size of international division of labor, the extent of the market, aggregate productivity, and terms of trade.<sup>6</sup>

There are two separate literatures on pattern of trade. Standard trade theory explains trade pattern by exogenous technological and endowment advantages in the Ricardo and Heckscher-Olin models with constant returns to scale in production. The literature of trade models with economies of scale are silent about which country exports which good since this makes no difference due to the symmetry assumed in these models (see Krugman, 1980 and Ethier 1982). In the literature of endogenous specialization, trade pattern is explained by endogenous comparative advantage. Individuals trade those goods which have greater economies of specialization, better transaction condition, and/or are more desirable if not all goods are traded (see Yang, 1991). But who sells which good is indeterminate in the models too because of the assumption that all individuals are ex ante identical.

In the current paper, we consider three different systems of production functions. One of them involves economies of specialization for individuals in one country in producing one good and for individuals in the other country in producing the other good.<sup>7</sup> The second of them displays economies of specialization in producing one good and constant returns in producing the other good for all individuals. The third of them exhibits economies of specialization for individuals in one country in producing all goods and constant returns for individuals in the other country in producing all goods. We then study effects of the different combinations of endogenous and exogenous comparative advantages on trade pattern. We shall show that if a

---

<sup>6</sup> Cypher and Dietz (1998) develop a dynamic model to investigate effects of declining terms of trade on economic development in the presence of dynamic comparative advantage.

<sup>7</sup> Panagariya (1983) develops a model with variable returns to scale to reestablish core trade theorems on trade pattern. Kemp (1991), Young (1991), and others examine implications of variable returns to scale for trade too. In these papers, dual structure and underemployment are not considered. Gomory (1994) introduces economies of scale into the Ricardian model. Since he adopts neoclassical dichotomy between consumers' decisions and firms'



country has endogenous comparative advantage and exogenous comparative disadvantage in producing a good, it may export the good with exogenous comparative disadvantage if the endogenous comparative advantage dominates exogenous comparative disadvantage.

The rest of this paper is organized as follows. Section 2 presents the 2x2 Ricardian model with transaction costs and endogenous and exogenous comparative advantages. Section 3 solves for general equilibrium and its inframarginal comparative statics. Section 4 extends the analysis to different combinations of endogenous and exogenous comparative advantages for the two countries and two goods. The concluding section summarizes the findings of the paper and suggests possible extensions.

## 2. A Ricardian Model with Endogenous and Exogenous Comparative Advantages

Consider a world consisting of country 1 and country 2, each with  $M_i$  ( $i=1, 2$ ) consumer-producers. The set of individuals is a continuum. The individuals within a country are assumed to be identical. The utility function for individuals in country  $i$  is

$$(1) \quad U_i = (x_i + k_i x_i^d)^b (y_i + k_i y_i^d)^{1-b}$$

where  $x_i, y_i$  are quantities of goods  $x$  and  $y$  produced for self-consumption,  $x_i^d, y_i^d$  are quantities of the two goods bought from the market, and  $k_i$  is the transaction efficiency coefficient in country  $i$ . The transaction cost is assumed to take the iceberg form: for each unit of good bought, a fraction  $1-k_i$  is lost in transit, the remaining fraction  $k_i$  is received by the buyer.

The production functions for a consumer-producer in country  $i$  are

$$(2a) \quad x_1 + x_1^s = L_{1x}^b, \quad y_1 + y_1^s = L_{1y},$$

$$(2b) \quad x_2 + x_2^s = aL_{2x}, \quad y_2 + y_2^s = L_{2y}^c,$$

where  $x_i^s, y_i^s$  are respective quantities of the two goods sold by a person in country  $i$ ;  $L_{ij}$  is the amount of labor allocated to the production of good  $j$  by an individual in country  $i$ , and  $L_{ix} + L_{iy} = B > 1$ . For simplicity, we assume that  $B = 2$ . It is assumed that  $a, b, c > 1$ . This system of production functions and endowment constraint displays economies of specialization in producing good  $x$  for an individual in country 1 and in producing good  $y$  for an individual in country 2. It exhibits constant returns to specialization for an individual in country 1 to produce good  $y$  and for an individual in country 2 to produce good  $x$ . But an individual in country 2 has a

---

decisions, there are multiple equilibria and equilibrium trade pattern is indeterminate.

higher productivity in producing good x than an individual in country 1 in producing good y. Economies of specialization are individual specific and activity specific, that is they are localized increasing returns, which are compatible with the Walrasian regime.

Suppose that  $b = c = 2$ . If all individuals allocate the same amount of labor to the production of each goods, then an individual in country 1 has the same average labor productivity of goods x and y as an individual in country 2 in producing good y. But the average labor productivity of good x for an individual in country 2 is higher. This is similar to the situation in a Ricardian model with exogenous comparative advantage. Country 1's productivities are not higher than country 2 in producing all goods, but may have exogenous comparative advantage in producing good y. But if an individual in country 1 allocates much more labor to the production of x than an individual in country 2, her productivity is higher than that of the latter. Similarly, if an individual in country 2 allocates more labor to the production of good y than an individual in country 1, her productivity of good y will be higher. This is referred to as endogenous comparative advantage, since individuals' decisions on labor allocation determine difference in productivity between them. But an individual in country 1 has no endogenous comparative advantage in producing good y and an individual in country 2 has no endogenous comparative advantage in producing good x since respective productivities never change, independent of their labor allocation.

The decision problem for an individual in country  $i$  involves deciding on what and how much to produce for self-consumption, to sell and to buy from the market. In other words, the individual chooses six variables  $x_i, x_i^s, x_i^d, y_i, y_i^s, y_i^d \geq 0$ . Hence, there are  $2^6 = 64$  possible corner and interior solutions. As shown by Wen (1998), for such a model, an individual never simultaneously sells and buys the same good, never simultaneously produces and buys the same good, and never sells more than one good. We refer to each individual's choice of what to produce, buy and sell that is consistent with the Wen theorem as a *configuration*.

There are three configurations from which the individuals can choose:

(1) *self sufficiency*. Configuration A, where an individual produces both goods for self-consumption. This configuration is defined by

$$x_i, y_i > 0, x_i^s = x_i^d = y_i^s = y_i^d = 0, i = 1, 2.$$

(2) *specialization in producing good x*. Configuration (x/y), where an individual produces only x, sells x in exchange for y, is defined by

