

Initial Resource Allocation, Improvement of Social Welfare and Comparative Advantage: Based on the Investigation of Economic Anthropology

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ABSTRACT This paper aims to deal with the influence of initial resource allocation on the comparative advantage and trade gain of entering countries. Firstly, a generalized theoretical model is constructed from which generalized trade terms are inferred. Based on the model, method of numerical analysis is used to embody the trade terms and derived relations. It is shown that under the circumstances of complete specialized division of labour, if a country allocates more resources to its disadvantaged industries, this resource mismatch when corrected will produce more trade gains to the country; if initial resource allocations of both countries are correct, the country of which trade term is closer to its domestic autarkic exchange price will obtain less benefit; if at least initial resource allocations of one country is wrong, it does not mean that the country of which trade term is closer to its domestic autarkic exchange price will obtain less benefit.

INTRODUCTION

Ever since the theory of comparative advantage was put forward by David Ricardo in his book titled by on the Principles of Political Economy and Taxation in 1817, it has gradually become the classical theory of international trade and aroused enduring interest among researchers.

In recent studies, a host of them placed great emphasis on analyzing particular products with comparative advantage in certain country or industry by way of certain indicators. Among them, integrating the method of production concentration ratio, revealed comparative advantage index and regional revealed comparative advantage index, Song and Zhang (2005) estimated comparative advantage of agricultural products in Pan Pearl River Delta and its inner provinces and regions. On the basis of classical comparative advantage, Jiang et al. (2005) discussed comparative advantage of water right transaction and its constraints. Many researchers as-

sumed that there exists certain positive correlation between export percentage and high ISO participation rate in a corporation; however, Bellesi et al. (2005) found only few empirical research could confirm it. Using revealed comparative advantage method, Chi and Kilduff (2006) made an analysis of comparative advantage of Chinese textile machinery, artificial fiber textile and clothing and discovered that China's position in competition is not simple and unitary as regards different industries and countries. Amirteimoori and Chizari (2008) gave an analysis of comparative advantages in the production and export of pistachio nuts by way of policy analysis matrix framework and revealed comparative advantage method, finding that the two advantages coexist though the comparative advantage in production is decreasing. Through investigating the fishing industry in Eritrea, Teweldemedhin (2008) maintained that comparative advantage in this region had not transformed into competitive advantage, so it was imperative for the policy makers to make a strategic change to ascertain goal market and build a strong productivity in fishing industry. Debaere (2014) believed that since water has become a source of comparative advantage, those countries in possession of abundant water resources were capable of exporting more water intensive products. Chingarande et al. (2014) found by means of Bal-

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assa's revealed comparative advantage that MERCOSUR had comparative advantage in extremely limited product. Sarker and Ratnasena (2014) investigated on the Canadian agricultural competitiveness, finding that Canada had competitiveness in wheat sector but not beef or pork sector. Enyeart et al. (2015) applied comparative advantage principle to unicellular organisms and then suggested that cooperative trading was more beneficial when growth was difficult to achieve. Caporale et al. (2015) proved based on gravity model and economic indicator that Chinese sectors with comparative advantage have transferred from resource-intensive or labor-intensive industry to capital-intensive or technology-intensive industry. Ignjatijević et al. (2015) used revealed comparative advantage to investigate the level of competitiveness in the processed food sector of the Danube region.

Some studies are concerning with theoretical conditions and rationality of conclusions of comparative advantage theory. Gallardo (2005) showed that specialization in accordance with comparative advantage can indeed benefit a country and firms can be stimulated to take full advantage of resources to go in for production in the free competitive environment. Lusk et al. (2006) denied the assumption that consumer preferences in different countries are all the same. Gontijo (2007) pointed out that professional studies paid no attention to the inherent consistency in Ricardo's comparative advantage principle, which are embodied in imbalance in trade, incompatibility with commodity-monetary economy, and contradiction between golden rule mechanism and quantity theory of money. Costinot (2009) initiated the so-called comparative advantage theory of elementary neoclassical economy in which he summarized the sufficient conditions of factor productivity and factor supply to predict the international specialization pattern in generalized multi-factor Ricardo model and indicated the joint effect of technology and factor endowment. Deardorff (2014) maintained that a better measurement of comparative advantage should be trade cost if there is trade cost like transportation cost. Zhou and Yang (2014) pointed out that "differences" of resource endowment was an important factor responsible for migration of population. Levchenko and Zhang (2014) proved using input-output technique that sectoral heterogeneity in productivity and trade had much more effects on trade gains. Bahar et al.

