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Trade and Growth with Heterogeneous Firms and Non-Constant Elasticity

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1 Introduction

As one of the oldest subfield of economics, the purpose of a trade theory is to describe and predict how different trade policies affect the welfare of the economy. Before giving a correct prediction, a theory has to give correct description of the volume, structure and patterns of trade observed in the real world. Recently, because of the comparatively easier to obtain data and the rich of the disaggregated databases, researchers can extract more information on the characteristics of international trade. One of the major observations in recent empirical studies is that producers within an industry have different exporting behavior even though they produce similar products. They also have different operating scale, profit level and productivity. In particular, firms embarking export are more productive, larger and profitable.

Theory capturing this kinds of characteristics of trade is to consider a fixed trading cost causing heterogeneous exporting behavior. This kinds of model such as Melitz (2003) and Bernard, Redding, and Schott (2007) assume that there is a significant fixed cost of trade and therefore only high-productivity producers export. The intuition is that those firms are more productive and can charge lower price and therefore sell more quantity at equilibrium. Higher quantity of production guarantees the producers to have enough scale economy to cover the fixed trading cost. Trade also triggers reallocation of factors toward high-productivity producers and increase average productivity level in the industry. High-productivity agents have to obtain more factors in order to increase its quantity of production and to form the fixed trading cost. This implies that some firms have to decrease their production level or exit. Those firms are low-productivity firms because they cannot export and therefore their demand on factors does not increase.

In those kinds of model, the elasticity of demand is constant. Although this setup is mathematically easier to manipulate, to generate the result that trade elevates average productivity relies on the assumption that there is a fixed trading cost. Therefore trade increases the average productivity at the expenses

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that some resources are forgone. Baldwin and Robert-Nicoud (2006) based on this argument to show that although trade might increase average productivity in the short-run, because of the waste of resources to form the fixed trading cost, trade decreases the low-run growth rate of the economy. In some cases, especially when the technology spillover is weak, an economy faces a trade-off between short-run benefit and long-run loses .

In this research report, I will show a methodology to describe the empirical observations that exporting firms are more productive, larger and profitable. Trade also has positive impact on average productivity. However, there is no trade-off between a lower growth rate and the positive effect on average productivity. This is all due to the property of the proposed model which has an endogenous non-constant elasticity of demand for each variety. This implies that the mechanism comes from competition, and is not because of the costly trade. Therefore there are no resources wasted in order to elevate average productivity. The growth rate will not be lower under trade compared with that under autarky.

In the next section, I will give a short literature review on the previous researchers' work that I have mentioned. The purpose is for readers who are not familiar with this kind of model to capture the main idea I just mentioned. In section 3, I will describe a model shown in Hsu (2007). This model will be the driving horses of the work in this research. As it shows, the model is suitably fitted with the Heckshcer-Ohlin framework and generate rich implication on characteristics of trade patters and structures and its impact on micro behavior of agents. In section 4, I will give a simple example to capture the major idea of this model. This is a one sector one production factor version of model described in section 3. The final section describes contribution and further proceeding of this research.

2 Literature Review

2.1 A Static Melitz Model

I hereby give a simple version of Melitz type model. The purpose is to let readers who are not familiar with this type of model be able to quickly get the idea and the mechanism behind it and understand the purpose and contribution of this research proposal.

Melitz model is a combination of Helpman and Krugman (1985) with heterogeneous producers and continuous entries and exits of them in the long-run. The continuous entries and exits behavior are generated from the assumption that each producer will die instantaneously with a probability and the influx of new entrants is needed to restore the general equilibrium. Because the major contribution of his work is the endogenous heterogeneity, the probability to die is omitted in this review. I therefore do not focus on the dynamic stationary equilibrium. The model described below is a static model.

Suppose there are two symmetric countries. The utility function is a typical constant elasticity version of Dixit-Stiglitz type.

$$U = \left[\int_{\omega \in \omega} q(\omega)^{\rho} d\omega \right]^{\frac{1}{\rho}} \tag{1}$$

, where $0 < \rho < 1$. Labor is the only input and there is a infinite amount of potential producers who will enter the market if the production is profitable. The production side can be summarized by 1. This figure exemplifies how the production decision is made by each potential producer at each instantaneous point of time. He first decide whether to invest f_e amount of labor before he learns his productivity level. The investment is financed by issuing stocks to the labor. Once the investment has been made , the productivity level is drawn from a distribution function $G(\phi)$ with support $[0, \infty]$. After learning productivity level he has to invest another fixed cost comprising of f amount of labor to start production. If the production is not profitable to recover the fixed investment. He will not invest it and exit the market. An extra fixed cost $f_x > f$ has to be implemented if he decides to export to the foreign markets.

