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IS FREE TRADE GOOD FOR ENDOGENOUS GROWTH?: MONOPOLISTIC AND DUOPOLISTIC COMPETITION

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This paper examines the role of market power and market structure in determining the endogenous economic growth. Contrary to free trade under monopolistic competition, free trade under duopolistic competition by opening up the economy increases competition in intermediate input markets through the higher elasticity of substitution between inputs after trade. This reduces the incentive to invest in new technology development and thus free trade would be detrimental to endogenous growth in such an economy. The results of this paper suggest that in an intra-industry trade, policy makers when making decisions on opening up markets need to consider market structures after trade and thereby combine open markets with interventionist industrial policies.

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I. INTRODUCTION

Endogenous growth model has a characteristic of the static and dynamic scale effect by the stock of R&D technologies. Trade enlarges the stock of R&D technologies and changes the profits of intermediate good producers, which leads to different economic growth from an autarkic economy. Many studies have been in favor of either a free trade economy or an autarkic economy. On one hand, most of the studies that favor open economy have tended to concentrate on the beneficial effects of free trade due to increased market size and monopoly rent, and it becomes presumption that free trade is good for the growth and welfare

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(Schumpeters notion). On the other hand, a positive correlation between market competition and growth hints that free trade forces firms to innovate in order to survive in the world markets because of competition (Darwinian view or Porters notion). In this respect, this paper revisits some classical issues related to openness and endogenous growth in imperfect competition and intends to investigate whether free trade is good or bad for the endogenous economic growth.

We start with a question as to whether opening up the markets will give the developers of new technologies an increased incentive to participate in research, fostering the endogenous growth in technology. In order to answer the question, by emphasizing the effect of market structure and market power in the intermediate goods markets, we find the condition under which a free trade can be preferred to an autarkic economy in terms of favorable long-run performance or vice-versa. This paper sheds light on the role of market structure in the intermediate input markets as an incentive to invest in new technologies and examines the appropriate trade policies as to whether keeping open economy or closed one, corresponding to different market structures. In order to analyze the effect of openness on the long-run performance, two different market structures in intermediate goods markets are considered: monopolistic and duopolistic competition. Under a monopolistic competition presented in this paper, regardless of openness, the dynamic comparative advantage in intermediate input markets does not arise from trade because intermediate inputs in a region are differentiated from those in other. Thus, intermediate input producers in both regions face the same market structure that existed before trade. However, under duopolistic competition, intermediate inputs produced in a region are not horizontally differentiated, namely perfect substitute, from those in the other region after trade, which leads intermediate goods markets to be more competitive. Each intermediate input producer faces a competitor in another region and loses monopoly power because there arises a set of shared blueprints under free trade. This paper examines both the Schumpeterian view that the monopoly power induces the economy to grow due to monopoly rent, and the Darwinian view (Porter, 1990) that the duopolistic competition is better for growth than the monopolistic competition because of competition. The two different market structures affect economic performance, dynamic comparative advantage, and thus profit in all intermediate goods markets differently. Therefore, our analysis sets out of difference in the market structure of intermediate input markets and then investigates the condition under which openness is good for growth.

We maintain the Schumpeterian view that economic growth results from the intentional investment decisions of economic agents responding to perceived profit opportunities of intermediate inputs. In a closed economy, Lucas (1988) analyzed a scale effect with the size of human capital as the engine of growth and Young (1991) and Boldrin and Sheinkman (1988) showed that learning by doing generates endogenous growth because it leads to knowledge spillover. There have been many studies about the relationship between trade and growth based on scale effect and knowledge spillover. The effects of trade on endogenous growth are complicated in the most general case as demonstrated by Goo (1998), Goo and Park (1999) and Grossman and Helpman (1990, 1991a, 1991b, 1996). They have shown that it is hard to discern distinctions on universally applicable conclusions. On one hand, there have been studies to explain how imperfect competition calls for trade restrictions to speed up the worldwide growth rate. For example, there are some multilateral protections to capture the shift of profits from foreign to domestic region by using the tariff and price control including subsidy (Katrak 1977, Meza 1979, Brander and Spencer 1981). On the other hand, trade restriction or intervention could slow down the worldwide growth rates. Grossman and Helpman (1990, 1991b), Rivera-Batiz and Romer (1991a, 1991b) extended knowledge spillover to an open economy, so knowledge diffuses across and within regions, which plays an important role in enhancing growth. However, what has been ignored on the analysis of the effect of trade on growth is that different market structures of imperfect competitions may change profits in intermediate goods markets. In this respect, a well-known general equilibrium model of Krugman (1986), Dixit and Stigliz (1977), Grossman and Helpman (1990) and Romer (1990) is adapted to investigate how two regions interact when final goods and intermediate inputs are tradable with perfect knowledge spillover across region. For simplicity, we specify one factor model and examine the effects of different market structure in stimulating individual investment.