(2014) proposed that neighboring countries had similarities in the patterns of comparative advantage, but this would lead to their producing specifically different but similar products. Costinot et al. (2015) expanded new classical comparative advantage model of which policy implications to import and export trade were discussed.

A few researches facilitate the researchers to have a comprehensive understanding of comparative advantage from other views. By reviewing the history of economic thoughts, Grancay (2012) held that it was Torrens rather than Ricardo that discovered comparative advantage theory. But surprisingly enough, he related the discovery with Napoleonic wars and the resulted agricultural issue. Bils et al. (2012) built a model with which workers can differentiate themselves by way of comparative advantage in job market. The U.S has a colossal deficit in goods trade but medium surplus in service trade while Japan, Germany and China display an opposite trade equilibrium. Barattieri (2014) believed that such a case was caused by the lagging of service trade liberalization behind merchandise trade liberalization and there existed time difference of the implementation of trade policies. Bombardini et al. (2014) studied the comparative advantage from skill distribution of labor. Ferrara et al. (2014) constructed a two-region, two-commodity environmental pollution model, which concluded that decentralized decision would lead to weaker environmental standard and the strictness of standard was dependent on the degree of regional comparative advantage.

The second kind of literatures attracts the interest of this paper, which focuses on the conditions forming Ricardo's comparative advantage. Different from the previous studies, this paper assumes that initial resource allocation exerts great influence on the existence and magnitude of comparative advantage. This assumption defines the scientific problem: the judging criteria whether the social welfares of trading countries will increase determine a reasonable way of initial resource allocation which can bring about comparative advantage. The traditional viewpoint is that the closer trade term is to domestic exchange price of a country, the more disadvantageous the trading result is to the country. Nevertheless, initial resource allocation gives challenge to this view.

The research aim: gives a generalized analysis of the basic Ricardo comparative advantage

model so as to discuss the effect of initial resource allocation on social welfare improvements in trading countries.

The research methodology: the extension to the basic Ricardo model of comparative advantage theory, numerical simulation.

Scientific novelty of the paper lies in that initial resource allocation of one country itself is likely to decide on whether it may gain trade gain and how much trade gain it will gain when production technologies of two trade-partner countries are given. Apart from this, this paper tries to demonstrate that it is gratuitous to assume that the closer trade term is to a country, the more disadvantageous it is to the country.

METHODOLOGY

The present paper is based on the basic Ricardo model. Therefore, it is required that the researchers observe the classical assumptions as follows: first, there are two countries A and B which produce commodity X and Y respectively; second, only one production factor, namely labor, is used; third, workers are permitted to move freely within a country but not to move towards the other countries; fourth, product market is fully competitive; fifth, two trade partner countries may trade freely without being intervened; sixth, there is no trade cost like transportation cost and exchange rate; and seventh, it is assumed that there exists only barter trade, not exchange of money.

The researchers will use the Ricardo model under the above mentioned assumptions. Regardless of decision-making process or naturally forming process of the initial resource allocation, what is only taken into account is the effect of different initial resource allocation on comparative advantage and trade gain. If the effect does exist, what is the reasonable method of initial resource allocation? In the neoclassical economics, optimal allocation of resources in a country is equated with social welfare maximization. So, in international trade, only the initial resource

allocation that uplifts the social welfare is reasonable, and therefore, should be pursued.

