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A Model of Temporary and Permanent Jobs and Trade

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December 2016

Abstract

This paper proposes a monopolistic competition model in which firms facing demand uncertainty use both permanent and temporary workers to evade the labor adjustment costs associated with permanent workers, and explores links between the demand for temporary and permanent workers and economic globalization. The model highlights intensified product market competition as a driving force behind the shift in demand from permanent to temporary workers. In addition, our model shows that international outsourcing effectively reduces labor adjustment costs, which decreases the demand for permanent workers. We empirically test these links using industry-level data from the Japanese manufacturing sector. We find a positive correlation between foreign outsourcing and the replacement of permanent workers with temporary workers in domestic production. Additionally, we find that industries losing their global share of value-added tend to decrease their employment of permanent workers and increase the proportions of temporary workers.

Keywords: temporary workers, permanent workers, outsourcing, international trade, monopolistic competition

JEL classification: F16, F66, J23

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1 Introduction

In recent years, there has been a rapid increase in the number of temporary workers in the Japanese manufacturing sector. During 2001–2006, the total manufacturing workforce decreased by 0.6 million, with 1 million permanent workers lost and 0.4 million temporary positions created: thus, about 40% of permanent work has been replaced with temporary work.[1] This trend of a substantial shift from permanent workers to temporary workers has already resulted in a broad range of debates on employment stability, income inequality, and human capital accumulation in the Japanese political arena, and the relaxing of regulations on temporary workers in the 2000s has been postulated as an important reason for the rise of temporary workers in Japan.[2]

Nevertheless, economic globalization, such as trade and foreign outsourcing, may also play a role in the rapid increase in temporary work by downplaying national borders and thereby encouraging firms to reconsider labor contracts with their employees. In particular, in countries with strong labor protections and rigid labor markets, such as European countries and Japan, as a result of facing intensified international competition, firms might have experienced more pressure from substantial labor adjustment costs. As anecdotal evidence, Keidanren (Japan Business Federation), Japan's largest lobbying group, claimed that labor market flexibility and more aggressive use of temporary workers were vital because of increasing market uncertainty and sales volatility caused by incrementally tougher global competition.[3]

This paper investigates whether international trade encourages manufacturers to be more aggressive in their employment of temporary workers rather than permanent workers. It is important to examine the effects of economic globalization on labor contracts, because a firm's choice of labor contracts potentially influences workers' welfare through their rewards and job security, yet the choice has rarely been investigated as a source of the distributional effects of trade. The motivation of this paper is best described in Figure 1, which presents the ratios of temporary workers to total employment in Japanese manufacturing firms. In 1999, the ratio of temporary workers tends to decline as the size of establishments increases.

[1] These figures are the authors' calculation using the Census of Establishment and Firms.

[2] The Worker Dispatching Act, enacted in 2004, allowed the manufacturing sector to use temporary workers dispatched from private agencies. This deregulation might be responsible for manufacturers' more aggressive use of temporary workers.

[3] Their report (in Japanese) is available at http://www.keidanren.or.jp/japanese/policy/2004/041/index.html as of October 2015.

However, this pattern is less clear in 2006, implying that larger establishments increased their numbers of temporary workers more aggressively. The recent heterogeneous firm trade literature has established that firms engaged in international activities, such as exporting, are superior to non-internationalized firms in many respects, including size and productivity. Thus, the pattern observed in Figure 1 leads to the conjecture that the internationalization of firms may raise firms' relative demand for temporary workers.

To examine the validity of this conjecture, we extend the monopolistic competition model developed by Ottaviano, Tabuchi, and Thisse (2002) by incorporating the dual-labor market structure proposed by Saint-Paul (1996), who studied the coexistence of workers with long-term contracts associated with firing costs (permanent workers) and those with short fixed-duration contracts (temporary workers) within the same firm. Endogenous elasticities of substitution enable us to examine the effects of product market competition on firms' optimal choice of the employment of permanent and temporary workers. Indeed, the endogenous feature of elasticities of substitution proves crucial for reproducing the size-decreasing trend of the relative demand for temporary and permanent workers in Figure 1. The key mechanism is as follows. When there are firm-specific output fluctuations due to taste shocks, firms may employ both permanent and temporary workers to reduce the labor adjustment costs, even though temporary workers are less productive than permanent workers. In such a framework, intensified product market competition makes the product demand more elastic and magnifies the impact of output fluctuations caused by firm-specific demand shocks on firms' labor demand. As a result, firms increase their demand for temporary workers relative to permanent workers. Thus, our model elucidates the linkage between product market competition and the relative demand for temporary and permanent workers. Furthermore, because the product demand for productive firms is always less elastic than for unproductive firms, productive firms have a lower demand for temporary workers.

Placing our model in a two-country open economy with trade costs leads to more nuanced predictions on firms' demands for temporary and permanent workers, but product market competition continues to play a key role. If trade openness occurs in the form of mutual trade cost reductions between the two countries, intensified product market competition will raise the relative demand for temporary workers for all firms. However, for exporting firms, the productivity gain due to the trade cost reduction will reduce the demand for temporary workers by making export demand less elastic. Thus, whereas the total effect for exporting firms is unclear, non-exporting firms will always increase their relative demand for temporary workers.

In contrast, if trade openness occurs in the form of an foreign market expansion (e.g., emerging economies join international market competition), only exporting firms will increase their demand for temporary workers relative to permanent workers. Non-exporting firms will not change the relative demand for temporary workers because the exit of the least productive firms cancels the effect of increasing import competition in the domestic market. Thus, our model predicts that this form of trade openness encourages exporting (and larger) firms to increase their relative demand for temporary workers while not changing that of non-exporting (and smaller) firms, which is largely consistent with the pattern observed in Figure 1.

We also examine the effects of foreign outsourcing—replacing home production with imported intermediate goods.[4] Our model highlights the market competition effect of outsourcing: outsourcing reduces firms' production costs and increases the profitability, which invites new entrant firms to enter the product market which consequently becomes more competitive. Thus, outsourcing also has an upward effect on the relative demand for temporary workers.

Interestingly, the model identifies two additional effects of outsourcing on the demand for temporary and permanent workers. It is well known that the effect of outsourcing on a firm's total employment is in general ambiguous because labor in outsourced tasks is replaced by imported intermediate goods (job relocation by substitution) while the cost reduction by outsourcing increases the labor demand for the remaining tasks (job creation by cost reduction).[5] Our model suggests that, whereas the substitution effect of outsourcing is neutral for the firms' relative demand for temporary workers, the cost reduction effect of outsourcing is more powerful for temporary workers than permanent workers. As a result, the cost reduction effect tends to raise the ratio of temporary workers. Another effect is that outsourcing mitigates the employment distortion for permanent workers. Due to the adjustment cost, firms retain too many permanent workers, compared to the level that would be chosen if there were no firing costs. Intuitively, outsourcing reduces the labor share in the production cost, which lowers the burden of the labor adjustment cost and,

[4] In this respect, vertical FDI is essentially the same as foreign outsourcing. Thus, the model's predictions about outsourcing are applicable to vertical FDI.

[5] See, for example, Groizard, Ranjan, and Rodriguez-Lopez (2014) for detailed discussions about the various effects of foreign outsourcing on firms' employment.

as a result, firms *decrease* the number of permanent workers engaged in home production. This distortion mitigation effect also increases the relative demand for temporary workers.

We explore the empirical relevance of the model's theoretical predictions. Constructing a panel dataset of Japanese manufacturing sectors from various sources, we find evidence that economic globalization is associated with the shift from permanent to temporary workers. Our main empirical findings are twofold. First, industries losing world share of output tend to increase the ratio of temporary workers. Second, industries more reliant on outsourcing tend to decrease their employment of permanent workers, thereby increasing the ratio of temporary workers. In summary, our empirical findings are largely consistent with the model's predictions.

[Related Literature] Our paper contributes to the literature of labor market flexibility. Saint-Paul (1996) produced an early comprehensive study of the dual labor market in which both permanent and temporary workers coexist. Wasmer (1999) theoretically examined the effects of business cycles on the demand for temporary and permanent workers. However, the analysis in these studies largely remains within the macroeconomic framework, and does not deal with product market competition. A permanent-to-temporary shift in the labor force is not a phenomenon exclusive to Japan, and there is a rich body of literature that contributes to the study of temporary labor markets in Europe. Dolado, Garcia-Serrano, and Jimeno (2002) reviewed the Spanish experience of the aggressive use of temporary employment contracts since the mid-1980s. Blanchard and Landier (2002) found that temporary workers in France who stay in entry-level jobs longer were not likely to obtain permanent jobs. Holmlund and Storrie (2002) observed that adverse Swedish macroeconomic conditions in the 1990s made firms more prone to offer temporary jobs and workers more willing to accept such offers. More recent studies based on the framework proposed by these studies include Costain, Jimeno, and Carlos (2010), Ono, Qinghua, and Jin (2010), and Aguirregabiria and Alonso-Borrego (2014). None of these papers examines the linkage between product market competition and firms' demand for temporary workers. Our study explores how economic globalization could affect firms' demand for temporary and permanent workers, and in particular, theoretically highlights the role of production market competition.

The relationship between trade and employment has been intensively examined in empirical trade research. For example, Slaughter (2001) found that trade-related variables had a mixed effect on increasing labor-demand elasticities. Tomiura (2003) found that import competition intensity reduced employment in recessionary periods when the yen appreciated. In addition, Tomiura (2004) showed that import competition also has a significant effect on job creation and loss through plant startups and shutdowns. Using the assumption that intense import competition causes firms and industries to switch away from implicit contracts, Bertrand (2004) found that the sensitivity of wages to the current unemployment rate should increase when import competition increases. More recently, Autor, Dorn, and Hanson (2013) examined the effects of Chinese import competition on US labor-market outcomes. None of these studies examined the dual labor market.