Because the elasticity of demand on each variety implied by the utility function is constant and each variety enters the utility in a symmetric fashion, the price charged by a producer and his revenue proportionally increase with his productivity level. The revenue also proportionally decreases with the total mass of producers M and the average productivity of the industry, $\tilde{\phi}$. The intuition is that because the elasticity of substitution is not infinite and consumers love varieties according to the utility function, when M increases, consumers must divert part of income to new varieties and the demand for a certain variety decreases. When the average productivity in the industry increases, the price charged by other producers is relatively low and because varieties are not perfectly compliment, consumers must divert part of income to cheaper varieties. We therefore can write down revenue as

$$r\left(\phi, M, \tilde{\phi}\right)$$

and the gross profit as

$$\frac{r\left(\phi, M, \tilde{\phi}\right)}{\sigma}$$

where $\tilde{\phi}$ is the average productivity level in the industry and $\sigma = \frac{1}{1-\rho} > 1$ is the elasticity of demand.

A producer who learn his productivity level will produce or export if and only if the following conditions are satisfied

$$\frac{r\left(\phi, M, \tilde{\phi}\right)}{\sigma} \geq f \tag{2}$$

if he produces

$$\frac{r\left(\phi, M, \tilde{\phi}\right)}{\sigma} \geq f_x \tag{3}$$

if he exports. Because of this property of revenue and gross profit function, for a given M and $\tilde{\phi}$, gross profit is decreasing with ϕ. This implies that there will be a unique $\phi = \phi^*$ such that equation (2) is binding and a unique $\phi = \phi_x^*$ such that equation (3) is binding. This implies that only producers with $\phi \geq \phi_x^*$ will export and producers with $\phi \geq \phi^*$ will not exit the market. Because of the assumption that $f_x > f$, $\phi_x^* > \phi^*$. This replicates the empirical observation that only high-productivity producers embark export.

Once the cut-off points of productivity level have been determined, the productivity distribution of producers is determined. This helps us to calculate $\tilde{\phi}$; therefore $\tilde{\phi}$ is also a function of ϕ^* and ϕ_x^* and it is increasing with them. When we consider that $\tilde{\phi}$ also changes with cut-off points, whether the left hand sides of inequalities (2) and (3) are monotonically increasing with cut-off points is questionable. Melitz shows that when the distribution is lognormal, contracted normal, Pareto etc, the monotonic property remains; however, the uniqueness of cut-off points still hold in a general case of distribution function.

A potential producer prior learning his productivity level decides whether to invest f_e. He will do so if and only if

$$E\left[\pi\left(\tilde{\phi}, M\right)\right] = \bar{\pi} \geq \frac{f_e}{1 - G(\phi^*)} \tag{4}$$

where $E[\bullet]$ is the operation of taking expected value. Notice that $E[\pi]$ is also the average profit level of producers in the industry and it can be written as a function of $\tilde{\phi}$ and M. When cut-off points are determined, the left hand side of inequality (4) decreases with M; therefore this condition as well as the two conditions determined the cut-off points mentioned previously, simultaneously pin down the three endogenous variables, ϕ_x^*,ϕ^*, M.

The impact of f_x and trade on average productivity can be observed in a simple experiment. Let's first consider an extreme case that $f_x = 0$. This implies that $\phi_x^* = \phi^*$ and all producers embark export. In this example, trade is costless. Trade therefore has the same impact as doubling the size of a country. When the size of the economy is doubled, because the elasticity of demand is constant, the price charged by each producer is constant when the labor is treated as numeraire. The demand faced by each producers also therefore doubled when all endogenous variables are hold constantly. This doubles the revenue and profit of all producers and so does the average profit of the producers in the industry. This triggers entries and when M is doubled, inequality (4) is binding. Because gross profit also shrinks proportionally with M, inequalities (3) and (2) are binding at the same cut-off points level. However if f_x is significant enough such that not all producers export, the production level of the non-exporting producers must decrease or they have to exit in order to release labor to form f_x for exporting producers and also let them to expand output[1]. This will be guaranteed to happen in a general equilibrium setup. Because the non-exporting producers only face demand in the domestic markets where part of the demand is diverted to importing varieties, the production level of those firm as well as profit must decrease. The latter trigger the marginal producers exit. Both the decrease of production and exit of producers release labor to exporting firms who have higher productivity level. The average productivity of the industry therefore increases.

What I want the reader to pay attention is that the positive impact on average productivity is at the expenses of the fixed cost, f_x. Because consumers love varieties, they must have willingness to divert part of income to buy varieties produced by the foreign country. However part of them are non-traded because of the significant fixed trading cost. Although the existence of this fixed cost

[1]The output of the exporting firms must increase relatively to the non-exporting firms because they face higher fixed cost and need higher level of scale of operation to cover it and because they export the demand the face is higher.

can let trade increase productivity, the welfare is higher when the fixed cost is zero although in this case, the average productivity level remains constantly. Nevertheless, in this static example, although costly trade still increase total welfare even in some extreme case that the set of varieties consumers face is smaller after trade. The increase of productivity can be high enough to guarantee welfare improvement[2]. However as Baldwin and Robert-Nicoud (2006) argues, in a dynamic case, this costly trade might harm a country.