There are different views on the source of comparative advantage. In this paper, it is assumed that comparative advantage comes from high technological level measured by labor productivity. The higher labor productivity of a product is, the more advanced its technological level is and the more competitive this kind of product will be in the international market.

Model

Suppose initial resource allocation and labor productivity are represented in Table 1 in which labor productivity may be calculated by piece per workday? Without loss of generality, it is assumed that country B is reduced to absolute disadvantage in producing both commodities but in producing commodity y, its absolute disadvantage is much smaller, that is $a > c$, $b > d$, and $d/b > c/a$, which determines that country A has comparative advantage in producing commodity x while country B has comparative advantage in producing commodity y. In accordance with the prediction of Ricardo's comparative advantage theory, country A should specialize in producing and exporting commodity x and importing commodity y while country B should specialize in producing and exporting commodity y and importing commodity x.

Therefore, the total quantity of the workforce resources of country A is $m+n$ working day and that of country B is $s+t$ working day. The quantity of commodity x and that of commodity y country A can produce are am and bn respectively while that of country B is cs and dt respectively. So, domestic exchange prices of commodity x and y are $bn:am$ and $dt:cs$ respectively in country A and B. International exchange price should be in between domestic exchange prices of two trade partner countries. If $(bn/am) < (dt/cs)$, country A should export commodity x and country B commodity y, which conforms to Ricardo's comparative advantage theory; however, if $(bn/am) > (dt/cs)$, coun-

Table 1: Initial resource allocation and labor productivity

Country	Labor productivity (piece/ working day)		Initial resource allocation	
	Commodity x	Commodity y	Commodity x	Commodity y
Country A	a	b	m	n
Country B	c	d	s	t

try A should produce and export commodity y and country B commodity x, which runs counter to Ricardo's comparative advantage theory. So, it is evident that improper initial resource allocation stops a country from making full use of its productive force and the international division of labor thus formed is of low-efficiency.

Therefore, rational initial resource allocation should satisfy

$$\frac{bn}{am} < \frac{dt}{cs} \quad (1)$$

Since complete specialized division of labor benefits a country the most, it is assumed that the two countries adopt the division of labor. As a result, country A should allocate all its resources to produce commodity x and country B commodity y. Thus, country A can produce commodity x $a(m+n)$ unit and country B commodity y $d(s+t)$ unit. It is definitely the case that the quantities of the two commodities in the world will go on, for both two countries produce with efficiency. So, $a(m+n) > am+cs$ and $d(s+t) > bn+dt$, simplified as

$$c/a < n/s < d/b \quad (2)$$

Let's assume that country A exports commodity x e unit and country B commodity y f unit. Then, the quantity of commodity x that can be consumed in country A is $a(m+n)-e$ unit and the quantity of y $d(s+t)-f$ unit. Therefore, the trade term is that 1 unit of commodity x can exchange f/e unit of commodity y. Because international exchange price is certainly in between domestic exchange prices of two trade partner countries under the circumstances of autarky, we have

$$(bn)/(am) < f/e < (dt)/(cs) \quad (3)$$

Consumer's utility function is $U=U(Q_x, Q_y)$ in which U refers to consumer utility, Q_x and Q_y refer to quantity of consumed commodity x and y respectively. To simplify the issue, the researchers assume that the utility quantity produced by consuming commodity x and y can not be mutually replaced, that is, the utility function is of Leontief type.

Under the condition that international trade increases social welfare of two trade partner countries, it is necessary to satisfy

$$\begin{cases} a(m+n) - e > am \\ f > bn \\ e > cs \\ d(s+t) - f > dt \end{cases} \quad (4)$$