$$x_i, x_i^s, y_i^d > 0, x_i^d = y_i = y_i^s = 0.$$

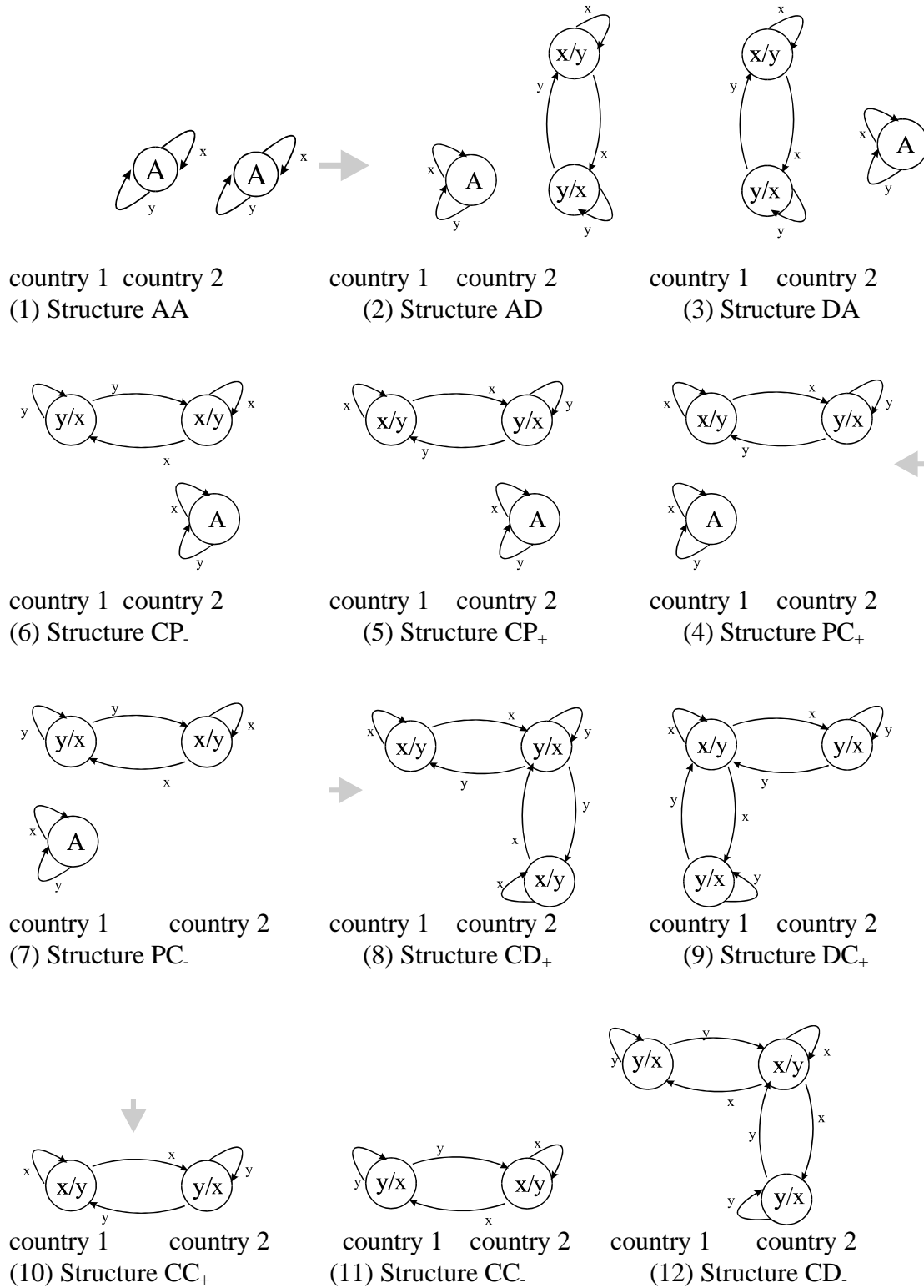
(3) *specialization in producing good y*. Configuration (y/x), where an individual produces only y, sells y in exchange for x, is defined by

$$y_i, y_i^s, x_i^d > 0, y_i^d = x_i = x_i^s = 0.$$

The combination of all individual's configurations constitutes a *market structure*, or *structure* for short. Given the configurations listed above, there are thirteen feasible structures that may satisfy market clearing and other conditions for a general equilibrium.

Structure AA, as shown in panel (1) of Fig. 1, is an autarky structure where individuals in both countries choose self-sufficiency (configuration A). Structure AD, shown in panel (2) of Fig. 1, is asymmetric between the two countries: all individuals in country 1 choose autarky configuration A, while some individuals in country 2 choose configuration (x/y) and others choose configuration (y/x). Hence, there is domestic division of labor and related domestic trade in country 2, but no international division of labor and related international trade. Structure DA is symmetric to structure AD: country 1 has domestic division of labor and country 2 is in autarky. This structure involves a type I dual structure between countries.

Structure PC<sub>+</sub>, shown in panel (4) of Fig. 1, involves a type II dual structure between the two countries as well as in country 1. Some individuals in country 1 choose configuration (x/y), the rest of the population choose autarky, and all individuals in country 2 choose configuration (y/x). There is a dual structure between professional individuals choosing (x/y) and self-sufficient individuals in country 1 despite their ex identical characteristics. The professional individuals in country 1 are involved in international trade with country 2. Structure CP<sub>+</sub> is symmetric to structure PC<sub>+</sub>.



**Figure 1: Configurations and Structures**

Structure  $PC_-$ , shown in panel (6) of Fig. 1, is the same as structure  $PC_+$  except that professional individuals in country 1 choose configuration  $(y/x)$  instead of  $(x/y)$  and individuals in country 2 choose configuration  $(x/y)$  instead of  $(y/x)$ . Structure  $CP_-$  is the same as structure  $CP_+$  except that individuals in country 1 choose configuration  $(y/x)$  instead of  $(x/y)$  and professional individuals in country 2 choose configuration  $(x/y)$  instead of  $(y/x)$ .

Structure  $DC_+$ , shown in panel (9), is the same as structure  $PC_+$  except that those individuals choosing autarky in country 1 in structure  $PC_+$  choose configuration  $(y/x)$  instead in structure  $DC_+$ . Hence, in structure  $DC_+$  all individuals completely specialize, but country 1 is involved in both domestic and international trade, whereas country 2 is involved only in international trade. Also, country 1 exports good  $x$  and country 2 exports good  $y$ . Structure  $DC_-$  is the same as structure  $DC_+$  except that country 1 exports good  $y$  instead of good  $x$  and country 2 exports good  $x$  instead good  $y$ .

Structure  $CD_+$ , shown in panel (8) of Fig. 1, is symmetric to structure  $DC_+$ : country 1 has only international trade whereas country 2 has both international and domestic trade, and country 1 exports good  $x$  and country 2 exports good  $y$ . Structure  $CD_-$  is the same as  $CD_+$  except that country 1 exports good  $y$  instead of  $x$ ; country 2 exports good  $x$  instead of  $y$ .

Structure  $CC_+$ , shown in panel (10) of Fig. 1, is international complete division of labor between two countries in which all individuals in country 1 choose configuration  $(x/y)$  and all individuals in country 2 choose configuration  $(y/x)$ . Structure  $CC_-$  is symmetric to structure  $CC_+$ : all individuals in country 1 choose configuration  $(y/x)$  and all individuals in country 2 choose configuration  $(x/y)$ .

### **3. General Equilibrium and Its Inframarginal Comparative Statics**

According to Zhou, Sun, and Yang (1998), a general equilibrium exists and is Pareto optimal for the kind of the models in this paper under the assumptions that the set of individuals is a continuum, preferences are strictly increasing and rational; both local increasing returns and constant returns are allowed in production and transactions. Also, the set of equilibrium allocations is equivalent to the set of core allocations. An equilibrium is defined as a relative price of the two goods and all individuals' labor allocations and trade plans, such that

- (a) Each individual maximizes her utility, that is, the consumption bundle generated by her labor allocation and trade plan maximizes utility function (1) for given  $p$ .
- (b) All markets clear.

