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Executive Summary

This paper analyzes how TAA for workers plays a role on intra-sectoral redistribution of labor in response to trade liberalization by placing Riordan and Staiger's (1993) TAA model within Melitz's (2003) framework of international trade with heterogeneous monopolistically competitive firms. Due to the existence of asymmetric information of worker quality between firms and workers, high-productivity firms abstain from rehiring workers laid-off from low-productivity firms when the average quality of those workers is relatively low. Hence a job training program of TAA can have an important role in reducing unemployment and income deterioration in low productivity firms, and raise efficiency in high-productivity firms within a sector in response to trade liberalization. In addition, the job training program is more necessary with respect to the process of intra-redistribution of production factors when trade opens at a low level, and also when a sector has comparative advantage, skill-intensive technology and a large portion of low quality labor in the labor market.

Keywords: Trade Adjustment Assistance (TAA), International Trade, Heterogeneous Firms, Monopolistic Competition
JEL Classification: F12, F16, D21

국문요약

무역자유화의 경제적 효과에 대한 고전학파 모형은 비교우위이론을 통해 생산요소의 산업 간 이동의 중요성을 주로 다루는 반면에, Melitz(2003)를 기점으로 하는 최근의 무역이론은 산업 내부에서 이질적 생산성을 가지는 기업 간의 생산요소 이동 또한 중요함을 강조하고 있다. 한편 Riordan and Staiger(1993) 등 무역조정지원제도(TAA: Trade Adjustment Assistance)의 경제적 효율성 근거를 분석하는 연구들은 고전학파의 비교우위이론을 바탕으로 무역자유화 이후 노동의 산업간 이동에서 TAA의 역할에 대해 주로 논하고 있다.

무역자유의 경제적 효과를 극대화하기 위해 서는 노동의 산업간 이동뿐만 아니라 산업내 이동 또한 중요한 요소임에 착안하여, 본 연구에서는 무역자유화 이후 발생하는 노동의 산업 내 재배분(intra-sectoral redistribution of labor) 과정에서 TAA의 효과적 역할에 대해 분석하고자 한다. 이에 따라 본 연구는 국제무역모형에서 독점적 경쟁시장 내 기업의 이질적(heterogeneous) 특성을 다루는 Melitz(2003)의 이론에 대해 Riordan and Staiger(1993)의 TAA 모형을 접목 시켰다.

현실적으로 노동시장 내에서 노동자들의 능력에 대해 기업과 노동자 간 정보의 비대칭성이 존재함에 따라 무역자유화 이후 산업 내 기업 간에도 노동 분배가 원활히 진행되지 않는 문제점이 발생할 수 있다. 이에 대해 본 연구에서는 TAA가 노동시장 내 정보의 비대칭성에 따른 기업의 비용을 줄여주고, 무역자유화 이후 생산성이 낮은 기업에서 퇴출된 노동자들이 생산성이 높은 기업에 더 많이 고용되는 유인을 제공함을 보인다. 또한 퇴출 후 재취업 시 기존 업종 내에서 재취업할 경우의 임금이 다른 업종 전환 시보다 더 높다는 선행연구 결과를 인용하여, 무역자유화 이후 산업내 노동의 재분배에서 TAA의 효과적 운용은 TAA의 사회적 형평성 근거 확보 차원에서도 필요함을 강조한다. 따라서 본 연구는 현재 산업간 재취업에 중점을 두고 있는 미국 TAA 직업훈련 프로그램의 문제점을 지적하고, 산업내 기업간 재취업 훈련 프로그램의 중요성을 강조한다.

핵심용어: 무역조정지원제도, 무역자유화

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저서 및 논문

『최근 WTO 회원국의 TBT 동향과 정책시사점』(공저, 2010)
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Trade Liberalization, Intra-Industry Reallocation of Labor and Trade Adjustment Assistance

Yong Joon Jang*

I. Introduction

Trade adjustment assistance (TAA) for workers is the U.S. governmental program that provides compensation for workers when jobs are lost or wages are reduced due to trade liberalization. The TAA program was created under the Trade Expansion Act of 1962 and defined further under the Trade Act of 1974 to promote liberal trade policies.[1] Workers are eligible for the TAA program if they are negatively impacted by a surge in imports or business restructuring from trade policies. The compensation for TAA participants consists of a variety of benefits and services such as income support payment, a job training program and a job search program.

Figure 1 shows trends in the case number of petitions and certifications over the period 1974-2009. About 68,590 petitions of TAA for workers have been made and 36,116 of the petitions submitted have been certified. Both petitions and certifications for TAA show sudden

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[1] For the political background of the TAA program in the 1960's and the 1970's, see Aho and Bayard (1980).

increases in 1980, 1989, 1999, 2003 and 2009 when there were recessions in the United States. Meanwhile, trends for both petitions and certifications for TAA show that they have increased slightly in the 1980's and 1990's, but rapidly in the 2000's as the U.S. government raised substantially funding and applications for TAA under the Trade Adjustment Assistance Reform Act of 2002 and the Trade Globalization Adjustment Assistance Act of 2009. The main reform involving the TAA program in the 2000's was to reinforce job training and search programs[2] to obtain higher economic efficiency which are explained in the following paragraph.

There are three main justifications for the TAA program: political efficacy, distributional equity and economic efficiency (Magee 2001). First, most TAA experts conclude that TAA is the best policy tool for internal negotiation to obtain the approval of interest groups (Aho and Bayard 1984; Gray 1995; Bonahan and Flowers 1998; Ehrlich and Hearn 2010). In this respect, compensation for losses due to trade liberalization can be an excellent substitute for protection. Second, TAA can increase distributional equity by aiding the TAA participants with financial support and shortening the period of unemployment for displaced workers (Revenga 1992; Deckor and Corson 1995; Kletzer 2001;x OECD 2005; Vijaya 2010).

Finally, TAA can also increase economic efficiency by addressing labor market failure due to incomplete information and moral hazard (Riordan and Staiger 1993; Feenstra and Lewis 1994; Brander and

[2] Baicker and Rehavi (2004) provide the detailed comparison of the TAA programs in the 1980's, 1990's and 2000's.

Spencer 1994; Fung and Staiger 1994). In other words, TAA can facilitate industry restructuring though redistribution of labor in response to trade liberalization. In this respect, smooth redistribution of labor in an economy is a key factor for maximization of effects of trade liberalization policies. Thus, one important issue in trade liberalization policy is how TAA plays an important role in smooth redistribution of labor to obtain higher economic efficiency in response to trade liberalization.