$$\text{So } cs < e < an \text{ and } bn < f < ds \quad (5)$$

$$\text{Hence } \frac{b}{a} < \frac{f}{e} < \frac{d}{c}$$

To enable trade to take place, import and export quantity should satisfy condition (3), (5) and (6). Condition (5) constitutes an absolute constraint to trade volume while condition (3) and (6) constitute relative constraints to trade volume. There are four possibilities (see Table 2) in order to turn (3) and (6) into effective constraints. Trade volume will change as initial resource allocation changes. If utility brought to consumers by different commodities can be mutually replaced, it is enough for us to only take total trade gain into consideration. Therefore, the researchers may transform consumption quantity of different commodities into resource quantity needed to produce these commodities. Then, by making a contrast of the actually disposed quantity of resources before and after the trade, the researchers can see clearly the magnitude of trade gain. Hence, it satisfies

$$\frac{a(m+n)-e}{a} + \frac{f}{b} > m+n \quad (7)$$

and

$$\frac{e}{c} + \frac{d(s+t)-f}{d} > s+t \quad (8)$$

The above inequalities can be simplified as $f/b > e/a$ and $e/c > f/d$ respectively.

So, the relative constraint of trade volume is $b/a < f/e < d/c$, the same as (6). In this way, relative constraint is among the four possibilities in Table 2, which as a result can be seen as the basic patterns of relative constraints of trade volume.

RESULTS

Suppose labor productivities of two trade products in the partner countries are $a=60$, $b=100$, $c=20$, $d=80$ and then it is divided into four cases to discuss rational value of m , n , s , t , e and f , and its effect on the social welfares of the two partner countries.

The First Case

Country A allocates more resources to its industries with comparative advantage while country B its industries with comparative disadvantage.

According to formula (1) to (6) and condition (i) in Table 2, m , n , t and s need to satisfy, $n/m < 1$, $t/s < 1$ and $1/3 < n/s < 4/5$. If $s=4500$, $1500 < n < 3600$, take $n=3000$. Accordingly, take $m=4000$, $t=3000$. Then the total resource quantity of country A is $m+n (=7000)$ working days and that of country B is $s+t (=7500)$ working days. Under the condition of autarky, the combination of commodity x and y consumed by country A and B is (240000, 300000) and (90000, 240000) respectively. e and f should satisfy $90000 < e < 180000$, $300000 < f < 360000$, and $5/3 < f/e < 8/3$. So take $f=320000$, $e=160000$.

With these parameters being determined, it can be seen that the quantity of commodity x and y consumed by country A is 260000 and 320000 unit respectively and the quantity of commodity x and y consumed by country B is 160000 and 280000 unit respectively. Then, obviously, both of the quantity of commodity x and y consumed by country A increased 20000 unit and the quantity of commodity x and y consumed by country B increased 70000 and 40000 unit respectively.

It is to be seen clearly that the benefit distribution of international trade among participating countries is uneven. Country B gains more from it. For the trade condition $f/e=320000/160000=2$ is closer to the domestic production price ($dt/cs=8/3$) of country B rather than to that ($bn/am=5/4$) of country A. That is contradictory to the traditional view that the closer the trade terms are to the domestic production price under the circumstance of autarky, the more disadvantageous it is to the country. What calls for attention is that in initial resource allocation, country A allocates more resources to its industries with

comparative advantages while country B its industries with comparative disadvantage. Though the social welfare of the two countries is both increased, the benefit distribution between countries is not what is expected.

The Second Case

Both countries allocate their own resources to their own industries with comparative advantage.

According to formula (1) to (6) and condition (ii) in Table 2, m , n , t and s need to satisfy $n/m < 1$, $t/s > 1$ and $1/3 < n/s < 4/5$. For $m+n=7000$, $s+t=7500$, take $m=4500$, $n=2500$, $s=3500$, $t=4000$. Under the condition of autarky, the combination of commodity x and y consumed by country A and B is (270000, 250000) and (70000, 320000) respectively. Under the same condition, the domestic exchange price of commodity x and y for country A is $25/27$ and for country B is $32/7$. e and f should satisfy $70000 < e < 150000$, $250000 < f < 280000$, and $5/3 < f/e < 4$. So if take $f=270000$ and $e=90000$, $f/e=3$. The quantity of commodity x and y consumed by country A is 330000 and 270000 unit respectively and the quantity of commodity x and y consumed by country B is 60000 and 20000 unit respectively. The quantity of commodity x and y consumed by country A increased 60000 and 20000 unit respectively and the quantity of commodity x and y consumed by country B increased 20000 and 10000 unit respectively. The trade term is closer to the domestic exchange price of country B but the trade gains of country B is smaller than that of country A. Therefore, such a result conforms to the traditional view.