2.2 A Melitz-type Growth Model

Notice that the inequality (4) is exactly the same as the free entry condition of a homogeneous producer model such as Helpman and Krugman when all producers have the productivity equal to $\tilde{\phi}$, when $f_x = 0$ and when the fixed entry cost is equal to $f + f_e$. We therefore can easily extend the model to discuss various issues using the homogeneous producers such as the impact of trade on endogenous growth rate. This is what Baldwin and Robert-Nicoud (2006) has done.

Suppose that the equation (1) is treated as a production function of a final good and the varieties are the intermediate inputs producing the final good. The market structure of the final good market is perfectly competitive. The intertemporal utility function is

$$V = \int_0^\infty lnU_t dt \tag{5}$$

where U_t is the value of equation (1) at time t. Let all fixed costs be treated as the research investment in order to successfully invent a profitable variety. The expected research expenditure to obtain a variety is

$$\bar{k} = \frac{1}{M}\left[f + \frac{1 - G(\phi_x^*)}{1 - G(\phi^*)} f_x + \frac{f_e}{1 - G(\phi^*)}\right] \tag{6}$$

where $\frac{1}{M}$ captures the idea that as the size of knowledge base increases, the cost of invention decreases. As I mentioned, because the aggregate property of the Melitz model is the same as the homogeneous model, we can directly jump to the conclusion that we have already known before. In the long-run M as well as final good production level grow at a constant rate at the steady state. When M grows, because the right hand sides and left hand sides of inequalities (2), (3) and (4) decreases at the same rate, the same cut-off points such that three inequalities are binding are the same while M is growing.

From equation (6), we can observe that trade has two effects on growth rate. First if we allow technology spillover across countries, trade enlarges knowledge base and therefore increases growth rate. However, because trade is costly , it increases the cost of invention and reduces the growth rate. The increase of cost is reflected on the fixed cost of export and the cost to generate a profitable invention $\left(\frac{f_e}{1-G(\phi^*}\right)$ when ϕ^* increases because of trade. In an extreme case when there is no spillover effect, the growth rate is definitely lower. Therefore in the short-run although trade can increase productivity of the final good production

[2]This is proven by Melitz (2003)

through expanding the number of varieties and increase the average productivity level of producers of intermediate goods, it is at the expenses of a long-run growth rate. The productivity of the economy is lower in the long-run as shown by Figure 2.

In the next section I will argue that the trade-off between short-run and long-run benefit is the consequence of the property of the Melitz model that the increase of productivity relies on the costly trade. Once we consider the effect of competition on the average productivity, there is no such trade-off.

3 Methodology

I hereby propose a methodology to deal with the idea that competition instead of costly trade trigger productivity increase. In the next section I will describe how to extend the model to an endogenous growth model by using a simple example.

3.1 Demand

I first consider a closed economy consisting of a fixed supply of capital endowment $K = \overline{K}$ and labor $L = \overline{L}$. Consumers have identical indirect utility function

$$V = \sum_{k \in \{x,y\}} \beta_k \ln U_k \left(I, \{P_k(\omega)\} \right) \tag{7}$$

k, $0 < \beta_k < 1 \; \forall \; k$ and $\sum \beta_k = 1$. I is the total income, $P_k(\omega)$ is the price of variety ω in sector k and $\omega \in \Omega_k$, where Ω_k is the measure of a set of goods available in sector k. It can be immediately observed that a fraction β_k of total income is spending on sector k due to the property of the Cobb-Douglas utility function. The total income is chosen as a numeraire.

The subutilities of the two sectors, by applying a continuous version of Feenstra (2003), which is proven in Hsu (2007). The subutilities comprise continuous numbers of varieties determined endogenously and is homothetic:

$$\begin{aligned} \ln U_k &= \ln \beta_k - \alpha_k - \int_{\omega \in \Omega_k} \alpha_k(\omega) \ln P_k(\omega) d\omega \\ &\quad - \frac{1}{2} \int_{\omega \in \Omega_k} \int_{\omega' \in \Omega'_k} \gamma_k(\omega, \omega') \ln P_k(\omega) \ln P_k(\omega') d\omega d\omega' \end{aligned} \tag{8}$$

The parameters of the function are chosen as the follows so that the utility is homogeneous of degree one in prices, and varieties enter the utility function symmetrically:

$$
\begin{aligned}
\alpha_k &= \alpha_0 + \frac{\widetilde{\Omega} - \Omega_k}{2\gamma\Omega_k\widetilde{\Omega}} \\
\alpha_k(\omega) &= \frac{1}{\Omega_k} \\
\gamma_k(\omega,\omega) &= -\frac{\gamma(\Omega_k - \int_{\omega'=\omega} d\omega\prime)}{d\omega\Omega_k} \\
\gamma_k(\omega,\omega') &= \frac{\gamma}{\Omega_k}\ \forall\ \omega \neq \omega'
\end{aligned}
$$

where $\gamma > 0$ affects the elasticity of demand, as will be clear later. $\widetilde{\Omega}$ is the total mass of the potential varieties in this economy, which I treat as fixed and large. The function $\gamma(\omega,\omega)$ is called δ function in mathematics. Which has measure equal to the right hand side of $\gamma(\omega,\omega)$ and zero when $\omega \neq \omega'$.

