The effects of globalization on job choice and unemployment under labor search friction*

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Abstract

Trade liberalization increases the import of foreign goods and makes local markets more competitive. To survive the severe competition, local firms must improve the quality of production factor, and employ more highly skilled workers than unskilled workers. An increase in the demand for skilled workers encourages workers to pursue higher education. However, the recent employment of highly educated workers is stagnant globally. Although trade liberalization enhances the demand for skilled workers, it may not contribute to increasing their employment.

I analyze how trade liberalization affects the local employment of skilled workers, occupational choice, and wage inequality. Firms can always produce low-quality goods by using only unskilled labor. If a firm succeeds in employing an appropriately skilled worker, it can improve the quality of the goods it produces. However, due to search friction, matches are not always successful. If firms and workers fail to match appropriately, the unmatched skilled workers remain unemployed and the unmatched firms continue to produce low-quality goods. With this knowledge, workers choose their occupations: and either remain to be unskilled or lean skills. Trade liberalization raises the skilled wage rate and the successful probability of matching, which encourages unskilled workers to learn skill but increase the number of the skilled workers after trade liberalization. Therefore, the unemployment rate of skilled workers may increase after globalization.

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1. Introduction

The volume of world trade increased after World War II, and globalization increased rapidly through various free trade agreements. Simultaneously, the level of education also increased in many developed countries. In Japan, for example, the university enrollment rate was approximately 15 % in the 1950s, increased to 51% in 2013. The main reason for the increase in the university enrollment rate is the improvement of household incomes. Recently, the trend of globalization promotes firms to demand well-educated workers to survive severe competition by foreign firms. Some firms requires people with the communication skills to negotiate with the foreign companies. Others require those with a high education to advance ahead of the market competition. Many countries introduce foreign language course work in compulsory education and invite foreign engineers and businessmen to attend to these courses. Consequently, trade liberalization accelerates the popularization of higher education.

How do the trend of globalization and the popularization of higher education affect the domestic labor market? The results of basic survey of Japanese schools show that the university advancement rate has increased in Japan, but the employment rate is flattening out. Furthermore, the employment rate of those who graduated from higher education professional schools is also not increasing. Not only Japan, but other OECD countries face the similar situation. In Korea, only about 60 % of young people who graduated from university can get a job[1]. The university enrollment rate is 70% in Korea, which is higher than Japan in 2010[2]. Moreover, jobless rate for young people is

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[1] Han, H. (2016) Envious of Japanese young people whose employment markets have been opened widely = South Korea, *Korean Joongang Daily translated by Japanese*, Retrieved from November 22, 2016 from http://japanese.joins.com/article/593/213593.html

[2] OECD (2012) "Education at a Glance 2012"

12.5% in 2016. In the United States, Associated Press (AP) reported that 1 in 2 (53%) new graduates are jobless or underemployed or underemployed in 2012[3]. Although the university enrollment rate is 74%, many young people faces the problem of unemployment.

Consequently, the recent trend of globalization and popularization of higher education does not always get good effects on the local labor market.

This article considers the relationship between popularization of higher education and the employment rate from the aspect of international trade. In particular, I investigates how globalization affects various types of jobs and the unemployment rate (and the employment rate). There are two symmetric countries that produce differentiated goods with labor. I consider two types of labor: skilled and unskilled workers. Unskilled workers are used for the production of the differentiated good and the unskilled labor market is perfectly competitive. If a firm employs one skilled worker, it can raise the quality of its differentiated goods and can earn higher profit. However, there is information asymmetry between firms and skilled workers in the skilled labor market. Firms and the skilled worker do not always match. If the matching between a firm and skilled worker fails, the firm must produce a lower quality of their differentiated good and the skilled worker is unemployed. If the matching between a firm and a skilled worker succeeds, the firm can produce a higher quality of the differentiated goods, and workers earn the higher negotiated wage income. I use the Diamond-Mortensen-Pissarides search and matching model to consider the matching between firm and skilled workers. Workers can choose to be

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[3] Yen, H. (2012, April 24) 1 in 2 new graduates are jobless or underemployed *Associated Press* Retrieved November 22th, 2016 from https://www.yahoo.com/news/1-2-graduates-jobless-underemployed-140300522.html

either skilled or unskilled. If one chooses to be unskilled, he or she works as unskilled labor and earns a wage determined by the market. However, if he or she pursues an education and masters a skill, he or she can negotiate with a firm. As long as the matching with a firm succeeds, he/she negotiates the wage with the firm.

Next, I consider international trade between two symmetric countries; additionally, there are ice-berg costs for exporting the differentiated goods to the foreign country. Only the firms producing high-quality differentiated goods can export their goods, whereas low-quality firms provide their goods to the local market. Because recent empirical articles support this assumption[4], I adopt it in my model. When ice-berg costs decrease, the bargaining wage rate and the demand of the skilled workers increase. Trade liberalization makes it easy to export differentiated goods for the high-quality firms, and the profit of the high-quality goods increases. Since the profit is distributed to a firm and skilled workers through negotiation, the increase in profit leads to an increase in the bargaining wage rate. The increase in the profit of the high-quality goods attracts the low-quality firm to enter the search for the skilled workers. Therefore, the demand of the skilled worker increases. The increase of the bargaining wage rate and the demand for skilled workers increases the incentive to become the skilled worker. However, these changes raise the total income of a country, and the value of unskilled workers also increases. The effect of globalization is ambiguous on worker's job choices. However, I find it possible that globalization may increase unemployment.