Analyzing duopolistic competition with endogenous growth is nothing new. There have been studies to analyze the North-South trade in dynamic models by innovation and imitation. Firms in the North initially develop and manufacture new products and imitation takes place in the South. The production moves from the North to the South in which labor is relatively cheaper than the North. Naturally, the main debate of the studies has been whether intellectual property rights protection will enhance growth or not. Segerstrom, Anant and Dinopoulos (1990), Grossman and Helpman (1991c, 1991d) and Helpman (1993) found that the rate of innovation decreases with the length of patent duration in the North or the tight intellectual property right protection in the South. Their results seem to support the Darwinian view and go against the Schumpeterian view.

An open economy under duopolistic competition analyzed in this paper is different from the one Grossman and Helpman (1991c) and Segerstrom, Anant and Dinopoulos (1990) considered. They analyzed duopoly game in the quality ladder model, but we analyze it in the model of varieties of knowledge. Our model is also different from the one Grossman and Helpman (1991d) and Helpman (1993) considered. They adopted price competition of duopoly game but we analyze quantity competition of duopoly game. Considering the Cournot model of oligopoly (quantity competition), instead of the Bertrand model of oligopoly (price competition),[1] between the North and the South, which yields the contrast in terms of growth. There has not been any study of which we are aware that links different market structure of imperfect competition in intermediate input markets between before and after trade. Even though the paper revisits some classical issues, the focus is on how different market structures create different imperfect competition and induce different patterns of trade, influencing long-run growth. Furthermore, this paper provides trade policies of decision on free trade or autarkic economy for policy-makers.

The paper is organized as follows. Section II explains the basic model and describes balanced growth equilibrium, demonstrating how differently market structure determines long-run growth in an autarkic and a free trade economy. Section III discusses and compares the balanced long-run growths between different market structures. Conclusions are summarized in Section IV.

II. THE MODELS OF BALANCED GROWTH PATH

In an open economy, we consider the model of perfect knowledge spillover across two regions as well as within a region and identical endowments and technologies between two regions, which assures that the resulting dynamic comparative advantages in the input markets disappear. The monopolistic competition increases the varieties of intermediate goods while decreasing quantity demanded from the final good producers. Duopolistic competition can transfer some profits from domestic to foreign intermediate input producers or create new profits stemmed from the increased market size. The potential duopolistic or monopolistic rent in free trade of intermediate goods entails ax ante profit, which is the financial basis for inducing new technology. Thus the economy with duopolistic competition model can be expected to grow at a different rate from the economy with monopolistic competition.

1. Autarkic Economy

We briefly describe the environment of autarkic economy. A representative consumer in region k tries to maximize her lifetime utility $U^k(t)=\int_t^{\infty} e^{-\rho(\tau-t)} \log[u^k(C^k(\tau))]d\tau$, which is the sum of the felicity, where k indicates the South or the North, and ρ is the subjective discount rate. Let an instantaneous sub-utility function $u^k(C^k(t))$ be a felicity such as $u^k(C^k(t))=[C^k(t)]^{\sigma}$, for $0<\sigma$, where $1-\sigma$ is the coefficient of relative risk aversion and hence

[1] There is no general consensus about the best way to model oligopolistic markets because predictions of equilibrium output differ among various oligopoly models that depend on alternative assumptions about the rules of the game, firms' behavior, market conditions and so on. For example, if a firm cannot adjust its price immediately, then the model with firm setting output (Cournot) rather than the model with firm setting prices (Bertrand) would be more appropriate and vise versa, e.g., Holt (1985).

$[1-\sigma]^{-1}$ is the inter-temporal elasticity of substitution. A representative consumer in region k at time t faces her inter-temporal budget constraint, $P_{Y,k}(\tau) C^k(\tau)+\dot{a}_k(\tau)\leq w_k(\tau)\overline{L_k}+r_k(\tau)a_k(\tau)$, where $P_{Y,k}(\tau)$ is the price of final goods produced from region k, $w_k(\tau)$ is the wage rate of the consumer in region k, L_k is her labor supply, $a_k(\tau)$ is the value of the asset she holds at time τ, which receives the market rate of return $r_k(\tau)$, and $\dot{a}_k(\tau)$ is rate of change in $a_k(\tau)$. For simplicity, we can assume that she is endowed with a fixed amount of labor at each moment of time t, she cannot accumulate human capital and that time is considered to be continuous. Clearly, the felicity function is assumed to be monotonically increasing, concave, and satisfies the Inada conditions. From this maximization problem we get the equilibrium growth rate of consumption and it is given by

$$\frac{\dot{C}^k}{C^k}=\left[r-\rho-\frac{\dot{P}_{Y,k}}{P_{Y,k}}\right]. \tag{1}$$

