An Overview of Research into International Values in Japan

Hideo Sato

Abstract In Japan, research into international values has been conducted vigorously since the latter half of the 1940s. From a global perspective, studies that emphasize demand factors in the determination of international values have been dominant; however, this has not been the case in Japan. Neoclassical studies of this subject have not been as vitalized. Rather, many of the studies have succeeded the works of Ricardo, Marx, Graham, and Sraffa who placed a high priority on supply factors in the determination of commodity prices. Research on this topic is divided roughly into two periods owing to its contents and characteristics. One is the period until the 1980s and the other is that since the 1990s. Research in the first period was chiefly carried out by Marxian economists, and that in the second period, based on Graham and Sraffa, has led to the birth of the new theory of international values developed in this book. In this chapter, we provide an overview of research into international values in Japan. In addition, we explain Graham's relatively unknown theory of international values and show the fundamental structure of the Graham-type model (a modified version of Graham's original model and a multi-country multi-commodity Ricardian trade model). Furthermore, we present a way in which to derive an equilibrium solution of this model practically.

Keywords Multi-country multi-commodity • Link commodity • Frank D. Graham

1 Introduction

In Japan, research into international values has been conducted vigorously since the latter half of the 1940s. From a global perspective, studies that emphasize demand factors in the determination of international values have been dominant; however, this has not been the case in Japan. Neoclassical studies of this subject have not been as vitalized. Rather, many of the studies have succeeded the works of Ricardo, Marx,

H. Sato (✉)
Tohoku University, Sendai, Japan
e-mail: vermeer@qit.ne.jp

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Research in the first period was chiefly carried out by Marxian economists, although a few modern economists joined the discussion in the very early stages. Two of the many issues were central. Firstly, how is Marx's *labor theory of value*, which is constructed under the assumption of a single market with the free movement of labor and capital, modified in the world market without the free movement of labor? Secondly, which principles determine the patterns of the international division of labor (or international trade) and world commodity prices? The first problem relates to "the modification of the determination of value by the quantity of labor," while the second is the theory of the international division of labor or international trade.

These problems are virtually one for the following reasons. From the standpoint that affirms the labor theory of value, the second problem is solved automatically if the first is solved, while from the standpoint that denies the theory, the first does not exist at all.

The argument in the first period was polemical and appeared to be highly complex because many issues were connected. Researchers involved in the argument were strongly influenced by Marx's writings and debated the interpretations of the Marx's words. As Marx himself offered no definite or coherent writing dealing with international values or international trade, many researchers have relied on fragments found here and there in *Capital*, *Outlines of the Critique of Political Economy*, *Theories of Surplus-Value*, and so on in order to show their own views to be right.

Although the argument produced a large number of works, research diminished rapidly in the 1990s. Following the collapse of the Soviet Union and the communist states of Eastern Europe around 1990, the influence of Marxian economics waned. The natural result was that research relying on Marx's writings lost its force with a decline in Marxian economics. However, simultaneously, a new type of research into international values has begun to grow, although the number of researchers involved remains low. This new research stream, based on Graham and Sraffa, has led to the birth of the new theory of international values developed in this book.

In this chapter, we provide an overview of research into international values in Japan. The remainder of the chapter is organized as follows. Section 2 outlines the research until the 1980s. Although the issues are many, we focus our attention on the most central and important. Section 3 describes the new research conducted since the 1990s. In addition, we explain Graham's relatively unknown theory of international values and show the fundamental structure of the Graham-type model (a modified version of Graham's original model and a multi-country multi-commodity Ricardian trade model). Furthermore, we present a way in which to derive an equilibrium solution of this model practically. Finally, we refer to what we consider to be the remaining challenges.

2 Research into International Values Until the 1980s

2.1 Nawa's Research Motivation and the Theory of Key Commodity

Research into international values in Japan was started by Toichi Nawa. His research results related to this topic are contained in Nawa (1949). Nawa, a Marxian economist, was convinced that the labor theory of value was right. This theory is constructed under the assumption of a single market where labor and capital move freely. Is, then, the theory invalid in the world market where labor does not move? For him, this was an important matter of concern.

About this problem, David Ricardo also pondered, ultimately developing *the theory of comparative costs*. In Chapter 7 of *On the Principles of Political Economy and Taxation*, he stated that the "same rule which regulates the relative value of commodities in one country, does not regulate the relative value of the commodities exchanged between two or more countries" (p. 133). In addition, he argued that equal quantities of labor are exchanged in the same country, while unequal quantities of labor are exchanged between different countries. He did not explain, however, how international exchange ratios of labor are determined. The example that the labor of 100 Englishmen was given for the labor of 80 Portuguese was only deduced from the given commodity terms of trade between cloth and wine. For him, the labor theory of value is valid only in domestic trade and invalid in international trade.

Karl Marx also examined this problem. He had stronger conviction about the labor theory of value than Ricardo, suggesting that it was not invalid but rather modified in the world market in two ways. The first is related to the intensity of labor: "In every country there is a certain average intensity of labor below which the labor"[1] is not considered to be labor of normal quality in each country. In domestic market, "only a degree of intensity above the national average affects the measure of value by the mere duration of the working time." This is not the case in the world market. The average intensity of labor differs from country to country. "These national averages form a scale, whose unit of measure is the average" of the national averages. "The more intense national labor, therefore, as compared with the less intense, produces in the same working time more value." The second is related to the productivity of labor. In the world market, more productive national labor is considered to be more intense, producing more value in the same working time as compared with less productive national labor.

Marx described the above in Chapter 20 (Chapter 22 in the English edition published in 1887) of *Capital* Volume I. The description was qualitative rather than quantitative and lacking in concreteness. Indeed, it could not be proven that the labor theory of value is also valid in the world market unless international exchange

[1] Marx (1887, p. 396). The following quotations from Marx are on the same page.

ratios of labor are defined quantitatively. He, however, wrote nothing about this to the last. For Marxian economists, theory of international values was the missing link of Marx's theory of values.

