
Can Ricardian Model Really Explain Trade?

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Abstract — This paper aims to analyse the international trade in the real world by applying the Ricardian trade theory. In doing this, simple comparative advantage assumptions are used to examine trading of palm oil and rice between Malaysia and Vietnam. By using this theory, it is proven that international trade takes place because of efficiency to produce exported product. A country will export products that use its abundant and cheap factors of production and import products that use its scarce factors. Various empirical evidences of previous studies are also used to discuss the importance of the Ricardian model. However, it is also highlighted in the paper that the Ricardian model could be misleading as it has several limitations that restrict its usefulness.

Keywords – Comparative advantage, free trade, international trade, Ricardian model

ARTICLE INFO

Received 1 April 2018

Received in revised form 5 June 2018

Accepted 12 June 2018

Published 30 June 2018

I. Introduction

The first person to propose the theory of comparative advantage in international trade was Robert Torrens. In 1815, during the course of his study regarding the Corn Laws, Torrens concluded that England still gained an advantage by trading the grain with Poland, even though it is cheaper for the country to produce it locally.

However, in 1817 David Ricardo became closely related to this theory through his work “The Principles of Political Economy and Taxation”. The theory arose after Ricardo considered the limitations of Smith’s absolute theory. The question discussed is: what happens if a nation, by chance, has no absolute advantage at all? It cannot produce any goods at a lower cost compared to other nations. And what happens to a country that enjoys total absolute advantage, where every product is produced at a cheaper cost at home? Will trade still benefit these nations?

II. The Ricardian Trade Theory and Analysis

The comparative advantage theory shows how countries can gain from trading with each other, even if one of them is more efficient and has an absolute advantage. This theory is about identifying which activities a country or firm or individual is most efficient at doing. Proposed by David Ricardo (1817), this theory suggests that countries should specialise in the goods they can produce most efficiently, rather than trying for self-sufficiency. Thus, a country should specialise in the production of goods in which it is most efficient, and buy goods that it produces less efficiently from other countries. This theory views trade as a positive-sum game, in which a country that participates in trade could realise economic gains by reaping benefits from specialising in what it is best at producing and trading with other nations.

Comparative advantage refers to the ability of a country to produce particular product at a lower opportunity cost than another country. The underlying basis for this theory is the ability of a country to produce a product most efficiently, given all the other products that could be produced.

Table 1: Labour Requirement per Unit of Output

| | Wine | Cloth |
|----------|----------------------|--------------------|
| England | 120 hours per barrel | 100 hours per yard |
| Portugal | 80 hours per barrel | 90 hours per yard |

Using the example of trade between England and Portugal of wine and cloth in Table 1, Ricardo explains that the relative cost of producing each good is different in the two nations. While both countries are capable of producing wine and cloth, it takes less effort for Portugal to produce both goods compared to England. Meanwhile, it is very hard for the England to produce wine and rather difficult for them to produce cloth. It is easier for Portugal to produce both of the goods at home. Will there be any benefit for it to trade with England? Neither wine nor cloth provides England with an absolute advantage compared to Portugal. How can England get any advantage from the trade with Portugal? Looking at this situation, it seems that England will have to import both products from Portugal following the theory of absolute advantage.

However, according to Ricardo, although it is cheaper for Portugal to produce both wine and cloth, Portugal can still benefit by manufacturing excess wine and trading it for cloth from England. This trade will not change the cost for England to produce cloth, but nonetheless, the lower cost to obtain wine, now at closer rate to the cost of producing cloth, will benefit England as well. Thus, both countries now benefit from the trade and are better off. The conclusion that may be drawn from this example is that a country should focus its production on products with a comparative advantage, and trade with other nations for products in which other nations have the comparative advantage. So, what is a comparative advantage?

According to the principle of comparative advantage, even if a nation has an absolute cost disadvantage in the production of both goods, a basis for mutually beneficial trade may still exist. The less efficient nation should specialise in and export the good in which it is relatively less inefficient (where its absolute disadvantage is least). The more efficient nation should specialise in and export that good in which it is relatively more efficient (where its absolute advantage is greatest).