We assume that the measure of type 1 persons is  $M_1$ , that of type 2 persons is  $M_2$ , and  $M_1 + M_2 = 1$ . For simplicity, let  $M_1 = M_2 = 0.5$  and  $\beta = 0.5$ . Let the number (measure) of individuals in country  $i$  choosing configuration (x/y) be  $M_{ix}$ , that choosing (y/x) be  $M_{iy}$ , and that choosing A be  $M_{iA}$ .

Since the interior solution is never optimal in this model of endogenous specialization and there are many structures based on corner solutions, we cannot use standard marginal analysis to solve for a general equilibrium. We adopt a two step approach to solving for a general equilibrium. In the first step, we consider a structure. Each individual's utility maximizing decision is solved for the given structure. Utility equalization condition between individuals choosing different configurations in the same country and market clearing condition are used to solve the relative price of traded goods and numbers (measure) of individuals choosing different configurations. The relative price and numbers, and associated resource allocation are referred to as a corner equilibrium for this structure.

According to the definition, a general equilibrium is a corner equilibrium in which all individuals have no incentive to deviate, under the corner equilibrium relative price, from their chosen configurations. Hence, in the second step, we can plug the corner equilibrium relative price into the indirect utility function for each constituent configuration in this structure, then compare corner equilibrium values of utility across those configurations and the configurations in other structures. The comparisons are called total cost-benefit analysis which yields the conditions under which the corner equilibrium utility in each constituent configuration of this structure is not smaller than any alternative configuration. This system of inequalities can thus be used to identify a subspace of parameter space within which this corner equilibrium is a general equilibrium.

With the existence theorem of general equilibrium proved by Zhou, Sun, and Yang (1998), we can completely partition the parameter space into subspaces, within each of which the corner equilibrium in a structure is a general equilibrium. As parameter values shift between the subspaces, the general equilibrium will discontinuously jump between structures. The

discontinuous jumps of structure and all endogenous variables are called inframarginal comparative statics of general equilibrium.

We now take the first step of the inframarginal analysis. As an example, we consider structure  $CP_+$ . Assume that in this structure,  $M_{2y}$  individuals choose configuration (y/x) and  $M_{2A}$  individuals choose autarky in country 2, where  $M_{2y} + M_{2A} = M_2 = 0.5$ .  $M_1 = 0.5$  individuals in country 1 choose configuration (x/y). Since all individuals in the same country are ex ante identical in all aspects (the same utility and production functions, the same transaction condition, and the same endowment), the maximum utilities in configurations A and (y/x) must be the same in country 2 in equilibrium. Marginal analysis of the decision problem for an individual in country 2 choosing autarky yields the maximum utility in configuration A:  $U_{2A} = (a2^{c+1}\gamma)^{0.5}$ , where  $\gamma \equiv c^c/(c+1)^{c+1}$ . Marginal analysis of the decision problem for an individual in country 2 choosing configuration (y/x) yields the demand function  $x_2^d = 2^{c-1}/p$  the supply function  $y_2^s = 2^{c-1}$  and indirect utility function:  $U_{2y} = 2^{c-1}(k_2/p)^{0.5}$ . The utility equalization condition  $U_{2y} = U_{2A}$  yields  $p \equiv p_x/p_y = k_2 2^{c-3}/a\gamma$ . Similarly, the marginal analysis of the decision problem of an individual choosing configuration (x/y) in country 1 yields the demand function,  $y_1^d = 2^{b-1}/p$ , the supply function  $x_1^s = 2^{b-1}$ , and indirect utility function:  $U_{1x} = 2^{b-1}(k_1p)^{0.5}$ . Inserting the corner equilibrium relative price into the market clearing condition for good x,  $M_1 x_1^s = M_{2y} x_2^d$ , yields the number of individuals selling good y,  $M_{2y} = 0.5 k_2/2^{3-c} a\gamma$ , where  $M_1 = 0.5$  by assumption. Indirect utility functions for individuals choosing various configurations in the two countries are listed in Table 1.

**Table 1: Indirect Utility Functions**

Configurations	Indirect utility functions		
	(x/y)	(y/x)	A
Country 1	$U_{1x} = 2^{b-1} (k_1 p)^{0.5}$	$U_{1y} = (k_1/p)^{0.5}$	$U_{1A} = (2^{b+1}\gamma)^{0.5}$
Country 2	$U_{2x} = a(k_2 p)^{0.5}$	$U_{2y} = 2^{c-1}(k_2/p)^{0.5}$	$U_{2A} = (2^{c+1}a\gamma)^{0.5}$

Following this procedure, we can solve for corner equilibrium in each structure. The solutions of all corner equilibria are summarized in Table 2. Then we can take the second step to carry out total cost-benefit analysis for each corner equilibrium and to identify the parameter

subspace within which the corner equilibrium is a general equilibrium. Consider the corner equilibrium in structure  $CP_+$  as an example again.

**Table 2: Corner Equilibria**

Structure	Relative price of x to y	Numbers of individuals choosing various configurations
AA		$M_{1A} = M_{2A} = 0.5$
AD	$2^{c-1}/a$	$M_{1A} = 0.5, M_{2x} = M_{2y} = 1/4$
DA	$2^{1-b}$	$M_{2A} = 0.5, M_{1x} = M_{1y} = 1/4$
$PC_+$	$2^{3-b}\alpha/k_1$	$M_{2y} = 0.5, M_{1A} = 0.5(1 - k_1 2^{c-3}/\alpha), M_{1x} = 0.5k_1 2^{c-3}/\alpha$
$CP_+$	$2^{c-3}k_2/\gamma a$	$M_{1x} = 0.5, M_{2A} = 0.5(1 - k_2 2^{b-3}/\gamma a), M_{2y} = 0.5k_2 2^{b-3}/\gamma a$
$CP_-$	$2^{c+1}\gamma/ak_2$	$M_{1y} = 0.5, M_{2x} = 0.5k_2 2^{-c-1}/\gamma, M_{2A} = 0.5(1 - k_2 2^{-c-1}/\gamma)$
$CC_+$	$2^{c-b}$	$M_{1x} = M_{2y} = 1/2$
$CD_+$	$2^{c-1}/a$	$M_{1x} = 0.5, M_{2y} = (1+2^{b-1}/a)/4, M_{2x} = (1-2^{b-1}/a)/4$
$CD_-$	$2^{c-1}/a$	$M_{1y} = 0.5, M_{2x} = 0.25+2^{-c-1}, M_{2y} = 0.25-2^{-c-1}$

