CHAPTER 2

LITERATURE REVIEW

There have been many recent researches regarding the theory of neoclassical growth that incorporate international trade. The first attempt to integrate international trade into neoclassical growth began in 1960s when Oniki and Uzawa (1965) developed the two-sector Solow model of consumption goods and investment goods with 2×2×2 Heckscher-Ohlin trade model by assuming exogenous saving rate in each trading country. Stiglitz (1970) started to fundamentally assume a representative, infinitely lived consumer with endogenizing saving rates as a constant rate of time preference. His model concludes that the main determinant of long-run comparative advantages is the countries' saving rate. These two studies could be considered as one research area in the dynamic Heckscher-Ohlin model that has been increasingly interesting.

However, the central question of the early studies is whether the income convergence across countries follows the characteristics of 'conditional convergence' or 'club convergence'. Mostly, the closed economy neoclassical growth theory predicts that if countries have the same preferences, production technologies, and population dynamics, they will converge to the same steady state level of income no matter of the initial endowments of capital and labor in each economy. That is, the conditional convergence always occurs in this identical environment of closed economies. On the other hand, the dynamic of open economy neoclassical growth model with two or more tradable commodities and different initial capital intensities may result in different steady states of income levels or 'club convergence'.

Several studies in the past decade have explained the reasons why international trade in growth model possibly induces multiple steady states. Chen (1992), for example, studies long-run equilibria in open economies using a dynamic two-sector general equilibrium model with endogenous savings and labor supply. His study verifies that two countries with identical time discount factor but different initial capital-labor ratios will not converge to a common capital-labor ratio in the long run.

The reason is that when factor prices are equalized, the rates of return to capital in each economy are identical. If the return on investment is high enough to increase the capital stock of the economy, agents with the same preference in both countries will act accordingly. Thus, the levels of capital stocks in the two countries move in the same direction overtime, so do the income levels. Consequently, international trade according to different in factor abundant in Hecksher-Ohlin model still occurs in the long run.

One crucial result from trade theory that becomes an essential factor to the existence of multiple steady states is the factor price equalization (henceforth FPE); with the same technologies of production and the endowments within the same cone of diversification, any two countries trading freely and facing the same prices of goods will have the same factor prices. According to Lerner Diagram, a descriptive graph for relating goods prices and factor prices in a two-factor, two-good, Hechscher-Ohlin model, the diversification cone is the region between the rays from the origin through the points of tangency between the unit value isoquant curves of both goods and the unit isocost line, which ensures the economy to produce both commodities[1]. Thus, when countries whose endowments are within the diversification cone diversify by producing all tradable goods, the occurrence of factor price equalization implies that the countries face the same rate of return to capital. As a result, if one country is in a steady state, then all countries with a capital-labor ratio within the diversification cone are in steady states and hence the conditional convergence may occur in the long run. On the contrary, when countries start outside the diversification cone, for example, with a very low capital-labor ratio compared to the world capital-labor ratio, such countries will grow until they reach the lower boundary of the diversification cone. In consequence, they will not be able to enter the diversification cone and will completely specialize in the production of less capital intensive tradable goods. In this case, factor prices are not equalized and hence the initial conditions matter to the long run convergence.

There have been many studies associated with the assumption of factor price equalization. These studies vary in details of the model; for example, the

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[1] See further in Deardorff's lecture (2002) and Feenstra (2004)

environment is in a small economy or two large countries, the time analysis is continuous or discrete, the production structures are set up differently between intermediate tradable goods and a single final good or two final tradable goods, as well as the representative consumer follows infinitely lived agent model, known as Ramsey model, or overlapping-generation model. Although these researches are involved in FPE and convergence, they focus on different attentions. The reviews of these dynamic trade studies are grouped by neoclassical growth model: Ramsey vs. Overlapping generations.