My study relates to the literature of international trade with the labor-search model. Davis (1998) and Davidson and Matusz (2004) introduced incompleteness of

[4] See Bernard, A. and J. Jensen (1999).

labor market into neoclassical trade model and investigated the effect of trade pattern and unemployment. Recently, researches introducing incompleteness of labor market into monopolistic competition model has increased. For example, Helpman et al. (2010a,b), Egger and Kreickemeier (2009, 2012), and Ferlbermayr et al. (2011) investigated the effects of globalization on local unemployment. They showed that there are two contradictory effects international trade on the labor market. First, globalization increases the average productivity of the industry through the selection of low-productivity firms, which increases employment. Secondly, since an increase in the average productivity means an increase in the effective firms, the rise in employment is not much greater than the increase in production. Consequently, the employment contracts. However, their model does not determine the firm's productivity in the labor market. In their model, the lottery determines the productivity of a firm. A firm with relatively high productivity negotiates with skilled workers, whereas another firm with relatively low productivity exits from the market. Although the entry and exit of a firm depend on the productivity lottery and labor matching, productivity and the industry structure are not affected as much by labor matching. Ara and Furusawa (2012) created a model in which the productivity of a firm and the industry structure are determined by matching in the market. They consider the matching problem between upstream and downstream firms. If matching between upstream and downstream firms is a success, they jointly produce high-quality goods and earn high profits. I follow their matching system, but I focus on matching between firms and workers.

This article also relates to the choice between skilled and unskilled workers. Development economics investigates the literature on the dual labor markets. Zenou (2008) introduced the labor search model into the skilled labor market and investigated

the worker's job choices between skilled and unskilled workers. Some may argue that the unemployment problem with the unskilled workers is more important than that of skilled workers[5]. However, Zenou noted that the laws of regarding skilled workers are stricter and that their position is more affected by policy change than that of unskilled workers. Because I focus on the relationship between the popularization of higher education and the low employment rate of highly skilled workers, it is reasonable to consider the unemployment problem of skilled workers. Zenou addresses this problem only with a partial equilibrium and in an autarky economy. I expand his model into the general equilibrium and consider the effect of globalization.

The remainder of the paper is organized as follows. Section 2 explains the base of the model and the equilibrium under autarky. Section 3 analyzes the effect of globalization. Section 4 concludes with a summary and a discussion of future research.

2. The model

2.1 Preference

Consumer preferences are identical across all countries and are modeled by the following utility function:

$$U = \left[\int_{\omega\in\Omega} q(\omega)^{\frac{1}{\sigma}} x(\omega)^{\frac{\sigma-1}{\sigma}} \mathrm{d}\omega\right]^{\frac{\sigma}{\sigma-1}}, \sigma > 1 \tag{1}$$

where ω is the consumption of the variety ω, $q(\omega)$ denotes the quality of the variety, and Ω is the set of the variety of the differentiated goods. σ is is the elasticity of substitution between any two varieties. From Eq. (1), the demand of each variety is given by

$$x(\omega) = \frac{q(\omega)p(\omega)^{\sigma}E}{P^{1-\sigma}} \tag{2}$$

[5] See Deréze and Sneeseens (1994) and Sener (2001).

where $p(\omega)$ is the price of the variety ω, E is total income, and P denotes the price index of all of the varieties.

$$P^{1-\sigma} \equiv \int_{\omega \in \Omega} q(\omega) p(\omega)^{1-\sigma} \mathrm{d}\omega \tag{3}$$

The quality of the variety, $q(\omega)$, is determined by whether a matching between a firm and a skilled worker is successful.

$$q(\omega) = \begin{cases} 1, & \text{if matched sucessfully} \\ \frac{1}{\gamma}, & \text{if mismatched} \end{cases} \tag{4}$$

where $\gamma \in (1, \infty)$ is a parameter.

2.2 Production

Each good is well differentiated and produced by a continuum of monopolists, each firm choosing to produce a different variety. There are L units of labor and N units of firms; the number of firms in production is endogenously determined by free entry. Regardless of quality, we assume that the production of each variety requires an unskilled worker. A firm pays an unskilled worker a wage, w. To simplify, we set the wage as a numeràire, $w = 1$. The number of unskilled workers is denoted by l, which l is determined endogenously in the model.

To raise the quality of a variety, a firm must match with a skilled worker. I assume that search friction exists in skilled labor market. A firm and a skilled worker are randomly matched, but the matching process is not always successful. Only a small fraction of $n < \min\{L - l, N\}$ of firms and skilled workers find their pairs. The number of matched pairs, n, is also endogenously determined in the model, and the properties of matching technology are detailed in section 2.3.