On the production side, there is one final good, Y, a continuum of intermediate inputs, x, and a set of blueprints in the economy, A, attached to the intermediate inputs one-to-one in each region. Let A_k be the level of the technologies developed in region k. Formally, the final goods are produced by the set of intermediate inputs and for convenience, labor is not used as input for the final good production. The production function for final goods in each region is CES function. Let Y_k be the output of final goods produced in region k, $Y_k=\left[\int_{i=0}^{A_k}[x_i^k)^{\mu}di\right]^{\frac{1}{\mu}}$, for $0<\mu<1$, where x_i^k denotes the input demand in region k for intermediate goods i. The profit function for final goods in region k becomes $\Pi_{Y,k}=P_{Y,k}Y_k-\int_{i=0}^{A_k}P_{x_i}{}^k x_i^k di$, for $k=S$ and N, where $P_{x_i}{}^k$ is effective price in region k for intermediate goods i. Assuming that the final goods market is perfectly competitive, the firm will maximize its profit given the price of the final goods and the prices of inputs, as follows:

$$P_{Y,k}[Y_k]^{1-\mu}[x_i^k]^{-[1-\mu]}=P_{x_i}{}^k, \tag{2}$$

Suppose that each intermediate input producer is in monopolistically competitive input markets and a unit of labor is required to produce a unit of intermediate inputs in region k, $x_i^k=L_{x_i\,k}$, where $L_{x_i\,k}$ is the labor employed in producing each intermediate good. Since the demand elasticity for the intermediate goods is $1/[1-\mu]$ in region k, the monopoly prices for intermediate goods become $P_{x_i}{}^k=w_k/\mu$ which is the constant markup over the marginal costs. With the monopoly price for intermediate goods, we can derive the equilibrium allocations of $x's$ in terms of the level of final goods and the set of prices, $x_i^k = [w_k/\mu]^{-\frac{1}{1-\mu}} Y_k [P_{Y,k}]^{\frac{1}{1-\mu}}$. Plugging the preceding equilibrium allocations into production function of final goods yields the price function of final goods

$$P_{Y,k} = [A_k]^{-\frac{1-\mu}{\mu}} \left[\frac{w_k}{\mu}\right]. \tag{3}$$

This shows that the price of final goods reflects the wage rate and the number of intermediate goods. Three important facts are noted. (1) The economy with a larger number of intermediate goods has an advantage in competing against the other economy in the final good markets. (2) The economy with a lower elasticity of substitution among intermediate goods has an advantage against the other, given $\log A_k > \mu$. (3) The economy with the cheaper wage rate has an advantage against the other. Then, we explicitly compute the profit of each firm in the intermediate input market.

$$\Pi_{i,k} = \frac{[1-\mu] w_k x_i^k}{\mu}. \tag{4}$$

Turning to the R&D sector, following Romer (1990), the flow of new technology is developed by employing the historically accumulated stock of R&D as well as the labor,

$$\dot{A}_k = A_k L_{A,k}, \tag{5}$$

where $L_{A,k}$ is the total labor input used for technology development in region k. Since there is no knowledge spillover across regions in an autarkic economy, the technologies are non-excludable within a region, but excludable across regions. Whoever engaged in the technologies in the South can freely access the entire stock of these technologies only within the South and anyone in the North can do only in the North. Let $P_{A,k}$ be the price of new technology development in region k. The necessary condition for the equilibrium new technology development requires marginal revenue to be equal to marginal cost in region k such that

$$P_{A,k} \frac{\dot{A}_k}{L_{A,k}} = P_{A,k} A_k = w_k, \tag{6}$$

since these technologies are free input to potential entrepreneur. The price of new technology development in region k is the expected future profits discounted by the market interest rate, so the price of new technology development in region k at time t is $P_{A,k}(t) = \int_t^\infty e^{-R_k(\tau)} [\Pi_{i,k}(\tau)] d\tau$, where

$R_k(\tau)=\int_t^{\tau} r_k\,(h)dh$. The no-arbitrage condition for investment in new technology development can be obtained by differentiating the price of new technology with respect to time t and is given by

$$\dot{P}_{A,k}=-\Pi_{i,k}(t)+r_k(t)P_{A,k}(t) \tag{7}$$

As Grossman and Helpman (1990) noted, this no-arbitrage condition implies that the interest rate is equal to instantaneous profit over the cost of new technology development, so-called dividends, and the rate of change in the price of new technology development, namely capital gains.