Nawa attempted to discover the link, writing that in the world market, the specific national labor that produces a globally important commodity or a *key commodity* is the measurement standard to determine the weight of national labor; further, national labor that produces other commodities is also evaluated according to the same standard. He offered the following numerical example. Suppose that the key commodity (e.g., cotton yarn) is *P* and the other commodity (e.g., agricultural products) is *Q*. Further, developed country *A* requires each one working day to produce each unit of *P* and *Q,* while developing country *B* requires 12 working days to produce a unit of *P* and two working days a unit of *Q*. Then, according to each country's labor productivity of *P*, the evaluation that one working day of country *A* is equal to 12 working days of country *B* is given for the labor of both countries. Hence, one unit of *P* produced in country *A* is exchanged for six units of *Q* produced in country *B*.

Nawa's *theory of key commodity* was not supported by researchers, however. His numerical example is a two-country two-commodity model in the same way as Ricardo's. Both examples are also the same in that the more productive country in both commodities exports the commodity with the higher degree of productivity advantage and imports the commodity with the lower degree. However, Nawa did not explain why country *A* exported *P*, even though country *A*'s *P* produced in one working day had an equal international value to country *B*'s *P* produced in 12 working days. Moreover, in his numerical example, country *B* received no gain from trade and, therefore, should have no incentive to trade in the first place.

2.2 Theory of National Productivity Differentials

International values were a topic of the plenary sessions in the second (1950) and third (1951) academic conferences of the Japan Society of International Economics, which was founded in 1950. The argument was developed with a central focus on the review of Nawa's theory, and heated discussion took place among Marxian economists and modern economists. Is an international exchange of unequal quantities of national labor an unequal exchange of value? What is the relation between Ricardo's trade theory and Marx's? How should John Stuart Mill's *theory of reciprocal demand* be evaluated? What does the introduction of currency into trade theory bring about? While the active argument[2] continued after the conferences, the views of researchers still did not converge, but an exception was the so-called *theory of national productivity differentials*.

[2]See Kinoshita (1960) and Naruse (1985) about the outline of the argument.

This theory, which replaced the theory of key commodity, insisted that the measurement standard to determine the weight of national labor was the national productivity differentials obtained by averaging the productivity differentials of individual sectors. Based on a two-country two-commodity model, the national productivity differential is determined somewhere between the respective productivity differentials of two commodities. Using Nawa's example above, the national productivity differential is somewhere between the productivity differential of commodity P (12 versus 1) and that of commodity Q (2 versus 1), for example, 6 versus 1. One working day of country A produces the same international value produced by six working days of country B. Country A exports P and imports Q. The commodity terms of trade are thus "1 unit of $P = 3$ units of Q"; consequently, both countries gain from trading.

This was the same composition as Ricardo's theory of comparative costs. However, although many researchers accepted this theory, problems remained. For example, there was no convincing explanation about a way to average the productivity differentials of individual sectors. If some kind of weighted average were to be used, we would need to specify the weights based on three options. The first would be to use trade values as weights. However, we would immediately understand this to be wrong if we recollect that the theory of international values is also the theory of clarifying trade values, trade volumes, and other factors relating to trade. Selecting the trade values as weights is to put the cart before the horse.

The second would be to use output values as weights. This also has a drawback. Output values are prices multiplied by output volumes, and prices and output volumes (therefore output values) vary according to the patterns of the international division of labor. The weights could not be determined without first determining the patterns. If we need to specify the weights in order to determine the patterns, this is circular logic. Then, can we use demand values as weights? Demand values are prices multiplied by demand volumes. Prices vary by pattern, and the demand volumes vary by price. It is not until the patterns are determined that the weights can be. Again, the same problem as in the case of the output values arises.[3]

The shortcomings of the second and third weights were barely noticed. The reason of this was concerned with the fact that research into international values in Japan was carried out exclusively with two-country two-commodity models. In these models, the patterns of the international division of labor are already decided. Hence, researchers did not consider the abovementioned relation between the patterns and the weights in depth. If multi-commodity (at least three or more) models had been used, the situation would have changed a little.

[3]Although most researchers did not give a quantitative definition of national productivity differentials, a number of them, we think, adopted the second standpoint, as Japanese Marxian economists believed that demand was never involved in the determination of values. Exceptionally, Kihara (1986) adopted the first standpoint and Yukizawa (1957) the third.

More serious problems emerge in multi-country multi-commodity models. Regardless of which weights we use, it is impossible to calculate a weighted average if we do not know the productivity differentials of individual sectors in all countries. Can we know the productivity level of the car industries in developing countries or crude oil industries in non-oil-producing countries? Nevertheless, the theory of national productivity differentials has continued to reign as a popular theory[4] with such problems neglected.

One main reason for this is that no alternative was presented until the 1980s. Another is that real-world statistics seemed to show the labor productivity level of a whole country. The data are obtained by dividing GDP by the total working population or the total working hours in a country, being the labor productivity per person or per hour. It might be possible to assert that the very differentials of these levels were the national productivity differentials; indeed, many researchers asserted so. The existence of these practical data, however, never removed the theoretical problems of the theory; it only concealed them.

2.3 Aspects as Trade Theory

Here, we compare Ricardo's theory of comparative costs (Ricardo 1817, Chapter 7), Mill's theory of reciprocal demand (Mill 1848, Chapter 18), and the theory of national productivity differentials and summarize features as a trade theory. The basic models of all three theories are two-country two-commodity models, but each has a different logical structure to determine the commodity terms of trade (CTT), or world relative prices, and the double factorial terms of trade (DFTT), or international exchange ratios of national labor. Ricardo determined DFTT by taking CTT as given, Mill determined CTT and DFTT by adopting reciprocal demand, and the theory of national productivity differentials determined CTT and DFTT by adopting national productivity differentials.