There is a growing body of studies that consider labor market frictions in open economy settings. Davidson, Matusz, and Shevchenko (2008), Helpman and Itskhoki (2010), and Helpman, Itskhoki, and Redding (2010) are recent studies. Hummels, Jørgensen, Munch, and Xiang (2014) investigated the wage-effect of offshoring, using Danish employer-employee matched data. Lommerud, Meland, and Straume (2009) studied the effects of a unionized labor force and foreign outsourcing. Groizard, Ranjan, and Rodriguez-Lopez (2014) examined various effects of foreign outsourcing on heterogeneous firms' employment. However, none of these consider workers in terms of employment flexibility. Our paper considers the effects of trade openness on the demand for two types of workers, permanent and temporary, that are different in terms of both rewards and job stability.

The rest of this paper is organized as follows. Section 2 proposes a theoretical model in a closed economy setting to highlight the role of product market competition. Section 3 extends the model to open economy settings and examines the impact of globalization on the demand for temporary and permanent workers. Section 4 presents our empirical methodology and Section 5 presents the estimation results. Section 6 concludes.

2 The Base Model

This section proposes a dual labor market model in which permanent and temporary jobs coexist within the same firm, following Saint-Paul (1996, chapters 6 and 7). To examine the effects of market competition on the demand for good and bad jobs, we extend the Saint-Paul model by placing it in a monopolistically competitive environment proposed by Melitz and Ottaviano (2008).

2.1 Demand

Consider an economy populated with L households that consume a homogenous good and differentiated goods. The representative consumer maximizes the following quasi-linear utility function based on Ottaviano, Tabuchi, and Thisse (2002) and Melitz and Ottaviano (2008):

$$U = q_0^c + \alpha \int_0^N q_i^c di - \frac{\zeta}{2} \int_0^N [q_i^c]^2 di - \frac{\eta}{2} \left[\int_0^N q_i^c di \right]^2 , \tag{1}$$

where q_0^c and q_i^c denote individual consumption of the homogeneous good and each variety i of the differentiated goods, respectively. N is a measure of the consumed varieties of differentiated goods. Parameters α, ζ, and η are nonnegative. Parameters α and η denote a consumer's maximum willingness-to-pay for the differentiated goods: increases in α and decreases in η shift demand from the homogeneous good to the differentiated goods. Parameter ζ indexes the degree of product differentiation between the varieties: when $\zeta = 0$, the varieties are perfect substitutes.

We introduce demand uncertainty for the differentiated goods. It is assumed that parameter α is composed of a constant part ($\bar{\alpha}$) and a stochastic part (α_s) so that $\alpha = \bar{\alpha} + \alpha_s$. While $\bar{\alpha}$ is common across all varieties of the differentiated goods, α_s is independent and identically distributed (i.i.d.) across varieties. Specifically, α_s follows a two-state Markov process in which each variety is either in the high state ($\alpha_H > 0$) or the low state ($\alpha_L < 0$), and the probability of transition from α_L to α_H is given by β and that of the reverse transition is given by γ. For simplicity, we impose the parameter restriction that $\beta\alpha_H + \gamma\alpha_L = 0$ to ensure that the mean value of α across varieties is $\bar{\alpha}$.[6]

As usual, the utility maximization for (1) generates the demand for each variety i for the individual consumer as follows:

$$q_i^c = \frac{1}{\zeta} \left[\alpha - \eta Q^c - p_i \right] , \tag{2}$$

where $Q^c = \int_0^N q_i^c di$. By summing equation (2) over all varieties, we obtain the expression for Q^c. Note that Q^c is not stochastic due to the parameter restriction on α_s for $s = \{H, L\}$ and the transition probabilities. Substituting the expression for Q^c into equation (2) and

[6] We are implicitly considering a continuous time model in which infinitely long-lived households optimize their consumption flows over a time horizon. Thus, equation (1) should be regarded as the instantaneous utility function. However, our specification of utility function is quasi-linear, and, thus, all income effects are absorbed by the consumption of the homogenous good, which allows us to disregard the dynamic optimization of consumption flows.

the summing over all households, we obtain the (inverse) market demand for variety i such that

$$p_i = \frac{\eta N\bar{p} + \bar{\alpha}\zeta}{\eta N + \zeta} + \alpha_s - \frac{\zeta}{L}q_i, \quad s = \{H, L\}, \tag{3}$$

where $\bar{p} = (1/N)\int_0^N p_i di$ represents the average price of the differentiated goods. The linear demand in equation (3) indicates that the upper boundary price, beyond which demand for variety i goes to zero, has two states depending on the realization of α_j with mean value $\bar{z} \equiv (\eta N\bar{p} + \bar{\alpha}\zeta)/(\eta N + \zeta)$.

For notational brevity, we will hereafter drop the subscript i and express the inverse demand function in (3) by

$$p = z_s - \frac{b}{2}q, \quad s = \{H, L\}, \tag{4}$$

where $b \equiv 2\zeta/L$ and $z_s \equiv \bar{z} + \alpha_s$. The price elasticity of demand in state s is given by $\epsilon_s = |(\partial q/\partial p)(p/q)| = [(\bar{z} + \alpha_s)/p - 1]^{-1}$. An increase in the number of competing varieties N or a reduction in average prices $\bar{p}$ lowers $\bar{z}$, leading to an increase in ϵ_s for any given price p, that is, a "tougher" competitive environment.

2.2 Production

Each household inelastically supplies one unit of labor that is a single production input in our model. Workers are freely mobile between the homogenous good and differentiated goods sectors. The homogenous good is perfectly competitive and serves as the numeraire good in the model. Assuming that the households possess sufficient income to consume the homogenous goods, the competitive wage rate is determined by labor productivity in the homogenous goods.

As for the production of differentiated goods, we assume that each firm may have different productivities and produces its own variety of differentiated goods. Each variety of the differentiated goods is produced by a linear production technology such that $y = l/\varphi$ where l represents labor input in units of temporary workers and φ represents the unit labor requirement (productivity). Following Melitz (2003) and Melitz and Ottaviano (2008), the unit labor requirement is time-invariant and randomly assigned from a commonly known distribution $G(\varphi)$ with support on $[0, \varphi_m]$ upon market entry. When drawing sufficiently low productivities (high unit labor requirements), firms will immediately exit from the market. Otherwise, firms stay in the market and generate revenues of $z_s l/\varphi - b(l/\varphi)^2/2$. Because φ

is firm-specific and each firm specializes in its own variety of differentiated goods, we will hereafter use φ as an index of firms and differentiated goods.

It is assumed that there are two types of labor contract—long-term and fixed-duration contracts—in the differentiated good sector. Long-term contracts do not specify any predetermined duration so we will refer to these workers as "permanent workers." Although long-term contracts are open-ended, firms can terminate those at any time period by paying a linear firing cost δ measured in units of the homogenous good. In contrast, firms can freely create and destroy fixed-duration contracts at any time. Workers employed on these contracts will be referred to as "temporary workers."

We assume that although workers are perfectly substitutable for each other regardless of their contract type, permanent workers are $\lambda > 1$ times more productive than temporary workers. When a firm employs l_1 units of permanent workers and l_2 units of temporary workers, its labor input is given by $l = \lambda l_1 + l_2$ in units of temporary workers.

The assumption of perfect substitutability between the two types of worker crystalizes a key determinant of firms' demand for temporary workers relative to permanent workers—the degree of product market competition. The productivity superiority of permanent workers over temporary workers can be justified as follows. The employment of permanent workers is less volatile than that of temporary workers. Thus, firms may use this job security as a device to induce workers to expend effort to acquire firm-specific skills, resulting in the efficiency advantage of permanent workers over temporary workers. The tradeoff between the efficiency advantage and the adjustment-cost disadvantage enables permanent and temporary workers to coexist within the same firm.[7]

2.3 Employment Policy

We now characterize firms' employment policies. To begin, we note that when firms use both permanent and temporary workers, the wage for permanent workers, w_1, has to be lower than the effective wage for temporary workers, λw_2. Otherwise, firms will never use permanent workers. Furthermore, λw_2 must be lower than the sum of w_1 and the expected

[7] If temporary jobs are potential "stepping stones" to permanent employment, workers on temporary contracts might be motivated acquire such skills (Engellandt and Riphahn, 2005). However, Booth, Francesconi, and Frank (2002) empirically showed that even though there was some evidence that temporary jobs are stepping stones to permanent jobs, temporary workers still faced lower probabilities of receiving work-related training and tended to be poorly paid even after moving to permanent jobs (especially among male temporary workers). It is also difficult for temporary workers to convert their labor contracts to permanent ones in Japan (Shikata, 2012).

firing cost of a permanent worker, $\gamma\delta$.[8] Otherwise, firms will never use temporary workers.

Given that $w_1 < \lambda w_2 < w_1 + \gamma\delta$ holds, a firm's employment policy is as follows. (i) A firm in the low state uses only permanent workers. This is because no dismissals occur in the low state and permanent workers are less expensive than temporary workers without the firing cost. (ii) When the state switches from the low to the high state, the firm will hire only temporary workers to fill the increasing labor demand. (iii) When the demand switches from the high to the low state, the firm will dismiss all the temporary workers and never dismiss the permanent workers. Although this employment policy is highly stylized, we emphasize that it still captures an important characteristic of temporary workers—a buffer to demand fluctuations.