In this structure  $M_1$  individuals choose configuration (x/y) in country 1, and  $M_{2y}$  individuals choose configuration (y/x) and  $M_{2A}$  individuals choose autarky in country 2. For an individual in country 1, equilibrium requires that her utility in configuration (x/y) is not smaller than in configurations (y/x) and A under the corner equilibrium relative price in structure  $CP_+$ . Also equilibrium requires that all individuals in country 2 are indifferent between configurations (y/x) and A and receive a utility level that is not lower than in configuration (x/y). In addition, this structure occurs in equilibrium only if  $M_{2y} \in (0, 0.5)$ . All the conditions imply

$$U_{1x} \geq U_{1y}, \quad U_{1x} \geq U_{1A}, \quad U_{2A} = U_{2y} \geq U_{2x}, \quad M_{2y} \in (0, 0.5),$$

where indirect utility functions in different configurations and corner equilibrium relative price are given in Tables 1 and 2. The conditions define a parameter subspace:

$$k_1 k_2 \geq 2^{6-b-c} a \alpha \gamma, \quad k_2 \in (2^{4-b-c} a \gamma, \text{Min}\{4\gamma, a \gamma 2^{3-b}\}), \quad a < 2^{4-b-c}, \quad k_1 > \text{Max}\{2^{4-b-c} a \alpha, \alpha 2^{3-c}\},$$

where  $\alpha \equiv b^b / (1+b)^{b+1}$  and  $\gamma \equiv c^c / (c+1)^{c+1}$ . Within this parameter subspace, the corner equilibrium in structure  $CP_+$  is the general equilibrium. Following this procedure, we can do total cost-benefit analysis for each structure. The total cost-benefit analysis in the second step and marginal analysis of each corner equilibrium in the first step yields inframarginal comparative statics of general equilibrium, summarized in Table 3. From this Table, we can see that the parameter subspace for structure  $DC_+$ ,  $DC_-$ , or  $CC_-$  to occur in general equilibrium is empty.



**Table 3: General Equilibrium Structure: Inframarginal Comparative Statics**

	$k_2 \in (0, 4\gamma)$			$k_2 \in (4\gamma, 1)$		
$k_1 \in (0, 4\alpha)$	$a < 2^{b+c-2}$		$a > 2^{b+c-2}$	$a < 2^{b+c-2}$		$a > 2^{b+c-2}$
	$k_1 k_2 < \alpha \gamma 2^{6-b-c}$	$k_1 k_2 > \alpha \gamma 2^{6-b-c}$		$k_1 k_2 < \alpha \gamma 2^{b+c+2}/a$	$a < 2^{b-1}$	$a > 2^{b-1}$
	AA	$a < 2^{b-1}$	$a > 2^{b-1}$	AA	$k_1 < \alpha \alpha 2^{4-b-c}$	
					AD	
	$k_1 < \alpha 2^{3-c}$	CP <sub>+</sub>		$k_1 \in (\alpha \alpha 2^{4-b-c}, \alpha 2^{3-c})$	$k_1 > \alpha \alpha 2^{4-b-c}$	$k_1 \in (\alpha 2^{b+c}/a, 4\alpha)$
	PC <sub>+</sub>			PC <sub>+</sub>	CD <sub>+</sub>	CD <sub>-</sub>
	$k_2 < \alpha \gamma 2^{3-b}$			$k_1 k_2 > \alpha \gamma 2^{b+c+2}/a$		
	$k_1 > \alpha 2^{3-c}$		CP <sub>-</sub>	$k_1 > \alpha 2^{3-c}$		
	$k_2 > \alpha \gamma 2^{3-b}$			CC <sub>+</sub>		
$k_1 \in (4\alpha, 1)$	$a < 2^{b-1}$	$a > 2^{b-1}$	$k_2 < \gamma 2^{b+c}/a$	$a < 2^{b-1}$	$a > 2^{b-1}$	CD <sub>-</sub>
	$k_2 < \alpha \gamma 2^{4-b-c}$		DA	DA		
	$k_2 \in (\alpha \gamma 2^{4-b-c}, \alpha \gamma 2^{3-b})$	$k_2 > \alpha \gamma 2^{4-b-c}$	$k_2 > \gamma 2^{b+c}/a$			
	CP <sub>+</sub>	CP <sub>+</sub>	CD <sub>-</sub>	CC <sub>+</sub>	CD <sub>+</sub>	
	$k_2 > \alpha \gamma 2^{3-b}$					
	CC <sub>+</sub>					

where  $\alpha \equiv b^b / (1+b)^{b+1}$ ,  $\gamma \equiv c^c / (1+c)^{c+1}$ . C stands for complete specialization in a country, D stands for the domestic division of labor in a country, A stands for autarky in a country, P stands for the partial division of labor where the population is divided between autarky and specialization in a country, subscript + stands for a pattern of trade in which country 1 exports good x and imports good y, and subscript - stands for a trade pattern in which country 1 exports good y and imports good x. Hence, structure AA involves autarky in both countries, structures AD and DA involve autarky in one country and division of labor in the other, structures PC and CP involve complete specialization in one country and coexistence of autarky and complete specialization in the other. The country with the lower transaction efficiency in this structure looks like underdeveloped in the sense that it receives none of gains from trade and income differential between it and the other country with higher transaction efficiency increases as a result of a shift of equilibrium from autarky to this structure. Also, ex ante identical individuals in the less developed country in this structure are divided between a professional occupation that trades with the foreign country and those who are self-sufficient and not involved in commercialized production. These self-sufficient individuals look like in underemployment since

they cannot find a job to work for the market. All individuals completely specialize in structures CD and CC. But CC involves complete specialization of both countries in the absence of domestic trade, whereas CD involves complete specialization in country 1 and domestic division of labor in country 2. Figure 1 illustrates the equilibrium structures.<sup>8</sup> We say the level of division of labor increases if occurrence of letter A or P decreases or the occurrence of letter D or C increases in a structure.

In order to accurately describe the inframarginal comparative statics, we define endogenous comparative advantage as productivity difference between individuals that is caused by individuals' labor allocations and define exogenous comparative advantage as productivity difference between individuals that is independent of labor allocation. Since marginal and average productivity never changes as labor allocation alters for a production function with constant returns to scale, these definitions imply that endogenous comparative advantages come from economies of specialization and exogenous comparative advantages come from exogenous difference of production conditions with constant returns. Parameter  $b$  represents the degree of endogenous comparative advantage for a person in country 1 producing good  $x$  since as  $b$  increases, increases in productivity become more responsive to an increase in the amount of labor allocated to its production. Similarly,  $c$  represents the degree of endogenous comparative advantage for a person in country 2 producing good  $y$ .

If  $b=c=1$ , then country 2 has exogenous absolute and comparative advantage in producing good  $x$  and country 1 has exogenous comparative advantage in producing good  $y$  since  $a > 1$  in (2). This implies that  $a$  represents the degree of exogenous comparative advantage.

With the definitions, we can now have a close examination of Table 3 which consists of four blocks. The northwest block is associated with low transaction efficiencies in both countries. The north-east block is associated with low transaction efficiency in country 1 and high transaction efficiency in country 2. The southwest block is associated with low transaction efficiency in country 2 and high transaction efficiency in country 1. The southeast block is associated with high transaction efficiencies in both countries. As parameter values move from the north-west toward the south east, the occurrence of letter A representing autarky and letter P representing partial division of labor decreases and the occurrence of letters D and C representing

---

<sup>8</sup> It can be shown that there are multiple equilibria in some razor edge cases. For instance, if  $2^{b-1} > a$ ,  $0 < k_1 < 4\alpha$ ,  $k_1 <$

complete division of labor increases. Hence, as transaction conditions are improved, the level of domestic and international division of labor increases because of the trade off between economies of division of labor generated by endogenous and exogenous comparative advantages and transaction costs. If the transaction efficiency is low in one country and high in the other (northeast or southwest block), the country with the lower transaction efficiency has a dual structure (P) or in autarky (A) in a structure with asymmetric division of labor between countries (AD, DA, PC, or CP). If the transaction efficiencies are high in both countries, then complete division of labor occurs and dual structure disappears in equilibrium.