Table 2: Four possibilities of relative constraints of trade volume

	Conditions					The intersection of (3) and (6)				
(i)	$\frac{bn}{am} < \frac{b}{a}$	$\frac{b}{a}$	$\frac{dt}{cs} < \frac{d}{c}$	$\Rightarrow$	$\frac{n}{m} < 1$ and	$\frac{t}{s} < 1$	$\frac{b}{a} < \frac{f}{e}$	$\frac{f}{e} < \frac{dt}{cs}$		
(ii)	$\frac{bn}{am} < \frac{b}{a}$	$\frac{b}{a}$	$\frac{dt}{cs} > \frac{d}{c}$	$\Rightarrow$	$\frac{n}{m} < 1$ and	$\frac{t}{s} > 1$	$\frac{b}{a} < \frac{f}{e}$	$\frac{f}{e} < \frac{d}{c}$		
(iii)	$\frac{bn}{am} > \frac{b}{a}$	$\frac{b}{a}$	$\frac{dt}{cs} > \frac{d}{c}$	$\Rightarrow$	$\frac{n}{m} > 1$ and	$\frac{t}{s} > 1$	$\frac{bn}{am} < \frac{f}{e}$	$\frac{f}{e} < \frac{d}{c}$		
(iii)	$\frac{bn}{am} > \frac{b}{a}$	$\frac{b}{a}$	$\frac{dt}{cs} < \frac{d}{c}$	$\Rightarrow$	$\frac{n}{m} < 1$ and	$\frac{t}{s} < 1$	$\frac{bn}{am} < \frac{f}{e}$	$\frac{f}{e} < \frac{dt}{cs}$		

The Third Case

It is an impossible initial resource allocation.

According to formula (1) to (6) and condition (iii) in Table 2, m, n, t and s need to satisfy $n/m > 1$, $t/s > 1$ and $1/3 < n/s < 4/5$, so $m < n < 45/5 < 4t/5$. Under the circumstances that the total quantity of resources in both countries is close, this condition is more rigid than the former.

Because $m+n=7000$, $n>3500$. For $s+t=7500$, $s<3750$, $n<4s/5=3000$. That is contradictory. Therefore, initial resource allocation that satisfy this condition does not exist. To put it another way, such kind of initial resource allocation rids the two countries of the basis of trade.

The Fourth Case

Both countries allocate their own resources to their own disadvantage industries.

According to formula (1) to (6) and condition (iv) in Table 2, m, n, t and s need to satisfy $n/m > 1$, $t/s < 1$ and $1/3 < n/s < 4/5$. So take $m=3200$, $n=3800$, $s=5000$, $t=2500$. Under the condition of autarky, the combination of commodity x and y consumed by country A and B is (192000, 380000) and (100000, 200000) respectively. The domestic exchange price for country A and B is $95/48$ and 2 respectively. e and f should satisfy $100000 < e < 228000$, $380000 < f < 400000$, and $95/48 < f/e < 2$. Therefore $95/48 < f/e < 2$, if take $e=196000$, $f=390000$, $f/e=1.99$.

The combination of commodity x and y consumed by country A and B is (224000, 390000) and (196000, 210000) respectively. The quantity of commodity x and y consumed by country A increased 32000 and 10000 unit respectively and the quantity of commodity x and y consumed by country B increased 96000 and 10000 unit respectively. But it is to be noticed that the trade term is rather close to the domestic exchange prices of the two commodities in the trade partner countries and the bigger difference lies in the initial resource allocation. Although both countries allocate their resources to produce their products with comparative disadvantage, country B allocate more resources. The initial resource allocation for country A is relatively more balanced, so the trade is more advantageous towards country B.