To support this employment policy, the labor cost condition of $w_1 < \lambda w_2 < w_1 + \gamma\delta$ is necessary. The wage determination is as follows. Assuming flexible labor movement between the homogeneous and differentiated goods sectors, the wage rate for temporary workers is determined to be the competitive wage, which is denoted by w_2. We assume that firms apply efficiency wages à la Shapiro and Stiglitz (1984) to permanent workers to induce productivity supremacy λ. In the Appendix, we show that w_1 is pinned down at the competitive wage w_2 plus a wage premium depending on a set of exogenous parameters and that w_1 is state-independent under the aforementioned employment policy, which provides reasonable grounds for the condition of $w_1 < \lambda w_2 < w_1 + \gamma\delta$. It should be noted that this wage determination not only greatly simplifies the analysis but also highlight the effects of product market competition on the demand for temporary and permanent workers by eliminating the effects of wage changes.

With the firms' employment policy and wages in hand, we may now derive the employment levels of permanent and temporary workers.[9] The expected return from investing in a firm—composed of the instantaneous profits and the expected capital gains from state switching—must equal the return on an equal size investment in a safe asset. Hence, de-

[8] Dismissals occur when the state switches from high to low. Thus, given that firms dismiss permanent workers, the expected firing cost is $\gamma\delta$.

[9] We note that this is not the only employment policy that allows the co-existence of permanent and temporary workers within the same firm. Suppose that $w_1 + \gamma\delta \leq \lambda w_2$ holds in the low state. Then, as Saint-Paul (1996) showed, firms hit by a good shock may increase permanent jobs. However, this employment policy reduces job security for permanent workers because some permanent workers will be dismissed when the state switches to the low one. To induce permanent workers' effort, firms need to raise w_1. As firms increase permanent jobs in the high state, w_1 continues to rise because permanent jobs become less secured and once $w_1 + \gamma\delta$ reaches λw_2, then, firms will switch to hiring temporary workers. This employment policy may be more realistic than the one in the main text, but does note yield additional insights about the relative demand for temporary workers. Thus, we focus on the simpler employment policy.

noting the value of a firm in state $s = \{H, L\}$ by V_s, we have the following two asset equations.

$$\rho V_H(l_1, l_2, \varphi) = \pi_H(l_1, l_2, \varphi) + \gamma \left[V_L(l_1, l_2, \varphi) - V_H(l_1, l_2, \varphi) \right], \tag{5}$$

and

$$\rho V_L(l_1, l_2, \varphi) = \pi_L(l_1, \varphi) + \beta \left[V_H(l_1, l_2, \varphi) - V_L(l_1, l_2, \varphi) \right], \tag{6}$$

where ρ is the return rate of the safe asset and π_s are the instantaneous profits given by

$$\begin{aligned} \pi_H(l_1, l_2, \varphi) &= \frac{z_H(\lambda l_1 + l_2)}{\varphi} - \frac{b(\lambda l_1 + l_2)^2}{2\varphi^2} - w_1 l_1 - w_2 l_2, \\ \pi_L(l_1, \varphi) &= \frac{z_L \lambda l_1}{\varphi} - \frac{b(\lambda l_1)^2}{2\varphi^2} - w_1 l_1. \end{aligned}$$

Rearranging the asset equations in (5) and (6), we obtain

$$V_H(l_1, l_2, \varphi) = \frac{\pi_H(l_1, l_2, \varphi) + \gamma V_L(l_1, \varphi)}{\rho + \gamma}, \tag{7}$$

and

$$V_L(l_1, \varphi) = \frac{\pi_L(l_1, \varphi) + \beta V_H(l_1, l_2, \varphi)}{\rho + \beta}, \tag{8}$$

where argument l_2 is omitted from V_L because firms use temporary workers only in the high state without incurring any adjustment costs.

Note that firms use temporary workers to fill the infra-marginal labor demand in the high state. Thus, firms in the high state optimize the total employment level by adjusting l_2. In equation (7), the first-order condition (FOC) with respect to l_2 leads to the optimized total employment (in units of temporary workers) in the high state:

$$\lambda l_1 + l_2 = \frac{\varphi}{b}(z_H - \varphi w_2). \tag{9}$$

Firms employ permanent workers to the extent that the marginal cost of permanent workers is equalized to that of temporary workers. Plugging equation (9) into the FOC of equation (7) with respect to l_1 provides the following condition.

$$w_2 = \omega_1 - \frac{\gamma V_L'(l_1, \varphi)}{\lambda}, \tag{10}$$

where $\omega_1 \equiv w_1/\lambda$ is the effective wage of permanent workers.

Equation (10) implies that the marginal cost for temporary workers, w_2, must equal the effective wage for permanent workers, ω_1, plus the marginal expected loss in the low state, $-\gamma V_L'(l_1, \varphi)/\lambda$. Intuitively, as $w_2 > \omega_1$, the firm employs permanent workers up to the point where an efficiency loss of $V_L'(l_1, \varphi) < 0$ occurs in the low state. We obtain the expression of V_L' by differentiating equation (8) with respect to l_1:

$$V_L'(l_1, \varphi) = \frac{1}{\rho + \beta}\left[\frac{\lambda}{\varphi}\left(z_L - \frac{b\lambda l_1}{\varphi}\right) - w_1\right], \tag{11}$$

Note that setting $V_L'(l_1, \varphi)$ equal to 0 implies that $z_L/\varphi - b\lambda l_1/\varphi^2 = \omega_1$, which is the condition for maximizing the instantaneous profits in the low state. Thus, $V_L'(l_1, \varphi) < 0$ indicates that firms retain too many permanent workers, compared to the level that firms would choose in the low state without the firing cost. It should be noted that the over-employment of permanent workers in the low state occurs due to the firing cost and the usage of temporary workers partially eliminates the efficiency loss (see the Appendix).

Plugging (11) into (10) leads to the employment of permanent workers in units of temporary workers:

$$\lambda l_1 = \frac{\varphi}{b}\left[z_L - \varphi\left(\omega_1 - d\right)\right], \quad \text{where} \quad d \equiv \frac{\left(\rho + \beta\right)\left(w_2 - \omega_1\right)}{\gamma}. \tag{12}$$

The term d in equation (12) is interpreted as an index of the distortion in the employment of permanent workers. We note that non-negative employment of temporary workers by firms in operation requires $z_H/w_2 > z_L/(\omega_1 - d)$ and we assume that this normality condition always holds in what follows.

Figure 2 illustrates the employment determination of permanent and temporary workers. The marginal cost of temporary workers is expressed by a horizontal line at w_2, while the (true) marginal cost of permanent workers, $\omega_1 - \gamma V_L'(l)/\lambda$, is an upward-sloping schedule. Equation (10) is represented at point A—the employment of permanent workers in the low state. When z_H is realized, then the total employment level will be at point B where a downward marginal revenue schedule $\varphi^{-1}(z_H - bl/\varphi)$ intersects the marginal cost line w_2. As all employment fluctuations are absorbed by temporary workers, the model suggests that whereas the employment of temporary workers is positively correlated with output, the employment of permanent workers is insensitive to output fluctuations. In the empirical section, we will test this prediction.

Another important role of temporary workers is to reduce employment inefficiency due to the firing cost associated with permanent workers. The following two extreme cases highlight this point. First, suppose that temporary workers are so unproductive that firms are indifferent between filling the infra-marginal employment in the high state by permanent or temporary workers, namely, $w_2 = \omega_1 + \gamma\delta/\lambda$. In Figure 2, point A' represents the employment of permanent workers in the low state and point B' the total employment in the high state. The employment of permanent workers satisfies $-V_L'(l_1) = \delta$, which implies that firms set the marginal benefit of firing additional permanent workers equal to the marginal cost of firing δ. The over-employment of permanent workers in the low state is maximized in this case. Second, by contrast, suppose that $w_2 = \omega_1$: temporary workers are equally as productive as permanent workers. Then, firms would employ only temporary workers in both states and the employment in the low state is at point A'' satisfying $V_L' = 0$ while the employment in the high state is represented by point B''. These two cases illustrate that the introduction of temporary workers under the condition $w_1 < \lambda w_2 < w_1 + \gamma\delta$ partially mitigates the distortion in the employment of permanent workers.

Using equations (9) and (12), the ratio of temporary workers to total employment—an index for a firm's relative demand for temporary workers—is given by

$$RTW(\varphi, \bar{z}) \equiv \frac{l_2}{\lambda 1_1 + l_2} = 1 - \frac{\bar{z} + \alpha_L - \varphi(\omega_1 - d)}{\bar{z} + \alpha_H - \varphi w_2}, \tag{13}$$

where $z_s = \bar{z} + \alpha_s$ is used. Equation (13) reveals that decreases in the mean of the upper bound price, $\bar{z}$, will raise the proportion of temporary workers. Because decreases in $\bar{z}$ make the product demand more elastic for any given price, a "tougher" competitive environment increases the relative demand for temporary workers. Intuitively, the effect of demand fluctuations is pronounced under more elastic demand. Consequently, firms increase the relative demand for temporary workers as $\bar{z}$ decreases. This observation is particularly important for examining the effects of globalization on the demand for permanent and temporary workers. Hence, we record it as the following proposition.

Proposition 1. *Holding other things constant, if market competition is intensified and the product demand becomes more elastic, then, each firm will increase the proportion of temporary workers.*

Proof. See the Appendix. □

In the linear demand in equation (3), the price elasticity of demand ϵ_s monotonically increases with product price along the demand curve. Productive firms with higher output have lower price elasticities of demand, compared to less productive firms with lower output. Hence, the linkage between the price elasticity of demand and the ratio of temporary workers implies that more productive firms have lower proportions of temporary workers, which is largely consistent with the cross-plant differences in relative demand for temporary workers in Figure 1.