To demonstrate the principle of comparative advantage, Ricardo formulated a simplified model based on the following assumptions:

- (i) The world consists of 2 nations, each using a single input to produce 2 commodities.
- (ii) In each nation, labour is the only input (the labour theory of value). Each nation has a fixed endowment of labour and labour is fully employed and homogeneous. Labour can move freely among industries within a nation but is incapable of moving between nations.
- (iii) Production functions are characterised by constant returns to scale. A one-factor model with constant returns to scale will have a linear production frontier. The level of technology is fixed for both nations. Different nations may use different technologies, but all firms within each nation utilise a common production method for each commodity.
- (iv) Costs do not vary with the level of production and are proportional to the amount of labour used.
- (v) Perfect competition prevails in all markets. Because no single producer or consumer is large enough to influence the market, all are price takers. Product quality does not vary among nations, implying that all units of each product are identical. There is free entry to and exit from an industry, and the price of each product equals the product's marginal cost of production.
- (vi) Free trade occurs between nations; that is, no government barriers to trade exist.
- (vii) Transportation costs are zero. Consumers will thus be indifferent between domestically produced and imported versions of a product if the domestic prices of the two products are identical.
- (viii) Firms make production decisions in an attempt to maximise profits, whereas consumers maximise satisfaction through their consumption decisions.
- (ix) There is no money illusion; when consumers make their consumption choices and firms make their production decisions, they take into account the behaviour of all prices.
- (x) Trade is balanced (exports must pay for imports), thus ruling out flows of money between nations.

The fundamental tenet of comparative advantage is that a country can still benefit from trade by producing and exporting a product in which it has the lowest opportunity cost of production, even if it has no absolute advantage in the production of any goods. The opportunity cost of production of an item is defined as the amount of another item that needs to be reduced so that one more unit of the first item can be produced.

Now, let us analyse an example of palm oil and rice as 2 commodities for trade in 2 ASEAN countries, i.e. Malaysia and Viet Nam. The production of palm oil and rice in Malaysia and Viet Nam are labour intensive industries. We assume that labour endowments are 1 million workers each in Malaysia and Viet Nam. The opportunity cost of production for palm oil is the amount of rice that needs to be reduced in order to produce one more unit of palm oil, and vice versa. This is clarified in the example below based on data compiled from the Department of Statistics of Malaysia and the General Statistics Office of Viet Nam. Note that rounding numbers are used for simple and easy calculation.

Assume that production for 2 countries, devoting all of their resources to the production of palm oil in 2015 are as shown below:

- (i) Malaysia: 20 million tonnes
- (ii) Viet Nam: 2 million tonnes

However, if both countries exclusively produced rice, production in 2015 would be as follows:

- (i) Malaysia: 2 million tonnes
- (ii) Viet Nam: 50 million tonnes

Let's consider the following marginal products of labour for both palm oil and rice industries in Malaysia and Viet Nam as shown in Table 2.

Table 2: Marginal Products of Labour (MPL)

| | Malaysia | Viet Nam |
|--|----------------|----------------|
| Quantity of Palm Oil (million tonnes) = $MP_{Lp} \cdot L_p = MP_{Lp}$ (1 million workers) | $MP_{Lp} = 20$ | $MP_{Lp} = 2$ |
| Quantity of Rice (million tonnes) = $MP_{Lr} \cdot L_r = MP_{Lr}$ (1 million workers) | $MP_{Lr} = 2$ | $MP_{Lr} = 50$ |

Table 2 shows that the output of palm oil and rice produced from 1 million workers each in Malaysia and Viet Nam. In Malaysia, 20 million tonnes of palm oil are produced from 1 million workers and 2 million tonnes of rice are produced from 1 million workers. However, for Viet Nam 2 million tonnes of palm oil are produced from 1 million workers and 50 million tonnes of rice are produced from 1 million workers. Data from Table 2 can be translated into Figure 1, where it shows the production frontiers and autarky equilibriums for Malaysia and Viet Nam respectively.