When successfully matched, firms and skilled workers jointly create a high-quality variety $\tilde{x}(\omega)$ and obtain the joint profit $\tilde{\pi}(\omega)$. If a firm cannot match with skilled-worker, the firm produces a low-quality variety $x(\omega)$ only with unskilled workers and obtains the profit $\pi(\omega)$. Therefore, the demands and profits of both high- and low-quality firms are given by the following equation:

$$\tilde{x}(\omega) = \frac{\tilde{p}(\omega)^{-\sigma}\alpha E}{P^{1-\sigma}}, \qquad x(\omega) = \frac{p(\omega)^{-\sigma}\ \alpha E}{\gamma P^{1-\sigma}}$$

$$\tilde{\pi}(\omega) = [\tilde{p}(\omega) - 1]\tilde{x}(\omega), \qquad \pi(\omega) = [p(\omega) - 1]x(\omega)$$

where $\tilde{p}$ and p are the price of the high- and low-quality goods. From a firm's profit maximization, we obtain the following pricing rule:

$$\tilde{p}(\omega) = p(\omega) = \frac{\sigma}{\sigma - 1} \tag{5}$$

Notice that the price is identical between the high- and low-quality firms.

In Eq. (5), the products and operating profits of high- and low-quality firms are rewritten as follows:

$$\tilde{x} = \frac{\sigma - 1}{\sigma}\frac{E}{n + \frac{N-n}{\gamma}}, \qquad x = \frac{\sigma - 1}{\sigma}\frac{E}{\gamma\left(n + \frac{N-n}{\gamma}\right)} \tag{6}$$

$$\tilde{\pi} = \frac{E}{\sigma\left(n + \frac{N-n}{\gamma}\right)}, \qquad \pi = \frac{E}{\sigma\gamma\left(n + \frac{N-n}{\gamma}\right)} \tag{7}$$

Notice $\tilde{x}/x = \tilde{\pi}/\pi = \gamma$. In other words, γ denotes the differences of products and profits between high- and low-quality firms.

2.3 Labor markets

Labor markets are segmented into skilled- and unskilled-labor markets. A skilled worker masters a high level of skills in his or her education and matches with a high-quality firm. The wage of skilled workers is determined through the bargaining with the matched firm. However, search friction exists between firms and skilled labor in

the market. Workers cannot always match with high-quality firms. If a worker fails to match with a firm, he or she is unemployed. When a skilled worker is unemployed, he or she must seek a firm that is searching and obtains unemployment insurance b. Unemployment insurance b is financed by the lump-sum tax collected from skilled workers and unskilled workers.

On the other hand, unskilled workers do not pursue an education, and engage in production activity at both high- and low-quality firms. They have no risk of unemployment and earn $w = 1$. When an unskilled worker obtains an education, he or she can master a high level of skill and enter the skilled-labor market.

Section 2.3.1 explains the structure of the skilled-labor market. Next, Section 2.3.2 describes the unskilled-labor market and the worker's job choices.

2.3.1 Skilled labor market

I assume that search frictions exists in skilled labor market, and use the Diamond-Mortensen-Pissarides (DMP)[6] search-matching framework to model these frictions. In the DMP model, a matching function describes a process in which a job seeker applies for a job vacancy posted by firms and negotiates an employment agreement. The number of successful matching between firms and skilled workers is n. Suppose that n depends on the number of vacancies $N - n$ and job seekers $u \equiv L - l - n$, we define the following matching function:

$$n \equiv M(u, N - n) \tag{8}$$

where $M(\cdot)$ is increasing in its arguments, concaves and homogenous of degree 1. When unemployment u increases, it is easier for searching firms to match with the best workers in the labor market. Therefore, an increase in unemployment u raises

[6] See B. Petrongolo and C. Pissarides (2001).

the possibility of matching. Similarly, an increase in low quality makes it easy for workers to find jobs, and then, the possibility of matching increases. From the assumption of homogenety of degree 1 for the matching function, I can rewrite the possibility of matching as a function of a ratio of unmatched firm and unemployment, $\theta \equiv N - n/u$ as follows:

$$\frac{M(u, N-n)}{N-n} \equiv m(\theta), \qquad \text{for unmatched firms} \tag{9}$$

$$\frac{M(u, N-n)}{u} \equiv \theta m(\theta), \qquad \text{for unemployment} \tag{10}$$

For unmatched firms, an increase in the ratio of unmatched firms and workers θ means that there are many rival firms in the labor market. Since this situation encourages competition among unmatched firms, the possibility of matching for unmatched firms decreases. Therefore, I obtain $\mathrm{d}m(\theta)/\mathrm{d}\theta < 0$. On the other hand, a large θ means that it is easier for a worker to find a firm. An increase in θ raises the possibility of matching for unemployment, which is implicated by $\mathrm{d}\theta m(\theta)/\mathrm{d}\theta > 0$. Suppose that a fraction $\lambda \in (0,1)$ of matchings is destroyed by exogenous shocks at every period.