Proposition 2. *Productive firms tend to have lower proportions of temporary workers than unproductive firms.*

Proof. See the Appendix. □

It should be noted that the model's predictions in Propositions 1 and 2 hold for a class of demand functions that are less convex than the iso-elastic demand. Thus, our results are quite general. For example, the mechanism highlighted by our model works in the monopolistic trade model pioneered by Krugman (1979) that stressed trade gains from more varieties of differentiated goods and lower markups charged by firms. The standard constant elasticity of substitution (CES) preferences insulate the relative demand for temporary workers from the effects of product market competition and firm heterogeneity and, as a result, all firms will have a common proportion of temporary workers, which contradicts with Figure 1 (See the Appendix for the detail).

2.4 Free Entry

As the demand shock is i.i.d., a fraction $h \equiv \beta/(\beta+\gamma)$ of all operating firms is in the high state, while a fraction of $1-h \equiv \gamma/(\beta+\gamma)$ is in the low state. From equations (9) and (12), the threshold productivities above which the output is driven to 0 are given by

$$\varphi_H(\bar{z}) = \frac{z_H}{w_2} \quad \text{and} \quad \varphi_L(\bar{z}) = \frac{z_L}{\omega_1 - d}. \tag{14}$$

By the normality condition, $\varphi_L < \varphi_H$ holds.[10]

Firms' flow profits follow those of standard monopolistic competition with linear demand except for the modifications due to labor adjustment. Using an indicator variable $I(\varphi)$ that takes 1 for $\varphi \in [0, \varphi_L)$ and 0 for $\varphi \in [\varphi_L, \varphi_H]$, firms' flow profits in the high state are given by

$$\pi_H(\bar{z}, \varphi) = \frac{L}{4\zeta}\left[\bar{z} + \alpha_H - \varphi w_2\right]^2 + I(\varphi) \cdot \varphi\,(w_2 - \omega_1)\, q_L(\varphi), \tag{15}$$

where

$$q_L(\varphi) = \frac{L}{2\zeta}\left[\bar{z} + \alpha_L - \varphi(\omega_1 - d)\right]$$

[10] Firms in the range of $[\varphi_L, \varphi_H]$ employ only temporary workers in the high state and no workers in the low state.

represents the optimal output in the low state. The second term in π_H presents the productivity advantage of permanent workers over temporary workers. The flow profits in the low state are given by

$$\pi_L(\bar{z}, \varphi) = \frac{L}{4\zeta} \left[(\bar{z} + \alpha_L - \varphi\omega_1)^2 - (\varphi d)^2 \right], \tag{16}$$

where the second term in the squared brackets is the profit loss stemming from employing too many permanent workers.

The average upper bound price $\bar{z}$ is the sole unknown variable in the model. We assume that firms incur a fixed investment f_e in units of the numeraire goods prior to entry. Free entry ensures that the expected firm value equals f_e in equilibrium. Equations (7) and (8) give firm values V_s with respect to the flow profits π_s. Denoting the average firm profits prior to entry by $\bar{\pi}_s(\bar{z}) \equiv \int_0^{\varphi_s(\bar{z})} \pi_s(\varphi) dG(\varphi)$, the free entry condition can be expressed by

$$h\bar{\pi}_H(\bar{z}) + (1-h)\bar{\pi}_L(\bar{z}) = \rho f_e, \tag{17}$$

which gives $\bar{z}$ in equilibrium. Once $\bar{z}$ is determined, the two threshold productivities in equation (14) pin down the distribution of firms in operation. The average product prices in each state are given by $\bar{p}_s = [\int_0^{\varphi_s} p_s(\varphi) dG(\varphi)]/G(\varphi_s)$ for $s = \{H, L\}$, which in turn gives the mass of firms $N = (\zeta/\eta) \cdot (\bar{\alpha} - \bar{z})/(\bar{z} - \bar{p})$ where the average price $\bar{p}$ is given by $\bar{p} = h\bar{p}_H + (1-h)\bar{p}_L$.

Holding other things constant, the average profits $\bar{\pi}_s$ increase as $\bar{z}$ increases. Thus, the comparative statics with respect to the economy size(L), the degree of product differentiation (ζ), and the production technology in the differentiated goods (φ_m) generates the following results.

Proposition 3. *If the economy size increases ($L \uparrow$), the differentiated goods become more substitutable with each other ($\zeta \downarrow$), or the productivity of the differentiated goods sector improves ($\varphi_m \downarrow$), then each firm will increase the relative demand for temporary workers.*

Proof. See the Appendix. □

Intuitively, larger markets, more substitutability between varieties of the differentiated goods, or improved productivity of the differentiated goods raise the average profits prior to entry and induce new entrants, which lowers the average upper bound price and the survival probability $G(\varphi_H)$. In such a competitive market environment, firms facing more elastic product demand increase their relative demand for temporary workers.

Productive firms tend to have lower relative demand for temporary workers (Proposition 2). Thus, when $\bar{z}$ declines (and φ_s also declines), each surviving firm increases the relative demand for temporary workers while the selection effect reduces the sectoral average of the relative demand for temporary workers. To see which effect is dominant on the relative demand for temporary workers at the sector level, we parameterize the productivity distribution as a standard Pareto distribution:

$$G(\varphi) = \left(\frac{\varphi}{\varphi_m}\right)^k, \quad \varphi \in [0, \varphi_m], \tag{18}$$

where $k > 0$ is the shape parameter.[11] As is well known, the Pareto distribution is unaltered by any truncation of φ from above. State switches occur randomly at the firm level. Thus, the distribution of firms in each state also follows a Pareto distribution such that $G_s(\varphi) = (\varphi/\varphi_s)^k$.

Because the average productivity of surviving firms in state s is given by

$$\tilde{\varphi}_s(\bar{z}) = \frac{1}{G(\varphi_s(\bar{z}))}\int_0^{\varphi_s(\bar{z})} \varphi dG(\varphi) = \frac{k}{k+1}\varphi_s(\bar{z}),$$

the average output in each state is

$$\tilde{q}_j(\bar{z}) = \frac{(\bar{z} + \alpha_j)L}{2\zeta(k+1)}, \quad \text{for} \quad j = \{H, L\} \tag{19}$$

Hence, the sector average of the proportion of temporary workers is given by

$$\widetilde{RWT}(\bar{z}) = 1 - \frac{\tilde{\varphi}_L \tilde{q}_L G(\varphi_L)}{\tilde{\varphi}_H \tilde{q}_H G(\varphi_H)} = 1 - \left(\frac{w_2}{\omega_1 - d}\right)^{k+1}\left(\frac{\bar{z} + \alpha_L}{\bar{z} + \alpha_H}\right)^{k+2}, \tag{20}$$

which is unambiguously decreasing in $\bar{z}$.[12] Thus, we conclude that Proposition 3 holds at the sector level when firm productivity follows the standard Pareto distribution. To facilitate analysis, we continue to use the Pareto distribution in equation (18) in what follows.

3 Open Economy

The purpose of the extension is to examine how international trade would affect firms' relative demand for temporary workers. Following the convention of the literature, we start our analysis with trade in final goods. Then, on the grounds that the recent trade literature has emphasized the role of international production fragmentation in trade, we will further extend our base model by incorporating foreign outsourcing.

[11] As k increases, the dispersion of firm productivity decreases. As an extreme, when k goes to infinity, all firms' unit labor requirements become degenerated with value φ_m.

[12] The characteristics of the average of operating firms performance measures are qualitatively similar to those in Melitz and Ottaviano (2008). See the Appendix for details.

3.1 The Effects of Trade in Final Goods

We consider an open economy composed of two countries, a home country and a foreign country (denoted by *), that have the same preferences and production technology as described in the base model. For analytical simplicity, we also assume that the two countries have the same labor market structure in which both permanent and temporary workers may coexist within the same firm.[13] However, we allow for a cross-country difference in economy size ($L \neq L^*$).

The trade environment between the countries is standard: while the numeraire goods are freely traded, the differentiated goods are associated with iceberg-type trade costs: home firms have to ship $\tau^* > 1$ units when supplying one unit of their products abroad, while there is no such trade costs for local supply. Similarly, foreign firms have to incur the trade cost $\tau > 1$ for exports to the home country. Labor is internationally immobile, but freely mobile across the sectors.

Firms in the differentiated good sector can sell their products in both markets regardless of their location. Because the two markets are segmented and production has constant returns to scale, firms separately determine the outputs for domestic supply and exports. A home firm with productivity φ exports q_{Xs} in state $s = \{H, L\}$ where

$$q_{XH}(\varphi) = \frac{L^*}{2\zeta}\left[z_H^* - \tau^*\varphi w_2\right], \qquad q_{XL}(\varphi) \equiv \frac{L^*}{2\zeta}\left[z_L^* - \tau^*\varphi\left(\omega_1 - d\right)\right], \tag{21}$$

which implies the following firm sorting: firms with $\varphi \leq \varphi_{XL} = z_L^*[\tau^*\omega_1 - d)]^{-1}$ choose to export regardless of the state, and those with $\varphi_{XL} < \varphi \leq \varphi_{XH} = \bar{z}_H^*(\tau^* w_2)^{-1}$ choose to export only when the state is high. The remaining firms do not export.