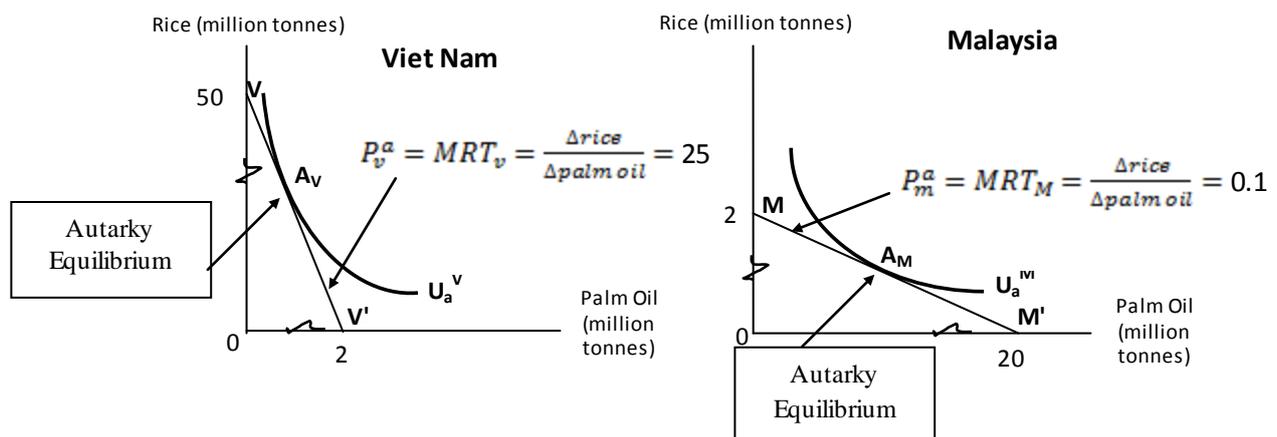


Figure 1: Production Frontiers and Autarky Equilibriums for Malaysia and Viet Nam

Ricardo's theory suggests that by trading between the 2 nations, both countries can gain a comparative advantage and thus both will benefit. In comparative advantage, trade can benefit all parties involved as long as there are different relative costs in producing goods. The net benefit from such activities is known as gain from trade. The opportunity cost for Malaysia to produce 1 tonne of palm oil is 0.10 tonne of rice, but the opportunity cost of producing 1 tonne of rice is 10 tonnes of palm oil. However, for Viet Nam the opportunity cost of producing 1 tonne of palm oil is 25 tonnes of rice, but the opportunity cost of producing 1 tonne of rice is 0.04 tonne of palm oil.

Table 3: Comparative Advantage

| Opportunity Cost | Malaysia | Viet Nam |
|--|-----------------------|------------------------|
| Opportunity cost of producing 1 additional tonne of palm oil | 0.10 tonne of rice | 25 tonnes of rice |
| Opportunity cost of producing 1 additional tonne of rice | 10 tonnes of palm oil | 0.04 tonne of palm oil |

From Table 3, it is obvious that Malaysia has a comparative advantage in the production of palm oil as seen by its lower opportunity cost compared to Viet Nam; while Viet Nam has a comparative advantage in the production of rice by giving up less palm oil in the production of rice compared to Malaysia. How this helps to benefit the 2 nations through trade and this will be shown in the following tables.

Assuming that Malaysia and Viet Nam choose not to trade, total production and consumption in autarky equilibrium would be as shown in Table 4.

Table 4: Total World Production and Consumption in Autarky Equilibrium (without specialisation)

| Country | Palm Oil | Rice | Total National Production and Consumption |
|--|-------------------|-------------------|---|
| Malaysia | 10 million tonnes | 1 million tonnes | 11 million tonnes |
| Viet Nam | 1 million tonnes | 25 million tonnes | 26 million tonnes |
| Total World Production and Consumption | 11 million tonnes | 26 million tonnes | - |

By trading goods in which they each have a comparative advantage, and assuming that there is no preference for both goods traded between the nations, the resulting production and consumption would be as shown in Tables 5 and 6.