There are two types of redistribution of labor in response to trade liberalization. First, the neoclassical trade theory shows that production factors would move from comparatively disadvantaged industries to ones with comparative advantages as each country would focus on the latter in an open economy. This is explained by *the inter-sectoral redistribution of labor*. On the other hand, Melitz (2003) shows that high productivity firms would produce more in both domestic and foreign markets, while low productivity firms would produce less or exit the market due to tighter competition with foreign firms as trade attains greater openness. Thus, production factors would move from low to high productivity firms in response to trade liberalization. This is explained by *the intra-sectoral redistribution of labor.*[3]

Consequently, it is important to argue the importance of the role that TAA plays in the intra-sectoral redistribution as well as the inter-sectoral redistribution of labor to maximize the effects of trade liberalization policies in an economy. For the role of TAA on the inter-sectoral redistribution of labor, Riordan and Staiger (1993) show that TAA can

[3] Wacziarg and Wallack (2004) and Levinsohn (1999) provide the evidence of redistribution of labor within a sector in response to trade openness.

reduce unemployment in situations where some workers laid off from a comparative disadvantage sector are not rehired by a comparative advantage sector due to incomplete information in the labor market. Thus, Riordan and Staiger (1993) provide justification for economic efficiency of the TAA based on the inter-sectoral redistribution of factors in terms of the neoclassical trade theory.

Unfortunately, however, no research has ever been conducted to study the role of TAA in the smooth intra-sectoral redistribution of labor in response to trade liberalization. This paper analyzes the importance of TAA for workers in facilitating intra-sectoral redistribution of labor after trade liberalization by placing Riordan and Staiger's (1993) TAA model within Melitz's (2003) framework of international trade with heterogeneous and monopolistically competitive firms. To do this, the paper first shows that there exist types of unemployment where the redistribution of workers from low- to high-productivity firms is in progress within the sector. In the model, two types of unemployment, structural and frictional, occur when there are minimum labor quality for the jobs and imperfect information of worker quality in the labor market within a sector.

The main results show that low levels of trade openness can increase total unemployment, while high levels of openness can lessen it in relative terms in the process of labor redistribution within a sector. In addition, as trade becomes more open, total unemployment increases as well at lower levels of trade openness, while it increases or decreases depending on how many workers a firm in the favored group plans to hire at higher levels of trade openness. In other words, there is

a positive relationship between trade openness and total unemployment at lower levels of trade openness, while this relationship is ambiguous at the higher levels of trade openness.

Third, with respect to different sectoral characteristics, comparatively advantaged and skill intensive industries, along with industries with larger percentages of low-quality labor are more likely to record higher total unemployment in the process of intra-redistribution of labor in response to trade liberalization. Hence this paper concludes that TAA is of greater necessity when an economy opens at low levels, an industry has comparative advantage, skill-intensive technology and large portion of low-quality labor in the process of intra-redistribution of labor. In addition, job training via TAA is preferable to other programs such as subsidy and tax reduction.

The rest of the paper is organized as follows. In Section 2, I have set up a basic model with heterogeneous worker quality and firm productivity in monopolistic competition. In Section 3, I analyze the effects of lower trade costs on unemployment and inefficiency under asymmetric information of worker quality between firms and workers. In Section 4, I argue the need for the TAA program on the process of intra-redistribution of production factors in response to trade liberalization. Section 5 concludes.

Ⅱ. Model Setup

1. Basic Assumptions

The feature of the basic setup is similar to Melitz (2003) and Helpman, Itskhoki and Redding (2010). Following Helpman *et al*. (2010), let us consider that 1) there are two countries, domestic and foreign, where both are symmetric in every respect, 2) Each country is populated by homogeneous consumers and heterogeneous firms, 3) There are two factors of production, labor and a firm's innate productivity,[4] 4) Labor consists of two factors, the number of workers hired and the quality of these workers, 5) Both a firm's innate productivity and a worker's quality are drawn from the Pareto distribution exogenously, 6) There is a minimum worker quality which is required for being hired by a firm.

Following Riordan and Staiger (1993), I have supposed that there are two periods of time. In the first period, 1) the distribution of workers quality is identical for all firms and a worker's quality is exogenous, 2) A firm cannot observe individual worker quality but knows whether his or her quality is above the minimum quality after employing, 3) Given the same distribution of worker quality, a firm enters the market,

[4] Total Factor Productivity (TFP) accounts for effects in total output not caused by the input, which is labor in the model.

finds out its exogenous productivity and decides whether to exit or produce only in the domestic market or in both the domestic and foreign markets.

In the second period, 1) trade liberalization occurs, 2) Low productivity firms might keep operating by controlling minimum requirement for its worker quality as they confront with the exit of their business in response to trade liberalization. Thus a worker's quality becomes a choice variable for low productive firms, 3) Low productivity firms increases their workers minimum quality until their profits revives to the original level in the first period, 4) On the other hand, high productive firms still keep the original level of worker quality and might hire more workers laid-off from low productive firms to assign them to the increase in production, 5) High productivity firms have no information about individual worker quality in other firms but can observe the average quality of the pool of workers laid-off, 6) Based on comparison between the minimum requirement for its worker quality and the average quality of the pool of workers laid-off, high productivity firms would decide whether to hire.

2. Demand

A representative consumer has income I and the constant elasticity of substitution (CES) preferences over a set of differentiated goods indexed by $x \in X$, where X is a set of all available goods. Consumer optimization problem is therefore defined as

$$\max_{q} U = \left(\int_{x \in X} q(x)^{\beta} dx \right)^{1/\beta}, \qquad 0 < \beta < 1,$$

$$\text{s.t.} \int_{x \in X} p(x) q(x)\, dx = I,$$

where $q(x)$ denotes consumption of variety x, $p(x)$ is the price of x, and β is the elasticity of substitution between varieties. As β is higher, differentiation among goods decreases.

Inverse demand function which is derived from the consumer maximization problem is

$$p(x) = I^{1-\beta} P^{\beta} q(x)^{-(1-\beta)}, \tag{1}$$

where P is the aggregate price index, which is the indirect utility of the CES preference, i.e.,

$$P = \left(\int_{x \in X} p(x)^{1-\sigma} \right)^{\frac{1}{1-\sigma}} \tag{2}$$

3. Production

In the product market there is a monopolistically competitive market consisting of M firms where each firm produces a different good x and output of each variety is given by

$$q = \theta \bar{a} h, \tag{3}$$

where $\theta \geq 1$ is the firm's heterogeneous productivity, h is the measure of workers hired, and $\bar{a}$ is the average ability of these workers. $\bar{a}$

implies that there are human capital spillovers in the labor supply.[5] The key feature of (3) is that the only factors of production are the number of workers hired, the quality of these workers and a firm's innate productivity.

Assuming wages are normalized to unity, the total cost for each firm in the domestic market is given by

$$TC_d = f_d + \frac{1}{\theta \bar{a}} q_d, \tag{4}$$

where subscript d denotes the domestic market, $f_d > 0$ is the fixed cost of production in the domestic market, which is identical for all firms, and q_d is domestic sales. Then the firm's profit maximization problem is

$$\max_p \pi_d = p_d q_d - \frac{1}{\theta \bar{a}} q_d - f_d,$$

From the inverse demand function in (1) and the profit maximization problem, the equilibrium price in the domestic market is

$$p_d = \frac{1}{\beta \bar{a} \theta} \tag{5}$$

Hence the equilibrium price in the domestic market is decreasing function of three exogenous variables, the elasticity of substitution between varieties, the average ability of hired workers and a firm's innate productivity.