DISCUSSION

In recent researches, there seems to be conscious about the influence of resource endow-

ment. For example, "differences" of resource endowment have been exploited to explain population mobility (Levchenko and Zhang 2014). At the same time, some paradoxes have been found in terms of the theorem of comparative advantage. If the theorem had no problem, the countries with similar advantages would have exported similar products. But the reality was otherwise, as Bahar et al. (2014) had proved. It is suggested by their work that it is necessary to reconsider the conditions of comparative advantage principle. In the previous four cases, only the result of the second case is in accord with the traditional point.

For most people, it is hopeful to improve the principle of comparative advantage in theory itself. Undoubtedly, introducing trade cost may make the classic model much closer to the reality (Deardorff 2014). However, it transcends the scope of the paper. Though accepting it may resolve some problems to appropriately extend the classic model, there are difficulties in getting rid of inherent inconsistency of the model as Gontijo have said.

From the point of the practice of developing countries, predicting results of the paper may be verified to part extent as well. China has sustained comparative advantage of labor-intensive and resource-intensive product until 2007, but so is the tragedy. In some labor-intensive industries, such as textile industry, much lower wage rate makes the workers of that industry in trouble. There is comparative advantage in coal industry in Shanxi Province, but it almost brings about the lowest growth rate and the worst environment to Shanxi Province. This seems as a typical paradigm of "resource curse".

CONCLUSION

The traditional comparative advantage theory pays little heed to the effect of initial resource allocation on the improvement of social welfare or if anything, it fixes initial resource allocation as it sets productivity and then considers their concerted effect on trade. More importantly, the traditional theory firmly believes that both countries can gain the greatest benefit from trade as long as labor divisions are decided on complete specialization. It is also believed that the closer trade term is to a country, the more disadvantageous the outcome is to the country.

This paper discusses the relevant conditions of improving social welfare in the most generalized form given initial resource allocation and technological level. Yet the following numerical analysis reveals some contradictions with traditional views. On one hand, the third case shows that even if both countries adopt complete specialized division of labor based, this kind of division will not necessarily increase social welfare so that the two countries would refrain from doing that. The first and the fourth case demonstrate to us that even if trade term is close to a country, the country is still capable of gaining the most from the trade.

RECOMMENDATIONS

According to the results of the paper, the following suggestions will be put forward so as to prompt entering countries to earn more trade benefits from their commercial trading with the other countries:

- ♦ When entering international division, a country not only should ascertain which industries have comparative advantages, but also the gap between domestic and international trade term.
- ♦ In some cases, the predictions in terms of the theory of comparative advantage do not hold. For instance, when more than one country have similar comparative advantage, it may be correct that one country amongst them specializes in its product with comparative disadvantage.
- ♦ It may be as well reasonable to specialize in an industry with comparative disadvantage for a country if the country is restricted in initial resource allocation. At least in the long term of economic development, the mode of division of labor is beneficial to economic advancement of a lagged country.
- ♦ Of course, development strategies of a country are not always fixed. If finding that initial institution arrangement (resource allocation) is not reasonable, the country would timely adjust and optimize institution arrangement in the next round competition.

LIMITATIONS

It is disheartening to some countries that initial resource allocation determines whether a country will gain from trade and how much it can gain. Nevertheless, the model presented in this paper is only static. Under the dynamic circum-

stances, it is possible that trade results may change to benefit the country if it can affect the next round initial resource allocation. Therefore, though the conclusion that initial resource allocation will affect trade results seems pessimistic, it embodies a hope of policy-changing. Given that long existence of countries, the competition between them will not call off just after one round. What is significant is to realize the rational allocation of initial resources or resource stock.

Because of that, the paper about comparative advantage is far from perfect. There is room for exploration even if a study is limited to the model with two products, two countries and unitary resource.

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