Table 5: Total World Production in Free Trade Equilibrium (with complete specialisation)

| Country | Palm Oil | Rice | Total National Production |
|------------------------|-------------------|-------------------|---------------------------|
| Malaysia | 20 million tonnes | 0 | 20 million tonnes |
| Viet Nam | 0 | 50 million tonnes | 50 million tonnes |
| Total World Production | 20 million tonnes | 50 million tonnes | - |

Table 6: Total World Consumption in Free Trade Equilibrium (with complete specialisation)

| Country | Palm Oil | Rice | Total National Consumption |
|-------------------------|-------------------|-------------------|----------------------------|
| Malaysia | 10 million tonnes | 25 million tonnes | 35 million tonnes |
| Viet Nam | 10 million tonnes | 25 million tonnes | 35 million tonnes |
| Total World Consumption | 20 million tonnes | 50 million tonnes | - |

The above production and consumption levels are achieved by assuming that the world trade price ratio (P^*) or terms of trade is 2.5, which lies between the 2 countries' autarky price ratios ($P_{ma} < P^* < P_{va}$). Malaysia will specialise completely in the palm oil production, exporting palm oil and importing rice to reach a higher consumption level. At the other hand, Viet Nam will specialise completely in the rice production, exporting rice and importing palm oil to reach a higher consumption level too. Malaysia will now be able to trade 10 million tonnes of palm oil for 25 million tonnes of rice, whereas before trading it can only produce 10 million tonnes of palm oil and 1 million tonnes of rice. As for Viet Nam, it can now consume 10 million tonnes of palm oil by trading 25 million tonnes of rice, instead of only 25 million tonnes of rice and 1 million tonnes of palm oil. It is said that both countries have now managed to consume beyond their production frontiers as depicted in Figure 2.

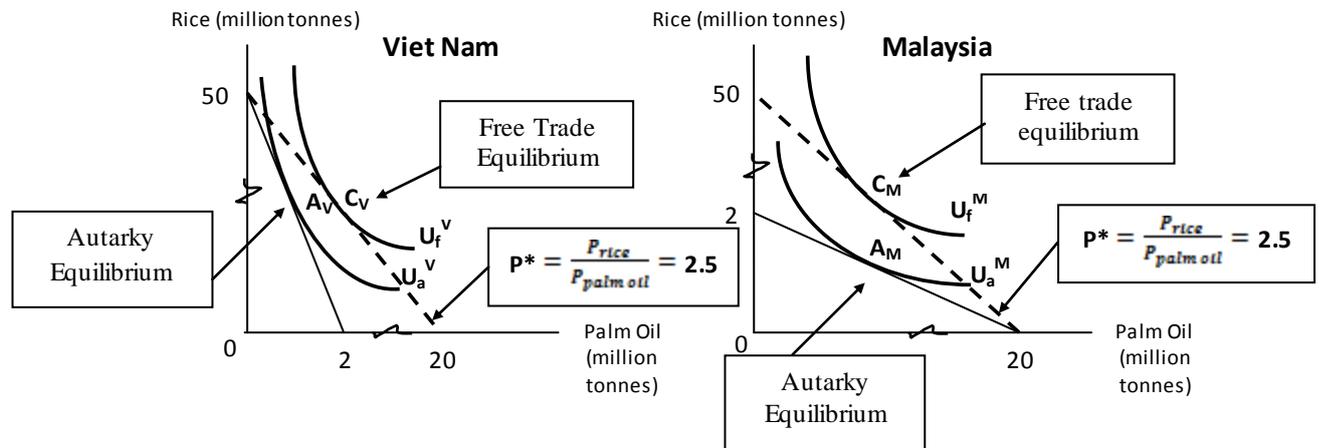


Figure 2: Free Trade Equilibriums for Malaysia and Viet Nam (with complete specialisation)

It is noted that when free trade occurs, total world production and consumption of palm oil and rice have increased by 9 million tonnes and 24 million tonnes respectively. It also allows both nations to specialise completely and thus increases both nations' total national production and consumption. In other words, both countries are made better off by trade.