The market share of each variety can be easily obtained by differentiating equation (8) with respect to the log prices. This gives us

$$s_k(\omega) = \beta_k z_k \tag{9}$$

where

$$z_k = [h_k - \gamma \ln P_k(\omega)] \tag{10}$$

$$h_k = \frac{1}{\Omega_k} + \gamma\overline{\ln P}_k \tag{11}$$

is the market share of product ω within the sector k and

$$\overline{\ln P}_k = \int_{\omega\in\Omega_k} \frac{\ln P_k(\omega)}{\Omega_k} d\omega \tag{12}$$

is the average price level in sector k. h_k is decreasing with Ω_k and is increasing with the average price of the industry; therefore it is the inverse measure of level of competition in that sector. A firm control more demand when the level of competition is lower in that sector. Notice that the total income is normalized to one so the market share also represents the total revenue of the firm.

The number of firms is continuous, so each firm treats the average price as given as it changes the price. The elasticity of demand can therefore be obtained as

$$\varepsilon_k(\omega) = 1 - \frac{d\ln s_k(\omega)}{d\ln P_k(\omega)} = 1 + \frac{\gamma}{z_k(\omega)} \tag{13}$$

The assumption that $\gamma > 0$ guarantees that elasticity is greater than unity. Because $z_k(\omega)$ is a function of average price and the number of producers in sector k, the elasticity is not a constant, contrary to the conventional setting in trade models considering monopolistic competition (Helpman and Krugman, 1985). It can be observed that equation (13) increases with Ω_k and decreases with $\overline{\ln P}_k$, meaning that when the market is more competitive, the demand faced by each firm is more elastic. The elasticity also increases as γ increases. The property of homotheticity is also reflected on the result that the elasticity is independent of β_k.

3.2 Production

It is assumed that there is a large number of potential entrants at each point of time. As shown by Figure 3, at each point of time potential entrants first decide which sector to enter. Then they pay a fix cost in order to learn their productivity. The fixed cost is financed by issuing stock to factors forming the fixed cost. Productivity is drawn from a distribution function $G(A)$, where $A \in [0, \overline{A}]$. Finally they decide whether to produce after learning their productivity level. If they do not produce, they simply exit. At the end of each point of time, each existing producers encounter a probability δ to exit the markets without any reason. This can be treated as a death rate of producers. The equilibrium of those decisions at each point of time can be solved by backward induction. We care about the stationary equilibrium. The market structure is monopolistic competition in each sector.

To produce one unit of good, producers have to use $\frac{1}{A(\omega)}$ units of intermediate input where $A(\omega)$ is the productivity of firm ω. To learn the productivity level, firm have to sacrifice f_e units of intermediate input. The intermediate input in each sector is produced by using the following technologies

$$\eta_j(\omega) = F_j(K(\omega), L(\omega))$$

where $j \in \{X, Y\}$, and $K(\omega)$ and $L(\omega)$ are capital and labor employed by firm $\omega \in \Omega_j$ The production function is CRS and X sector is labor intensive.

Suppose that producers know their productivity level. The CRS assumption implies that for a given wage, w, and rental rate, r ratio, the marginal cost of producing the intermediate input can be obtained. Let c_j $j \in \{x, y\}$ be the marginal cost in sector X and Y respectively. Because each firm produces a unique variety, it has monopoly power and the price charged by it is a markup of its marginal cost, we therefore have

$$P_k(\omega) = \frac{c_k}{A(\omega)} \left(1 - \frac{1}{\varepsilon_k(\omega)}\right)^{-1} \tag{14}$$

Therefore for a given level of competition, h_j and factor price vector (w, r), equations (10), (12), (13) and (14) determine the equilibrium price charged by firm ω. Those equations imply a mapping from $\ln P_k(\omega)$ to it self. Since the set of $\ln P_k(\omega)$ is non-empty, convex and compact, we can apply Brouwer's fixed point theorem to obtain equilibrium. The existence and uniqueness of equilibrium is shown in Figure 4.

3.3 Entry, Exit and Market Selection Decisions

The profit generated by firm ω in sector k can be obtained as:

$$\pi_k(\omega) = \frac{s_k(\omega)}{\varepsilon_k(\omega)} = \beta_k \frac{z_k^2(\omega)}{z_k(\omega) + \gamma} \tag{15}$$

which is increasing with $z_k(\omega)$. It is clear that $z_k(\omega)$ is higher when h_k is higher which happens when the mass of producers is lower, when producers are on average less productive. $z_k(\omega)$ is also higher when firm ω is more productive so charges lower price. We can therefore write profit as a function of h_k and $A(\omega)$.

A producer in each sector producers if and only if the profit is greater or equal to zero. Because for a given h_k. $\pi_k\{\omega\}$ is increasing with $A(\omega)$. Therefore if an interior solution exists, there is an $A = A^*$ such that $\pi_k(A^*) = 0$ which implies $z_k(A^*) = 0$. This is the ZCP (zero cut-off point) condition.