We can complete the model by stating market clearing conditions. First, goods markets are composed of final goods and intermediate goods. In an autarkic economy, the output of final goods produced in each region k at time t should be equal to the consumption of final goods in that region at time t. The total output supply of intermediate goods in each region at time t is equal to the input demand for final goods in each region at time t. That is, goods market clearing conditions for final goods and intermediate goods in an autarkic economy become $Y_k=C^k$ and $X_k=\int_0^{A_k}[X_i^k]di$, where X_k is the total supply of intermediate goods in region k and is given by $X_k=A_k[w_k/\mu]^{-\frac{1}{1-\mu}}Y_k[P_{Y,k}]^{\frac{1}{1-\mu}}$ with equilibrium allocation of x's and the market clearing condition for the intermediate goods. Second, labor in each region at time t is demanded in developing new technologies as well as producing intermediate goods in each region at time t. Since labor is not movable, labor market clears when it satisfies the following $\overline{L_k}=L_{X,k}+L_{A,k}$, where $L_{X,k}=A_kL_{x_i,k}$. Third, asset market clearing condition implies $a_k=P_{A,k}A_k$, for all time t with the initially given $a_k(0)=P_{A,k}(0)A_k(0)$.

Along the balanced growth path, the growth rate of each variable is constant over time and labor allocations among the sectors are constant over time by definition. From consumer's budget constraint, the necessary condition for the equilibrium new technology development given by Equation (6), and asset market clearing condition, we get a balanced growth path relation such as $\dot{P}_{Y,k}/P_{Y,k}+\dot{C}^k/C^k=\dot{w}_k/w_k$ (see appendix 1 for derivation). The market clearing condition for final goods implies that the balanced-path steady-state growth rate of consumption is equal to that of final goods, that is, $\dot{C}^k/C^k=\dot{Y}_k/Y_k$. Those two growth relations give us

$$\frac{\dot{P}_{Y,k}}{P_{Y,k}}+\frac{\dot{Y}_k}{Y_k}=\frac{\dot{w}_k}{w_k}. \tag{8}$$

Besides, together with the growth relation between consumption and final goods derived from the market clearing condition for final goods, the growth rate of consumption given by Equation (1) can be rewritten as

$$\frac{\dot{Y}_k}{Y_k}=\left[r_k-\rho-\frac{\dot{P}_{Y,k}}{P_{Y,k}}\right]. \tag{1'}$$

As in Grossman and Helpman(1990, 1991a, 1991b), Rivera-Batiz and Romer (1991a, 1991b) and Romer(1990), this paper analyzes a balanced-path steady-state growth such that $P_{A,k}$ is a constant, implying that there are no capital gains. When there are no capital gains, the growth rate of technology development becomes equal to that of wage rate in each region in the economy where knowledge diffuses only within regions. Since the balanced-path steady-state growth rate of technology development is constant, the evolution of new technologies implies that given $\overline{L}$, from the labor market clearing condition, total labor supply for producing intermediate goods, $L_{X,k}$, is also constant along the balanced path, and in turn we get $\dot{A}_k/A_k=-\dot{x}^k/x^k$ since $L_{x,k}=A_k x_i^k$. Substituting growth path of $x's$ in Equation (2) into Equation (8) gives us

$$\frac{\dot{A}_k}{A_k}=\frac{\mu}{1-\mu}\frac{\dot{Y}_k}{Y_k}=\frac{\mu}{2\mu-1}\frac{\dot{P}_{Y,k}}{P_{Y,k}} \tag{9}$$

Since $L_{X,k}=A_k x_i^k$, by plugging this labor supply function for producing intermediate goods into profit function for producing intermediate goods, we get $\Pi_{i,k}=[1-\mu]w_k L_{X,k}/[\mu A_k]$. In the steady state where $P_{X,k}$ becomes constant for all t, the no-arbitrage condition for investment in new technology development becomes $P_{A,k}=\Pi_{i,k}/r_k$ by Equation (7) and hence $L_{X,k}=\mu r_k/[1-\mu]$. By labor market clearing condition, the evolution of technology development becomes

$$\frac{\dot{A}_k}{A_k}=[\overline{L}-L_{X,k}]=\overline{L}-\frac{\mu}{1-\mu}r_k, \tag{10}$$

By plugging the growth rates of final goods and the price given by Equation (9) into Equation (1′), we get the stationary interest rate in each region in terms of parameters and the growth rate of technology development and it is given by $r_k=\rho+\dot{A}_k/A_k$. From this interest rate equation and the evolution of technology development given by Equation (10), we get the stationary interest rate in each region and it is given by

$$r_k=[1-\mu][\overline{L}+\rho]. \tag{11}$$

Hence we can find all the growth rates in variables by substituting the above endogenously determined stationary interest rate into the relevant variables. First, the growth rate of technology development in each region is as follows.

$$\frac{\dot{A}_k}{A_k} = [1-\mu]\overline{L} + \mu\rho \tag{12a}$$

The growth rate of technology development is positively affected by the total labor force available in each region, but negatively by the parameter value of μ, and hence, the demand elasticity for intermediate goods. Higher market power enhances growth in technology development. Second, the growth rate of final goods in each region is given by

$$\frac{\dot{Y}_k}{Y_k} = \frac{1-\mu}{\mu}[[1-\mu]\overline{L} - \mu\rho]. \tag{13a}$$

Higher market power accelerates the growth rate of final goods through the coefficient in the growth relation between final goods and technology development.