A high-quality firm and a skilled worker that succeed in matching negotiate a wage for skilled worker. Both the firm and the worker set a skilled worker wage so that their *ex post* situation is better than that of *ex ante* negotiation. To consider the negotiation problem, I must know the values of high and low-tech firms, skilled and unskilled worker. I set the following Bellman equation:

$$r\tilde{V} = \tilde{\pi} - \tilde{w} + \lambda[V - \tilde{V}] + \dot{\tilde{V}} \tag{11}$$

$$rV = \pi + m(\theta)[\tilde{V} - V] + \dot{V} \tag{12}$$

$$rW = \tilde{w} - T + \lambda[U - W] + \dot{W} \tag{13}$$

$$rU = b + \theta m(\theta)[W - U] + \dot{U} \tag{14}$$

where $\tilde{V}$ is the value function of a high-tech firm, V is the value function of a low-tech firm, W is the value function of a skilled worker, U is the value function of unemployment, r is the rental rate, T is the lump-sum tax, and the superscript dotted value is the dynamics of the value. A high-tech firm earns a joint profit $\tilde{\pi}$ and obtains value $\tilde{V}$ by employing a skilled worker but has to pay the worker $\tilde{w}$. The high-tech worker faces a risk of destroying the matching at rate λ. If the high-tech firm suffers from destroying the matching, the firm cannot produce the high-tech well and obtains the value V instead.

A low-tech firm produces a low-tech good with only unskilled workers and earns a profit π. To improve the quality of the good, low-tech firms must search for a skilled worker in the labor market. The searching firm can find a skilled worker at the possibility of $m(\theta)$. Once the firm succeeds in matching with a skilled worker, it can produce high-tech goods and earn profit $\tilde{\pi}$. Suppose that free entry for firms are allowed and that a new firm has to pay a fixed cost F for entry, where F is measured by labor unit. Therefore, the free entry condition becomes $V = F$ and the number of all firms, N, is determined.

A skilled worker who successfully matches with a high-tech firm obtains a wage $\tilde{w}$ and pays a lump-sum tax T. However, matching is destroyed at possibility λ, and skilled worker lose W but obtain the value of unemployment U. Unemployed workers obtain unemployment insurance b and seek a job at every time. Unemployed worker can match a high-tech firm at possibility $\theta m(\theta)$ and can obtain the value of skilled worker W.

In each period, the total surplus is shared through a generalized Nash-bargaining process between high-tech firm and skilled worker. The total surplus is the sum of the surplus of skilled worker, $W(\tilde{w}) - U$, and the surplus of the high-tech firm, $\tilde{V}(\tilde{w}) - V$. I determine the wage in the following problem:

$$\tilde{w} \in \arg\max[W(\tilde{w} - U)]^{\beta} [V(\tilde{w}) - V]^{1-\beta} \tag{15}$$

where $\beta \in (0.1)$ is the bargaining power of the skilled workers.

Differentiating with respect to $\tilde{w}$ gives the first order condition:

$$\beta[\tilde{V}(\tilde{w}) - V] = (1 - \beta)[W(\tilde{w}) - U]$$

To focus on the analysis of a steady state, I set $\dot{\tilde{V}} = \dot{V} = \dot{W} = \dot{U}$. Using Eq. (11), (12), (13), (14), first order condition, and $V - F$ gives the following equation:

$$\tilde{w} = b + (1 - \beta)T + \beta[\tilde{\pi} - b + rF + \theta(\pi - rF)] \tag{16}$$

where $\pi = \tilde{\pi}/\lambda$. This equation is called the "Wage determination condition." When θ is large, a worker can find a job more easily and requires him or her to raise his or her wage in bargaining. Since the equation has many endogenous variables, I cannot clarify the relationship between wage $\tilde{w}$ and job-opening-to-application ratio θ.

Next, I consider the labor demands of firms. Using Eq. (11), (12), and free entry condition $V = F$ gives another equation:

$$\tilde{w} = \tilde{\pi} + rF - \frac{r + \lambda}{m(\theta)}[-\pi + rF] \tag{17}$$

This equation is called as the "Job creation condition." When θ is high, severe competition exists among firms, which makes difficult for firms to find one skilled worker. Under these circumstances, firms do not want to raise the bargaining wage $\tilde{w}$. Similarly to wage determination, this equation has endogenous variables and does not give the relationship between $\tilde{w}$ and θ.

In the steady state, the number of pairs that break the matching must be equal to the number of pairs that newly match. Thus, the following relationship exists:

$$\lambda n = \theta m(\theta) u$$

Using $L = n + u + l$ and rearranging the equation for u, I obtain the number of unemployment:

$$u = \frac{\lambda(L - l)}{\theta m(\theta) + \lambda} \tag{18}$$

2.3.2 Unskilled labor market

Unskilled workers obtain wage $w = 1$ at every time. Each unskilled worker has two options and chooses one at the beginning of time. The first option is to remain an unskilled worker. The second option is to obtain an education and become a skilled worker. I assume that an unskilled worker cannot search directly for a job in the skilled labor market but must first be unemployed in the skilled labor market. Under this assumption, an unskilled worker chooses the following two values: one is the value of not being educated and obtaining a stable job and the other is the value of being educated and unemployed and finding a high-paying job. If an unskilled worker decides not to obtain an education, he or she receives a wage of the unskilled job $\mathrm{w} = 1$ and must pay the lump-sum tax T. Therefore, the expected wage income for the unskilled worker becomes $(1 - T)/r$. On the other hand, the value of the educated worker equals to the expected value for unemployment: U. Using Eq. (13) and (14), the condition of job choice for the unskilled worker is shown by the following equation.