Therefore we should be able to write the equilibrium conditions as:

$$h_x = \frac{1}{N_k M_k} + \gamma \int_{A_k}^{\overline{A}} \ln P(h_k, c_k, A)\mu_k dA \tag{16}$$

where

$$\mu_k = \begin{cases} \frac{g(A)}{M_k} \text{ if } A_k \leq A \leq \overline{A} \\ 0 \text{ otherwise} \end{cases}$$

$M_(k) = 1 - G(A_k)$ and $N_k M_k$ is the number of producers survive at each point of time; therefore N_k is the number of entrants needed to have this amount of surviving producers. Combining equations (16), (10), (12), (13) and (14) it is easy to observe that for a given distribution of productivity within a sector and N_k, the equilibrium average price can be determined through a contraction mapping. We can therefore obtain the equilibrium average price in each sector through Brouwer fixed point theorem. The proven of the uniqueness and existence of equilibrium is shown by Figure 5.

Therefore for a given A_k and N_k we can derive the equilibrium level of price charged by each producers as well as the level of competition, h_k. The profit of all producers $\pi(A, \bullet)$ is also determined. Hence the profit and market share of a producers with $A \geq A_k$ can be written as a function of A, A_k and N_k

$$\pi_k(A) = \pi(A, A_k, N_k)$$

$$z_k(A) = z(A, A_k, N_k)$$

The ZCP condition can therefore be written as

$$z(A_k, \bullet) = 0$$

. As I have shown in Hsu (2007), for a given N_k, z is decreasing with A. Therefore we can find a unique A such that $z = 0$. This gives us $A_k = A_k(N_k)$.

Because a potential entrant has to pay a fixed cost $f_e c_k$ before learning his productivity level. The entrant will pay the fixed cost so long if the expected profit is higher than the fixed cost. The free entry implies that at equilibrium

$$\overline{\pi}(N_k) = fec_k$$

where

$$\overline{\pi}(N_k) = \frac{1}{\delta} M_k \int_{A_k(N_k)}^{\overline{A}} \pi\left(A_k(N_k), N_k, A, c_k\right) g(A) dA$$

is the long-run expected profit of a potential entrant. As shown by Figure 6, the expected profit is decreasing with N_k. Therefore for a given factor price vector (w, r), the equilibrium level fo N_k can be uniquely determined.

3.4 Factor Market Equilibrium

Equilibrium factor price vector can be determined by the factor market equilibrium condition. Factors are used to produce intermediate inputs which is used for production and form the fixed entry cost. Therefore the market clearing condition implies that

$$\begin{bmatrix} a_{xL} & a_{yL} \\ a_{xK} & a_{yK} \end{bmatrix} \begin{bmatrix} \eta_x \\ \eta_y \end{bmatrix} = \begin{bmatrix} \overline{L} \\ \overline{K} \end{bmatrix} \tag{17}$$

which is a function of $\frac{w}{r}$. Because it is exactly as factor proportion theory, we can immediately show $\frac{\eta_x}{\eta y}$ is an increasing function of $\frac{w}{r}$ as shown in Figure 7. Each point on the positive slope curve in Figure 7 represent the relative production level of intermediate inputs such that the factor markets are clear under the given level of $\frac{w}{r}$. The actual demand of relative level of intermediate inputs at a give relative factor price depends on the commodity market clearing condition. This is what we are deriving now.

Because at each point of time there are δ portion of producers die. This triggers new entrants to maintain equilibrium. The mass of new entrant must be equal to the mass of producers die to satisfy the FE condition. This implies that $N_{k,e} = \delta N_k$ where $N_{k,e}$ is the mass of entrants needed to maintain the FE condition. Substitute this relationship into the free entry condition, we know that

$$\delta \overline{\pi}_k Nk = \delta N_k f_e c_k$$

Therefore at each point of time, total profit is equal to the expenses on fixed costs. If we assume that factor owners provided their endowments to form fixed cost are well diversified among entrants. The stocks they own will on average have the value equal to the average long-run profit of the entrants. Because this average level is constant in the long-run, factor owners have no aggregate risk. The value of stock is exactly equal to the value of factors. Therefore total expenditure on the economy is equal to the income of factors. This implies that

$$\frac{\eta_x}{\eta_y} = \frac{\beta_x c_y}{\beta_y c_x}$$

Because $\frac{c_y}{c_x}$ is decreasing with $\frac{w}{r}$ according to the Stolper-Samuelson theorem, we therefore have a negative relationship between $\frac{\eta_x}{\eta_y}$ and $\frac{w}{r}$ as shown in Figure 7. Each point on it represents the demand of the intermediate inputs given the relative factor price.

The equilibrium of the closed economy is summarized by Figure 7. Once the equilibrium relative factor price is determined, the absolute factor prices can be obtained by the assumption that total factor income is equal to one. The absolute level of η_k can be obtained by solving equation (17) when the equilibrium factor prices are known. The production level, price and profit of each variety can be obtained from the profit maximization condition given the equilibrium factor prices. ZCP and FE conditions determine equilibrium level of marginal producers' productivity and N_k. $N_{k,e} = \delta N_k$ determines the mass of new entrants at each point of time.