[5] Helpman, Itskhoki and Redding (2010) state it as complementarities in worker ability, implying that one worker's productivity is increasing relative to others in the firm. Please see Bauer and Vorell (2010) for the empirical evidence of human capital spillovers within a firm.

Similarly, the profit function in the foreign market is defined as

$$\pi_x = p_x q_x - \frac{\tau}{\theta a} q_x - f_x,$$

where subscript x denotes the foreign market, p_x, q_x and f_x are price, quantity and fixed cost for exporting, respectively.[6] $\tau > 1$ is a per-unit iceberg cost for exporting such as tariffs, transportation costs and etc. Then the equilibrium price in the foreign market is

$$p_x = \frac{\tau}{\beta \bar{a} \theta} \tag{6}$$

Also note that the equilibrium price in the foreign market is decreasing function of three exogenous variables, the elasticity of substitution between varieties, the average ability of hired workers and a firm's innate productivity, but increasing function of a per-unit iceberg cost for exporting.

Applying (1), (5) and (6) in two profit functions for the domestic and foreign markets, the equilibrium profit functions are, respectively,

$$\pi_d = I(1-\beta)(P\beta\bar{a}\theta)^{\sigma-1} - f_d, \tag{7}$$

$$\pi_x = I(1-\beta)\left(\frac{P\beta\bar{a}\theta}{\tau}\right)^{\sigma-1} - f_x, \tag{8}$$

where $\sigma = \frac{1}{1-\beta} > 1$.

[6] As f_x includes the cost of investigating preferences, legal system and distribution networks in the foreign market, the entry fixed cost in the foreign market is greater than that in the domestic market, i.e., $f_x > f_d$. f_x is also identical for all firms.

4. Cutoff Levels of Productivity and Worker Quality

By assumption there are two periods of time. In the first period a firm enters the market and finds out its productivity θ which is identically and independently distributed and drawn from a Pareto distribution with the cumulative distribution function, $F(\theta) = 1 - \frac{1}{\theta^k}$ for $\theta \geq 1$ and $k > 1$. k is the Pareto index which represents the measure of productivity dispersion. After observing its productivity, a firm will decide whether to exit the market or serve only the domestic market, or both the domestic and foreign markets. Once a firm begins operations, it should pay the fixed cost for the market, f_d or both f_d and f_x.

To express this phenomenon with (7) and (8), consider that there exist cutoff levels of productivity, $\bar{\theta}_d$ and $\bar{\theta}_x$, such that $\pi_d(\bar{\theta}_d) = 0$ and $\pi_x(\bar{\theta}_x) = 0$ for the domestic market and the foreign market, respectively. Then two cutoff levels of productivity are

$$\bar{\theta}_d = \left(\frac{f_d}{I(1-\beta)}\right)^{1/(\sigma-1)} \frac{1}{P\beta\bar{a}}\ , \tag{9}$$

$$\bar{\theta}_x = \left(\frac{f_x}{I(1-\beta)}\right)^{1/(\sigma-1)} \frac{\tau}{P\beta\bar{a}} \tag{10}$$

After entering the market a firm with productivity $\theta < \bar{\theta}_d$ will decide not to produce while a firm with $\theta \geq \bar{\theta}_d$ will operate, given the elasticity of substitution between varieties(β and σ), the average ability of hired worker($\bar{a}$), income(I), the aggregate price index(P) and the fixed cost of production in the domestic market(f_d). Similarly, a firm with productivity $\bar{\theta}_d \leq \theta < \bar{\theta}_x$ will serve only the domestic market while a firm with $\theta \geq \bar{\theta}_x$ will serve both the domestic and the foreign

markets,[7] given the elasticity of substitution between varieties(β and σ), the average ability of hired worker($\bar{a}$), income(I), the aggregate price index(P), a per-unit iceberg cost for exporting(τ) and two fixed costs of production(f_d and f_x).

With a Pareto distribution of productivity the aggregate price index in(2) can be rewritten as follows:

$$P^{1-\sigma} = M\left(\int_{\theta_d}^{\infty} p_d^{1-\sigma} dF(\theta) + \int_{\theta_x}^{\infty} p_x^{1-\sigma} dF(\theta)\right)$$

$$= \left(\frac{k-(\sigma-1)}{Mk(\beta\bar{a})^{\sigma-1}\left(\bar{\theta}_d^{-(k-(\sigma-1))} + \frac{1}{\tau^{\sigma-1}}\bar{\theta}_x^{-(k-(\sigma-1))}\right)}\right)^{\frac{1}{\sigma-1}} \tag{11}$$

From (9), (10) and (11), we get the equilibrium price index and two equilibrium cutoff levels of productivity which depend on the exogenous variables:

$$P = \left(\frac{k-(\sigma-1)}{Mk(\beta\bar{a})^{\sigma-1}\left(f_d^{-\xi_1} + \tau^{-k} f_x^{-\xi_1}\right)}\left(\frac{I}{\sigma}\right)^{\xi_1}\right)^{\frac{1}{k}}, \tag{12}$$

$$\bar{\theta}_d = \left(\frac{f_d}{I(1-\beta)}\right)^{1/(\sigma-1)} \frac{1}{\beta}\left(\frac{Mk(\beta)^{\sigma-1}\left(f_d^{-\xi_1} + \tau^{-k} f_x^{-\xi_1}\right)}{k-(\sigma-1)}\left(\frac{\sigma}{I}\right)^{\xi_1}\right)^{\frac{1}{k}} (\bar{a})^{-\xi_2}, \tag{13}$$

$$\bar{\theta}_x = \left(\frac{f_x}{I(1-\beta)}\right)^{1/(\sigma-1)} \frac{\tau}{\beta}\left(\frac{Mk(\beta\bar{a})^{\sigma-1}\left(f_d^{-\xi_1} + \tau^{-k} f_x^{-\xi_1}\right)}{k-(\sigma-1)}\left(\frac{\sigma}{I}\right)^{\xi_1}\right)^{\frac{1}{k}} (\bar{a})^{-\xi_2}, \tag{14}$$

where $\xi_1 = \frac{k-(\sigma-1)}{\sigma-1}$ and $\xi_2 = \frac{k-(\sigma-1)}{k}$.

Following Riordan and Staiger(1993) I have supposed that after en-

[7] Note that $\bar{\theta}_x > \bar{\theta}_d$, as $f_x > f_d$ and $\tau > 1$. Then $\frac{\bar{\theta}_x}{\bar{\theta}_d} = \tau\left(\frac{f_x}{f_d}\right)^{1/(\sigma-1)} > 1$ implies $\tau^{\sigma-1} > \frac{f_d}{f_x}$.

tering the market and observing its worker quality, a firm screens out workers with qualities below the cutoff (a_c), assuming that it seriously damages a firm's profit to hire a worker whose quality is lower than a_c. In addition, a is assumed to be given and identical to all firms in the first period.[8] Thus each firm would be willing to retain all workers above a_c in the first period. Laid-off workers in the first period go to the job market, but no hiring will occur there because every firm knows their quality to be below a_c. Laid-off workers in the first period also know that there is no hiring activity in the first period so that they abandon applying for a job in the sector.