2.1 Heckscher-Ohlin with Neoclassical Ramsey Growth Framework

Several papers relating convergence issue in the area of dynamic Heckscher-Ohlin with Ramsey growth model are Ventura (1997), Atkeson and Kehoe (2000), Cuñat and Maffezzoli (2004), Bajona and Kehoe (2006), and Chatterjee and Shukayev (2006). All of them are conducted in a competitive environment, leaving out human capital and technological process.

The main influential paper was developed by Ventura (1997). He constructed an alternative formulation of a two-sector growth model in which a single nontraded final good, used domestically for consumption and investment, is produced by two traded intermediate goods. To simplify the mathematics, his production function of each intermediate good uses only one factor of production, capital or labor, while a final good production follows a CES technology to capture the effect of the elasticity of substitution between capital and labor on economic convergence. Since the world economy consists of small countries with different initial endowments and variation in labor productivity, prices of intermediate goods are cleared at world market without having been dominated any particular country, and hence the factor prices are also equalized across countries. As a result, he used the method of integrated world average[2] to study the evolution of world economy and

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[2] The resource allocation of the integrated equilibrium (world average) follows the closed economy planner's problem. Thus, any results can solve endogenously in the integrated equilibrium. This method can be used to solve in both small economy version and two-country version. See further in Dixit and Norman (1980)

how small economies develop with the world economy. His central discussion is to explain the East Asian Miracle. With further assumed differences in rates of time preference, population growth, and rates of return to capital, a small economy that combines a high saving rate with a low rate of population growth can overcome the effect of diminishing returns on capital accumulation by adopting an open trade regime. The miracle economy absorbs the extra capital by expanding the production of capital-intensive goods and then exporting more capital-intensive goods while contracting labor-intensive goods. This process is an application of Rybczynski theorem of international trade. Therefore, the model in Ventura can predict the conditional convergence.

Since Ventura's study depended crucially on the assumption of factor-price-equalization whose result is derived from having assumed technology with constant return to scale, Bajona and Kehoe (2006) generalize Ventura model with the production of intermediate good following CES technology and alternatively presenting in Cobb Douglas version. Unlike Ventura, intermediate goods in Bajona and Kehoe model are used for consumption and produced nontraded investment goods. They further studied the conditions under which countries remain in the diversification cone and which they leave it, as well as the possibility of equilibria in which one or more countries have zero investment in some periods (in the case that FPE does not hold).

Cuñat and Maffezzoli (2004) exhibited a different scenario in which there exist large cross-country differences in relative initial factor endowments so that factor price equalization does not hold. Their model consists of three traded intermediate goods, two of which produced by using either labor or capital. The other remaining one makes use both labor and capital for its production. Similar to Ventura's environment, a single nontraded final good used for consumption and investment, is produced by using three intermediate goods with Cobb-Douglas production function. Due to lack of factor price equalization, the international trade equilibrium is characterized by complete specialization on the production side, making country's factor prices depend on its own capital-labor ratio. However, the assumption that countries are identical, except for their initial conditions, finally leads to FPE in the long run, where the rate of return to capital is determined by the world's

capital-labor ratio. Poor countries therefore do not necessarily catch up with the rich countries, especially when the factor-endowment ratios are very large and the elasticity of intertemporal substitution is low.

Atkeson and Kehoe (2000) modeled in the complete specialization similarly to Cuñat and Maffezzoli, but with different scenario. They focused on the economic development path of poor, late-blooming country whose endowments start outside the cone of diversification, and it then specializes in producing the labor-intensive good. Since the late-bloomer has a lower capital-labor ratio compared to the early-bloomers, its rental rate on capital is higher. As a result, the late-bloomer accumulates capital until its capital-labor ratio reaches the steady state at the lower boundary of diversification cone. Since the rental rate is the same across labor-intensive production countries, consumers in the late-blooming country have no further incentive to accumulate capital. Thus, the late-bloomer faces a lower level of output even though in the long run all countries have the same rate of growth. This is another trade and neoclassical growth study substantiating the empirical result that the poor countries cannot catch up the rich ones.