3.5 Open Economy

The simplest form of the open economy can be observed by assuming that there are two symmetric countries. Therefore there is no comparative advantage. Trade simply causes the effect similar to the increase of market size. As shown by Figure 6, because we normalized income to one, doubling income is the same as decreasing marginal cost by one half. The average profit is therefore higher than the fixed cost. This triggers more entrants until the economy reach new equilibrium. At equilibrium N_k increases and the level of competition as well as average productivity level also increases. Notice that we do not have to use any fixed trading cost to generate this result.

We can also assume that one country is labor abundant, then the aggregate effect is the same as that in the standard H-O model as shown by Figure 7. However, there are also some micro impact on entry and exit decisions in each sector. This kind of information is missing in the standard H-O model.

4 An Example

In this section I propose a special case described in section 3. Suppose that there is only one sector and one input which is labor. The utility function described in section 3 is explained as a production function for final good. The intertemporal utility function is described by equation (5). The fixed entry cost is explained as the $R\&D$ expenditure. We ignore all possible technology spillover effect. Other settings are the same as section 3. Total income is still normalized to one. The equilibrium wage is $w = \frac{1}{L}$ as all income goes to labor.

The growth rate will be zero in the long-run as there is no spillover effect in this special example. What we care about is the impact of trade on average productivity. Trade immediately increases average productivity as it brings higher level of competition. Since there is no extra cost needed to generate productivity improvement, intuitively, trade does not decrease growth rate.

We first observe that in the integrated world economy, the equilibrium wage remain the same. Because the total income is now equal to two (each country has income normalized to one) and size of population is doubled, wage is the same as under autarky. However, the expected profit is higher because the size of economy is doubled. This trigger more entrants and increase the level of competition. Since we ignore the spillover effect the effect is very similar to the case when f_e suddenly decreases by one half. Therefore trade has the same impact as the suddenly drop of f_e such that the average productivity of the economy increases; however the growth rate remain zero in the long-run. Notice in the Melitz-type model, although there is no impact on growth rate, as it is always zero without spillover-effct. However, the negative impact on welfare is reflected by the decrease of number of varieties, as some resources are used to form fixed trading costs.

5 Contribution and Further proceedings

At this moment most of the work has been done except for writing the draft of the paper and submitting it for publishing in the international journal.

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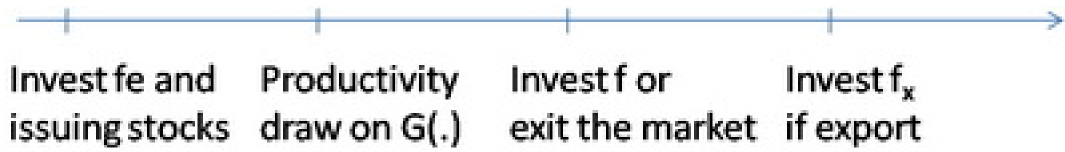
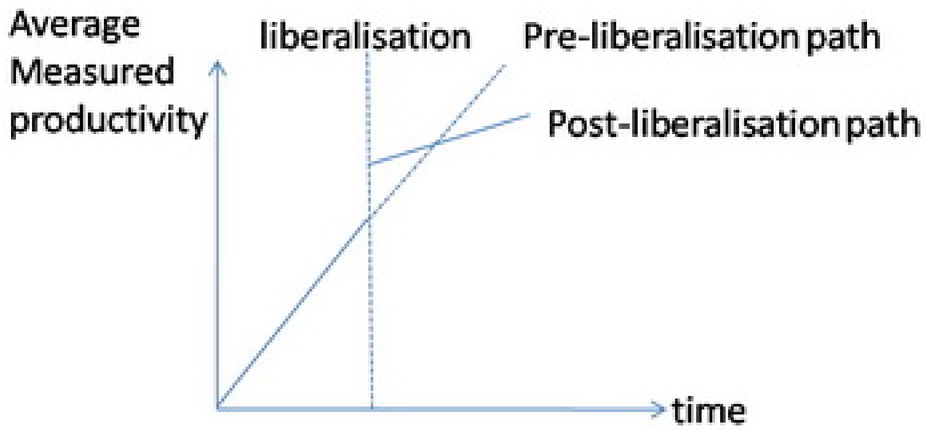


Figure 1:



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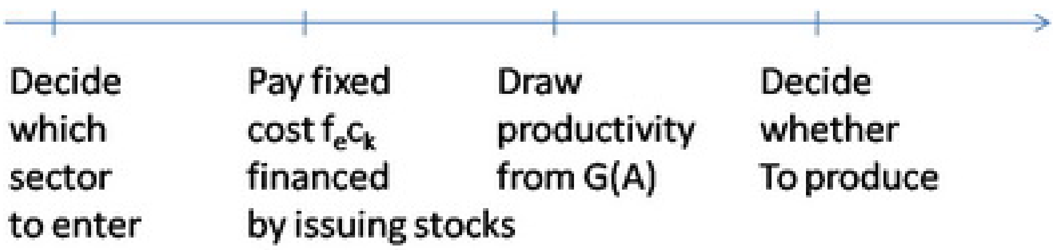