The distribution of worker quality (a) is also assumed to be identically and independently drawn from a Pareto distribution with the cumulative distribution function $G(a) = 1 - \frac{1}{a^\gamma}$ for $a \geq 1$ and $\gamma > 1$. γ is the Pareto index which represents the measure of quality dispersion. Note that a firm cannot observe individual worker quality but knows whether his or her quality is above the minimum quality, i.e., a_c in the first period.

$\bar{a}$ can be written as $\bar{a} = \int_{a_c}^{\infty} a\, dH(a) = \frac{\gamma}{\gamma-1} a_c$, implying that the aggregate price index, two cutoff levels of productivity in (12), (13) and (14) can be rewritten as, respectively,[9]

$$P = \left(\frac{k-(\sigma-1)}{Mk\left(\frac{\beta\gamma}{\gamma-1}\right)^{\sigma-1}\left(f_d^{-\xi_1} + \tau^{-k} f_x^{-\xi_1}\right)} \left(\frac{I}{\sigma}\right)^{\xi_1} \frac{1}{a_c^{\sigma-1}} \right)^{\frac{1}{k}}, \tag{15}$$

[8] Thus $\bar{a}$ is the exogenous variable in the first period in (12)-(14).
[9] Also a_c is the exogenous variable in the first period in (15)-(19).

$$\bar{\theta}_d = \left(\frac{f_d}{I(1-\beta)}\right)^{\frac{1}{\sigma-1}} \frac{1}{\beta} \left(\frac{Mk(\beta)^{\sigma-1}\left(f_d^{-\xi_1}+\tau^{-k}f_x^{-\xi_1}\right)}{k-(\sigma-1)} \left(\frac{\sigma}{I}\right)^{\xi_1} \right)^{\frac{1}{k}} \left(\frac{\gamma-1}{\gamma}\right)^{\xi_2} a_c{}^{-\xi_2}, \quad (16)$$

$$\bar{\theta}_x = \left(\frac{f_x}{I(1-\beta)}\right)^{1/(\sigma-1)} \frac{\tau}{\beta} \left(\frac{Mk(\beta)^{\sigma-1}\left(f_d^{-\xi_1}+\tau^{-k}f_x^{-\xi_1}\right)}{k-(\sigma-1)} \left(\frac{\sigma}{I}\right)^{\xi_1} \right)^{\frac{1}{k}} \left(\frac{\gamma-1}{\gamma}\right)^{\xi_2} a_c{}^{-\xi_2} \quad (17)$$

From (7), (8) and (15)-(17), the equilibrium profits for domestic sales and exporting can be rewritten as

$$\pi_d = I(1-\beta) \left(\frac{k-(\sigma-1)}{Mk\left(f_d^{-\xi_1}+\tau^{-k}f_x^{-\xi_1}\right)} \right)^{\frac{\sigma-1}{k}} \left(\frac{I}{\sigma}\right)^{\xi_2} \left(\frac{\beta\gamma}{(\gamma-1)}a_c\right)^{(\sigma-1)\xi_2} \theta^{\sigma-1} - f_d,$$

$$\text{for } \bar{\theta}_d \le \theta < \bar{\theta}_x, \quad (18)$$

$$\pi_x = I(1-\beta) \left(\frac{k-(\sigma-1)}{Mk\left(f_d^{-\xi_1}+\tau^{-k}f_x^{-\xi_1}\right)} \right)^{\frac{\sigma-1}{k}} \left(\frac{I}{\sigma}\right)^{\xi_2} \left(\frac{\beta\gamma}{\tau(\gamma-1)}a_c\right)^{(\sigma-1)\xi_2} \theta^{\sigma-1} - f_x,$$

$$\text{for } \theta \ge \bar{\theta}_x \quad (19)$$

Ⅲ. Effects of Trade Openness on Unemployment: Second Period

1. New Cut-Off Levels of Worker Quality

Trade liberalization occurs in the second period, which is expressed by lower variable trade costs, i.e., τ to τ', where $\tau' < \tau$.[10] In addition, note that some firms might keep operating in response to trade liberalization by controlling minimum requirement for its worker quality.[11] In (16) and (17) the results of comparative statics show $\frac{\partial \bar{\theta}_d}{\partial \tau} < 0$ and $\frac{\partial \bar{\theta}_x}{\partial \tau} > 0$,[12] implying that there are new cutoff levels of productivity, $\bar{\theta}'_d$ and $\bar{\theta}'_x$, for domestic sales and exporting in the second period, respectively, and $\bar{\theta}'_d > \bar{\theta}_d$, while $\bar{\theta}'_x < \bar{\theta}_x$. As a result, firms with productivity $\bar{\theta}'_x \leq \theta < \bar{\theta}_x$ will decide to begin exporting as their profits become greater than zero, i.e., $\pi_x \geq 0$, in response to lower τ.[13] Firms with productivity $\bar{\theta}_x^{'} \leq \theta < \bar{\theta}_x$ are termed the favored group.

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[10] From now on the prime symbol is used to represent a new variable after trade liberalization in the second period.

[11] It is well known that forcing out employees with lower quality is one of the major processes of business restructuring.

[12] These results can be driven from (9), (10) and (15). In (15), it is shown that $0 < \frac{\partial P}{\partial \tau} < 1$. So it is clear to show that $\frac{\partial \bar{\theta}_d}{\partial P} < 0$ in (9). In (10) there are two forces of lower trade cost on $\bar{\theta}_x$, the positive direct effect of τ and the negative indirect effect of τ through P. As the elasticity of P to τ is less than one, the former is greater than the latter. Thus $\frac{\partial \bar{\theta}_x}{\partial \tau} > 0$.

[13] Chaney (2008) terms this phenomenon as the extensive margins of international trade.

On the other hand, some domestic firms might suffer from tougher competition with foreign exporters in the domestic market: the profit of a firm with productivity $\bar{\theta}_d \leq \theta < \bar{\theta}'_d$ becomes less than zero, i.e., $\pi_d < 0$, in response to lower τ. Firms with productivity $\bar{\theta}_d \leq \theta < \bar{\theta}'_d$ are termed an injured group. Trade liberalization forces firms in the injured group to exit the market.

In the second period every firm has prior knowledge of their own individual worker quality during the first period but still has no information about individual worker quality in other firms. By assumption, only firms in the injured group will make decisions for new layoff and hiring decision in order to survive in the market. Thus given θ and other variables in (18), a firm with productivity $\bar{\theta}_d \leq \theta < \bar{\theta}'_d$ will increase a worker's minimum quality to make π_d be greater than or equal to zero.