It is an important feature of the labor theory of value that relative prices are determined regardless of demand, making the theory incompatible with the theory of reciprocal demand. While, in Mill's trade theory, a change in demand causes immediately a simultaneous change in price and quantity supplied, in the theory of national productivity differentials, a change in demand brings only a change in quantity supplied since prices are already determined by fixed production costs. This is why many Marxian economists support the theory.

Thus, in Japan, two trade theories with the same origin as Ricardo's trade theory, namely, neoclassical trade theory, which was formed through Mill, and

[4]There was criticism of the theory by Marxian economists. Sasaki (1989) pointed out that it was fundamentally impossible to average the productivity differentials of different sectors, while Motoyama (1982) wrote that we could never know the productivity level of the car industry in developing countries.

Marxian trade theory, which was formed through Marx, confronted each other. Marxian economists continued to criticize *the Heckscher-Ohlin-Samuelson model* (HOS model), which was recognized as the core of neoclassical trade theory. They criticized the assumption of the model that both countries have identical production technologies as unrealistic. They also suggested that factor price equalization, the logical consequence of the model, does not occur in the real world; rather, there are very large wage differentials among countries. It appeared as if the theory of national productivity differentials had a huge advantage in explaining wage differentials, because, to explain these, only the existence of national productivity differentials (the productivity differentials of the key commodity in case of Nawa's theory) is needed. They further stated that the neoclassical production function that assumes smooth substitutability between capital and labor is impractical.

On the contrary, the mainstream economists claimed that Ricardo's and Marx's models are primitive one-factor models in which there is no capital and thus that these models are lacking in reality. This argument is wrong. Labor input coefficients in the labor theory of value consist not only of "direct labor" expended by workers to produce commodities but also of "indirect labor" embodied in intermediate goods and the consumption of capital goods. In these models, capital is not nonexisting; it is merely converted into labor. If there is capital, there are ordinarily profits. In an economy with profits, the proportional relationship between the labor input coefficients and prices is lost. Japanese Marxian economists were fully aware of this matter, and therefore, the "transformation problem," or transformation from labor values into production prices, became an important subject of debate.

However, researchers interested in the transformation problem were not working in the field of international values, while researchers interested in international values did not tackle transformation problems. They both went on their own paths independently without crossing each other. Researchers of international values, although they knew the existence of the transformation problem, constructed a trade theory not in terms of prices but in terms of labor values, which they considered to be permissible as an approximate approach.

Roughly speaking, Marxian trade theory followed Ricardo's theory of comparative costs. What the former added to the latter was the determination of world relative prices and wage-rate differentials by using the productivity differentials of the key commodity or national productivity differentials. The addition, as stated above, met with little success.

Despite many similarities, there were two great differences between Ricardo's trade theory and Marxian trade theory. One is the relation between foreign trade and foreign direct investment (FDI). Ricardo indicated "the difficulty with which capital moves from one country to another, to seek a more profitable employment" (Ricardo 1817, pp. 135–136) and did not deal with FDI. The HOS model, because of the factor price equalization theorem, was also indifferent to FDI. In Marxian trade theory, some studies arguing for a logical relation between foreign trade and FDI

existed,[5] though a few in numbers. From the viewpoint of the present-day world economy, it is clear that they both have a close connection. The pioneering of such studies cannot be denied.

The other is the dynamic aspect of trade. As is well known, Ricardo thought that all trading countries gain from trade, meaning that a peaceful and harmonious world society should be realized through the international division of labor based on the comparative costs in each period. Marxian economists opposed this thought. They argued that all trading countries gaining from trade is only right from a static short-run viewpoint. From a dynamic long-run viewpoint, another aspect emerges: according to industries specializing in the international division of labor, the future economic growth of each country is greatly affected. A typical example is the international division of labor in agriculture and manufacturing: while a future high growth rate is expected in countries specializing in manufacturing, economic development may be restrained in countries specializing in agriculture. Consequently, the per capita income differentials between manufacturing countries and agricultural countries will widen over time. From such a viewpoint, they strongly supported Alexander Hamilton, who advocated developing manufacturing in the United States after independence, and Friedrich List, who argued in favor of adopting protective trade policy toward England to progress the industrialization of Germany. This dynamic viewpoint concurs with the history of the world economy and shows an advantage of Marxian trade theory over neoclassical trade theory.

2.4 Kojima's and Negishi's Interpretations of Ricardo

At the last of this section, we introduce two exceptional theories. Although most mainstream economists accepted the theory of reciprocal demand, there were two exceptions, Kojima (1951) and Negishi (1982, 1996). Both these representative modern economists in Japan, from a completely different viewpoint to Marxian economists, insisted that Ricardo's trade theory could determine the terms of trade without considering reciprocal demand.

Kojima (1951) constructed a two-country three-commodity model in which the third commodity (gold) was added to two ordinary commodities (cloth and wine) and determined the terms of trade by combining the specie-flow mechanism with the comparative costs structure. We explain his theory with a little arrangement. His model is divided into two cases. In the first case, gold is produced in both countries and does not move internationally. The real production costs of one unit of cloth, wine, and gold are the labor of 100, 110, and 100 men in England and 90, 80, and 80 men in Portugal. If it is assumed that one unit of English money (£e) and Portuguese money (£p) both contain 1/45 units of gold (the official prices of gold are £e 45 and £p 45), gold parity is £e 1 = £p 1. Then the English wage rate per person is £e 0.45

[5] See Muraoka (1968) and Sasaki (1998).

(45/100) and that of Portugal is £e 0.5625 (45/80). Accordingly, England exports cloth at a price of £e 45, and Portugal exports wine at a price of £e 45. Thus, the terms of trade are determined without demand conditions.