$$\frac{\theta m(\theta)\{\tilde{w} - T\} + (r + \lambda)b}{\theta m(\theta) + r + \lambda} = 1 - T \tag{19}$$

2.4 Equilibrium

To describe the overall model, I have to derive some endogenous variables: total expenditure E, profits $\tilde{\pi}$ and π. First, the total expenditure E is the sum of the wage income for all workers. From the definition of each worker in the last section, the total expenditure E is calculated as follows:

$$E \equiv n(\tilde{w} - T) + ub + l(1 - T)$$

$$= n\tilde{w} + l$$

Using Eq. (18), the total expenditure is rewritten as follows

$$\frac{E}{\sigma} = \frac{\theta m(\theta)\ \tilde{w} + \{\lambda\theta + \theta m(\theta)\}F}{\theta m(\theta) + \lambda}(L - l) \tag{20}$$

Next, the profit for a high-tech firm $\tilde{\pi}$ and a low-tech firm π in Eq. (7) consists of the total expenditure E and the number of the matching firms n. Using Eq. (18) and (20), $\tilde{\pi}$ and π in Eq. (7) are calculated as follows:

$$\tilde{\pi} = \frac{\gamma[m(\theta)\tilde{w} + \{\lambda + m(\theta)\}F]}{\gamma m(\theta) + \lambda} \tag{21}$$

$$\pi = \frac{m(\theta)\tilde{w} + \{\lambda + m(\theta)\}F}{\gamma m(\theta) + \lambda} \tag{22}$$

Substituting Eq. (21) and Eq. (22) into Eq. (16), I obtain the new wage determination equation which is described by only two endogenous variables the recruit rate θ and the wage income for a skilled worker $\tilde{w}$:

$$\frac{(r + \lambda)\{\gamma\theta m(\theta) + \lambda\} + (1 - \beta)\theta m(\theta)\{\gamma m(\theta) + \lambda\} - (\gamma - \theta)(r + \lambda)\beta m(\theta)}{(r + \lambda)\{\gamma m(\theta) + \lambda\}}\tilde{w}$$

$$= b + (1 - \beta)\frac{\theta m(\theta) + (r + \lambda)(1 - b)}{r + \lambda} \tag{23}$$

$$+ \beta\left[\frac{(\gamma - \theta)F\{\lambda + m(\theta)\}}{\gamma m(\theta) + \lambda} - b - rF + \theta rF\right]$$

On the other hand, substituting Eq. (21) and Eq. (22) into Eq. (17) gives me the new job creation condition which is described only by two endogenous variables θ and $\tilde{w}$:

$$\tilde{w} = \frac{\gamma[m(\theta)\tilde{w} + \{\lambda + m(\theta)\}F]}{\gamma m(\theta) + \lambda} - rF$$
$$- \frac{r + \lambda}{m(\theta)}\left[-\frac{m(\theta)\tilde{w} + \{\lambda + m(\theta)\}F}{\gamma m(\theta) + \lambda} + rF\right] \quad (24)$$

Since the wage determination equation in Eq. (23) and the job creation condition in Eq. (24) have non-linear relationship between θ and $\tilde{w}$, it is difficult to analytically derive θ and $\tilde{w}$ from the above two equations. I investigate the relationship between θ and $\tilde{w}$ from these two equations. First, I can show[7] by the numerical calculation that there is a positive relationship between $\tilde{w}$ and θ in the Wage determination equation if the quality gap between high- and low-tech firms γ is adequately large. Figure 1 describes the relationship between $\tilde{w}$ and θ. The horizontal axis indicates the job-offers-to-seekers ratio θ, and the vertical axis denotes the bargaining wage rate $\tilde{w}$. In Figure 1, the Wage determination equation has an increasing curve of θ. The large job-offers-to-seekers ratio θ large indicates that it is easier for unemployed people to find jobs in the skilled labor market. The unemployed people require a higher wage rate for a firm in the bargaining process even if the bargaining between them breaks down.

On the other hand, the Job creation equation in Eq. (24) describes the free entry condition for firms. From the free entry condition, the bracket in the third term of the equation becomes the following:

$$-\frac{m(\theta)\tilde{w} + \{\lambda + m(\theta)\}F}{\gamma m(\theta) + \lambda} + rF = m(\theta)[\tilde{V} - F]$$

$\tilde{V} - F$ is the disparity between the values of a high- firm low-tech firm. If the disparity is negative, there are no firms to bargain with a skilled worker. Therefore, $\tilde{V} - F$ has

[7] I use the following parameter in the numerical calculation: $\beta = 0.5, \gamma = 200, F = r = \lambda = 0.1, m(\theta) = \theta^{-0.5}$.

to be positive so that all firms have incentive to become high-tech firm. Since $\tilde{V} - F$ depends on both the job-offers-to-seekers ratio θ and the wage rate $\tilde{w}$, I have to restrict on θ and $\tilde{w}$ as follows:

$$\tilde{V} - F > 0 \quad \Leftrightarrow \quad \tilde{w} < \frac{(r\gamma - 1)m(\theta) + (r-1)\lambda}{m(\theta)}$$