So far, we examined the economic growth in a closed economy. In the next section, we analyze the economic growth in an open economy to compare them with that in an autarkic economy.

2. Open Economy

In order to focus on the effect of market power and market structure on the economic growth in an open economy, two different market competitions, monopolistic and duopolistic competitions, are introduced. Under imperfect competition, each of two regions has tradable final goods and intermediate goods, but intermediate inputs in one region are either perfect or imperfect substitutes for those in the other region. For example, if a firm holds its own R&D technology in producing intermediate inputs and does not have its competitor's in an open economy no matter how much two regions advance in developing new R&D technology, each firm lies in a monopolistic competition market. Contrarily, if a firm shares its R&D technology and has to face its competitor in the other region, intermediate input producers are put in a duopolistic competition market due to opening up markets. Furthermore, we assume that knowledge is non-excludable across regions, namely perfect knowledge spillover. First, we analyze an open economy with monopolistic competition where intermediate goods produced in a region are totally differentiated from those in the other. Even in an open economy, two regions face the same market power as in the autarkic economy analyzed in the previous section and the same market structure of monopolistic competition. Each region, however, enjoys varieties of intermediate goods by openness, leading to a higher economic growth. Second, we turn to an open economy with duopolistic competition where each intermediate imput is an imperfect substitute for others within that region but has a perfect substitute in the other region. An open economy under duopolistic competition analyzed in this paper is different from the one Grossman and Helpman (1991c, 1991d), Helpman (1993) and Segerstrom, Anant and Dinopoulos (1990) considered. We analyze quantity competition of duopoly game between the North and the South in the model of varieties of knowledge. Since the market structure of intermediate goods is changed from monopolistic to duopolistic competition by openness, this economy faces the decreased market power or increased demand elasticity for intermediate goods compared with an autarkic economy. As soon as they open their markets to each other, the level of technology development in each region becomes the sum of the knowledge in both regions because of perfect knowledge diffusion across regions. As noted in Devereux and Lapham (1994), in order for an economy to have stable convergent growth rates between two regions with identical endowments, the level of technology development prior to trade should be the same between two regions. In this point of view, we consider the economy that the level of technology development in a region is equal to that in the other and thus in an open economy with imperfect competition the level of technology becomes twice as much as that in an autarkic economy. Since profit rent is the source of the incentive to invest in new technology development, the reduced profit rent due to the changed market structure from monopolistic competition to duopolistic competition, is expected to lead to a slower economic growth. However, the doubled varieties of intermediate goods as well as the doubled market size by opening up the markets are expected to accelerate economic growth. Whether or not the growth rate in autarky is higher than in free trade under duopolistic competition, depends on which effect dominates the other. In other words, we can anticipate that an autarkic economy is more favorable than an open economy with duopolistic competition if the former dominates the latter, vice versa. Monopolistic competition after trade is analyzed in the appendix and we show how harmful free trade under duopolistic competition, even though free trade doubles the stock of knowledge as well as market size.