In the second case, the starting point is the situation in which the labor costs of wine fall from 110 men to 100 men after an improvement in winemaking in England, but all other factors remain unchanged. Through this improvement, the price of wine made in England falls from £e 49.5 to £e 45, and the export of wine made in Portugal stops. An English trade surplus thus occurs, which, in turn, causes appreciation of English money and an outflow of gold from Portugal into England. As a result, English prices rise uniformly (e.g., by 3.3%), and Portuguese prices fall uniformly (e.g., by 3.3%). Then, the English prices of cloth, wine, and gold all rise from £e 45 to £e 46.5, and the Portuguese prices of cloth, wine, and gold fall from £p 50.6 to £p 48.9, from £p 45 to £p 43.5, and from £p 45 to £p 43.5, respectively.

Through these adjustments, it becomes possible for Portugal to export wine and gold, and the trade equilibrium is restored. Under this new equilibrium, the official prices of gold change from £e 45 to £e 43.5 and from £p 45 to £p 43.5 in England and Portugal, respectively, and the exchange rate settles into gold parity. The English wage rate per person changes from £e 0.45 to £e 0.465 (46.5/100) and that of Portugal from £e 0.5625 to £e 0.54 (43.5/80). Kojima, after having provided the explanation above, insisted that the terms of trade were determined without demand conditions in this second case as well as in the first case.

However, Kojima's use of numerical examples to provide this explanation was lacking in clarity. In particular, he offered no explanation about why the trade equilibrium occurred in the second case when the fluctuation band of prices was not 2% or 4%, but 3.3%. Being aware of such gaps, Negishi (1996) aimed to compensate for the weaknesses of Kojima (1951). While he disagreed with Kojima's idea in the early days,[6] he later altered his view and became a supporter with some reservations.

Negishi constructed a two-country three-commodity model in which England specializes in the production of cloth and Portugal in the production of wine. In the model, P_c and P_w represent the prices of cloth and wine in terms of gold after starting trading, L_e and L_p are the supply of labor in England and Portugal, a_{ce} and a_{ge} are the unit labor cost of cloth and gold in England, a_{wp} and a_{gp} are the unit labor cost of wine and gold in Portugal, V_e and V_p are the constant velocity of circulation of money in England and Portugal, and G and M are the world stock of gold and its distribution to England. Given that gold is used exclusively for money, the international distribution of gold can be explained by the quantity theory of money:

$$P_c * L_e / a_{ce} = V_e * M \tag{1}$$

$$P_w * L_p / a_{wp} = V_p * (G - M) \tag{2}$$

[6] See Negishi (1982, p. 202).

If conditions (1) and (2) are satisfied, trade between England and Portugal is balanced, and there is no movement of gold between the countries. Suppose that gold is produced only in Portugal. Then,

$$P_w = a_{wp}/a_{gp} \tag{3}$$

From the three equations, the following is obtained:

$$P_c/P_w = \left(a_{gp} * V_p * G - L_p\right) V_e * a_{ce} / \left(V_p * L_e * a_{wp}\right)$$

The left-hand side represents the equilibrium terms of trade, which are determined without introducing reciprocal demand for cloth and wine provided the values of the exogenous parameters of the model meet several conditions (not stated here). Further, if gold is produced only in England, the terms of trade are different from those above, becoming $P_c/P_w = V_e{*}L_p{*}a_{ce}/(a_{ge}{*}V_e{*}G - L_e)V_p{*}a_{wp}$. Furthermore, if gold is produced in both countries, $P_c/P_w = a_{gp}{*}a_{ce}/(a_{ge}{*}a_{wp})$.

There are some problems in the argument above, however. While he stated that trade between England and Portugal is balanced if conditions (1) and (2) are satisfied, the reason is unclear. It seems that the left-hand side of the equations represents national income and the right-hand side national expenditure, since the trade equilibrium is realized when national income equals national expenditure. It is, however, not convincing to regard the product of the gold stock and the velocity of circulation of money as national expenditure. Moreover, it is hard to understand that the gold stock is given, even though there are three patterns of gold production and the terms of trade are different according to these patterns. His attempt to compensate for the shortcomings of Kojima's work does not succeed.

Negishi (1982) presented another way in which to determine the terms of trade without recourse to demand factors. Here, his model is a compact one that uses Ricardo's numerical example of comparative cost theory. According to him, Ricardo had the notion that the wage rate of laborers equals the amount necessary to purchase the commodities required to support of themselves and their families. Therefore, in the Ricardian two-commodity model, the wage rate is expressed by

$$w = c_1 p_1 + c_2 p_2$$

where c_1 and c_2 denote the given quantities of cloth and wine, w is the wage rate, and p_1 and p_2 are the prices of cloth and wine. To simplify, it is assumed that c_1 and c_2 are identical among different countries.

Next, let us introduce a profit rate into Ricardo's numerical example in which cloth in England and wine in Portugal require 100 and 80 units of labor, respectively; further, we assume that England specializes perfectly in the cloth industry and Portugal in the wine industry.[7] Then, prices are expressed by

[7] Although Negishi (1982) did not exclude the case in which one country produces two commodities, we omit it here to explain the case.

$$p_1 = (1 + r)\, 100\, (c_1 p_1 + c_2 p_2)$$
$$p_2 = (1 + r')\, 80\, (c_1 p_1 + c_2 p_2)$$

where r and r' denote the profit rates of England and Portugal.

The difference in labor productivity brings about a difference in the profit rate, given that the wage rate is identical in both countries. If the gap in the profit rate is very large, international movements of capital occur and the gap diminishes. However, the profit rates of both countries do not equalize fully because, as emphasized by Ricardo, most men of property are satisfied with a lower profit rate in their own country rather than seeking a higher profit rate in foreign nations.

So , let us assume $R' = aR (a < 1)$, where $R = 1/(1 + r)$ and $R' = 1/(1 + r')$.Then, the relative prices of p_1 and p_2 or the terms of trade between cloth and wine are determined regardless of the demand factors.