Letting $I(\varphi)$ be an indicator variable that takes 1 for $\varphi \in [0, \varphi_{XL})$ and 0 for $\varphi \in [\varphi_{XL}, \varphi_{XH}]$, the export profits in the high and low states are given by

$$\pi_{XH}(\varphi) = \frac{L^*}{4\zeta}\left[z_H^* - \tau^*\varphi w_2\right]^2 + I(\varphi)\cdot\tau^*\varphi\left(w_2 - \omega_1\right)q_{XL}(\varphi), \tag{22}$$

and

$$\pi_{XL}(\varphi) = \frac{L^*}{4\zeta}\left[\left(z_L^* - \tau^*\varphi\omega_1\right)^2 - \left(\tau^*\varphi d\right)^2\right]. \tag{23}$$

[13] In reality, countries may differ in labor adjustment costs. However, the assumption of the identical labor market structure greatly helps to maintain the model's tractability without qualitatively affecting the insights from the model. Indeed, if we assume that the foreign country can freely adjust permanent workers, the model's important predictions about the demand for permanent and temporary workers in the home country are unaltered.

As in the closed economy in the previous section, the free-entry condition equalizes the expected profits (prior to entry) to the entry cost in each country:

$$h\left[\bar{\pi}_H(\bar{z}) + \bar{\pi}_{XH}(\bar{z}^*)\right] + (1-h)\left[\bar{\pi}_L(\bar{z}) + \bar{\pi}_{XL}(\bar{z}^*)\right] = \rho f_e, \tag{24}$$

$$h\left[\bar{\pi}^*_H(\bar{z}^*) + \bar{\pi}^*_{XH}(\bar{z})\right] + (1-h)\left[\bar{\pi}^*_L(\bar{z}^*) + \bar{\pi}^*_{XL}(\bar{z})\right] = \rho f_e, \tag{25}$$

where $\bar{\pi}_{Xs} \equiv \int_0^{\varphi_{Xs}(\bar{z}^*)} \pi_{Xs}(\varphi)dG(\varphi)$ for $s = \{H, L\}$ and those with asterisk are the foreign counterparts. Note that as foreign firms' threshold productivity for domestic supply are given by $\varphi^*_H = \bar{z}^*_H/w_2$ and $\varphi^*_L = \bar{z}^*/(\omega_1 - d)$, home firms' threshold productivity for export is given by $\varphi_{Xs} = \varphi^*_s/\tau^*$. Therefore, home firms' expected profits from export can be expressed in terms of foreign firms' expected profits earned from the domestic market. In particular, by using the Pareto distribution in equation (18), it can be shown that $\bar{\pi}_{Xs}(\bar{z}^*) = [\tau^*]^{-k}\bar{\pi}^*_s(\bar{z}^*)$. The analogous equations hold for foreign firms' exports. Thus, we can rewrite the free entry conditions in equations (24) and (25) using firms' average profits earned from their domestic markets:

$$\Pi(\bar{z}) + (\tau^*)^{-k}\Pi^*(\bar{z}^*) = \rho f_e, \tag{26}$$

$$\tau^{-k}\Pi(\bar{z}) + \Pi^*(\bar{z}^*) = \rho f_e, \tag{27}$$

where $\Pi(\bar{z}) \equiv h\bar{\pi}_H(\bar{z}) + (1-h)\bar{\pi}_L(\bar{z})$ and $\Pi^*(\bar{z}^*) \equiv h\bar{\pi}^*_H(\bar{z}^*) + (1-h)\bar{\pi}^*_L(\bar{z}^*)$. Given that τ and τ^* are greater than 1, solving equations (26) and (27) with respect to $\Pi(\bar{z})$ and $\pi^*(\bar{z}^*)$, we obtain

$$\begin{bmatrix} \Pi(\bar{z}) \\ \Pi^*(\bar{z}^*) \end{bmatrix} = \frac{1}{1 - \tau^{-k}(\tau^*)^{-k}} \begin{bmatrix} \left[1 - (\tau^*)^{-k}\right]\rho f_e \\ \left[1 - \tau^{-k}\right]\rho f_e \end{bmatrix}. \tag{28}$$

It is evident that $\partial\Pi(\bar{z})/\partial\bar{z} > 0$ and $\partial\Pi^*(\bar{z}^*)/\partial\bar{z}^* > 0$. Hence, equations (28) uniquely determine $\bar{z}$ and $\bar{z}^*$, as in the closed economy described in the previous section.

We will focus on the analysis of the home country. As product markets are segmented, it is convenient to consider the relative demand for temporary workers by market. The relative demand for temporary workers to the total employment in domestically supplied goods is the same as the one in equation (13). Similarly, from equation (21), the relative demand for temporary workers in exported goods is given by

$$RTW_X(\varphi, \bar{z}^*) = 1 - \frac{\bar{z}^* + \alpha_L - \tau^*\varphi(\omega_1 - d)}{\bar{z}^* + \alpha^*_H - \tau^*\varphi w_2}. \tag{29}$$

We examine the effects of trade on the relative demand for temporary and permanent workers in the following three scenarios: (i) symmetric trade liberalization in which $\tau = \tau^*$

holds initially and both trade costs decline proportionally; (ii) increases in the foreign market size (increases in L^*); and (iii) improving the foreign productivity in differentiated goods (decreases in the upper-bound of the support of the distribution of unit labor requirements, φ_m^*). The first two address the effects of trade openness while the last one considers changes in comparative advantage.

3.1.1 Symmetric Trade Liberalization

When the trade costs are symmetric, equations (28) are simplified such that

$$\Pi(\bar{z}) = \Pi^*(\bar{z}^*) = \frac{\rho f_e}{1+\tau^{-k}}.$$

Thus, a proportional decline in the trade costs lowers $\bar{z}$ and $\bar{z}^*$, leading to intensified market competition in both countries.[14]

Equation (29) reveals that symmetric trade liberalization has two opposite effects on the relative demand for temporary workers in export production. On the one hand, symmetric trade liberalization intensifies market competition in the export market ($\bar{z}^* \downarrow$), which increases the relative demand for temporary workers (the market competition effect). On the other hand, the decrease in τ^*, equivalent to a production efficiency gain, reduces firms' relative demand for temporary workers (the productivity effect). In general, it is not clear which effect is dominant, and symmetric trade liberalization may or may not increase firms' relative demand for temporary workers in export production. In contrast, such a productivity effect does not exist in domestically supplied goods, and the relative demand for temporary workers unambiguously increases.

3.1.2 Foreign Market Expansion

Since $\Pi(\bar{z})$ does not include L^*, an increases in the size of the foreign economy lowers $\bar{z}^*$ and does not affect $\bar{z}$. As Melitz and Ottaviano (2008) pointed out, although the increase in the foreign market size intensifies the competition in the home market by increasing imports, which gives a downward pressure on $\bar{z}$, a smaller proportion of entrants of home firms offsets the downward pressure.[15] Thus, increases in the size of the foreign market raise the relative

[14] In the case of unilateral trade liberalization by the foreign country (i.e., τ^* falls while τ is unchanged), $\bar{z}$ decreases while $\bar{z}^*$ increases.

[15] As shown in the Appendix, as L^* increases, the mass of home firms decreases and the mass of foreign firms exporting to the home country increases. The decrease in home firms balances the increase in foreign firms in the home market, leading to an unaltered total mass of firms in the home market.

demand for temporary workers in export production without affecting that in domestically supplied goods.

3.1.3 Comparative Advantage

All else being equal, a decrease in φ_m^* enhances the foreign country's comparative advantage in the differentiated goods sector (in a Ricardian sense) and increases foreign firms' expected profits prior to entry. Hence, more foreign firms enter and consequently, $\bar{z}^*$ falls. Similar to increases in the foreign market size, this change does not affect the home country's average upper bound price, $\bar{z}$. Thus, only exporting home firms increase their relative demand for temporary workers.

These results about the effects of international trade on the relative demand for temporary and permanent workers are summarized in the following proposition.

Proposition 4. *In an open economy that consists of two countries that are identical except for their market size (i.e., home and foreign),*

(i) A proportional decrease in the trade costs between the two countries raises the relative demand for temporary workers for non-exporting firms. However, the effect of the trade cost reduction on exporting firms' relative demand for temporary workers is ambiguous.

(ii) An increase in the size of the foreign country raises the relative demand for temporary workers for exporting firms in the home country, but does not affect that for non-exporting firms in the home country.

(iii) An improvement in the productivity in the differentiated goods in the foreign country raises the relative demand for temporary workers for exporting firms in the home country, but does not affect that for non-exporting firms in the home country.

Interestingly, international trade affects the relative demand for temporary workers differently across firms depending on their export status. In particular, when the foreign market size increases (e.g., emerging economies participate in the world market) or when the foreign county improves its productivity in the differentiated goods sector, only exporting firms increase the relative demand for temporary workers in the home country: namely, productive firms increase their demand for temporary workers more aggressively than unproductive firms. Figure 1 shows the trend that larger plants increased the relative demand for temporary workers more aggressively than smaller plants. Although data limitation does not allow us to empirically examine the effect of international trade at the firm level, the observed trend is largely consistent with our model's prediction about foreign market expansion and foreign firms' technological improvement.

Before closing this section, we describe the relative demand for temporary workers at the sector level. As shown in Proposition 4, the total effect of a symmetric trade reduction on the relative demand for temporary workers for exporting firms is unclear. However, we note that under the Pareto distribution, a symmetric trade cost reduction unambiguously raises the average of the relative demand for temporary workers in export production. Indeed, the average of the relative demand for temporary workers in exported goods takes the same form as that in domestically supplied goods:

$$\widetilde{RTW}_X(\bar{z}^*) = 1 - \left(\frac{w_2}{\omega_1 - d}\right)^{k+1} \left(\frac{\bar{z}^* + \alpha_L}{\bar{z}^* + \alpha_H}\right)^{k+2}, \tag{30}$$

which is independent of trade costs. This is because while an increase in τ^* decreases each firm's exports, it also urges the least productive exporters to exit. These two effects offset each other in the average export volume.