Most studies in dynamic trade focus on the deterministic model, Chatterjee and Shukayev (2006), however, add uncertainty as productivity shocks into the model with small open economy. The same fashion in setting up two tradable intermediate goods combining to produce final good which can be consumed and invested is also applied in this model. In addition to world capital-labor ratio, the boundaries of the diversification cone for each country depend on the shocks faced by the country. Then, the country that faces the larger productivity shocks will also face the faster convergence. Thus, poor countries take a very long time to catch up with rich countries, constituting the same result as the non-stochastic version of the dynamic Heckscher-Ohlin model.

2.2 <u>Heckscher-Ohlin with Overlapping Generations Framework</u>

In addition to the studies in open economy neoclassical Ramsey growth framework, there have been several works devoting to open economy overlapping generations (OLG) with different interesting questions, apart form the convergence issue. Matsuyama (1988), for example, analyzed Stolper-Samuelson effects on the current account of a two-period OLG small economy in life-cycle saving model, similar to Guillo (2001), who studied the relation between the terms-of-trade and the trade balance in the two-country, two-sector OLG model. Ju and Wei (2007) also use overlapping generations to provide a theory of current account adjustment regarding the rigidity of labor market.

Most studies in the area of overlapping-generation and open economy apply the two-sector model fundamentally developed by Galor (1992). This original two-sector overlapping-generation consists of a perishable consumption good and an investment good, produced by using two factors, capital and labor, with different intensities. Both goods can be traded in the world market so that the model satisfies both Stolper-Samuelson and Rybczynski theorems. The dynamics of the model are described by two loci in (p_t, k_t) space with the perfect-foresight equilibrium condition in the world capital good sector. Thus, no international borrowing and lending exist in the model.

Cremers (2001) proved that in the two-sector OLG neoclassical growth model with international trade in consumption goods may be sufficient for the equalization of real returns to physical capital across countries. With the conditions that each economy' saving rate does not much deviate from the world average, factor price equalization and real interest rate parity with trade balance are achieved. This is why trade in goods can completely substitute with international capital flows.

However, there have been a few studies on convergence in overlapping generations. Mountford (1998), for example, extended the two-sector, two-country, and two-period OLG model in the context of convergence and overtaking. By assuming FPE and identical production technologies but different preferences in country A and B, the higher saving rate country also has a larger GDP per capita and exports the investment good in a steady state of the world economy under free trade.

Thus, international trade may allow a low GDP per capita country in autarky to catch up and overtake a higher GDP per capita country. However, the reduction in the return to labor in the developed economies as a result of FPE may cause a reduction in long run world income due to a decrease in saving as well as in capital stock for the next period. In addition, Mountford (2006) extended further by adding the more realistic assumption of non-homothetic preferences to a two-sector overlapping-generation to capture the growth miracle process, the same question as Ventura (1997). Similarly to the previous study, a wage rate in labor abundant country will rise relative its autarkic equilibrium and hence raising country's saving rates which consequently lead to and increase in national income, as well as the next period's capital stock. Thus, with more incentive to accumulate capital stock, the higher saving rate country can raise its income rapidly and catch up with the high-income country.

Sayan (2004) also used 2×2×2 model of Heckscher-Ohlin with an overlapping generations framework to investigate the role of different speed of population growth in determining patterns of trade through the closed-form solutions and simulation results. His consumer utility function is modified to allow for consumption in both goods. Moreover, the two regions are assumed to have the same amounts of capital-labor endowment at the initial stage. The result, therefore, shows that the inequality of population growth rates would create Heckscher-Ohlin differences in relative factor endowments, with the slower population growth region becoming relative capital-abundant overtime. These would give rise to differences in autarky relative prices, creating grounds for trade as in the static HO model.

In conclusion, my study uses an alternative formulation of a two-sector growth model by adding a tradable final good. It incorporates the usual studies in Ramsey and overlapping generations with trade model. Based on Heckscher-Ohlin and assumed factor price equalization, my studies are analyzed in two different approaches: an integrated economy in the small economy model followed Ventura(1997) and all market clearing in the two-economy model followed Sayan(2004).