Despite the strengths of Ricardo's interpretation by Negishi, the wage differential is nowadays very large, and capital moves around the world swiftly and easily compared with period of Ricardo. Negishi (1982) should be understood as a paper in the field of the history of economics.

3 Research into International Values Since the 1990s

3.1 Rediscovery of Graham's Theory of International Values

Research into international values which is within the scope of Marxian economics has tapered off since the 1980s, and the number of researchers interested in the subject has also decreased. Instead, new research outside the framework of Marx has started. In this section, this new body of research is addressed.

First, we describe the "rediscovery" of Graham's theory of international values. Frank D. Graham (1890–1949), a mainstream US economist, researched international values from the 1920s and published his major book *The Theory of International Values* in 1948.[8] His research, however, has not been praised within mainstream economics and has been almost forgotten. The reason is that while the origin of mainstream trade theory is Mill's theory of reciprocal demand, Graham criticized Mill's theory thoroughly. On the contrary, Marxian economists, who are critical of Mill's theory, have also refused to accept Graham's theory as excellent and have ignored it entirely. The reason is that, while the labor theory of value is the most important foundation for Marxian economics, Graham regarded the theory as a stumbling block and refused it. However, Graham's theory was decisively important for the new theory of international values. We explain the features of his theory in some detail.

[8]His related works are Graham (1923, 1932, 1948). The following explanation mainly relies on Graham (1948).

(1) *Graham was the first to present the existence of an equilibrium solution in a multi-country multi-commodity trade model.*

We can sum up the fundamental structure of Graham's model as follows:

1. There are many countries and many commodities.
2. There are no intermediate goods and no profits. All commodities are for consumption.
3. For each country, constant opportunity costs, economic scales, and demand structures are given.
4. Full employment and trade equilibrium (or national expenditure equals national income in each country) are fulfilled.
5. There are no transport costs and no trade barriers.

Under these assumptions, the patterns of the international division of labor, international values, and each country's volumes of production, export, import, and consumption are determined uniquely.

Graham explains the above, while providing no mathematical treatment,[9] by using many numerical examples. In earlier trade theories, although there was the example that an equilibrium solution is derived in a two-country multi-commodity case,[10] some possible patterns of the international division of labor were only shown at best in a multi-country multi-commodity case.[11] Indeed, Graham was the first to present the existence of an equilibrium solution in a multi-country multi-commodity (four-country three-commodity or ten-country ten-commodity) case.

(2) *To explain domestic values and international values by the same logic, Graham expresses production techniques of commodities not by labor costs (inputted labor), but by opportunity costs.*

According to Graham, each country's production techniques differ in every sector. While the labor theory of value expresses the difference in these techniques by using the difference in labor input coefficients, he expresses it by using the difference in the opportunity cost of each commodity. Concretely, he designates a specific commodity as a benchmark commodity (the opportunity cost of this commodity is one) and expresses the production techniques of other commodities by the number of units producible by giving up production of one unit of the benchmark commodity. The opportunity costs are essentially constant,[12] as distinct from those

[9] McKenzie (1954a) presented a mathematical treatment for Graham's model, and McKenzie (1954b) tried to prove the existence and uniqueness of the equilibrium solutions in the model. Shiozawa (2014), however, indicated that the proof was wrong because the demand functions assumed by McKenzie were different from Graham's (p. 290).

[10] See von Mangoldt (1975).

[11] See Section 4, Chapter 8 of Viner (1937).

[12] Graham refers to the case of variable opportunity costs too and indicates that the number of commodities produced in common in more than one country would grow under the increasing opportunity costs (Graham 1948, pp. 146–151).

of neoclassical trade theory which are increasing. Graham describes the reason for using opportunity costs as follows:

> When we think in terms of opportunity cost it can be conclusively demonstrated that Ricardo, Mill, and the neo-classicists, were wholly wrong in supposing that the same rule which regulates the relative value of commodities in one country does not regulate the relative value of the commodities exchanged between two or more countries. (Graham 1948, p. 333)

We also explain the other two given conditions. The economic scale of each country is expressed by the production volumes of the benchmark commodity which is realized when each country specializes in the commodity. Although full employment is supposed, the volumes of production factors and absolute productivity levels are not shown. Therefore, differentials in per capita income or wage rates among countries are not argued in the theory of international values directly and are treated as another problem.[13] The demand structures of each country are given by the expenditure coefficients of each commodity (amount expended on each commodity divided by national income). The sum of the coefficients is one (i.e., all income is expended) in every country.

(3) *International values are determined by the opportunity costs in each country and link commodities.*

International values or the world relative prices of commodities are determined not by reciprocal national demand, but by the opportunity costs in each country just like domestic values. What is important in this determination is the existence of commodities produced in common in more than one country, termed *link commodities*. This link commodities link the opportunity costs of countries that produce the same link commodities, meaning that the relative prices of all the commodities produced in these countries are determined uniquely. In principle, every country has at least one link commodity, suggesting numerous link commodities in the world at large. As a result, a body of link commodities links the opportunity costs of all countries and thus determines the international values of all the commodities in the world. The link commodities are, in turn, determined by the interaction among the opportunity costs, economic scales, and demand structures in each country. According to Graham, the link commodity was the missing link of the classical theory of value.

(4) *In the face of changes in demand, international values are highly stable.*

International values, formed once, are highly stable in the face of changes in demand. Such changes are adjusted through changes in production volumes

[13]Graham is not indifferent to the problem. For example, he writes that national prosperity (per capita income or wage rate) is a function of two variables, per capita physical productivity and the terms of trade, and the former is more important (ibid., p. 50, pp. 212–213, p. 233). He also refers to money wages (ibid., p. 261, p. 307).

and export-import volumes without price changes. If drastic changes in demand occur, prices might change slightly. In this case, the price changes are necessarily accompanied by changes in the pattern of the international division of labor. Newly formed international values are also based on the linkage of the opportunity costs in each country.