Let a_I be quality of marginal worker laid off in an injured group, then $a_I > a_c$. Fundamentally, a_I is a function of the difference between $\bar{\theta}_d$ and $\bar{\theta}'_d$, i.e., $a_I = H(\bar{\theta}'_d - \bar{\theta}_d)$. As τ decreases, $(\bar{\theta}'_d - \bar{\theta}_d)$ increases by (16). Thus a_I will increase. To solve the function of $(\bar{\theta}'_d - \bar{\theta}_d)$ explicitly I have assumed that a firm in an injured group increases a_I until its profit revives to the original level in the first period because it is too costly to increase a_I.[14] Note that the profit of a firm with productivity $\bar{\theta}_d$ is zero, i.e., $\pi_d(\bar{\theta}_d, a_c) = 0$, in the first period but

[14] More specifically, as there are business structuring costs, a firm might find the optimal a_I. However, the model does not solve the optimal a_I and has the following assumption to simplify exposition while producing stark results. As a_I is an increasing function of $(\bar{\theta}'_d - \bar{\theta}_d)$ in both methods, the qualitative nature of the results would not change.

becomes less than zero, i.e., $\pi_d'(\bar{\theta}_d, a_c) < 0$, in the second period.[15] Thus there is a_I such that the profit of a firm with productivity $\bar{\theta}_d$ in the second period revives to the original level in the first period. i.e., $\pi_d'(\bar{\theta}_d, a_I) = I(1-\beta)\left(\frac{P'\beta\gamma}{(\gamma-1)}a_I\bar{\theta}_d\right)^{\sigma-1} - f_d = 0$. Then a_I is

$$a_I = \left(\frac{P}{P'}\right)a_c = \left(\frac{f_d^{-\xi_1}+(\tau')^{-k}f_x^{-\xi_1}}{f_d^{-\xi_1}+\tau^{-k}f_x^{-\xi_1}}\right)^{1/k} a_c \tag{20}$$

Note that $\frac{\partial a_I}{\partial P'} < 0, \frac{\partial^2 a_I}{\partial (P')^2} > 0$, $\frac{\partial a_I}{\partial \tau'} < 0$ and $\frac{\partial^2 a_I}{\partial (\tau')^2} > 0$ in (20).

On the other hand, as firms in the favored group begin to export, their total quantity will increase by new export sales, q_x. Note that it is harmful to a firm's profit to hire a worker below a_c. Thus if firms in the advantaged group can observe worker quality in the hiring hall, then they will hire more workers with quality $a_c \le a < a_I$. Under uncertainty of worker quality available in hiring halls, however, a firm would decide whether to hire by comparing the profit without additional hiring with the profits expected from hiring laid-off workers.

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[15] Note that $P' = \left(\frac{k-(\sigma-1)}{Mk\left(\frac{\beta\gamma}{\gamma-1}\right)^{\sigma-1}\left(f_d^{-\xi_1}+\tau'^{-k}f_x^{-\xi_1}\right)}\left(\frac{I}{\sigma}\right)^{\xi_1}\frac{1}{a_c^{\sigma-1}}\right)^{\frac{1}{k}}$. Thus

$$\pi_d'(\bar{\theta}_d, a_c) = I(1-\beta)\left(\frac{P'\beta\gamma}{(\gamma-1)}a_c\bar{\theta}_d\right)^{\sigma-1} - f_d = \left(\frac{f_d^{-\xi_1}+\tau^{-k}f_x^{-\xi_1}}{f_d^{-\xi_1}+\tau'^{-k}f_x^{-\xi_1}}\right)^{\frac{\sigma-1}{k}} f_d - f_d$$
$$< 0 \quad as \frac{f_d^{-\xi_1}+\tau^{-k}f_x^{-\xi_1}}{f_d^{-\xi_1}+\tau'^{-k}f_x^{-\xi_1}} < 1.$$

2. Comparison of Worker Quality Between Groups

Note that firms in the favored group can observe only the average quality of the pool of workers laid-off from the injured group needed for their hiring decision. Following Riordan and Staiger (1993), there is the additional assumption that the expected profit of hiring laid-off workers in the hiring hall is greater than the profit without additional hiring if the average quality of workers in the hiring hall is greater than a_c. Hence there is no hiring activity in the hiring hall if the average quality of workers in the hiring hall is less than a_c.

The average quality of the pool of workers laid off from a disadvantaged group is defined as

$$Z(a_I) = \int_1^{a_I} \frac{a}{H(a_I)} dH(a) = \frac{\gamma}{(\gamma-1)} \frac{(a_I^{\gamma} - a_I)}{(a_I^{\gamma} - 1)} \tag{21}$$

Remark 1.

(i) $Z(a_I)$ is increasing in a_I: $\frac{\partial Z(a_I)}{\partial a_I} > 0$ and $\frac{\partial^2 Z(a_I)}{\partial (a_I)^2} < 0$

(ii) Trade liberalization forces up the average quality of the pool of workers laid off from a disadvantaged group: $\tau \downarrow \rightarrow a_I \uparrow \rightarrow Z(a_I) \uparrow$

(iii) Large proportion of low quality workers in the sector forces down the average quality of the pool of workers laid off from an injured group: $\frac{\partial Z(a_I)}{\partial \gamma} < 0$

From (21) the ratio of the quality of the marginal retained worker in a favored group to the average quality of workers laid off in the injured

group can be written as

$$\Omega = \frac{a_c}{Z(a_I)} = \frac{(\gamma-1)}{\gamma}\frac{(\rho^{1-\gamma}a_c{}^{\gamma}-\rho)}{(\rho^{1-\gamma}a_c{}^{\gamma-1}-1)}, \tag{22}$$

where $\rho = \frac{P'}{P}$.

Remark 2.

(i) Trade liberalization forces down the ratio of the quality of the marginal retained worker in a favored group to the average quality of workers laid off in an injured group: $\frac{\partial \Omega}{\partial \rho} > 0$

(ii) Skill intensive sector forces up the ratio of the quality of the marginal retained worker in a favored group to the average quality of workers laid off in an injured group[16]: $\frac{\partial \Omega}{\partial a_c} > 0$

(iii) Large proportion of lower-quality workers in the sector forces up the ratio of the quality of the marginal retained worker in a favored group to the average quality of workers laid off in an injured group: $\frac{\partial \Omega}{\partial \gamma} > 0$

If $\Omega > 1$, then the quality of the marginal retained worker in a favored group is greater than the average quality of workers laid off in an injured group. By assumption firms in the favored group have no incentive to hire random workers laid off in the injured group so that

[16] It is assumed that skill intensive sectors require a relatively higher minimum worker quality than others.

there is no hiring activity in the hiring hall. On the other hand, if $\Omega \leq 1$, then firms in the favored group have a positive incentive to randomly hire workers laid off in an injured group. In this case, the expected profit of hiring random workers in the hiring hall is greater than the profit with no additional hiring of workers. By considering these phenomena and following Riordan and Staiger(1993), I obtain the following lemma.[17] (The proof of Lemma 1 is presented in the Appendix.)