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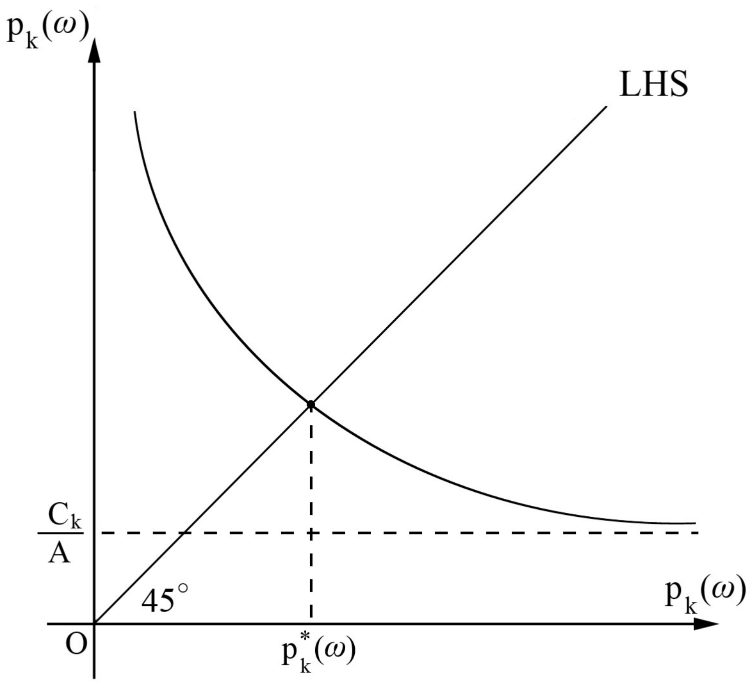

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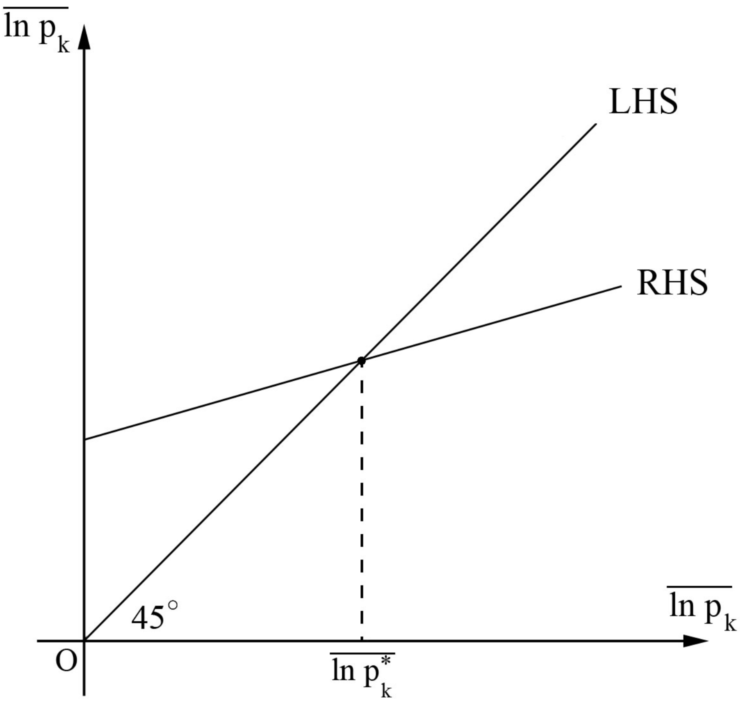

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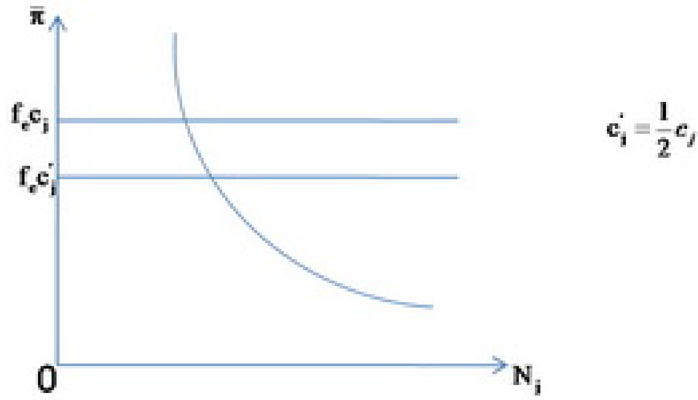

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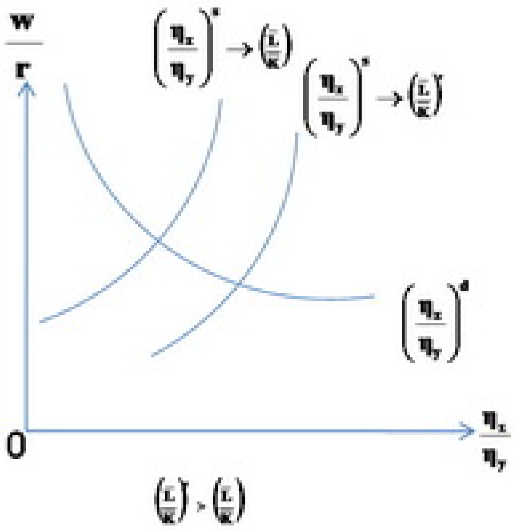