However, depending on the three given conditions of 3 in the above (1), the linkage of opportunity costs may be disconnected. Graham calls such a state of disconnection *limbo* (see the next subsection for more details) and regards this state as highly improbable. In the limbo case, a small change in demand brings about an immediate change in international values. Exemplified by using a two-country two-commodity model, the limbo case is a situation in which each country specializes in a commodity with a comparative advantage, an ordinary case used in textbooks. According to him, however, a situation in which one country produces two commodities and the other country produces either commodity with a comparative advantage has a far higher probability. Then, international values are determined by the opportunity cost of the former country, and reciprocal demand plays no part.

Graham's theory of international values was also introduced to Japan by several researchers from the 1950s to the 1980s. However, these introductions were either critical of his theory or only partial offerings.[14] Sato (1990) gave high acclaim to the theory and introduced the whole picture of it to Japan. Furthermore, Sato (1994) presented a two-country multi-commodity model, which was a modified version of Graham's model in three ways: production techniques are expressed not by opportunity costs, but by labor input coefficients, volumes of usable labor are given, and not only the linkage case but also the limbo case is treated. Hereafter, we refer to this modified model as a *Graham-type model* to distinguish from Graham's original model. In the next subsection, we explain a way in which to obtain an equilibrium solution of the Graham-type model.

Another stream of research into multi-country multi-commodity model that started from Jones (1961) aimed to solve the patterns of each country's specialization in the setting in which countries and commodities are equal in number. Several modern economists in Japan also wrote related papers.[15] However, although they typically referred to Graham, they did not understand the importance of link commodities.

[14] Kojima (1949) and Minabe (1956) were critical. Noguchi (1987) introduced the two-country two-commodity case affirmatively.

[15] About this research stream, see Sect. 2, Chapter "Analysis of Production Efficient Patterns of Specialization Allowing Intermediate Inputs: The Meaning of Shiozawa's Model with a Viewpoint of Modern Economics" of this book.

3.2 Derivation of the Equilibrium Solution in the Graham-Type Model

Graham's attempt to present a general equilibrium in a multi-country multi-commodity Ricardian trade model had several weaknesses. First, his model did not include intermediate goods and profits. Second, he did not show how to derive the equilibrium solution from the given conditions: he showed only the calculation results of his numerical examples. Third, he virtually ignored the limbo case, which he regarded as highly improbable. However, as McKenzie (1954a) indicated, this was wrong. The probability of the limbo case, while certainly small, is not negligible. We also have to derive an equilibrium solution about the limbo case as long as we cannot ignore the limbo. Fourth, he did not address underemployment case, although his model was essentially compatible with an underemployment.[16]

As stated later, the first problem was solved by Shiozawa (2007, 2014), and the content of the solution is shown in Chapter "The New Theory of International Values: An Overview" of this book. In this subsection, the second and third problems are addressed on the basis of Sato (2016). Although Sato (2016) also presented an underemployment version of the Graham-type model, this is not covered here.

Model Setting and Definition of Terms There are M countries and N commodities (M, N: an integer of ≥ 3 and $M < N$). The labor input coefficients, volumes of usable labor, and expenditure coefficients in each country are given. Conditions 2, 4, and 5 of (1) in the previous subsection are adopted, with another condition that domestic wage rates are equal in all sectors added.

Given the international division of labor, some sectors in each country continue the production activity, and other sectors cease it. The former is called *active point* and the latter *non-active point*. The patterns of the international division of labor have to be *reasonable*. Here, "reasonable" means a situation in which both the "production costs of active points = prices of commodities" and "production costs of non-active points > prices of commodities" are fulfilled.

The patterns of the international division of labor (hereafter, the patterns) can be classified into two types. One is when all countries are linked through link commodities. We refer to this as *the linkage type*. In this type, there are $M + N - 1$ active points, and all the active points are linked (see McKenzie, 1954a). Hence, by taking a commodity as the numéraire, the prices of all commodities and wage rates of all countries can be expressed by the labor input coefficients (see three-country four-commodity case mentioned later). In other words, once the patterns are determined, all the relative prices and wage rates (hereafter, the prices/wage rates) are determined by the patterns themselves, or there is a one-to-one correspondence between the patterns and the prices/wage rates.

[16] See Sect. 4 for the reason.

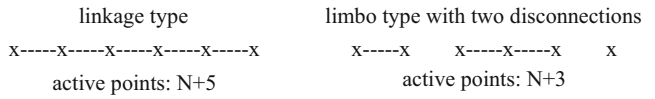

Fig. 1 An example of the two types of the international division of labor

The second type is called *the limbo type*. In this type, the patterns have fewer active points than $M + N - 1$. Here the linkage of countries and active points is not perfect, and one or more disconnections of the linkage occur. Therefore, determining all the prices/wage rates by the patterns only is not possible. As mentioned above, Graham called such a situation limbo and virtually ignored the limbo type; however, we cover this type. The disconnection is not always one. Theoretically, the disconnection can occur in the range from 1 to $M - 1$, and the number of active points decreases according to the number of disconnection. If a pattern of the international division of labor has two disconnections, the active points of this pattern are $M + N - 3$. Figure 1 illustrates these two types in a six-country N-commodity case (commodities are not shown in the figure).

Six countries (expressed by x) are all linked in the linkage type, whereas in the limbo type, the linkage is disconnected in two places, and countries are divided into three groups within which they are linked.

Process of the Derivation of the Equilibrium Solution An equilibrium solution is derived through the following process. First, we have to search for and identify reasonable linkage-type patterns, which are determined only by the labor input coefficients. The number of the reasonable linkage-type patterns is $(M + N - 2)!/\{(M - 1)!(N - 1)!\}$ in an M-country N-commodity case.[17]

Second, for all reasonable linkage type patterns, we calculate the production volumes of the active points and prices/wage rates. As the prices/wage rates are determined according to each pattern, only the production volumes are unknown. Since the number of active points in the linkage type is $M + N - 1$, the number of unknowns is also $M + N - 1$. On the contrary, the number of equations is also $M + N - 1$, where the M equations express the conditions of full employment in each country and the $N - 1$ equations the conditions of the supply-demand balance for each commodity.[18] As the unknowns and equations are equal in number, we can solve all the equations mathematically. However, whether the solutions obtained mathematically are valid economically is another problem, leading to the next process.