Lemma 1. There exists a unique $\rho^* \in (0,\ 1)$ such that

$$\Omega(\rho^*) \begin{cases} > 1 & for\ \rho \in (\rho^*, 1] \\ = 1 & for\ \rho = \rho^* \\ < 1 & for\ \rho \in [0,\ \rho^*) \end{cases}$$

The followings are results from Lemma 1. In case of $\rho \in (\rho^*, 1]$, i.e., low levels of trade openness, Ω is greater than one, implying $a_c > Z(a_I)$. In addition, as $a_I > a_c$, $Z(a_I) > Z(a_c)$. Hence I obtain the ordering of worker quality as follows:

$$a_I > a_c > Z(a_I) > Z(a_c)$$

As the quality of the marginal retained worker in a favored group is greater than the average worker quality in the hiring hall, i.e., $a_c > Z(a_I)$, there is no reason for firms in a favored group to hire ran-

[17] This lemma is rhetorically identical to Riordan and Staiger (1993). The difference between Riordan and Staiger (1993) and this paper, however, is that they show inter-sectoral redistribution of workers in response to trade openness, while I consider redistribution of workers within a sector, i.e., intra-sectoral redistribution.

dom workers from the hiring halls of the injured group. Thus the Labor hiring hall becomes inactive.

On the other hand, if there are high levels of trade openness, i.e., $\rho \in (0, \rho^*)$, then $\Omega < 1$. Hence the ordering of worker quality is

$$a_I > Z(a_I) > a_c > Z(a_c)$$

As $Z(a_I) > a_c$, the expected profit from additional hiring workers from the hiring hall is greater than current profits, implying that firms in a favored group have a positive incentive to hire workers laid off from firms in a injured group.

Consequently, higher levels of trade openness are catalysts for higher levels of the average quality of workers laid-off from the injured group. A firm in the favored group becomes active in hiring random workers in the hiring hall in response to higher levels of trade openness.

3. Structural and Frictional Unemployment

There exist two types of unemployment in the model. First, a worker can be unemployed because he or she lacks the minimum skills needed for jobs in the firm. Hence structural unemployment occurs where there is a mismatch between the skills of the unemployed workers and the requirements for the jobs available in the model. Second, as firms have imperfect information of worker quality in the model, they sometimes abstain from hiring new workers in the labor market. Hence frictional unemployment occurs when it takes time for the labor mar-

ket to match the available jobs with those people seeking work.[18]

As every firm assumes that quality of laid-off workers are below a_c in the first period, there exists only structural unemployment in the labor market. Following Riordan and Staiger (1993)[19] structural unemployment can be defined as

$$U_i = 1 - \int_{a_c}^{\infty} \frac{a}{\bar{a}} dH(a),\ i = F\ or\ I \tag{23}$$

As $Z(a_c) = \int_1^{a_c} \frac{a}{H(a_c)} dH(a)$, $H(a_c)Z(a_c) = \int_1^{a_c} a\, dH(a)$, implying $1 - H(a_c)Z(a_c) = 1 - \int_1^{a_c} a\, dH(a) = \int_{a_c}^{\infty} a\, dH(a)$. Thus U_i can be written as

$$U_i = \frac{H(a_c)Z(a_c)}{\bar{a}} = \frac{a_c^{\gamma-1}-1}{a_c^{\gamma}}\ ,\ i = F\ or\ I \tag{24}$$

The equation of unemployment in (24) does not change between the first and the second period for the favored group.

On the other hand, total unemployment of the injured group in the second period consists of both structural and frictional unemployment due to imperfect information on the quality of workers laid-off from an injured group. Let μ be the portion of hired workers from the hiring

[18] Two definitions of structural and frictional unemployment are from Wikipedia, http://www.wikipedia.org.

[19] Riordan and Staiger (1993) define structural unemployment as the situation in which a portion of laid off workers remain unemployed in equilibrium despite the fact that they are of sufficient quality to be productively employed somewhere in the economy. Thus the definition of structural unemployment in Riordan and Staiger (1993) combines the two types of unemployment which this paper considers.

hall of the injured group to a favored group ($0 \leq \mu < 1$). When $\mu > 0$, the optimal μ^* of a firm in the favored group is determined by

$$\max_{\mu} \pi = B(\mu) - C(\mu) \tag{25}$$

where $B(\mu)$ and $C(\mu)$ are the benefits and the costs for hiring workers laid-off from an injured group, respectively. Let $\mu^* = \mu^*(b,\ Z(a_I))$, where b represents a rehiring cost as a search cost, assuming $\frac{\partial \mu^*}{\partial \mathrm{b}} < 0$, and $\frac{\partial \mu^*}{\partial Z(a_I)} > 0$. Then total unemployment of an injured group in the second period is defined as

$$U_I = 1 - \int_{a_I}^{\infty} \frac{a}{\bar{a}} dH(a) - \mu^* \int_{1}^{a_I} \frac{a}{\bar{a}} dH(a) = \left(\frac{H(a_I)Z(a_I)}{\bar{a}} - \frac{\mu^* H(a_I)Z(a_I)}{\bar{a}} \right)$$

$$= (1-\mu^*)\left(\frac{H(a_I)Z(a_I)}{\bar{a}}\right) = (1-\mu^*)\frac{(a_I^{\gamma-1}-1)}{a_I^{\gamma-1}a_c} \tag{26}$$

As there is no trade in the first period, $a_I = a_c$ and $\mu = 0$ in (26), only structural unemployment occurs both in the favored and the injured sector, and their unemployment are identical.

$$U_F = U_I = \frac{a_c^{\gamma-1}-1}{a_c^{\gamma}} \equiv U_1 \tag{27}$$

[20]

In the second period there are two situations depending on levels of trade openness. First, in the case of low levels of openness represented by $\rho \in (\rho^*, 1]$ in the model, I obtain $a_c > Z(a_I)$. Thus there is no hiring activity in the hiring hall, i.e., $\mu = 0$. The unemployment of the in-

[20] Riordan and Staiger (1993) define U_1 as the natural rate of unemployment.

jured group in the second period is

$$U_I^{LOW\ OPEN} = \frac{a_I^{\gamma-1}-1}{a_I^{\gamma}} > U_1 = \frac{a_c^{\gamma-1}-1}{a_c^{\gamma}} \tag{28}$$

There are several implications in (28). First, in the range of $\rho \in (\rho^*, 1]$, trade liberalization increases total unemployment in an injured group as $\frac{\partial a_I}{\partial \rho} < 0$ and $\frac{\partial U_I}{\partial a_I} > 0$. Second, some workers in an injured group are laid-off because their quality is below a_I and not all of them can be rehired by firms in the favored group due to $a_c > Z(a_I)$. Under imperfect information in the hiring hall, firms in the favored group do not employ workers with quality between a_c and a_I even though they display sufficient productive work performance. As a result, the unemployment of workers with $a \in [a_c, a_I]$ is characterized by frictional unemployment as well as structural unemployment.[21] On the other hand, workers with $a \in [0, a_c)$ in the injured group are characterized only by structural unemployment.