3.2 Outsourcing

We follow Lommerud, Meland, and Straume (2009) and Groizard, Ranjan, and Rodriguez-Lopez (2014) in incorporating foreign outsourcing into our base model, and examine the effects of foreign outsourcing on the relative demand for temporary and permanent workers. Specifically, we modify the base model as follows. Each firm produces its own variety by assembling a continuum of intermediate goods indexed by $j \in [0, 1]$ with a Leontief technology, in which unit production of a variety of the differentiated goods requires one unit of each intermediate good. Firms can either produce the intermediate goods (in-house production) or purchase them from foreign suppliers at an exogenously-given price p_m (outsourcing). Labor is a single production input for the in-house production, and each intermediate good is produced by the linear production technology described in the base model. Thus, one unit of imported intermediate goods is equivalent to one unit of temporary workers in production. To focus on the effects of imports of intermediate goods, we abstract trade in the final goods.

We assume that firm i has a border intermediate good indexed by $\theta_i \in [0, 1]$ so that it replaces in-house production with imported intermediates for all $j \geq \theta_i$. The border intermediate goods with index θ_i can be endogenously determined by introducing outsourcing costs that differ across the intermediate goods. For example, Grossman and Rossi-Hansberg (2008) and Groizard, Ranjan, and Rodriguez-Lopez (2014) use iceberg-type outsourcing costs, while Lommerud, Meland, and Straume (2009) use fixed outsourcing costs. In both formulations, it is assumed that making imported intermediate goods compatible with domestically produced intermediate goods is costly and that each intermediate good has different outsourcing costs. Thus, by ordering the intermediate goods along the continuum of [0,1] in a descending order with respect to the outsourcing costs, each firm may optimize the range of outsourced intermediate goods.[16] However, for analytical simplicity, we abstract firms' choice of the range of outsourced intermediate goods from the model and regard θ_i as a state independent exogenous parameter that expresses the degree of foreign outsourcing for firm i. Further, we assume that all outsourcing firms apply the same range of foreign outsourcing ($\theta_i = \theta$ for all outsourcing firms).[17]

We introduce a fixed cost f_o for foreign outsourcing. Firms outsource the intermediate good production only if the net profits from outsourcing are positive: $\pi_{Os}(\varphi,\theta) - \pi_s(\varphi) - f_o \geq 0$ where $\pi_{Os}, s = \{H, L\}$ are the flow profits of outsourcing firms. The flow profits π_{Os} are given by

$$\pi_{OH}(l_1, l_2, \varphi, \theta) = \frac{z_H(\lambda l_1 + l_2)}{\varphi} - \frac{b(\lambda l_1 + l_2)^2}{2\varphi^2} - \theta(w_1 l_1 + w_2 l_2) - (1-\theta)p_m(\lambda l_1 + l_2), \tag{31}$$

and

$$\pi_{OL}(l_1, \varphi, \theta) = \frac{z_L \lambda l_1}{\varphi} - \frac{b(\lambda l_1)^2}{2\varphi^2} - \theta w_1 l_1 - (1-\theta)p_m \lambda l_1. \tag{32}$$

[16] More specifically, for the case of the iceberg-type outsourcing costs as in Grossman and Rossi-Hansberg (2008) and Groizard, Ranjan, and Rodriguez-Lopez (2014), the price of foreign intermediate goods is given by $bt(j)p_m$ where b is the common part of the outsourcing cost and $t(j)$, a decreasing function of j, is the variable part of the outsourcing cost. Firms will outsource intermediate goods j as long as $bt(j)p_m$ is cheaper than the unit in-house production cost. The breakeven intermediate goods $j = \theta_i$ exist by appropriately setting the cost parameters. Because firms' productivity is Hicks-neutral, all firms choose the same range of outsourcing ($\theta_i = \theta$ for all firms). For the case of fixed outsourcing costs (as in Lommerud, Meland, and Straume (2009)), it is assumed that the fixed outsourcing cost for intermediate goods j, $k(j)$, is decreasing in j. Firms with the outsourcing range $[\theta, 1]$ incur an outsourcing cost $K(\theta) \equiv \int_\theta^1 k(j)dj$. Postulating that p_m is lower than the unit in-house production cost of the intermediate goods, firms' profits $\pi(\theta,\varphi)$ are decreasing in θ. Thus, assuming $K(\theta)$ is sufficiently convex, there exists the threshold intermediate goods that satisfy the first order condition for maximizing the net profits $\pi(\theta,\varphi) - K(\theta)$. In this specification, the range of outsourcing may vary across firms: firms with lower φ will outsource more intermediate goods, while unproductive firms will not outsource any intermediate goods.

[17] Firms are divided into outsourcing and non-outsourcing firms according to their productivity. All outsourcing firms chose the same outsourcing range. As Groizard, Ranjan, and Rodriguez-Lopez (2014) showed, the ice-berg type outsourcing costs may result in a common range of outsourcing for all outsourcing firms.

Foreign outsourcing can reduce the unit production cost in both states if $p_m \leq \omega_1$ holds. To maintain the model's tractability, we assume that this price condition is satisfied.

By defining $\tilde{\omega}_1(\theta) \equiv \theta\omega_1 + (1-\theta)p_m$ and $\tilde{w}_2(\theta) \equiv \theta w_2 + (1-\theta)p_m$, we can obtain the maximized profits for a given $\bar{z}$ as in the base model. Assuming that f_o is sufficiently high for the least productive firms not to choose outsourcing, the model identifies the threshold productivity φ_{Os} at which firms are indifferent between outsourcing and self-production. The free-entry condition closes the model as in the base model, determining the average upper bound price $\bar{z}$.

Holding $\bar{z}$ constant, firms can increase profits by outsourcing more intermediate goods for two reasons. First, the marginal cost of using foreign intermediate goods is lower than the marginal cost of temporary workers. Thus, outsourcing more intermediate goods ($\theta \downarrow$) will increase the profits (at least in the high state). Second, outsourcing mitigates the distortion in the employment of permanent workers by reducing the share of labor in the total cost. This mitigation effect can be clearly observed by setting the price of intermediate goods equal to ω_1 so that there is no gain from cost reduction in the low state: the flow profits in the low state are expressed as

$$\pi_{OL} = \frac{L}{4\zeta}\left[(z_L - \varphi\omega_1)^2 - (\theta\varphi d)^2\right], \tag{33}$$

which gives a rise to $\partial\pi_{OL}/\partial\theta < 0$. Therefore, the free-entry condition ensures that $\bar{z}$ decreases as θ decreases. As foreign outsourcing increasingly prevails, each firm can improve its profitability, which induces new entrant firms and intensifies product market competition.

The proportion of temporary workers for outsourcing firms is given by

$$RTW_O(\varphi, \bar{z}) = \frac{l_2}{\lambda l_1 + l_2} = 1 - \frac{\bar{z} + \alpha_L - \varphi[\tilde{\omega}_1(\theta) - \theta d]}{\bar{z} + \alpha_H - \varphi\tilde{w}_2(\theta)}, \tag{34}$$

and that for non-outsourcing firms is the same as in the base model.

Equation (34) shows that foreign outsourcing affects the relative demand for temporary workers through three channels. First, more outsourcing ($\theta \downarrow$) lowers $\bar{z}$ by intensifying product market competition. This effect raises the relative demand for temporary workers for all firms.

Second, while foreign outsourcing reduces firms' labor demand by substituting in-house production with imported intermediate goods, it also increases the labor demand for in-house production by lowering the production cost. This cost reduction effect is more pronounced in the high state because the marginal production cost in the high state w_2 is higher than that in the low state (i.e., ω_1), which tends to raise the relative demand for temporary workers.

Third, as already mentioned, foreign outsourcing mitigates the distortion in the employment of permanent workers and reduces the employment of permanent workers. Intuitively, foreign outsourcing functions as another type of temporary worker and enables firms to choose the employment level of permanent workers closer to the one without the firing cost.

The existing literature suggests that foreign outsourcing can increase home employment when the the productivity gain effect overweighs the job substitution effect (e.g., Groizard, Ranjan, and Rodriguez-Lopez (2014)). Our study complements the existing results by pointing out that foreign outsourcing may create new jobs, increasing the net number, but the share of goods jobs (in terms of job security and rewards) is likely to decrease. The following proposition summarizes the results of foreign outsourcing.[18]

Proposition 5. *When firms outsource more intermediate inputs, they tend to increase the employment of temporary workers relative to permanent workers. Furthermore, if the price of imported intermediate goods is not very low, the employment of permanent workers will decline.*

Proof. See the Appendix. □

4 Empirical Evidence

In this section, we test the empirical validity of our model of the impact of economic globalization on the demand for permanent and temporary workers.