I restrict on θ and $\tilde{w}$ so that the inequality is satisfied. If the quality gap γ is adequately large, the equilibrium values of θ and $\tilde{w}$ satisfy the inequality. When the inequality is satisfied, the job creation equation in Eq. (24) is a decreasing function of the job-offers-seek ratio θ. A large θ means that the labor market is more competitive for firms. Severe competition with rival firms reduces the possibility that a firm appropriately matches with a skilled worker and extends the term of the search. Since it is difficult for the firm to raise the bargaining wage rate $\tilde{w}$, the job creation condition has a negative relationship between θ and $\tilde{w}$. In Figure 1, the job creation equation depicts a downward sloping curve. An equilibrium of the closing model, $\tilde{w}^*$ and θ^* is solved by the interaction between the Wage determination condition and the Job creation condition in Figure 1.

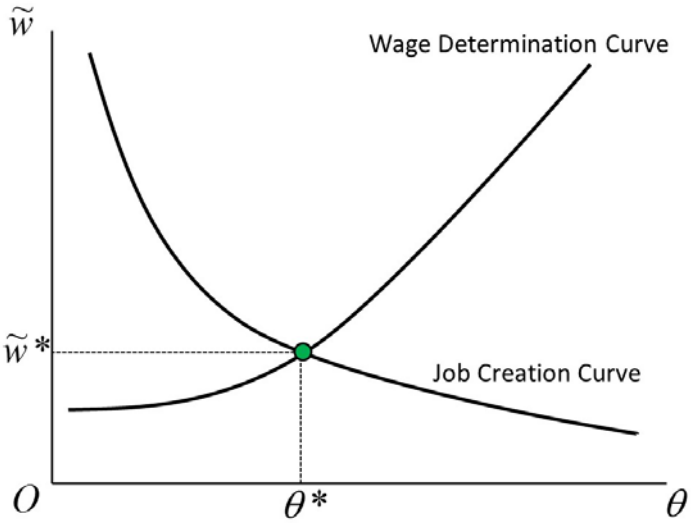

Figure 1: Equilibrium in the skilled labor market

When θ^* and $\tilde{w}^*$ are determined, the other variables are also determined. From Eq. (19) and the definition of the lump-sum tax, $ub = (n + l)T$, the number of unskilled workers l is characterized as follows:

$$\frac{\theta^* m(\theta^*)\tilde{w}^* + (r+\lambda)b}{\theta^* m(\theta^*) + r + \lambda} = 1 - \frac{\lambda}{\theta^* m(\theta^*) + \{\theta^* m(\theta^*) + \lambda\}\frac{l}{L-l}} \frac{r+\lambda}{\theta^* m(\theta^*) + r + \lambda} \tag{25}$$

Finally, the number of the unemployment is determined by Eq. (18).

3. The effects of globalization

3.1 Effects on the skilled labor market

I investigate the effect of globalization on a worker's job choice and the the number of unemployment of a country. There are two symmetric countries with the same preferences, production technology, number of workers, and characteristics of the labor market. I assume that the systems of the labor market are independent from each other. These assumptions do not change the job choice condition in Eq. (25) and the unemployment equation in Eq. (18). Since the both countries produce differentiated goods, trade liberalization causes the exports of the differentiated goods to each other. Suppose that high-tech firms only export their goods and that it costs an ice-berg type tariff $\tau \geq 1$ to exporting goods. The price of the exporting goods is as follows:

$$\tilde{p}^T \equiv \frac{\tau\sigma}{\sigma - 1}$$

A household in each country can consume three types of goods: domestic high-tech goods, importing high-tech goods, and low-tech goods. The price index is modified as follows:

$$P^{1-\sigma} = \left(\frac{\sigma}{\sigma - 1}\right)^{1-\sigma} [n(1 + \tau^{1-\sigma}) + (N - n)/\gamma]$$

High-tech-good firms produce domestic goods and goods to export and earn the following (joint) operating profit for these:

$$\tilde{\pi} = (\tilde{p}^T - \tau)\tilde{x}^T + (\tilde{p} - 1)\tilde{x} = \frac{\Gamma[\theta m(\theta)\tilde{w} + \lambda b]}{\Gamma\theta m(\theta) + \lambda\theta}$$

where $\Gamma = \gamma(1 + \tau^{1-\sigma})$. On the other hand, the low-tech firms sell their goods only to domestic consumers. The profits for low-tech firms are as follows:

$$\pi = \tilde{\pi}/\Gamma$$

Opening international trade changes the two conditions for the skilled labor market in Eq. (23) and (24) as follows:

$$\frac{(r+\lambda)\{\Gamma\theta m(\theta) + \lambda\} + (1-\beta)\theta m(\theta)\{\Gamma m(\theta) + \lambda\} - (\Gamma - \theta)(r+\lambda)\beta m(\theta)}{(r+\lambda)\{\Gamma m(\theta) + \lambda\}}\tilde{w}$$

$$= b + (1-\beta)\frac{\theta m(\theta) + (r+\lambda)(1-b)}{r+\lambda} \tag{26}$$

$$+ \beta\left[\frac{(\Gamma - \theta)F\{\lambda + m(\theta)\}}{\Gamma m(\theta) + \lambda} - b - rF + \theta rF\right]$$

$$\tilde{w} = \frac{\Gamma[m(\theta)\tilde{w} + \{\lambda + m(\theta)\}F]}{\Gamma m(\theta) + \lambda} - rF - \frac{r+\lambda}{m(\theta)}\left[-\frac{m(\theta)\tilde{w} + \{\lambda + m(\theta)\}F}{\Gamma m(\theta) + \lambda} + rF\right] \tag{27}$$