[17] See Shiozawa (2014, p. 372). If M and N are large, it is very difficult even to identify the reasonable patterns. Including the rest of the process, the support of computer program would be needed in order to calculate actually.

[18] Although the number of conditions (therefore, equations) is N, one is invalid owing to Walras' law.

Third, from the $(M + N - 2)!/\{(M - 1)!(N - 1)!\}$ set of solutions, we select a set that has all positive solutions, as the production volumes must be positive economically. If there is such a set, the solutions of this set are the equilibrium solutions required. The pattern, production volumes, and the prices/wage rates are determined. The consumption volumes and export-import volumes in each country are also able to be calculated easily.

Fourth, when no set of solutions is all positive, we must expand the search range to find the equilibrium solution to the patterns of the limbo type. For all reasonable patterns of the limbo type,[19] we have to calculate the production volumes of the active points and prices/wage rates. We explain the process by assuming that the number of disconnections is l. Then, "$l + 1$" country groups are formed (see Fig. 1). The relative prices of the commodities produced in each country group and the relative wage rates of countries that belong to the same group are determined by the pattern itself, while the prices/wage rates among country groups are not determined only by the pattern. To determine the prices/wage rates among groups, we have to add the wage rates of a country in each country group which does not produce a numéraire commodity as unknowns. The number of additional unknowns is l. On the other side, the number of active points is $M + N - 1 - l$. Eventually, regardless of the number of disconnection, the total unknowns are still $M + N - 1$, and we can solve all the equations mathematically.

Lastly, we have to select a set of solutions that fulfills the following two conditions: all the solutions are positive and the solution set passes a competitive test. The test is to check whether non-active points are competitive by comparing the production costs of non-active points with the prices of the commodities. As all the prices/wage rates are already obtained by the fourth process above, the test itself is, though laborious, simple. If at least one non-active point is competitive, the set is disqualified. Only one set satisfies these two conditions and this set is the equilibrium solution.

Case of a Three-Country Four-Commodity We now give an example of the abovementioned in the case of a three-country four-commodity. There are the three countries of A, B, and C and the four commodities of 1, 2, 3, and 4. We define a_{ij}, b_{ij}, L_i, p_j, and w_i as commodity j's labor input coefficient in country i, commodity j's expenditure coefficient in country i, volumes of usable labor in country i, commodity j's price, and wage rate of country i, respectively. Consumption volumes are expressed as $w_i L_i b_{ij}/p_j$. The numéraire is commodity 1. The six unknowns are expressed as x_h ($h = 1, 2, \ldots, 6$).

Let us begin with the linkage type. The unknowns are all the production volumes of the active points. The unknowns' subscript number is assigned in order from the commodity of the smaller number in country A to the larger number in country C.

[19]The number of the reasonable patterns is $\sum(M + N - l - 2)!/\{(M - l - 1)!(N - l - 1)!l!\}$ ($l = 1, 2, \ldots, M - 1$), where l is the number of disconnections (suggested by the description of Shiozawa, 2012, p. 50).

For example, in the pattern that country A produces commodities 1 and 2, country B commodities 2 and 3, and country C commodities 3 and 4, the prices/wage rates and system of equations are expressed as follows:

Prices and wage rates:

$$p_1 = 1$$
$$p_2 = a_{A2}/a_{A1}$$
$$p_3 = a_{B3}/a_{B2} * p_2 = a_{B3}/a_{B2} * (a_{A2}/a_{A1})$$
$$p_4 = a_{C4}/a_{C3} * p_3 = a_{C4}/a_{C3} * (a_{B3}/a_{B2}) * (a_{A2}/a_{A1})$$
$$w_A = 1/a_{A1}$$
$$w_B = a_{A2}/a_{B2} * w_A = a_{A2}/\,(a_{B2} * a_{A1})$$
$$w_C = a_{B3}/a_{C3} * w_B = (a_{B3} * a_{A2})\,/\,(a_{C3} * a_{B2} * a_{A1})$$

Conditions of full employment:

$$a_{A1} * x_1 + a_{A2} * x_2 = L_A$$
$$a_{B2} * x_3 + a_{B3} * x_4 = L_B$$
$$a_{C3} * x_5 + a_{C4} * x_6 = L_C$$

Conditions of supply-demand balance (only three of the four are valid):

$$x_1 * p_1 = w_A L_A b_{A1} + w_B L_B b_{B1} + w_C L_C b_{C1}$$
$$x_2 * p_2 + x_3 * p_2 = w_A L_A b_{A2} + w_B L_B b_{B2} + w_C L_C b_{C2}$$
$$x_4 * p_3 + x_5 * p_3 = w_A L_A b_{A3} + w_B L_B b_{B3} + w_C L_C b_{C3}$$
$$x_6 * p_4 = w_A L_A b_{A4} + w_B L_B b_{B4} + w_C L_C b_{C4}$$

Although we have to rewrite these in the case of other patterns, this is easy and would be sufficient for exemplification.

Next is the limbo type. In the pattern that country A produces commodities 1 and 2, country B commodities 3 and 4, and country C commodity 4 only, the prices/wage rates and system of equations are expressed as below. Here, the production volumes of five active points (x_1–x_5) and country B's wage rate (x_6) are unknowns.