Each block consists of three sections. If the degree of exogenous comparative advantage  $a$  is small compared to the degree of endogenous comparative advantage ( $b, c$ ), each country exports the good with economies of specialization in production. This is denoted by subscript +. Otherwise, a country exports the good with constant returns and exogenous comparative advantage.

All the results on evolution of division of labor, dual structure, and trade pattern are summarized in the following proposition, illustrated in Fig. 1 where large arrows indicate the direction of the evolution in division of labor.

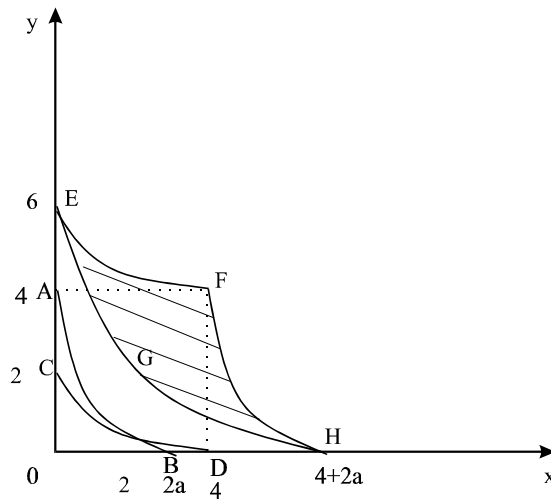
**Proposition 1: As transaction efficiency increases from a very low to a very high level, the equilibrium level of domestic and international division of labor increases from complete autarky in both countries to the complete division of labor in both countries. In the transitional stage, two types of dual structure may occur. In a type I dual structure the country with the lower transaction efficiency is in autarky and the other has domestic division of labor and higher productivity and per capita real income. In a type 2 dual structure, the country with higher transaction efficiency completely specializes and obtains all of gains from trade, the other country has a domestic dual structure between commercialized sector and self-sufficient sector (autarky) which looks like in underemployment. The dual structures of two types disappear as individuals in all countries are involved in international and domestic division of labor. Each country exports goods of exogenous comparative advantage if exogenous comparative advantage**

---

$a\alpha 2^{4-b-c}, k_2 = 4\gamma$ , multiple equilibria occur.

**dominates endogenous comparative advantage in producing this good. Otherwise, each country exports goods with endogenous comparative advantage and economies of specialization in production.**

The inframarginal comparative statics of general equilibrium can be used to establish two corollaries. The first is that evolution in division of labor generated by improvements in transaction conditions will raise equilibrium aggregate productivity. In order to establish the above statement, we consider the aggregate PPF for individual 1 (from country 1) and individual 2 (from country 2). As shown in Fig. 2 where  $b = c = 2$ , the PPF for individual 1 is curve AB, that for individual 2 is curve CD. In autarky, the two persons' optimum decisions for taste parameter  $\beta \in (0, 1)$  are  $x_1 = [4\beta/(1+\beta)]^2$ ,  $x_2 = 2a\beta/(2-\beta)$ ,  $y_1 = 2(1-\beta)/(1+\beta)$ ,  $y_2 = [4(1-\beta)/(2-\beta)]^2$ . Let  $\beta$  change from 0 to 1; we can calculate values of  $Y = y_1 + y_2$  and  $X = x_1 + x_2$  as functions of  $\beta$ . The values of  $X$  and  $Y$  for different values of  $\beta$  constitute curve EGH in Fig. 2. The equilibrium aggregate production schedule in structure AA is a point on the curve, dependent on value of  $\beta$ . But the aggregate PPF for the two individuals is the curve EFH. Since in structure CC, CD, or DC the equilibrium production schedule is point F which is on the aggregate PPF, the aggregate productivity in a structure with the complete division of labor is higher than in structure AA. The difference between EFH and EGH can be considered as economies of division of labor.



**Figure 2: Economies of Division of Labor Based on Endogenous and Exogenous Comparative Advantage**

Following the same reasoning, we can prove that the equilibrium aggregate productivity in structure AD, DA, PC, or CP is lower than the PPF. Hence, proposition 1 implies that as transaction efficiencies are improved, the equilibrium level of division of labor and equilibrium aggregate productivity increase side by side.

The second corollary is that deterioration of a country's terms of trade and increase of gains received by this country from trade may concur. Suppose that the initial values of parameters satisfy  $k_1 \in (0, 4\alpha)$ ,  $k_2 \in (0, 4\gamma)$ , and  $k_1 k_2 > a\gamma\alpha 2^{6-b-c}$ , which implies, from Table 3, we are considering northwest block. Suppose that the initial value of  $k_2$  satisfies  $k_2' < a\gamma 2^{3-c}$ , so that the equilibrium structure is  $CP_+$  in which country 2 exports  $y$  and imports  $x$  and its terms of trade, from Table 2, is  $1/p = 2^{c-3} a\gamma/k_2'$ . Now, the value of  $k_2$  increases to  $k_2'' > a\gamma 2^{3-c}$ , which implies, from Table 3, the general equilibrium jumps from  $CP_+$  to structure  $CC_+$  in which country 2's terms of trade, from Table 2, is  $2^{b-c}$ . It can then be shown that country 2's terms of trade deteriorate as a result of the change in  $k_2$ . But this shift of the equilibrium from  $CP_+$  to  $CC_+$  increases utility of each individual in country 2 from autarky level. This has established the claim that the deterioration of a country's terms of trade may concur with an increase of gains that this country receives from trade. There are other parameter subspaces within which changes in parameters may generate concurrence of the deterioration of one country's terms of trade and an increase in its gains from trade.

Although an equilibrium in this model is always Pareto optimal, it generates interesting implications of economic development and trade for income distribution. It is straightforward that as the equilibrium jumps from a structure in which at least some individuals in a country are in autarky (structure AD, DA, PC, CP) to a structure in which all individuals are involved in trade and division of labor, all individuals' utilities in this country will be increased. Hence, immiserizing development never occur for a less developed economy in our model since all individuals in our model of endogenous specialization can choose occupation configurations, they will not choose trade if autarky is better off.<sup>9</sup> But effects of trade and development on utility of an individual in the developed economy are not monotonic. As the equilibrium jumps from

---

<sup>9</sup> This differentiates our model from Krugman and Venables (1995) which predicts a decline of real income in the less developed economy in the early development stage.

autarky to the partial division of labor (AD, DA, PC, or CP), the developed country gets all gains from trade and development. But as the equilibrium jumps, say from  $PC_+$  to  $CC_+$ , it is possible that utility of a person in the developed country may decline. It can be shown that this takes place within the parameter subspace in the southwest block in Table 3. This prediction is consistent with the fact, documented in Krugman and Venables (1995, pp. 857-58), that in the 1970s the general view was that integration of world markets produced a rise in the living standards of rich nations at the expense of the poor, but in the 1990s, it is believed that the rise of Third World manufacturing nations has serious adverse impacts on developed economies. But according to our model, this reverse of tide is just compensation to the less developed economies which did not receive gains from trade in the early development stage. Also, in our model there exists some parameter subspace within which such immiserizing development never occurs. This is the case when the improvements in the transaction efficiency of the developed country keep the pace of the improvements of the transaction efficiency of the less developed country (for instance in the northeast block of Table 3).