4.1 Empirical Strategy and Indicators of Globalization

Based on the theoretical framework discussed in the previous section, we test whether trade openness is attributable to increases in the relative demand for temporary workers over permanent workers. Unfortunately, firm-level data that contain information about job

[18]There can be another mechanism that may cause a firm to reduce its employment of permanent workers. It is likely that the possibility of outsourcing makes the relationship between a firm and its permanent workers less durable. A higher likelihood of layoffs may discourage permanent workers from accumulating firm-specific skills. If so, the firm has to pay more to its permanent workers to induce their effort in acquiring firm-specific skills, which will reduce the demand for permanent workers. However, we abstract this dynamics from our model not only to maintain the model's tractability, but also to emphasize the effects of product market competition and the mitigation of the biased employment of permanent workers. In a similar vein, our analysis is a static comparison between two different values of θ.

types were not available to us. Hence, we rely on sector level data and estimate reduced-form equations for the response of the proportion of temporary workers to various indices of economic internationalization, controlling for the effects of other potential causes. We estimate the following reduced-form regression:

$$RTW_{it} = \mathbf{X}'_{git}\boldsymbol{\beta}_g + \mathbf{X}'_{it}\boldsymbol{\beta} + d_i + d_t + u_{it}, \tag{35}$$

where RTW_{it} is the ratio of temporary workers to total employment in industry i at time t, $\mathbf{X}_{git}$ is a set of explanatory variables that measure economic internationalizaton, $\mathbf{X}_{it}$ is a set of control variables including technological changes, and d_i and d_t represent industry and time fixed effects, respectively. The industry dummy variables absorb all unobservable industry-specific effects. For example, some industries may intrinsically have high demand for temporary workers depending on the variability of their business. The year dummies absorb all time effects common across industries such as economy-wide regulation changes and macroeconomic effects. In particular, we expect that the year dummies deal appropriately with the effect of the Worker Dispatching Act in 2004 that has enabled private temporary job agencies to dispatch workers to manufacturers since 2004. In addition, business cycles would influence the demand for permanent and temporary workers (Wasmer, 1999). The year dummies also absorb all such macroeconomic effects.[19]

Letting $Temp_{Dit}(Temp_{Xit})$ and $Total_{Dit}(Total_{Xit})$ denote the employment of temporary and total workers in domestically supplied (exported) output, respectively, the dependent variable in (35) can be decomposed as follows:

$$RTW_{it} = \frac{Temp_{Dit} + Temp_{Xit}}{Total_{Dit} + Total_{Xit}} = (1 - EX_{it})\frac{Temp_{Dit}}{Total_{Dit}} + EX_{it}\frac{Temp_{Xit}}{Total_{Xit}}, \tag{36}$$

where $EX_{it} \equiv Total_{Xit}/(Total_{Dit}+Total_{Xit})$ is the employment share of exported output in the total employment. Our theory predicts that trade openness (including outsourcing) influences the average ratios of temporary workers, $Temp_{Dit}/Total_{Dit}$ and $Temp_{Xit}/Total_{Xit}$, through changes in $\bar{z}$ and $\bar{z}^*$ (see equations (20) and (30)). This decomposition suggests that in addition to trade openness, RTW_{it} can be affected by the employment share of

[19] Another macroeconomic effect in the Japanese labor markets is increases in social insurance taxes (e.g., unemployment insurance, pension fund, and health insurance). Japanese firms are obliged to pay these taxes partially when employing permanent workers, but can evade this burden for temporary workers when certain labor conditions are satisfied. Thus, when the government increases social insurance taxes, the relative labor cost of permanent to temporary workers would increase, leading to higher proportions of temporary workers. Such government policy changes are in general uniform across sectors. Thus, the year dummy also appropriately absorbs this effect.

exported output. Therefore, we will include the export share of the total output in $\mathbf{X}_{it}$ as a proxy for EX_{it}.

Our theory suggests that firms use temporary workers as a buffer against employment fluctuations, which implies that, whereas the employment of permanent workers is insensitive to output changes, that of temporary workers shows a positive correlation with output. In addition, foreign outsourcing is likely to affect the relative demand for temporary workers by lowering the employment of permanent workers. Thus, we also examine changes in the numbers of permanent and temporary workers by replacing the dependent variable in equation (35) with the number of permanent and temporary workers.

We collected our data from different sources. For information about permanent and temporary workers, we used the Establishment and Enterprise Census. Covering all sites and firms, the census provides detailed workforce information according to the three-digit Japanese Industrial Classification. The data are available for four years (1999, 2001, 2004, and 2006).[20] We define total labor input as the sum of permanent employees, temporary employees, and workers dispatched from temporary employment agencies. We also define the number of temporary workers as the sum of temporary employees and workers dispatched from temporary employment agencies. The fraction of temporary workers in total labor input is calculated for each manufacturing industry.

We construct explanatory variables using the Japan Industrial Productivity Database 2009 (JIP 2009) and the UNIDO Industrial Statistics Database (INDSTAT). The JIP 2009 database contains annual data on 108 sectors covering the entire Japanese economy from 1970 to 2006, counting 52 manufacturing sectors. INDSTAT provides production-related data such as value added according to the three-digit ISIC Revision 3 classification. Based on these two databases, we construct indices of world market competition, outsourcing, and other control variables for each manufacturing industry. We begin with four key explanatory variables.

- World share of value added: We use the Japanese share of value added among OECD countries from the INDSTAT.[21] In our theoretical model, both increasing foreign

[20] The Japanese government began the Economic Census, a new comprehensive census, in 2010 as a replacement for the Establishment and Enterprise Census. The latest data from the Establishment and Enterprise Census is for 2006. One appealing characteristic of the Establishment and Enterprise Census is the comprehensive coverage of firms and detailed classifications of the workforce. The census reports the total number of workers, the number of employees, the number of permanent employees, the number of temporary employees, and the number of workers dispatched from temporary employment agencies.

[21] INDSTAT reports value added in current U.S. dollars. Two sets of the world share of value added are

market size and improving foreign productivity intensify product market competition in the foreign market and lower the home country's output share in the world. Further as long as the size of the home country is smaller than the foreign country, symmetric trade cost reductions also reduce the home country's output share with fierce product market competition. We, thus, interpret a decline in the share of value added as a sign of intensified global competition and expect a negative sign in the estimation of the ratio of temporary workers and a positive sign for the employment of permanent workers.

- Share of imported intermediate goods: This index captures the extent to which each industry relies on imported intermediate inputs as a proxy index of outsourcing. Following Feenstra and Hanson (1999), we construct this index using the input-output table and import data in JIP 2009.[22] Based on our model of foreign outsourcing, we expect that the sign of the coefficient is positive for the ratio of temporary workers and negative for the employment of permanent workers.

- Export share: The ratio of exports to output is calculated from JIP 2009. This is a proxy measure of the employment share of exported products in total employment. Without intensified product market competition, the ratio of temporary workers at the sector level could still increase when the export share rises if the ratio of temporary workers in exports is higher than that in domestic supply. We need to control this effect to identify the effects of product market competition. Assuming that the world market is more competitive than the Japanese domestic market, we expect that the coefficient is positive for the ratio of temporary workers.

- Real output: As has been discussed, fluctuations in real output are mostly absorbed by the employment of temporary workers. Hence, we expect that the coefficient of real output has a positive sign in the regressions of the ratio and number of temporary workers, while being not statistically insignificant in the permanent employment regression.

prepared. One is simply computed from the original data. For the other, we convert the unit of values from current U.S. dollars to PPP-based U.S. dollars. PPP-based U.S. dollars are taken from the Penn World Table 6.3. Both measures give similar results in our estimation, so we report the results of the PPP-based world share of valued added.

[22] Feenstra and Hanson (1999) propose two foreign outsourcing indices: one includes non-energy inputs from all industries and the other one uses only within-industry purchases. As the two indices did not generate substantially different results, we report the results by the first (broadly defined) outsourcing measure.

Among these four explanatory variables, the first two are especially interesting for us. However, it should be noted that the index for outsourcing (the share of imported intermediates) tends to suffer from reverse causality: firms can increase outsourcing simply by reducing the number of permanent workers and increasing the number of temporary workers. Although we admit that it is difficult to control for such reverse causality using our dataset, we attempt two-stage least squares (2SLS). We use the event of the Chinese accession to the WTO in 2001 as a natural experimental event. As we will verify, this event is highly likely to affect Japanese firms' outsourcing activity, but not directly influence firms' decisions on the relative demand for permanent workers. More concretely, we create an instrumental variable by multiplying the share of trade (export plus import) with China in total trade with a time dummy that is 0 before 2001 but 1 afterwards.

To control possible influences on the temporary worker ratio other than international markets, we also include the following indicators: the capital-labor ratio, technological changes, and demographical changes. All indicators are calculated from JIP 2009.

- Capital intensity (K/L): Saving labor adjustment costs may be less important in high-capital-intensity industries than in low-capital-intensity industries. Alternatively, firm-specific skills may be more important in industries with high capital intensity; such industries may hold high upper bounds in the number of permanent employees and show low proportions of temporary workers. We expect that the coefficient is negative in the temporary-ratio regression.

- Total factor productivity (TFP): It is a priori uncertain how TFP would affect the relative employment of temporary and permanent workers. If it captures Hicks-neutral technological change, it is highly likely that this index is neutral for the ratio of temporary workers. Conditioning upon real output, this index will not be significant in both temporary and permanent employment regressions. However, technological changes may yield biased labor demand changes, which in turn may affect the ratio of temporary workers.

- Information technology (IT): The literature on "job polarization" emphasizes that the rapid development of IT (computerization) has encouraged the replacement of labor by computers for routine tasks, decreasing the demand for middle-skilled jobs relative to high-skilled and low-skilled jobs (Autor, Levy, and Murnane, 2003).[23] Firms are likely

[23] Goos, Manning, and Salomons (2014) and Goos and Manning (2007) study the effect of computerization

to use temporary labor contracts (or dispatched workers) for routine jobs, resulting in increases in demand for temporary workers. We use the ratio of computers and other IT-related equipment to total labor input (IT-capital intensity) as a proxy of the prevalence of IT.