Third, there are two policies to render μ greater than zero, given the fact that the government also has no information of worker quality. The first policy is to increase μ directly by lessening a search cost b, given $a_c > Z(a_I)$. On the other hand, if the government policy makes $Z(a_I)$ higher up to $Z(a_I) > a_c$, then a firm in the favored group will start to rehire workers in the hiring hall, given b. The second method

[21] The property of structural unemployment in the injured group comes from lack of quality. In addition, these workers are not rehired by the favored group because of imperfect information, implying that frictional unemployment also occurs.

increases μ indirectly. Total unemployment in an injured group will decrease by both ways in (26).

In the case of high levels of openness represented by $\rho \in (0, \rho^*)$ in the model, we obtain $Z(a_I) > a_c$ and $\mu^* > 0$. Then total unemployment of an injured group in the second period is

$$U_I^{HIGH\ OPEN} = (1-\mu^*)\frac{(a_I^{\gamma-1}-1)}{a_I^{\gamma-1}a_c} \tag{29}$$

Note that there are two forces affecting total unemployment $U_I^{HIGH\ OPEN}$ in response to trade openness in (29). First, as ρ decreases, a_I increases so that $U_I^{HIGH\ OPEN}$ increases. On the other hand, lower ρ drives up $Z(a_I)$, implying that μ^* increases and U_I^{HIGH} decreases. Hence two opposite forces create mixed effects on total unemployment of an injured group as trade becomes more open. As Riordan and Staiger (1993), it is ambiguous whether a firm in the favored group rehires more workers laid-off from the injured group as trade opens more at high levels of openness. Instead, other sectoral characteristics would affect a firm's decision on rehiring as trade opens more at high levels of openness.

As before, a certain portion of total unemployment in an injured group is both structural and frictional due to $a_I > a_c$, even if it is lower than in the case of low levels of openness, i.e., $U_I^{HIGH\ OPEN} < U_I^{LOW\ OPEN}$. In addition, two policies for decreasing total unemployment are the same as before.

I summarize these results in the following proposition.

Proposition 1.

(a) Low levels of trade openness can increase total unemployment, while high levels of openness can lessen it in relative terms during the process of labor redistribution within a sector.

(b) As trade becomes more open, total unemployment increases as well at low levels of trade openness, while it increases or decreases depending on how many workers a firm in the favored group plans to hire at high levels of trade openness

(c) Total unemployment of an injured group in the second period at low levels of openness is greater than that at high levels of openness.

(d) At any level of trade openness there will always be frictional employment present due to incomplete information.

Ⅳ. Role of TAA in the Process of Intra-redistribution of Production Factors

1. The Need for a TAA Job Training Program Within a Sector

As mentioned above, two policies are available for reducing total unemployment of an injured group in the second period of the model with incomplete information in the labor market. First, the government policy might encourage firms in the favored group to rehire a worker by conferring a benefit on them or reducing b directly.[22] However, the policy of simply reducing b actually raises inefficiency because the possibility that firms in the favored group will rehire less productive workers when $a < a_c$ would increase. Especially, the inefficiency resulting from reducing b is relatively higher at low levels of openness, which render $a_c > Z(a_I)$.

Note that there is incomplete information in the labor market. Hence if a firm in the favored group rehires more workers in the hiring hall, inefficient employment will increase because the possibility that quality of workers rehired from the hiring hall is below a_c will increase. Hence it would be more efficient to increase $Z(a_I)$ than to reduce b directly because the former reduces both total unemployment in an injured group (greater μ^*) and inefficiency in the favored group simultaneously.

[22] Two types of policy instruments can be considered: a subsidy and a tax reduction for rehiring.

This is the reason why the TAA program should focus on job training for intra-sectoral redistribution as well as for inter-sectoral redistribution of labor to workers laid-off from an injured group. The current job training program in TAA focuses more on change of occupations in a different industrial classification (Deckor and Corson 1995). Industrial restructuring can be obtained through both the intra-and the inter-redistribution of production factors and job training programs for both redistribution processes contribute significantly to reducing total unemployment and raise efficiency in an economy simultaneously.

2. Sectoral Characteristics

Up to this point, this paper analyzed how the level of trade openness affects incentives of more productive firms to rehire workers laid-off from less productive firms within a sector and which government policy is more conducive to labor market efficiency accordingly. In this section I analyze how sectoral characteristics affect the ordering between a_c and $Z(a_I)$ and firm's incentive for rehiring, given trade openness. The results will provide policy implications for the TAA program with job training for intra-sectoral redistribution of labor.

There are four sectoral variables which I can consider in (22): (i) how much does worker quality increase in response to trade liberalization, i.e., the level of a_I, (ii) the extent of a sector's need for original worker quality, i.e., the level of a_c, and (iii) the proportion of low quality workers in the labor market, i.e., the level of γ.

First, Bernard, Redding and Schott (2007) show that trade liberaliza-

tion forces domestic firms into tougher competition with foreign exporters in comparatively disadvantaged industries. Hence comparatively disadvantaged industries would experience net job destruction: job loss due to exit of less productive firms is greater than job creation due to growth or entry of more productive firms. This phenomenon is represented by relatively higher $\bar{\theta}_d'$ in comparatively disadvantaged industries in the model. As a_I is an increasing function of $\bar{\theta}_d'$, worker quality required in the disadvantaged group will be higher in comparatively disadvantaged industries. Thus $Z(a_I)$ is higher and a firm in the favored group has relatively more incentive to rehire workers laid-off from the disadvantaged group in comparatively disadvantaged industries.

On the other hand, $\bar{\theta}_d'$ is relatively lower in comparatively advantaged industries, implying that a_I is relatively lower and $Z(a_I)$ is less likely to be higher than a_c. Hence a firm in the favored group has less incentive to rehire laid-off workers in comparatively advantaged industries.[23] These results imply that it is more necessary to have the TAA program with job training for intra-sectoral redistribution of workers in comparatively advantaged industries than in comparatively disadvantaged industries in order to reduce both total unemployment in the injured group and inefficiency in the favored group.

Second, a high-skill intensive industry might require higher basic worker quality, i.e., higher a_c in the model. In (22), higher a_c raises

[23] Since comparatively advantaged industries have relatively smaller trade shocks than comparatively disadvantaged industries, these results are consistent with those cases involving levels of trade openness.

Ω (see (ii) of Remark 2). Thus a firm in the favored group is less likely to rehire workers laid-off from the injured group in response to trade liberalization. Similarly, every firm requires relatively lower basic worker quality in a low-skill intensive industry. Hence a firm in the favored group has more incentive to rehire laid-off workers from the low-skill intensive industry in response to trade liberalization. These results imply that a TAA program with job training for intra-sectoral redistribution of workers is more suited to high-skill intensive industries.