This corollary generates the following policy implications. In the transitional stage of economic development and globalization, the terms of trade are against the less developed country that has relatively low transaction efficiency: the less developed country receives autarky utility and all gains from trade go to the developed country. There are two policies to change this inferior position. One is to impose tariff to improve terms of trade and the other is to improve transaction condition to expand network of trade. The former is to increase share of gains received by the less developed country from a shrunk pie because of the deadweight caused by tariff. The latter is to get greater share of gains from trade by enlarging the pie. The expanded network of division of labor can generate productivity gains. As long as productivity improvements outpace the deterioration of terms of trade, the less developed country can receive more gains from trade not only because of productivity gains, but also because of more equal division of gains from trade between the countries as all individuals are involved in the international and domestic division of labor.

The inframarginal comparative statics in Table 3 can be used to address a recent debate on competitiveness between Krugman (1994a, b), on the one hand, and Sachs (1996b, c) and Prestowitz (1994) on the other. Krugman (1994a, b) argued that a nation should focus on

promoting free trade and that the emphasis on international competitiveness can be “a dangerous obsession”. Sachs (1996b, c) and Prestowitz. (1994) contended that international competitiveness plays an essential role in improving national welfare. Our results show that absolute level of transaction efficiency affects a country’s performance of development and trade. A country with low transaction efficiency cannot receive gains from trade in the transitional stage of economic development. From the northwest block of Table 3, we can also see that if the degree of economies of specialization in country 1,  $b$  which negatively relates to  $\alpha$ , is small, relative to  $c$  which negatively relates to  $\gamma$ , or  $k_1 < \alpha 2^{3-c}$ , structure PC is the equilibrium where this country is in an inferior position in the transitional stage. If  $c$  is small relative to  $b$ , or  $k_2 < a\gamma 2^{3-b}$ , structure CP occurs in equilibrium where country 2 is in an inferior position in the transitional state. If we interpret absolute level of transaction efficiency and degree of economies of specialization for a country in producing a good as degree of competitiveness, our results support the view of Sachs (1996b, c) and Prestowitz (1994) that competitiveness matters. However, the proposition also supports Krugman’s (1994) argument that a country should focus on promoting free trade and improving transaction efficiency. In our model, the promotion of free trade can be done through reducing tariff and non-tariff barriers of trade so as to improve transaction efficiency  $k$ . And Krugman’s emphasis on trade liberalization is particularly relevant if the pursuit of international competitiveness is used as an excuse for impeding free trade.

#### 4. Other Combinations of Endogenous and Exogenous Comparative Advantages

Since the inframarginal comparative statics change with the specification of the system of production functions, we report the sensitivity analysis of our result. The system of production functions in (2) displays economies of specialization in producing good  $x$  by a person in country 1 and in producing good  $y$  by a person in country 2. We now assume that there are economies of specialization for all individuals in producing  $x$ , but constant returns prevail in the production of good  $y$ . Hence, the system of production functions in (2) is replaced by

$$\begin{aligned} x_1 + x_1^s &= L_{1x}^b, & y_1 + y_1^s &= L_{1y}, \\ x_2 + x_2^s &= L_{2x}^c, & y_2 + y_2^s &= aL_{2y}, \end{aligned}$$

Then the inframarginal comparative statics of general equilibrium are summarized in Table 4.

**Table 4: Equilibrium Structure (economies of specialization in producing one good for all countries)**

	$k_2 \in (0, 4\gamma)$		$k_2 \in (4\gamma, 1)$			
$k_1 \in (0, 4\alpha)$	$a > 2^{c-b}$		$a < 2^{c-b}$			
	$k_1 k_2 < \alpha \gamma 2^{c-b+4}/a$ AA	$k_1 k_2 > \alpha \gamma 2^{c-b+4}/a$ CP <sub>+</sub>	$k_1 k_2 < a\alpha \gamma 2^{4+b-c}$ AA	$2^{c-b} > 1$ $k_1 < \alpha 2^{2+c-b}/a$	$2^{c-b} < 1$ AD	$k_1 < a\alpha 2^{2+b-c}$ AD
			$k_1 k_2 > a\alpha \gamma 2^{4+b-c}$ CP <sub>-</sub>	$k_1 > \alpha 2^{2+c-b}/a$ CD <sub>+</sub>	$k_1 > \alpha 2^{2+c-b}/a$ CC <sub>+</sub>	$k_1 > a\alpha 2^{2+b-c}$ CD <sub>-</sub>
$k_1 \in (4\alpha, 1)$	$k_2 < \gamma 2^{2+b-c}/a$ DA	$k_2 < a\gamma 2^{2+b-c}$ DA	$2^{c-b} > 1$	$2^{c-b} < 1$	CD <sub>-</sub>	
	$k_2 > \gamma 2^{2+b-c}/a$ CP <sub>+</sub>	$k_2 > a\gamma 2^{2+b-c}$ CP <sub>-</sub>	CD <sub>+</sub>	CC <sub>+</sub>		

where  $\alpha \equiv b^b / (1+b)^{b+1}$ ,  $\gamma \equiv c^c / (1+c)^{c+1}$ . The result yields the following proposition.

**Proposition 2: As transaction efficiency is improved, the equilibrium level of division of labor and aggregate productivity increase. The country with lower transaction efficiency and/or insignificant economies of specialization has a dual structure with underemployment in the transitional stage of the economic development. If a country has endogenous comparative advantage and exogenous comparative disadvantage in producing a good, it exports this good if the former dominates the latter. Otherwise it imports this good.**

This proposition can provide a theoretical explanation for recent empirical evidence that shows significant effects of geographical conditions on a country's performance of development and trade. Gallup and Sachs (1998) use cross country and cross region data to have shown that the countries with favorable geographical conditions for transportation have better development performance. They have also shown that the countries in the temperate regions outperform those in the tropic regions. According to them, this is because the geographical conditions in the tropic regions adversely affect health and production conditions. This is equivalent to a small value of productivity parameter  $a$ ,  $b$ , or  $c$ . Our theory shows that this will put the countries in the tropic regions in an inferior position in economic development and trade. This analysis is different from Krugman (1980), Fujita and Krugman (1995), and Yang (1991) who explain economic



development, structural changes, and trade pattern by economic changes in the absence of ex ante differences between decision makers. It is different from conventional trade theory and development economics concerning only exogenous comparative advantages. We explain complicated development and trade phenomena by the coexistence of endogenous and exogenous comparative advantages.