I consider a situation where the two countries simultaneously reduces the tariff τ (increasing Γ). The reduction in tariff directly expands the demand for the imported goods and raises the operating profits for the exporting firms. On the other hand, the low-tech firms face a reduction in operating profit. Since an increase in profits for high-tech firms leads an increase in joint profit for high-tech firm and skilled worker, the bargaining wage rate increases. This channel affects both the Wage determination condition and the Job creation condition. I technically show the result in Appendix 1. Figure 2 shows that the two conditions shift to the top. This result means the increase in the bargaining wage $\tilde{w}$.

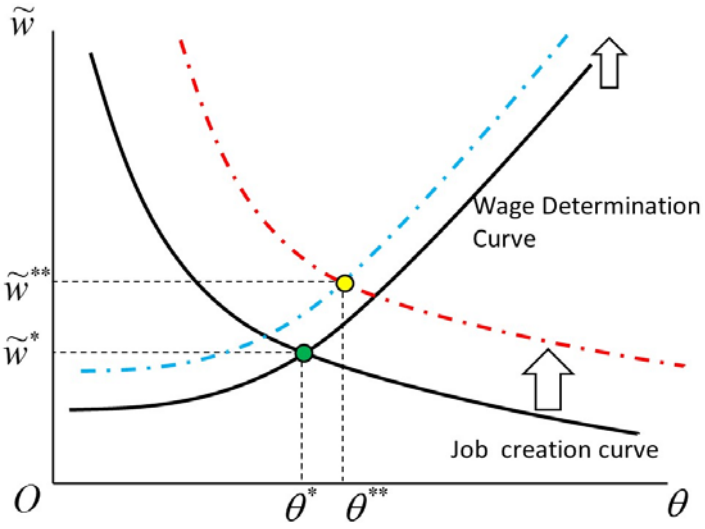

Figure 2: Trade liberalization and the skilled labor market

The effect on the job-offers-to-seekers ratio θ has two channels. Since trade liberalization increases the possibility the higher wages for skilled workers, the skilled worker require a firm to increase its wages. If the firm suggests the same wage as the former wage before reducing the tariff, a skilled worker break the negotiation and chooses to remain an unemployed and search for a firm which suggests with a better wage rate. This channel reflects the shift in the wage determination condition in Eq. (26) and forces the job-offer-to-seekers ratio θ to reduce. However, trade liberalization attracts firms to enter into the export market for higher profit. Since the entry into the skilled labor market increases, the job-offer-to-seekers ratio θ to increase. This channel reflects a shift in the Job creation condition in Eq. (27).

Which of the two channels is largeer is determined by the degree of the shift in the wage determination condition and the job creation condition. Totally differentiating the two condition and evaluating them at $\mathrm{d}\theta = 0$ gives that the Job creation condition shifts upwards more than the wage determination condition. I show the detail proof in Appendix 2. Therefore, trade liberalization increases the job-offer-to-seekers ratio θ.

3.2 Effects on workers' job choice

I consider the effects of trade liberalization on workers' job choice. Although the reduction in τ directly affects the job choice condition in Eq. (25), the condition is changed indirectly thorough a shift in θ and $\tilde{w}$. The Left-Hand-Side (LHS) in Eq. (25) is the value of unemployment. Totally differentiating the LHS gives the following:

$$\mathrm{d}[\mathrm{LHS}] = \frac{(r+b)(\tilde{w}-b)\{\theta m(\theta)\}'}{[r+\lambda+\theta m(\theta)]^2}\mathrm{d}\theta + \frac{\theta m(\theta)}{[r+\lambda+\theta m(\theta)]}\mathrm{d}\tilde{w}$$

When $\tilde{w} > b$, the above equation is positive. If a firm suggests $\tilde{w} < b$ to a skilled worker, the worker breaks the bargaining process and searches for another firm. In equilibrium, the bargaining wage has to be larger than the unemployment insurance: $\tilde{w} > b$. The positive effect reflects that the increase in both the job-offers-to-seekers ratio and bargaining wage raises the chance of a high-paying job and that it is advantageous to remain unemployed. If the Right-Hand-Side in Eq. (25) is constant, the effect on the LHS indicates that globalization increases the number of the unskilled workers.