In an open economy where all intermediate goods producers in a region face duopoly market with those in the other, the production function for final goods in region k is $Y_k=\left[\int_{i=0}^{A_k}[x_i^k]^\mu di+\int_{z=0}^{A_j}[x_z^k]^\mu dz\right]^{\frac{1}{\mu}}$, for $0<\mu<1$. The duopoly prices for intermediate goods become $P_{x_i k}=[w_k+w_j]/[1+\mu]$ which is the constant markup over the marginal costs. In this economy, the demand elasticity for the intermediate goods becomes $2/[1-\mu]$ in region k where the wage rates of two regions are identical. Compared with an autarkic economy, this demand elasticity is twice greater and hence the market power is reduced to the half. Where there is perfect knowledge spillover across regions, two trading regions' levels of technologies will be equal as soon as they open their markets to each other and start to trade. To focus on the market power in duopolistic competition and keep stable growth path with perfect knowledge spillover as well, we consider the same level of technology development between two regions. The stock of technologies in an open economy becomes twice as much as that in an autarkic economy. With the duopoly price for intermediate goods, we can derive the equilibrium allocations of x's in terms of the level of final goods and the set of prices. Plugging these equilibrium allocations into the production function for final goods gives us the price function of final goods such as $P_{Y,k}=[2A_k]^{-\frac{1-\mu}{\mu}}\left[\frac{w_k+w_j}{1+\mu}\right]$. The price function of final goods shows that the price of final goods increases as the wage rate increases while it decreases as the scale effect in the level of technology increases. With the effective duopoly price for intermediate goods, the profit function of intermediate goods in each region is given by $\Pi_{i,k}=[w_j-\mu w_k][x^k_{i,k}+x^j_{i,k}]/[1-\mu]$, for $k\neq j$. The labor devoted to the production of intermediate goods becomes $L_{X,k}=A_k[x^k_{i,k}+x^j_{i,k}]+A_j[x^k_{z,k}+x^j_{z,k}]$. Plugging these labor functions into profit functions for producing intermediate goods, we get $\Pi_{i,k}=\frac{[w_j-\mu w_k]L_{X,k}}{2[1+\mu]A_k}$. In a steady state where $P_{A,k}$ is constant, the no-arbitrage condition for investment in new technology development becomes $P_{A,k}=\Pi_{i,k}/r_k$ and hence we get $L_{X,k}=[1+\mu]r_k/[1-\mu]$ since $P_{A,k}=w_k/[2A_k]$. By labor market clearing condition, the evolution of technology development becomes $\dot{A}_k/A_k=2\left[\overline{L}-\frac{1+\mu}{1-\mu}r_k\right]$. By plugging the growth rates of final goods and its price given by Equation (9) into Equation (1′), we get a stationary interest rate in each region in terms of parameters and the growth rate of technology development. From this interest rate equation and the evolution of technology development, we get the stationary interest rate in each region. Compared with an autarkic economy, the endogenously determined interest rate in this economy is lower and thus it decreases the labor demanded for producing intermediate goods while the competition between two regions increases it. Whether or not the labor devoted to production activities is more in an open economy under duopolistic competition than in an autarkic economy depends on which effect dominates the other. By substituting this endogenously determined interest rate into the labor demanded for producing intermediate goods, we get the endogenously determined labor demand for intermediate goods. In an open economy with duopolistic competition, $L_{X,k}=[(\rho+\overline{L})(1+\mu)]/2$, which is larger than that in an autarkic economy. Labor demanded for developing new technologies decreases, given that total labor available is the same between two economies. We can find all the growth rates in variables by substituting the above endogenously determined stationary interest rate into the relevant variables. First, the growth rate of technology development in each region becomes

$$\frac{\dot{A}_E}{A_E} = \frac{\dot{A}_W}{A_W}; \frac{\dot{A}_k}{A_k} = \frac{2[[1-\mu]\overline{L}-[1+\mu]\rho]}{3+\mu} \tag{12b}$$

In an open economy under duopolistic competition, the balanced path steady state growth rate of technology development between two regions becomes equal. As in an autarkic economy, it is positively affected by the total labor force available in each region, while negatively by the parameter value of μ and hence the demand elasticity for intermediate goods. Higher market power enhances growth in technology development. Second, the growth rate of final goods in each region is given by

$$\frac{\dot{Y}_k}{Y_k} = \frac{1-\mu}{\mu}\frac{\dot{A}_k}{A_k} = \frac{1-\mu}{\mu}\left[\frac{2[[1-\mu]\overline{L}-[1+\mu]\rho]}{3+\mu}\right]. \tag{13b}$$

Higher market power accelerates the growth rate of final goods through the coefficient in the growth relation between final goods and technology development.

Ⅲ. DISCUSSION

In the previous section we analyzed the balanced-path steady-state growth in an open economy as well as in an autarkic economy. In an open economy, two different market structures are considered that lead to different economic growth paths, which result in the following proposition.

PROPOSITION 1. Schumpeter's notion is confirmed that in comparison with an autarkic economy, an open economy under monopolistic competition has a higher growth rate of technology development and hence final goods as well as consumption because free trade has the boosting effect on monopoly rent. On the contrary, an open economy under duopolistic competition has an opposite result, namely Porter's notion is denied.

Proof. Comparing the growth rates of technology development between in an autarkic economy and in an open economy under monopolistic competition, given by Equation (12a) and (12c), respectively, yields the growth rates of technology development in an open economy under monopolistic competition is higher than that in an autarkic economy. Let γ_k^a and γ_k^d denote the steady state growth rate of technology development for an autarkic economy and an open economy under duopolistic competition. Then we get

$$\begin{aligned}\gamma_k^a - \gamma_k^d &= [1-\mu]\overline{L} - \mu\rho - \frac{2[[1-\mu]\overline{L}-[1+\mu]\rho]}{3+\mu} \\ &= \frac{[1-\mu^2]\overline{L}+[1+\mu][2+\mu]\rho}{3+\mu} > 0,\end{aligned}$$

implying the above proposition.

It is rather intuitive because the economy with higher interest rates induces consumers to invest in asset markets and gives intermediate input producers higher monopoly rent, which is essential to endogenous economic growth. In the monopolistic competition, intermediate inputs produced in a region are completely differentiated, imperfect substitute, from those in the other region. Since perfect knowledge spillover between two regions doubles the initial level of R&D technologies in each region, free trade doubles the varieties of intermediate inputs without changing market structure and market power. The productivity in new technology development doubles. The increased productivity in technology development increases growth rate of technology development in each region. Furthermore, it increases labor force used for technology development, enhancing growth in technology development. In a word, free trade under monopolistic competition is good for growth and it coincides with the Schumpeterian.