If we assume that there are economies of specialization only for individuals in country 1 in producing two goods, whereas constant returns prevail in country 2 in producing the two goods, the system of production functions is then:

$$\begin{aligned} x_1 + x_1^s &= L_{1x}^b, & y_1 + y_1^s &= L_{1y}^c, \\ x_2 + x_2^s &= aL_{2x}, & y_2 + y_2^s &= L_{2y}, \end{aligned}$$

The inframarginal comparative statics of general equilibrium are summarized in Table 5. The result is consistent with propositions 1 and 2 except that the evolution of division of labor is more sensitive to the transaction efficiency in the country that has economies of specialization in producing all goods than to that in the country with constant returns technologies. Also, structures  $DC_+$  and  $CC_-$ , which never occur in equilibrium in Tables 3 and 4, may now occur in equilibrium.

**Table 5: Equilibrium Structure (economies of specialization for country 1 to produce all goods)**

	$k_2 < 1$			$k_2 = 1$			
$k_1 \in (0, 4\theta)$	$a > 2^{b-c}$		$a < 2^{b-c}$	$a > 2^{b-c}$		$a < 2^{b-c}$	
	$k_1 k_2 < \theta 2^{b-c+2}/a$	$k_1 k_2 > \theta 2^{b-c+2}/a$		$k_1 k_2 < a\theta 2^{c-b+2}$	$a > 2^{b-1}$	$a < 2^{b-1}$	
	AA	$a > 2^{b-1}$	$a < 2^{b-1}$	AA	AD		AD
		$k_1 < \theta 2^{b+1}/a$	$CP_+$	$k_1 k_2 > a\theta 2^{c-b+2}$	$k_1 \in (\theta 2^{c-b+2}/a, \theta 2^{b+1}/a)$	$k_1 > \theta 2^{c-b+2}/a$	$k_1 > a\theta 2^{c-b+2}$
$k_2 < 2^{1-c}$		PC <sub>-</sub>					
$k_1 > \theta 2^{b+1}/a$ $k_2 > 2^{1-c}$	CC <sub>-</sub>	PC <sub>+</sub>	CC <sub>-</sub>	PC <sub>-</sub>	PC <sub>+</sub>		
$k_1 \in (4\theta, 1)$	$a > 2^{b-1}$	$a < 2^{b-1}$	$k_2 < a 2^{c-b}$	$a > 2^{b-1}$	$a < 2^{b-1}$	$DC_+$	
	$k_2 < 2^{b-c}/a$						DA
	$k_2 \in (2^{b-c}/a, 2^{1-c})$		$k_2 > 2^{b-c}/a$	$k_2 > a 2^{c-b}$	CC <sub>-</sub>		DC <sub>-</sub>
	$k_2 > 2^{1-c}$						

where  $\theta \equiv b^b c^c / (b+c)^{b+c}$ .

## 5. Conclusion

In this paper, we have studied a general equilibrium 2x2 Ricardian model using the infra-marginal analysis. Departing from the neoclassical paradigm where individuals' levels of specialization are not endogenized, we explain international and domestic trade by individuals' choices of their levels and patterns of specialization. We provide a general equilibrium mechanism for the phenomena of underdevelopment and dual structure with underemployment in the less developed economy in the transitional stage of economic development. If transaction efficiencies in all countries are low, domestic and international autarky occurs in equilibrium. As the transaction efficiency in the developed country is improved, the equilibrium shifts to type I dual structure where there is domestic division of labor in the developed economy and the less developed economy stays in autarky. As the transaction efficiencies are further improved, type II dual structure occurs in equilibrium where each individual in the developed country completely relies on international trade and some individuals in the less developed country are involved in international trade and the rest of the population are in autarky. All gains from international trade go to the developed country. This dual structure is generated by the difference in transaction conditions between the developed and less developed countries. The relatively low transaction efficiency in the less developed country implies that not all home residents can be involved in the division of labor, so that their low productivity and per capita real income forces down average per capita real income and generates inferior terms of trade. As the transaction efficiency in the less developed country is sufficiently improved, the equilibrium network of domestic and international division of labor expands, so that aggregate productivity increases and more gains from trade are created and shared by all individuals. Hence, the less developed country will receive more gains from trade even if terms of trade deteriorate. Two types of dual structure disappear as the transitional stage is over due to further improvements in transaction conditions.

A logical extension of this paper is to add more goods and/or more countries and introduce tariff into the Ricardian model. More structures may then occur in equilibrium and therefore much richer equilibrium mechanisms for structural changes and dual structure in the development process can be investigated. Also, we may assume that there are two groups of ex ante different individuals in each country. Then effects of globalization on domestic income

distribution can be investigated using the extended models. From the results in this paper, we might speculate that in such an extended model, in the transitional stage of economic development, increasing trade dependence may generate dual structure and increase inequality of income distribution in a less developed economy. But significant further improvements of transaction conditions will expand network of division of labor and increase aggregate productivity, thereby creating greater scope for reducing inequality of income distribution.<sup>10</sup>

---

<sup>10</sup> Recent research on effects of international trade on domestic income distribution can be found, for instance, from Grossman (1998), Krugman (1995), Feenstra (1998), Williamson (1998), and Sachs (1996a).

## References

- Baldwin, Richard E and Venables, Anthony J. (1995), "Regional Economic Integration," in Grossman, Gene M. Rogoff, Kenneth, eds., *Handbook of International Economics*. Volume 3. Amsterdam; New York and Oxford: Elsevier, North-Holland.
- Barro, R. (1997), *Determinants of Economic Growth*, Cambridge, MA, MIT Press.
- Becker, Gary (1981), *A Treatise on the Family*, Cambridge, Massachusetts, Harvard University Press.
- Buchanan, James M. and Stubblebine, W. Craig (1962), "Externality," *Economica*, 29, 371-84.
- Chenery, M. (1979), *Structural Change and Development Policy*, New York, Oxford University Press.
- Coase, Ronald (1946), "The Marginal Cost Controversy," *Economica*, 13, 169-82.
- Coase, Ronald (1960), "The Problem of Social Cost," *Journal of Law and Economics*, 3, 1-44.
- Cypher, James and Dietz, James (1998), "Static and Dynamic Comparative Advantage: A Multi-period Analysis with Declining Terms of Trade," *Journal of Economic Issues*, 32, 305-14.
- Dixit, A. (1968), "The Optimal Development in the Labour Surplus Economy," *Review of Economic Studies*, 35, 23-34.
- Dixit, A. (1987), "Trade and Insurance with Moral Hazard," *Journal of International Economics*, 23, 201-20.
- Dixit, A. (1989), "Trade and Insurance with Adverse Selection," *Review of Economic Studies*, 56, 235-48.
- Dixit, A. and Norman, V. (1980), *Theory of International Trade*, Cambridge: Cambridge University Press.
- Din, M. (1996), "International Capital Mobility and Development Policy in a Dual Economy," *Review of International Economics*, 4, 185-201.
- Easton, Stephen and Michael, Walker (1997): "Income, Growth, and Economic Freedom", *American Economic Review, Papers and Proceedings*, 87, 328-32.
- Ethier, W. (1982), "National and International Returns to Scale in the Modern Theory of International Trade", *American Economic Review*, 72, 389-405.
- Feenstra (1998), "Integration of Trade and Disintegration of Production in the Global Economy," *Journal of Economic Perspectives*, 12, 31-50.
- Frye, Timothy and Shleifer, Andrei (1997): "The Invisible Hand and the Grabbing Hand." *American Economic Review, Papers and Proceedings*, 87, 354-58.
- Fujita, Masahisa and Krugman, Paul (1995), "When is the Economy Monocentric: von Thünen and Chamberlin Unified," *Regional Science & Urban Economics*, 25, 505-28.
- Gallup, John and Jeff Sachs (1998), "Geography and Economic Development," Working Paper no. 1, Center for International Development.
- Gomory, Ralph E. (1994), "A Ricardo Model with Economies of Scale," *Journal of Economic Theory*, 62, 394-419.