On the other hand, the Right-Hand-Side (RHS) in Eq. (25) is the value of an unskilled worker. Totally differentiating the RHS gives the following:

$$\begin{aligned}\mathrm{d}[\mathrm{RHS}] = \frac{\lambda b(r+\lambda)\{\theta m(\theta)\}'}{\{\theta m(\theta)+r+\lambda\}^2[\theta m(\theta)+\{\theta m(\theta)+\lambda\}f(l)]^2}[\theta m(\theta)\\ +\{\theta m(\theta)+\lambda\}f(l)+1+f(l)]\mathrm{d}\theta\\ +\frac{rb(r+\lambda)\{\theta m(\theta)+\lambda\}f'(l)}{\{\theta m(\theta)+r+\lambda\}[\theta m(\theta)+\{\theta m(\theta)+\lambda\}f(l)]^2}\mathrm{d}l\end{aligned}$$

where $f(l) \equiv l/(L-l)$. The effect of globalization on the RHS depends on θ and l and the sign of $\mathrm{d}\theta$ is positive. Due to the positive $\mathrm{d}\theta$, the effect of globalization decreases the number of the unskilled workers. Considering the effect on the LHS, globalization induces the ambiguous effects on the workers' job choices. As mentioned in Section 3.1,

trade liberalization raises the possibility of matching and the bargaining wage. These effects increase the value of remaining unemployed and the number of the unemployment increases. On the other hand, globalization also increases the production of differentiated goods and raises the demand for the unskilled workers. This effect raises the value of unskilled workers and decreases the number of unemployment. This model cannot solve the total effects on the unemployment analytically. However, I show the possibility that globalization may increase the number of unemployment. Other literature also shows the result of increase in unemployment. I focus on workers' choices in jobs and derive this result.

4. Conclusion

This article analyzes the effects of globalization on the worker' choice of jobs and employment. I assume that search friction exists only in the skilled labor market and that workers can choose to be skilled or unskilled worker. If a firm succeeds in matching with skilled worker, it can raise the quality of its differentiated goods. Only high-tech firms can export their goods to foreign countries. Trade liberalization among two symmetry countries increases the profit of the export goods, which raises skilled worker's wages and the demand for skilled workers. These effects attract both skilled and unskilled workers. I obtain ambiguous effects of globalization on the workers' choices of job. However, I find a possibility where the globalization promotes the popularization of high education and the unemployment of skilled workers. Moreover, the increase in skilled worker expands the wage inequality between skilled and unskilled workers.

I have two possible directions for future research. The first pertains to the problem of workers' choice of jobs. I assume that each skilled worker has the same ability if he or she pursues a higher education. However, workers possess heterogeneous abilities. In Japan, there has been pointed out that decrease in the quality of workers who pursue the university education. The assumption of heterogeneous workers is important in reflect reality.

Second direction of research would be to consider heterogeneous countries. My model assume symmetric countries, but this assumption does not depict the real world. Since I adopt a search-matching model in this study, it is difficult to consider heterogeneous countries. Although heterogeneous countries could complicate the model , the implication of heterogeneity gives us the new insight into the international trade and labor market literature.

Appendix 1

First, I totally differentiate Eq. (26) and Eq. (27) and have the change in the application ratio to zero ($\mathrm{d}\theta = 0$). Next, arranging it gives the change of the bargaining wage by globalization ($\Gamma \uparrow$):

$$\frac{d\tilde{w}}{d\Gamma}\Big|_{\substack{\text{Wage determination}\\ \mathrm{d}\theta=0}} = \frac{(r+\lambda)[\beta(r+\lambda)m(\theta)\{\theta m(\theta)+\lambda\}\tilde{w}+\beta\{m(\theta)+\lambda\}\{\theta m(\theta)+\lambda\}F]}{[(r+\lambda)\{\Gamma m(\theta)+\lambda\}+(1-\beta)\theta m(\theta)\{\Gamma m(\theta)+\lambda\}-\beta(\Gamma-\theta)(r+\lambda)m(\theta)]\{\Gamma m(\theta)+\lambda\}} > 0 \tag{A.1}$$

$$\frac{\mathrm{d}\tilde{w}}{\mathrm{d}\Gamma}\Big|_{\substack{\text{Job creation}\\ \mathrm{d}\theta=0}} = \frac{m(\theta)\tilde{w}+\{m(\theta)+\lambda\}F}{\Gamma m(\theta)+\lambda} > 0 \tag{A.2}$$

These equations mean that the Wage determination condition and the Job creation condition shift upward by trade liberalization.

Appendix 2

Subtracting the later from the former equation gives

$$\frac{d\tilde{w}}{d\Gamma}\Big|_{\substack{\text{Wage determination}\\ d\theta=0}} - \frac{d\tilde{w}}{d\Gamma}\Big|_{\substack{\text{Job creation}\\ d\theta=0}}$$

$$= \mathbb{C}\times\left\{\begin{bmatrix} -\beta(1-r-\lambda)\theta m(\theta) - \{1-\beta(r+\lambda)\}\lambda(r+\lambda) \\ -(1-\beta)(r+\lambda)\Gamma m(\theta) - (1-\beta)\theta m(\theta)\Gamma m(\theta) - (1-\beta)\lambda\theta m(\theta)\end{bmatrix}\tilde{w}\right.$$

$$\left. - (1-\beta)[\{\Gamma m(\theta)+\lambda\}(r+\lambda) + \{\Gamma\theta m(\theta)+\lambda\}\theta m(\theta)]F\right\}$$

$$< 0$$

where $\mathbb{C}$ is the positive term. From the result, globalization affects the Job creation condition larger than the Wage determination condition. Therefore, I can show that globalization increases the application ratio θ.

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