For more than 2 centuries, most economists have steadfastly promoted free trade among nations as the best trade policy. Free trade is a market situation in which trade in goods and services between or within countries flows uninhibited by government-imposed restrictions such as tariffs and quotas. According to Ricardo, through free trade based on the principle of comparative advantage, the world economy can achieve a more efficient allocation of resources and a higher standard of living than it can without free trade. In other words, for the world as a whole, free trade results in a higher level of output and income than no trade. It also allows each nation to obtain a higher level of production and consumption than can be achieved in isolation.

III. Empirical Evidence on the Ricardian Model

The Ricardian model of international trade is an extremely useful tool for thinking about the reasons why trade may happen and about the effects of international trade on national welfare. But is the model a good fit to the real world? Does the Ricardian model make accurate predictions about actual international trade flows? The answer is a heavily qualified yes. Clearly there are number of ways in which the Ricardian model makes misleading predictions as follows:

- (i) The first assumption is that there are merely 2 countries and 2 goods in the world, which is totally misleading, as in reality there are many countries with various products to offer.
- (ii) The simple Ricardian model predicts an extreme degree of specialisation that we do not observe in the real world. This has given rise to the argument that comparative advantage may reduce economic diversity to a risky level. As for the case of the Asian economic downturn in 1997, Malaysia for instance managed to overcome the crisis by diversifying its production of manufactured products and plantation products, especially palm oil. If Malaysia followed the theory of comparative advantage, it may not have been able to recover from the crisis.
- (iii) The Ricardian model assumes away effects of international trade on the distribution of income within countries, and thus predicts that countries as a whole will always gain from trade. However, in practice, international trade has strongly effects on income distribution.
- (iv) The Ricardian model allows no role for differences in resources among countries as a cause of trade, thus missing an important aspect of the trading system (the focus of the specific factors and the Heckscher-Ohlin factor endowment theories). Resources are postulated to move freely between the countries, whereas in reality, governments may block free trade with the implementation of tariffs, quotas and taxation to protect newly established industries within the country.

- (v) A constant returns to scale is assumed in the model, while authentically, both diminishing and increasing returns to scales still exist. The Ricardian model neglects the possible role of economies of scale as a cause of trade, which leaves it unable to explain the large trade flows between apparently similar nations.

In spite of these failings, however, the basic prediction of the Ricardian model is that countries tend to export those goods in which their productivity is relatively high. This has been strongly confirmed by a number of studies over the years.

The first test of the Ricardian model was made by the British economist G.D.A. MacDougall (1951). MacDougall used 1937 data on the United States (U.S.) and the United Kingdom (U.K.) exports in 25 industries. Recall that the Ricardian model implies that each country tends to export those goods in which it has a comparative advantage. Its comparative advantage lies in those goods in which its labour is highly productive compared to the trading partner's labour. MacDougall combined these 2 aspects of the Ricardian model to formulate the following testable hypothesis:

"Other things being equal, the higher the U.S. output per worker relative to the U.K. output per worker in a given industry, the higher the exports by the U.S. relative to those by the U.K. in that industry."