- Grossman, Gene (1998), "Imperfect Labor Contracts and International Trade," mimeo., Department of Economics, Princeton University.
- Grossman, S. and Hart. O (1986), "The Costs and Benefits of Ownership: A Theory of Vertical and Lateral Integration," *Journal of Political Economy*, 94, 691-719.
- Grossman, G. and Helpman, E. (1990), "Comparative Advantage and Long-Run Growth", *American Economic Review*, 80, 796-815.
- Kelly, Morgan (1997): "The Dynamics of Smithian Growth". *Quarterly Journal of Economics*, 112, 939-64.
- Kemp, Murray (1991), "Variable Returns to Scale, Non-uniqueness of Equilibrium and the Gains from International Trade." *Review of Economic Studies*. 58, 807-16.
- Khandker, A. and S. Rashid (1995), "Wage Subsidy and Full Employment in a Dual Economy with Open Unemployment and Surplus Labor," *Journal of Development Economics*. 48, 205-23.
- Kohli, Ulrich and Werner, Augustin (1998), "Accounting for South Korean GDP Growth: Index-Number and Econometric Estimates," *Pacific Economic Review*, 3, 133-52.
- Krugman, P. (1980), "Scale Economies, Product Differentiation, and the Pattern of Trade", *American Economic Review*, 70, 950-59.
- Krugman, Paul (1994a), "Europe Jobless, America Penniless?" *Foreign Policy*, 95, 19-34.
- Krugman, Paul (1994b), "Competitiveness: A Dangerous Obsession," *Foreign Affairs*, 73(2), 28-44.
- Krugman, Paul (1995), "Technology, Trade, and Factor Prices." NBER Working Paper No. 5355, National Bureau of Economic Research.
- Krugman, P. And A. J. Venables (1996), "Integration, specialization, and adjustment," *European Economic Review*, 40, 959-67.
- Krugman, P. And A. J. Venables (1995), "Globalization and the Inequality of Nations," *Quarterly Journal of Economics*, 110, 857-80.
- Lewis, W. (1955), *The Theory of Economic Growth*, London: Allen and Unwin.
- Mokyr, Joel, (1993), "The New Economic History and the Industrial Revolution," in Mokyr, J. ed. *The British Industrial Revolution: An Economic Perspective*, Boulder and Oxford: Westview Press.
- Morgan, T. (1970), "Trends in Terms of Trade, and Their Repercussion on Primary Products." in T. Morgan and G. Betz eds. *Economic Development Readings in Theory and Practice*, Belmont, Wadsworth.
- Murphy, K., Schleifer, A., and Vishny, R. (1989), "Income Distribution, Market Size, and Industrialization", *The Quarterly Journal of Economics*, 104, 537-64.
- North, D. (1958), "Ocean Freight Rates and Economic Development", *Journal of Economic History*, ??, 537-55.
- Panagariya, Arvind (1983), "Variable Returns to Scale and the Heckscher-Ohlin and Factor-Price-Equalization Theorems." *World Economics*. 119, 259-80.
- Prestowitz, Clyde V. Jr et al. (1994), "The Fight over Competitiveness," *Foreign Affairs*, 73(4), 186-197.

- Puga, Diego and Venables, Anthony (1998), "Agglomeration and Economic Development: Import Substitution vs. Trade Liberalisation," Centre for Economic Performance Discussion Paper No. 377.
- Ranis, G. (1988), "Analytics of Development: Dualism," in *Handbook of Development Economics*, ed. H. Chenery and T. Srinivasan, vol. 1, 4. A good survey of dualism.
- Ricardo, David (1817), *The Principles of Political Economy and Taxation*, London: J.M. Dent & Sons Ltd, 1965.
- Rosen, S. (1978), "Substitution and the Division of Labor," *Economica*, 45, 235-50.
- Rosen, S. (1983), "Specialization and Human Capital," *Journal of Labor Economics*, 1, 43-49.
- Sachs, Jeff (1996a), "Globalization and the U.S. Labor Market." *The American Economic Review: Papers and Proceedings*, May.
- Sachs, Jeff (1996b), "The Tankers Are Turning - Sachs on Competitiveness," *World Link*, September/October 1996
- Sachs, Jeff (1996c), "On the Tigers Trail, - Sachs on Competitiveness," *World Link*, November/December 1996.
- Sachs, J. and Warner, A. (1995) "Economic Reform and the Process of Global Integration," *Brookings Papers on Economic Activity*, 1.
- Sachs, Jeffrey and Warner, Andrew (1997): "Fundamental Sources of Long-Run Growth." *American Economic Review, Papers and Proceedings*, 87, 184-88.
- Sen, Partha (1998), "Terms of Trade and Welfare for a Developing Economy with an Imperfectly Competitive Sector," *Review of Development Economics*, 2, 87-93.
- Smith, Adam (1776), *An Inquiry into the Nature and Causes of the Wealth of Nations*, reprint, Oxford: Clarendon Press, 1976.
- Wen, M. (1998): "An Analytical Framework of Consumer-Producers, Economies of Specialisation and Transaction Costs," in K. Arrow, Y-K. Ng, X. Yang eds. *Increasing Returns and Economic Analysis*, London, Macmillan.
- Williamson, Jeffrey (1998), "Globalization, Labor Markets and Policy Backlash in the Past," *Journal of Economic Perspectives*, 12, 51-72.
- Yang, X. (1991), "Development, Structure Change, and Urbanization," *Journal of Development Economics*, 34: 199-222.
- Yang, Xiaokai (1994), "Endogenous vs. Exogenous Comparative Advantages and Economies of Specialization vs. Economies of Scale," *Journal of Economics*, 60, 29-54.
- Yang, X. and Borland, J. (1991): "A Microeconomic Mechanism for Economic Growth". *Journal of Political Economy*, 99: 460-82.
- Yang, Xiaokai and Ng, Siang (1998), "Specialization and Division of Labor: A Survey," in K. Arrow, Y-K Ng and X, Yang eds. *Increasing returns and Economics Analysis*, London, Macmillan.
- Yang, X., Wang, J., and Wills, I. (1992), "Economic Growth, Commercialization, and Institutional Changes in Rural China, 1979-1987", *China Economic Review*, 3, 1-37.
- Young, Leslie (1991), "Heckscher-Ohlin Trade Theory with Variable Returns to Scale." *Journal of International Economics*. 31, 183-90.

Zhou, Lin, Guangzhen Sun, and Xiaokai Yang (1998), "General Equilibria in Large Economies with Endogenous Structure of Division of Labor," Working Paper, Department of Economics, Monash University.