Prices and wage rates:

$$p_1 = 1$$
$$p_2 = a_{A2}/a_{A1}$$
$$p_3 = a_{B3} * x_6$$
$$p_4 = a_{B4} * x_6$$
$$w_A = 1/a_{A1}$$
$$w_B = x_6$$
$$w_C = a_{B4}/a_{C4} * x_6$$

Conditions of full employment:

$$a_{A1} * x_1 + a_{A2} * x_2 = L_A$$
$$a_{B3} * x_3 + a_{B4} * x_4 = L_B$$
$$a_{C4} * x_5 = L_C$$

Conditions of supply-demand balance (only three of the four are valid):

$$x_1 * p_1 = w_A L_A b_{A1} + x_6 * L_B b_{B1} + a_{B4}/a_{C4} * x_6 * L_C b_{C1}$$
$$x_2 * p_2 = w_A L_A b_{A2} + x_6 * L_B b_{B2} + a_{B4}/a_{C4} * x_6 * L_C b_{C2}$$
$$x_3 * p_3 = w_A L_A b_{A3} + x_6 * L_B b_{B3} + a_{B4}/a_{C4} * x_6 * L_C b_{C3}$$
$$x_4 * p_4 + x_5 * p_4 = w_A L_A b_{A4} + x_6 * L_B b_{B4} + a_{B4}/a_{C4} * x_6 * L_C b_{C4}$$

The above is one way of practically deriving an equilibrium solution in the Graham-type model.

3.3 Sraffian Trade Theory

Sraffa (1960), of which the Japanese translation was published in 1962, was well known among some nonmainstream economists in Japan. Japanese Sraffians were greatly interested in the re-switching of techniques and capital reversing being concerned with the Cambridge capital controversies. Studies of trade theory using Sraffa's price system, however, were delayed considerably, as it was difficult to incorporate intermediate goods or profits into a trade model, especially a multi-country multi-commodity trade model.

The first wide-ranging study was Takamasu (1991), which, based on the studies of Ian Steedman and John Stanley Metcalfe (Steedman 1979), examined Ricardian trade theory in detail. The author claimed that the introduction of profits or intermediate goods into the Ricardian trade model might cause losses from trade[20] and that the Heckscher-Ohlin theorem and factor price equalization theorem are not always valid even without the factor intensity reversal, as long as capital is not the given but commodities produced by means of commodities and human labor.[21] In addition, he proved that in a multi-country multi-commodity Ricardian trade model with intermediate goods and without profits, competitive equilibria exist.

[20]The probability that the existence of trade in intermediate goods brings about losses from trade is not zero but very small. On the contrary, the possibility for the existence to yield extended gains from trade is very large. (See McKenzie (1954a), Evans (1989), and Samuelson (2001).)

[21]However, his numerical example to show the invalidity of the theorems was in fact wrong, since the example did not satisfy the condition that there is no factor intensity reversal. Kurose and Yoshihara (2016) indicate this and give a correct example to show the invalidity of the theorems.

Thereafter, there was no noticeable progress in research into the theory of international values or trade theory by nonmainstream economists in Japan. The publication of the research achievements of Shiozawa changed this situation markedly (Shiozawa 2007, 2014). He succeeded in constructing the world production frontier of the multi-country multi-commodity model with intermediate goods and profits, proving that international values including the wage rates of each country were determined uniquely by a combination of three factors, namely, the production techniques of countries, distribution of labor powers to countries, and world demand (not national reciprocal demand). His model incorporates intermediate goods and profits into the Graham-type model and is the world market version of the Sraffian price system. He calls the model *the Ricardo-Sraffa trade economy*. Further explanation is omitted here since the model is described in detail in this book.

4 Remaining Challenges

Stimulated by Shiozawa's works, studies of trade theory by nonmainstream economists were revitalized since several years ago. In 2014, the workshop on the theory of international values, led by Shiozawa, began, and now research presentations and discussions are conducted four times a year. The topic are various: Trade and unemployment, Graham's theory of international values re-examined, Marxian trade theory revisited, Trade in value added and networks of production and trade, Thinking about the prospects of the Ricardo-Sraffa-Shiozawa trade model, Roles of demand in the determination of international values, Dynamic industry in the light of new trade theory, and so on. Several of the pertinent research achievements are included in this book.

Although research into international values has advanced recently, the remaining challenges are many. First, researchers must clarify how international values are determined under the condition of underemployment. Most trade models, for reason of necessity to close the models, are structured under the assumption of full employment. In the real world, however, underemployment is a normal state. Needless to say, it is desirable that the assumptions of models reflect reality. Further, in the case of the new theory of international values, which places high priority on quantity adjustments over price adjustments, the model settings of underemployment are especially desirable because the movement of productive resources among domestic industrial sectors, which requires a protracted period of time, is indispensable for quantity adjustments under full employment, while changes in the operating rate and employment rate are sufficient for those under the condition of underemployment.

Second, researchers must combine the knowledge obtained from the new theory of international values with economic growth theory and development economics. The new theory has a considerably different logical structure from mainstream trade theory. Therefore, a prescription for economic growth or economic development

may be different between the new theory and mainstream theory. For the new theory, it is necessary to build not only a logical but also a policymaking counterweight to the mainstream, by deepening our understanding of relations between markets or corporations and states.

Third, researchers must join the new theory of international values to the theory of the international movement of capital. Ricardo composed his trade theory on the premise that capital did not move internationally, although he knew that capital did really move between countries. As mentioned already, HOS theory does not deal with international capital movement. In Marxian trade theory, some attempts in this direction have been made, but it has been insufficient. The present world economy in which globalization is progressing is characterized by the fact that capital moves among countries vigorously. The new theory has to incorporate this fact.

Fourth, researchers must verify the relevance of the new theory. Until now, empirical testes have been performed on Ricardian trade theory and HOS theory. The test results of the former take the view that Ricardian theory can be generally supported (see Golub and Hsieh 2000 and Chapter 3 of Krugman et al. 2015). For the latter, the results are less good (see Trefler 1995 and Chapter 5 of Krugman et al. 2015). A theory must always be verified by reality. The new theory is no exception.

There may be other challenges, but we think the above four are the most important.

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