In a duopolistic competition economy, market is re-structured in such a way that two regions face duopolistic competition after trade. Whether or not free trade under duopolistic competition yields higher growth rate than autarkic economy depends on whether or not market structure effect dominates knowledge spillover effect. Free trade enhances the varieties of intermediate inputs and the level of technology development in each region becomes double because knowledge diffuses perfectly across regions. The productivity in technology development becomes double by openness, so the changed productivity has a direct effect on the growth rate of technology development in each region. Also, the changed stock of knowledge can create the external effect from product varieties in demanding intermediate inputs. On the contrary, free trade changes market structure of intermediate goods from monopolistic competition in an autarkic economy to duopolistic competition in an open economy. This reduces the profit rent in producing intermediate goods and weakens the incentive to invest in technology development. Less incentive to invest in technology development decreases labor demand for technology development, leading to a decrease in the growth rate of technology development. This paper showed that the incentive to invest in technology development is more important than knowledge spillover, so open economy is not always good for growth.

Ⅳ. CONCLUSION

This paper analyzed the question of whether free trade is good or bad for growth, focusing on the market power and market structure where two regions have identical endowments and technologies. An answer to the question is determined crucially by the change in the market structures, that is, monopolistic or duopolistic competition. The finding of our analysis is that free trade is not always good for growth.

Monopolistic competition model under free trade increases the broad number of the intermediate inputs still keeping the same market competition as an autarkic economy. Consequently, perfect knowledge spillover across regions has a role of doubling the level of R&D technologies. Open economy, therefore, generates a higher incentive to innovate new intermediate inputs. Like the Schumpeterian, monopolistic competition makes sure that monopoly power is necessary for economic growth and trade is good for growth. On the contrary, duopolistic competition model not only increases the varieties of intermediate inputs but also increases competition in producing intermediate goods. The higher elasticity of substitution between intermediate inputs after trade due to the increased competition reduces incentive to invest in new technology development. Even though knowledge diffuses perfectly across regions, the effect of the doubled level of technology development is dominated by the change in market structure from monopolistic competition to duopolistic competition. Duopolistic competition reduces monopoly power, which is the engine of economic growth, and thus trade is bad for growth unlike the Darwinian view. This paper, therefore, sheds light on the role of market power in determining the economic growth. As an engine of growth, market power, inverse of the elasticity of input substitution, plays an important role in fostering economic growth. In the light of this, the Schumpeterian is confirmed that monopoly power leads to economic growth.

It can be suggested that policy makers need to combine open markets with interventionist industrial policies when they decide whether or not they will open markets in intra-industry trade. The results of this paper show that in making decisions, they need to consider market structures between before and after trade. It is recommended that they make a policy to open their markets for some industries where the degree of product differentiation in each industry between two regions is strong[2]. Otherwise, market intervention policy is recommended.

This paper theoretically analyzed the effects of market power and market structure on trade and the economic growth. For the further study, it remains that the importance of them should be checked empirically in order to support our analysis and that two sectors should be explored. This paper also analyzed two extreme cases of market structure, so analyzing a mixed case by considering uncertainty of market structure in trade would be another extension.

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[2] These industries are likely to be newly emerging industries that will generate externalities, so protection may be needed until they become established (mature) enough to create positive externalities. For example, Japan adopted such a protectionist policy in semiconductor industry and Baldwin and Krugman (1988) found that without the policy the Japanese industry would have not developed random access memory (RAM) chips by the semiconductor industry otherwise the U.S. industry would have greatly absorbed, even though they concluded that the policy harmed both Japan and U.S. because of the more costly Japanese production.

APPENDIX

Appendix 1

The budget constraint can be rewritten as

$$P_{Y,k}C_k^k = w_k \overline{L}_k + r_k a_k - \dot{a}_k.$$

Since $P_{A,k}A_k = w_k$ by Equation (6), and $a_k = P_{A,k}A_k = w_k$ from the asset market clearing condition, we get $\dot{a}_j = \dot{w}_j$. The budget constraint becomes

$$P_{Y,k}C_k^k = w_k[\overline{L}_k + r_k - \dot{w}_k/w_k].$$

Since $[\overline{L}_k + r_k - \dot{w}_k/w_k]$ is constant in a balanced path steady state, we can derive

$$\frac{\dot{P}_{Y,k}}{P_{Y,k}} + \frac{\dot{C}_k^k}{C_k^k} = \frac{\dot{w}_k}{w_k}.$$