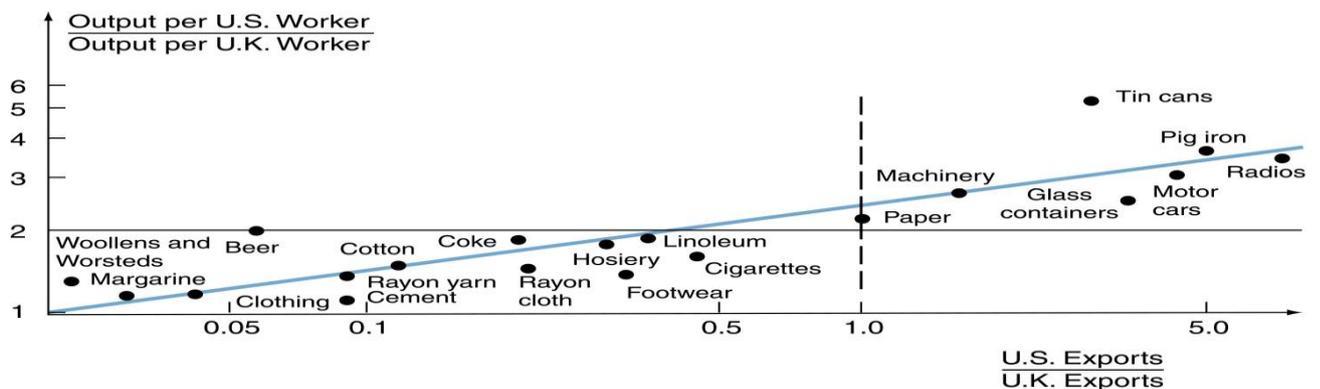


Figure 3: Relative Labour Productivities and Comparative Advantage – U.S. and U.K., 1937

Figure 3 reports MacDougall's findings, and they clearly support the major implication of the Ricardian model: High relative labour productivity in a given industry accompanied a high market share. MacDougall also confirmed the importance of comparative advantage as opposed to absolute advantage. U.S. labour productivity exceeded that of the U.K. in all 25 industries examined. On average, U.S. productivity was approximately twice U.K. productivity, as illustrated by the pale horizontal in Figure 4. If absolute advantage determined trade patterns, the U.K. wouldn't have exported in any of the industries. But because comparative determines trade patterns, the U.K. did export in those industries in which U.K. labour productivity was closer to that of the U.S. (for example, woollens, beer and clothing). The U.S. exported more in the industries where U.S. labour productivity most significantly exceeded that of the U.K. (for example, pig iron and tin cans).

Another test of the Ricardian model comes from Stephen S. Golub and Chang-Tai Hsieh (2000), who examined the relationship between relative labour productivity and relative exports for 39 industries and for 4 trading partner pairs: U.S. – Japan, U.S. – Germany, U.S. – U.K. and U.S. – France, using data from the late 1970s to the early 1990s. They found an industry's relative high productivity to be associated with relatively high exports. For instance, focusing on U.S. – Japan trade, a 1% rise in an industry's labour productivity relative to that in other country led to a 0.3% increase in that industry's relative exports.

Prior to that, Stephen Golub (1995) has also examined the relation between relative unit labor cost (the ratio of wages to productivity) and trade for the U.S. vis-à-vis the U.K., Japan, Germany, Canada, and Australia. He found that relative unit labour cost helps to explain trade patterns for these nations. The U.S. and Japanese results lend particularly strong support for the Ricardian model, as shown in Figure 4. The figure displays a scatter plot of U.S. – Japan export data for 33 industries investigated. It shows a clear negative correlation between relative exports and relative unit labour costs. A rightward movement along the figure's horizontal axis indicates that a rise in U.S. unit labour costs relative to Japanese unit labour costs; this correlates with a decline in U.S. exports relative to Japanese exports, a downward movement along the figure's vertical axis.