Figure 7:

附件四

國科會補助專題研究計畫項下出席國際學術會議心得報告

日期:100年01月30日

計畫編號	NSC 98-2410-H-004-195		
計畫名稱	非常數彈性與異質生產者下之貿易與成長模型		
出國人員姓名	徐則謙	服務機構及職稱	國立政治大學國貿系助理教授
會議時間	2010 年 8 月 17 日至 2010 年 8 月 21 日	會議地點	中國上海市
會議名稱	(中文)第十屆世界經濟學大會 (英文)Econometric Society World Congress 2010		
發表論文題目	(中文)無 (英文)無		

一、參加會議經過

於 2010 年八月十六日達上海，參與五日的研討會，於二十二日回國。

二、與會心得

此研討會為經濟學門中之位階最高者。此次在亞洲國家舉行，有幸參與並聆聽當今最重要的國際貿易領域學者 Melitz 及其他先進的演說，獲益良多。

四、攜回資料名稱及內容

Quantitative Economics, Journal of the Econometric Society

Theoretical Economics, Journal of the Econometric Society

國科會補助計畫衍生研發成果推廣資料表

日期:2011/01/30

國科會補助計畫	計畫名稱: 非常數彈性與異質生產者下之貿易與成長模型	
	計畫主持人: 徐則謙	
	計畫編號: 98-2410-H-004-195-	學門領域: 國際經濟學

無研發成果推廣資料

98 年度專題研究計畫研究成果彙整表

計畫主持人：徐則謙			計畫編號：98-2410-H-004-195-			
計畫名稱：非常數彈性與異質生產者下之貿易與成長模型						
成果項目			量化			單位	備註（質化說明：如數個計畫共同成果、成果列為該期刊之封面故事...等）

成果項目			實際已達成數（被接受或已發表）	預期總達成數(含實際已達成數)	本計畫實際貢獻百分比	單位	備註（質化說明：如數個計畫共同成果、成果列為該期刊之封面故事...等）
國內	論文著作	期刊論文	0	0	100%	篇	
		研究報告/技術報告	0	0	100%		
		研討會論文	0	0	100%		
		專書	0	0	100%		
	專利	申請中件數	0	0	100%	件	
		已獲得件數	0	0	100%		
	技術移轉	件數	0	0	100%	件	
		權利金	0	0	100%	千元	
	參與計畫人力（本國籍）	碩士生	1	1	100%	人次	
		博士生	0	0	100%		
		博士後研究員	0	0	100%		
		專任助理	0	0	100%		
國外	論文著作	期刊論文	1	0	0%	篇	
		研究報告/技術報告	1	0	60%		
		研討會論文	1	0	0%		
		專書	0	0	100%	章/本	
	專利	申請中件數	0	0	100%	件	
		已獲得件數	0	0	100%		
	技術移轉	件數	0	0	100%	件	
		權利金	0	0	100%	千元	
	參與計畫人力（外國籍）	碩士生	0	0	100%	人次	
		博士生	0	0	100%		
		博士後研究員	0	0	100%		
		專任助理	0	0	100%		

其他成果 (無法以量化表達之成果如辦理學術活動、獲得獎項、重要國際合作、研究成果國際影響力及其他協助產業技術發展之具體效益事項等，請以文字敘述填列。)	無

	成果項目	量化	名稱或內容性質簡述
科教處計畫加填項目	測驗工具(含質性與量性)	0	
	課程/模組	0	
	電腦及網路系統或工具	0	
	教材	0	
	舉辦之活動/競賽	0	
	研討會/工作坊	0	
	電子報、網站	0	
	計畫成果推廣之參與（閱聽）人數	0	

國科會補助專題研究計畫成果報告自評表

請就研究內容與原計畫相符程度、達成預期目標情況、研究成果之學術或應用價值（簡要敘述成果所代表之意義、價值、影響或進一步發展之可能性）、是否適合在學術期刊發表或申請專利、主要發現或其他有關價值等，作一綜合評估。

1. 請就研究內容與原計畫相符程度、達成預期目標情況作一綜合評估 ■達成目標 □未達成目標（請說明，以 100 字為限） □實驗失敗 □因故實驗中斷 □其他原因 說明：
2. 研究成果在學術期刊發表或申請專利等情形： 論文：□已發表 □未發表之文稿 ■撰寫中 □無 專利：□已獲得 □申請中 ■無 技轉：□已技轉 □洽談中 ■無 其他：（以 100 字為限）
3. 請依學術成就、技術創新、社會影響等方面，評估研究成果之學術或應用價值（簡要敘述成果所代表之意義、價值、影響或進一步發展之可能性）（以 500 字為限）