Finally, if there are large numbers of low-quality workers in the labor market (high γ), the average worker quality in the hiring hall will decrease (see two (iii)s of Remark 1). In this case, Ω is relatively higher and a firm in the favored group is less likely to rehire laid-off workers from an industry with large proportion of low-quality workers in the labor market. Hence it is more necessary to consider the TAA program with job training for intra-sectoral redistribution of workers if there are more low-quality workers or workers with low educational levels.

I summarize these results in the following proposition.

Proposition 2.

(a) Comparatively disadvantaged industry: $a_I \uparrow \leftrightarrow Z(a_I) \uparrow \leftrightarrow \Omega \downarrow \leftrightarrow \mu > 0$

(b) Skill intensive industry: $\frac{\partial \Omega}{\partial a_c} > 0 \leftrightarrow (a_c \uparrow > Z(a_I) \uparrow) \leftrightarrow \Omega \uparrow \leftrightarrow \mu \to 0$

(c) Low-quality labor: $\frac{\partial \Omega}{\partial \gamma} > 0 \leftrightarrow Z(a_I) \downarrow \leftrightarrow \Omega \uparrow \leftrightarrow \mu \to 0$

V. Conclusion

This paper analyzes the role TAA for workers plays in intra-sectoral redistribution of labor in response to trade liberalization by placing Riordan and Staiger's (1993) TAA model within Melitz's (2003) framework of international trade with heterogeneous, monopolistically competitive firms. The paper first examines how inefficiency and unemployment could occur in the process of intra-redistribution of production factors in response to trade liberalization. As in Melitz (2003), high-productivity firms are more likely to engage in production due to greater opportunities for export, while low-productivity firms are less likely to engage in production or exits the market altogether due to tighter competition with foreign firms when trade becomes more opens. Hence high-productivity firms might hire new workers laid-off from low-productivity firms when those workers are productive enough to increase the expected profit.

However, as there is asymmetric information on worker quality between firms and workers, high-productivity firms abstain from rehiring workers laid-off from low-productivity firms when the average quality of those workers is relatively low. Hence a TAA-associated job training program can have an important role in reducing unemployment in low productive firms and raise efficiency in high productivity firms within a sector in response to trade liberalization.

In addition, there is a greater necessity for a job training program in

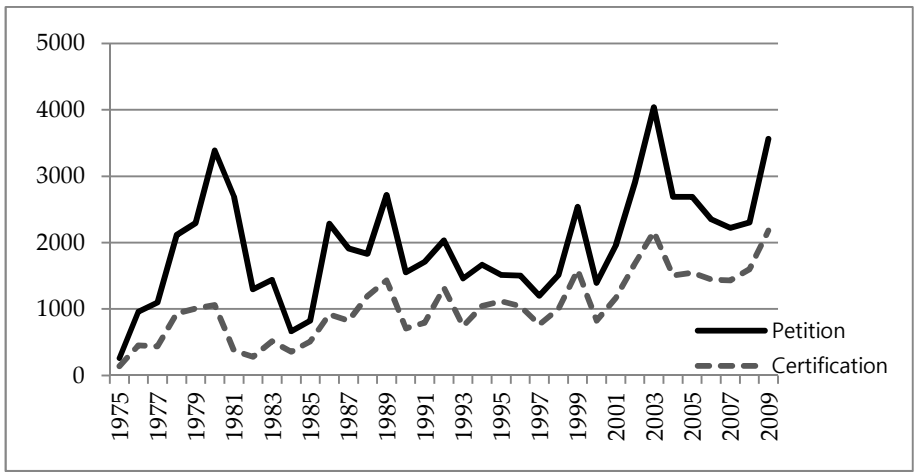
the process of intra-redistribution of production factors when trade opens at low levels, a sector has comparative advantage, has skill-intensive technology and the percentage of low-quality labor in the labor market is large. Especially, as the low level of trade openness usually becomes the high level gradually, the effect of TAA on unemployment would be more prominent in the short run.[24]

The TAA program in the process of intra-redistribution of production factors can improve distributional equity as well as economic efficiency. Jacobson (1991), Marcal (2001), Reynolds and Palatucci (2008) stated that there is little evidence that TAA is successful in preserving laid-off workers' income as new wage of the TAA participants in the new job is much lower than that in their previous jobs. The reason for this is that the current job training program in TAA encourages laid-off workers to move to a different industrial classification, especially the service sectors (Deckor and Corson 1995). Kletzer (2001) argues that income reduction can be minimized if laid-off workers could be rehired in the same category of business as their previous job. Hence if the job training program in TAA focuses on the intra-redistribution rather than the inter-redistribution of workers, it would contribute to improvement of distributional equity, which is the most important rationale of the TAA.

[24] In addition, Wacziarg and Wallack (2004) show that intra-sectoral redistribution of labor is more dominant than inter-sectoral redistribution of labor in the short run in response to trade liberalization.

Proof of Lemma 1. Note that $\Omega(\rho)$: continuous increasing function of ρ. Suppose that there is no trade liberalization, i.e., $\rho = 1$, then $\Omega(1) = \frac{(\gamma-1)}{\gamma}\frac{({a_c}^{\gamma}-1)}{({a_c}^{\gamma-1}-1)} > 1$ as $\gamma > 1$ & $a_c > 1$. In addition, when $\rho = 1, a_I = a_c$. Hence $\Omega(1) = \frac{a_c}{Z(a_c)}$. As $a_c > Z(a_c)$, $\Omega(1) > 1$. If there is perfect trade liberalization, i.e., $\rho = 0$, then $\Omega(0) = \frac{(\gamma-1)}{\gamma}\frac{(\rho^{1-\gamma}{a_c}^{\gamma}-\rho)}{(\rho^{1-\gamma}{a_c}^{\gamma-1}-1)}$. Note that $\lim_{\rho\to 0}\frac{(\gamma-1)}{\gamma}\frac{(\rho^{1-\gamma}{a_c}^{\gamma}-\rho)}{(\rho^{1-\gamma}{a_c}^{\gamma-1}-1)} = 0$. As a result, I obtain $\Omega(1) > 1$ and $\Omega(0) = 0$.

Figure 1. Case Number of Petitions and Certifications for TAA Over the Period 1974-2009



Data source: The U.S. Department of Labor.

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Yong Joon Jang

This paper analyzes how TAA for workers plays a role on intra-sectoral redistribution of labor in response to trade liberalization by placing Riordan and Staiger's (1993) TAA model within Melitz's (2003) framework of international trade with heterogeneous monopolistically competitive firms. Due to the existence of asymmetric information of worker quality between firms and workers, high-productivity firms abstain from rehiring workers laid-off from low-productivity firms when the average quality of those workers is relatively low. Hence a job training program of TAA can have an important role in reducing unemployment and income deterioration in low productivity firms, and raise efficiency in high-productivity firms within a sector in response to trade liberalization. In addition, the job training program is more necessary with respect to the process of intra-redistribution of production factors when trade opens at a low level, and also when a sector has comparative advantage, skill-intensive technology and a large portion of low quality labor in the labor market.

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