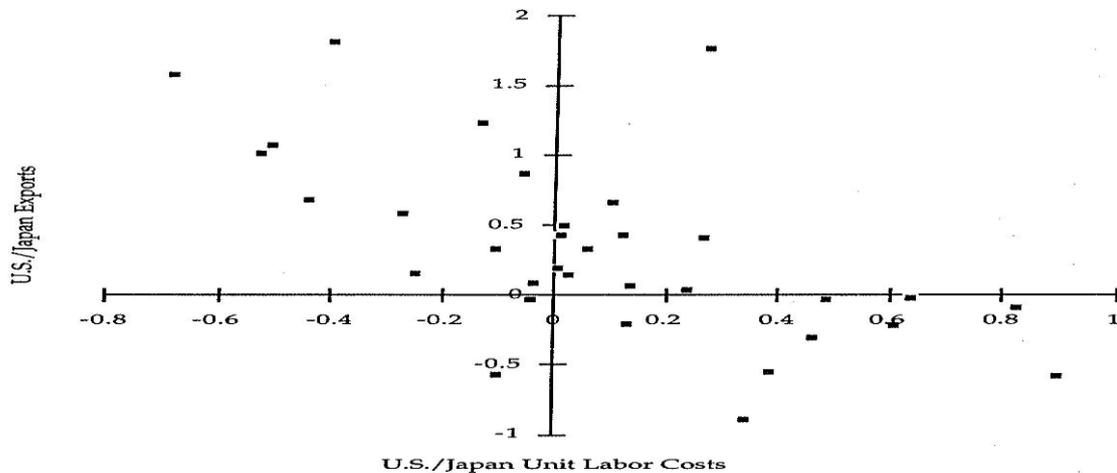


Figure 4: Relative Exports and Relative Unit Labour Costs: U.S. – Japan, 1990

Ricardian theory predicts that countries export the goods in which they have a comparative advantage, meaning that they enjoy a higher relative productivity. As a result of engaging in trade in this fashion, where the country exports goods from its relatively high productivity industries, the country as well as each of its trading partners will gain from trade. Johannes Van Biesebroeck (2005) examined approximately 200 manufacturing firms in 9 African countries (Burundi, Cameroon, Côte d'Ivoire, Ethiopia, Ghana, Kenya, Tanzania, Zambia, Zimbabwe) over the period 1992-1996. He first discovered that, in comparison with non-exporting firms, the exporting firms on average produced more than 50% greater output per worker and paid on average 34% higher wages. Economic theory would of course suggest that higher productivity would be reflected in higher wages. In the second part of the study, Van Biesebroeck determined that being an exporter in effect shifted the production function upward by 25% to 28%. This study has showed an increase in the firms' productivity.

Jan De Loecker (2007) analysed whether firms that start to export become more productive after doing so. He employed data for the manufacturing sector of Slovenia for the period 1994-2000. Over the period, on average per year, there were 4,258 firms in the study, of which 1,953 already were exporters and 312 firms began exporting. As in the Van Biesebroeck study, exporters were found to be more productive than non-exporters (by 29.59%) and to pay higher wages (by 16.14%). With respect to exporting and resulting increases in productivity, Jan De Loecker found that, relative to the situation of their domestic counterparts, the firms that started exporting had 17.7% greater productivity gains after 2 years and 46% greater gains after 4 years. The study has proven that high productivity firms tend to export and that the process of exporting leads to higher productivity for the firms engaged in it.

The multi-country and multi-product versions of the Ricardian model has also been formalised and subjected to rigorous empirical testing (Eaton and Kortum, 2002; Costinot et al., 2012). These models infer a country's productivity in a certain industry from its observed pattern of trade and have been successful in explaining a significant portion of bilateral trade. Yet, these models can only infer the relative productivity of a country in a product if the country actually makes the product but cannot infer the productivity if the country does not (Deardorff, 1984; Costinot et al., 2012). This is an important shortcoming as there are many instances in which it would be useful to infer the productivity level that a country would enjoy in products that it does not currently make.

As for the Malaysian commodity exports, there are many studies that have assessed the pattern of comparative advantage in exports. One of studies is by Noor Aini and Ahmad Fauzi (2010), who analysed the comparative advantage of wood products in the European market. The study found that high comparative advantage products are the secondary processing products and mechanised mass market products. The Revealed Comparative Advantage (RCA) is very relying on the quantity traded, a high quantity did not indicate the high comparative advantage. There are many factors influencing the comparative advantage such as abundant resources, communication and technology, production cost and demand pattern.

Nik Maheran and Haslina (2008) analysed export competitiveness of Malaysian Electrical and Electronic (E&E) products. The study used the Constant Market Share (CMS) and RCA to analyse the extent of the export competition between Malaysia and other competitor economies. RCA results showed that Malaysia's E&E products was highly perform only in the US market for almost all Standard International Trade Classification (SITC). Indonesia has monopolised the Singapore market and Hong Kong was dominated by China. Malaysia's E&E exports to the world generally has comparative advantage over other competitors namely Indonesia, Thailand and China.

Besides, as for the case of Viet Nam, Quoc-Phuong Le (2010) examined the Viet Nam's RCA and its changes since the country's reform programme began in 1986 till 2005. The findings indicated that despite a rapid shift in comparative advantage structure from primary products towards labour intensive manufacturing during 1991-1996, and a further slow shift towards technology intensive manufacturing since then. However, Viet Nam's comparative advantage in 2005 was still largely based on the country's endowments of labour and natural resources, in which **agricultural-based** and **resources-based** sectors still maintained their relative importance in the country's comparative advantage structure.