Appendix 2 : Open Economy under Monopolistic Competition

Intermediate goods produced in a region are completely differentiated from those in the other region. The production function of final goods in region k becomes $Y_k = \left[\int_{i=0}^{A_k}[x_{i,k}^k]^{\mu}di + \int_{z=0}^{A_j}[x_{z,j}^k]^{\mu}dz\right]^{\frac{1}{\mu}}$, for $0<\mu<1$ and $k \neq j$, where $x_{z,j}^k$ denotes the input demand in region k for intermediate goods z produced in region j. With the monopoly price for intermediate goods, the equilibrium allocations of x's could be expressed in terms of the level of final goods and the set of prices of intermediate inputs. Together with these equilibrium allocations, the production function for final goods generates the price of final goods as a function of the levels of technology development as well as wage rates of two regions and it is given by

$$P_{Y,k} = \left[A_k\left[\frac{w_k}{\mu}\right]^{-\frac{\mu}{1-\mu}} + A_j\left[\frac{w_j}{\mu}\right]^{-\frac{\mu}{1-\mu}}\right]^{-\frac{1-\mu}{\mu}}.$$

Also, with the effective monopoly price for intermediate goods, the profit function of intermediate goods is $\Pi_{i,k} = \Pi_{i,k}^k + \Pi_{i,k}^j$ and in each region it is given by $\Pi_{i,k} = [1-\mu]w_k[x_{i,k}^k + x_{i,k}^j]/\mu$, for $k \neq j$. As in Rivera-Batiz and Romer(1991a) considering perfect knowledge spillover across regions as well as within a region, the level of technology in each region evolves $\dot{A}_k = [A_k + A_j]$

$L_{A,k}$ for $k \neq j$. Since knowledge spillover is non-excludable across and within regions, anyone engaged in new technologies can freely access the entire stock of technologies existing in the world. Since $L_{X,k} = A_k[x^k_{i,k} + x^j_{i,k}]$, by plugging these labor supply functions into profit function for intermediate goods, we get $\Pi_{i,k} = [1-\mu]w_k L_{X,k}/[\mu A_k]$. In a balanced path steady state, the level of technology development between two regions becomes equal and hence from the no-arbitrage condition for investment in new technology development we get $L_{X,k} = \mu r_k/[2[1-\mu]]$ since $P_{A,k} = w_k/[A_k + A_j]$. By the labor market clearing condition, the evolution of technology development becomes $\dot{A}_k/A_k 2\overline{L} - \mu r_k/[1-\mu]$. By plugging the growth rate of final goods and the price given by Equation (9) into Equation (1′), we get a stationary interest rate in each region in terms of parameters and the growth rate of technology development and they are given by $r_k = \rho + \dot{A}_k/A_k$. From this interest rate equation and the evolution of technology development, we get the stationary interest rate in each region and it is given by $r_k = [1-\mu][2\overline{L} + \rho]$. The endogenously determined interest rate in this economy is higher than that in an autarkic economy and thus it increases the labor devoted to the production of intermediate goods while the doubled stock of technologies reduces it to the half, given the same interest rates between two economies. Since the endogenously determined interest is different between two economies, whether or not the labor demanded for producing intermediate goods will increase, due to opening up markets, depends on which effect dominates the other. By substituting this endogenously determined interest rate into the labor demanded for producing intermediate goods, we get the endogenously determined labor demand for intermediate goods which is less than that in an autarkic economy since in an autarkic economy, we get $L_{X,k} = \mu[\rho + \overline{L}]$ while in an open economy with monopolistic competition, $L_{X,k} = \frac{\mu}{2-\mu}[\rho + \overline{L}]$. This implies that the scale effect dominates the interest rate effect. Given that total labor available is the same between two economies, labor demanded for developing new technology in an open economy with monopolistic competition becomes more than that in an autarkic economy since total labor is composed of labor demand in intermediate goods and in technology development.

We can find all the growth rates in variables by substituting the preceding endogenously determined stationary interest rate into the relevant variables. First, the growth rate of technology development in each region becomes

$$\frac{\dot{A}_S}{A_S} = \frac{\dot{A}_N}{A_N}; \frac{\dot{A}_k}{A_k} = 2[1-\mu]\overline{L} - \mu\rho. \tag{12c}$$

The balanced path steady state growth rate of technology development between two regions becomes equal. As in an autarkic economy, it is positively affected by the total labor force available in each region, while negatively by the parameter value of μ, and hence, the demand elasticity for intermediate goods. Higher market power enhances growth in technology development. Second, the growth rate of final goods in each region is given by

$$\frac{\dot{Y}_k}{Y_k} = \frac{1-\mu}{\mu}\frac{\dot{A}_k}{A_k} = \frac{1-\mu}{\mu}[2[1-\mu]\overline{L} - \mu\rho]. \tag{13c}$$

Higher market power accelerates the growth rate of final goods through the coefficient in the growth relation between final goods and technology development.

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