Another study that focused on Malaysia manufactured export has been undertaken by Nazirah Zam et al. (2017). By calculating RCA indices over time, the study analysed the comparative advantage of 144 Malaysia's manufactured goods in the world and Viet Nam markets for the period 2010-2015. The RCA results showed that Malaysia has high comparative advantage in E&E products in the world market. However, E&E exports performance ratio is shrinking over the years. The decreasing pattern showed that Malaysia's specialisation in E&E industry has slowly declined. Other products that indicate high comparative advantage are **agricultural-based** products and process industries products. The study also showed that **agricultural-based** products, process industries products and other high technology products such as optical equipment have more dominance in the Viet Nam market. However, Malaysian manufactured products' competitiveness in Viet Nam market has shifted from low technology products to medium technology products which indicates the same pattern with the world market.

From these recent studies, it is noted that Balassa Index (Balassa 1965) is widely used in the literature to measure country-sector Revealed Comparative Advantage (RCA). However, being computed on observed trade flows, it mixes up all the factors influencing trade flows. In particular, Balassa Index cannot isolate exporter-sector specific factors which are the source of comparative advantage in the spirit of the traditional trade model. Furthermore, Balassa Index suffers some empirical distribution weaknesses, mainly time instability and poor ordinal ranking property (Yeats, 1985; Hinlopen and Van Marrewijk, 2001). A recent paper by Costinot et al. (2012) provides a micro-founded version of the Ricardian model and suggests a new measure for comparative advantage.

IV. Conclusion

David Ricardo originally intended his model as a simple framework for highlighting the principle of comparative advantage rather than as a full explanation for observed trade patterns in the world economy. Both the theoretical model and the empirical tests ignore many relevant issues, such as the presence of non-labour inputs, tariffs, transportation costs, economies of scale and the product differentiation.

The theoretical version of the Ricardian model implies that relative labour productivity determines opportunity costs, which in turn determine autarky price ratios, and thereby determine trade patterns. However, autarky prices typically are unobservable because trade is occurring. Thus, empirical tests must seek a direct relationship between labour productivity and trade patterns, bypassing the unobservable autarky prices. This problem in implementing the model empirically cannot disguise the comparative advantage/export relationship is a tribute to the power of Ricardo's insight.

In the two centuries since Ricardo wrote, economists have come to appreciate many explanations for trade patterns. However, in recent years, Ricardo's insights, particularly the importance of cross-country differences in technology and labour productivity, once again have come to the forefront. Two major issues in the world economy, i.e. the need to integrate developing countries and the formerly centrally planned countries into the world economy, which help explain this new appreciation of Ricardo's insights. When a country isolates its economy from the rest of the world, as many developing and centrally planned nations did for decades of the 20th century, and then re-emerges and tries to integrate itself into the world economy, the years of isolation leave a legacy of backward technology and low labour productivity. Policy makers must evaluate the

implications of this legacy and design policies for confronting it. Two centuries after his original contribution, David Ricardo continues to lend a powerful helping hand in this task.

While these various findings suggest that the Ricardian model may be generally consistent with observed trading patterns, they in no way suggest that this model is sufficient for understanding the basis for trade. Overall, the Ricardian model seems to raise more questions about the source of comparative than it answers. The Ricardian theory provides no guide as to how labour productivity and comparative advantage can be expected to evolve since it gives no explanation of differences in labour productivities across countries.

In today's complex trading world, the Ricardian model has several limitations that restrict its usefulness. Among the most limiting assumptions are the labour theory of value and constant costs, which are at odds with that can be observed in the present day world. In addition, as countries grow and develop, relative resource endowments, including labour, change. Consequently, a richer paradigm is needed to better grasp the underlying basis for international trade. Free trade is a means for a country and the world to enhance well-being. In order to realise the full benefits of specialisation and exchange through increased labour efficiency, resources need to be mobile within countries.

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