- Demographic changes: It is known that elderly or female workers are likely to have temporary labor contracts. For this reason, increases in elderly or female workers can raise the ratio of temporary workers. To control for these effects, we include the ratio of workers aged 55 or over and the ratio of female workers into our regressions.

To match the data from the Establishment and Enterprise Census with those constructed from JIP 2009 and UNIDO's INDSTAT, we use the industrial classification of JIP 2009 to the greatest extent possible. Although we have to merge some industries, we can construct a balanced longitudinal dataset of 45 manufacturing industries between 1996 and 2006, where the labor data with labor classifications are limited to four periods (1999, 2001, 2004, and 2006).

4.2 Data Description

Before proceeding to estimation, it is useful to examine the data for temporary and permanent workers in Japan. Table 1 presents the ratio of temporary workers to total workers across manufacturing sectors in Japan. The first two columns, the ratios of temporary workers in 1999 and 2006, show that shifts from permanent to temporary workers occurred in almost all manufacturing sectors. The top five sectors with high ratios of temporary workers in 2006 are Other Processed Food (4), Fish Products (2), Meat Products (1), Glass Products (23), and Plastic Products (44). Leather Products (14) and Beverages (6) also have high ratios of temporary workers. The ratio in Other Processed Food reaches approximately 60%. However, these sectors tend to have high temporary worker ratios as of 1999, and the shifts from permanent to temporary workers were not so striking.

More dramatic shifts from permanent to temporary workers can be found in Motor Vehicles (41) and Chemical Fibers and Textiles (18). The third column presents the average annual growth rate of the ratio of temporary workers during 1999–2006. The Motor Vehicles sector records a more than 10% annual growth rate, and the Chemical Fibers and Textiles sectors follow at about 9%. The fourth column presents annual growth rates of the ratio of

and outsourcing on job polarization.

temporary workers during 2004–06. In most industries, the average growth rates per annum of this period fall below those in the full sample period, which implies that the effect of the Worker Dispatching Act in 2004 may be limited.

The Establishment and Enterprise Census allows the inclusion of information about the number of permanent and temporary workers by enterprise size measured as the number of employees. Although we are unable to use these data for estimation because of the inaccessibility of matched firm-activity data, observing which firms change their relative demand for temporary workers is helpful when interpreting estimation results. Figure 1 presents changes in the ratio of temporary workers between 1999 and 2006 by establishment size. The figure shows that (i) in 1999, the ratio of temporary workers tended to become lower as the size of establishment increased, (ii) the shift from permanent to temporary workers mainly occurred in larger establishments, and (iii) as a result, the variation in the ratios of temporary workers across establishments substantially decreased. The recent literature on heterogeneous trade firms has empirically revealed that only sufficiently productive firms can cover fixed entry costs and will be internationalized through trade.[24] Because the size of enterprises is in general positively correlated with their productivity, the figure suggests that the numbers of temporary workers dramatically increased in enterprises that are likely to be engaged in international activities.

Summary statistics for the explanatory variables mentioned above are reported in Table 2. Because some measures including the world share of value added are limited to the nine years between 1997 and 2005, we take the same period for other measures. We find that the Japanese share is incredibly high (more than 80%) in Fish and Coal Products, which is simply because some countries' data are not reported in INDSTAT. We therefore drop these two industries from our sample, leaving 43 industries for regression.

Table 2 confirms that Japanese manufacturers have reduced the employment of permanent workers (defined as full-time workers) and increased the number of temporary workers during the sample period. In particular, among temporary workers, they have substantially increased the use of dispatched workers. As for globalization-related variables, the share of imported input increased more distinctively from about 6.1% to 8.6%. The world share of value added also has decreased by 0.7 percentage points during the sample period. The

[24]These studies include Bernard, Eaton, Jensen, and Kortum (2003) for the United States, Tomiura (2007) for Japan, Mayer and Ottaviano (2007) for various EU countries, and Kasahara and Lapham (2013) for some developing countries.

export share has increased from 13.7% to 17.6%.

Turning to the variables representing industrial characteristics and technological changes, TFP has slightly improved during the sample period. While Japanese manufacturers have increased their capital stock by about 44% during the sample period, they have increased their IT-related capital stock more aggressively, resulting in an increase in the share of IT-related capital in total capital by 2 percentage points. The share of elderly workers has increased by 5%, but that of female workers has declined during the sample period.

5 Estimation Results

5.1 Impact on Ratio of Temporary Workers

The estimation results on the ratio of temporary workers to total labor input are reported in Table 3. The coefficients of year dummies and fixed effects by industry are suppressed for brevity. As is expected, the impact of increases in world share of value added is negative and statistically significant (columns (1) and (3)), implying that the share of temporary workers increases when industries experience some loss of world share of value added. When estimated with the share of imported intermediate goods, the world share of value added is still significant at the 1% level.

The effect of outsourcing measured by the share of imported intermediate goods is positive and significant (columns (2) and (3)). Because the ratios of temporary workers and imported intermediates are expressed as percentages, a parameter estimate of 0.33 implies that a 10% increase in the share of imported intermediates will raise the ratio of temporary workers by 3.3 percentage points. These results support our hypothesis on outsourcing: industries with more outsourcing tend to increase their relative use of temporary workers.

We obtain positive and statistically significant coefficients for export share. Industries with larger increases in exports tend to increase the fraction of temporary workers in total labor input. This indicates that the ratio of temporary workers for exports is higher than that for domestically supplied goods, which is consistent with our theory. Furthermore, real output is significant at the 1% level with the correct sign. The parameter estimate of 0.07 implies that a 10% increase in real output will raise the share of temporary workers by 0.7 percentage points. This estimate is consistent with the theoretical model.

Capital intensity shows a negative sign with marginal significance. However, the effect is almost negligible. Technology-related variables such as the log of TFP and IT-capital intensity in general do not have significant explanatory power for the ratio of temporary workers.[25] Two demographic variables–Elderly worker ratio and Female worker ratio–are not statistically significant although the sign of the female worker ratio is as expected. These results suggest that the demographic change in labor force during the sample period was not a major reason for the demand shift toward temporary workers in the manufacturing sector.

Overall, the estimation results indicate a correlation between relative increases in the employment of temporary workers and the indices of world market competition and foreign outsourcing in the Japanese manufacturing sector. In contrast, technological change in the IT field appears to be irrelevant to the recent shift from permanent to temporary workers.

5.2 Impact on the Employment of Permanent and Temporary Workers

To examine further how internationalization would change the demand for temporary and permanent workers, we perform regressions of the log of the employment of permanent and temporary workers on the internationalization indices. In particular, we expect that the two indices of internationalization—world share of value added and the share of imported input—affect only permanent workers. In contrast, real output is positively correlated with the employment of temporary workers and irrelevant to the employment of permanent workers.

Table 4 presents the estimation results. We find that the estimation results largely support the predictions of the theoretical model. The coefficient of the world share of value added is significant and shows the predicted sign with respect to permanent workers. The share of imported input is negative and significant at the 1% level with respect to permanent workers. The dependent variable is expressed in logarithm and the share of imported input is a percentage. Hence, an estimate of -2.9 implies that as the share of imported input increases by 10 percentage points, the employment of permanent workers on average will decrease by 0.29%.

In contrast, these two explanatory variables are not statistically significant with respect to the employment or temporary workers. Instead, the coefficient of the log of real output is positive and significant only for temporary workers, consistent with the theory. While the coefficient of export share for permanent workers is positive but not significant, it is positive and significant for temporary workers, which reflects that temporary workers are

[25] Replacing IT-capital intensity with IT-capital share does not alter the estimation results.

more aggressively used in export production than on average.

These results imply that the direction of causality is likely to be as expected from the model's predictions. For example, firms may decrease domestic employment to use imported intermediates more aggressively. However, this mechanism hardly explains why firms decrease *only* the number of permanent workers, in spite of their adjustment costs. It is natural to interpret this estimation result as meaning that increasing opportunities for using imported intermediates raise the expected adjustment cost of permanent workers, so firms reduce their employment of permanent workers. The interpretation of the results for world share of value added is more straightforward. It is unlikely that firms decrease their permanent workforce, giving rise to decreases in their world share of value added in that industry.

Furthermore, the result from the 2SLS estimation for the share of imported input is reported in column 3 of Table 4. The share of imported inputs remains statistically significant. The coefficient of the share of imported input increases in 2SLS, compared to that in the OLS with fixed effects, which suggests that the simultaneity of the employment of permanent workers and outsourcing is likely to underestimate the impact of outsourcing on the employment of permanent workers. Consequently, we confirm two convincing channels of globalization—outsourcing and world market competition—that reduce firms' demand for permanent workers.

The coefficient of TFP is not significant for both permanent and temporary workers, which suggests that there is no room for TFP to influence the employment of permanent and temporary workers after controlling for output.[26] Capital intensity affects only permanent workers, but is almost negligible in magnitude. IT-capital intensity is not significant for both permanent and temporary workers, which clearly denies the effect of the prevalence of IT-technology.[27] Increases in the ratio of female workers raise the employment of temporary workers. This result is also consistent with the fact that the share of temporary workers is higher among female workers than male workers.

Overall, employing industry-level datasets, we find that more outsourcing (proxied by increases in the share of imported inputs) tends to decrease the employment of permanent workers. In addition, we find that in industries where world value added share declines, firms

[26] As Table 2 shows, TFP has hardly changed during the sample period. We note that this particular trend of TFP might contribute to generating these non-significant results.

[27] Using IT-capital share in total capital stock instead of IT-capital intensity does not change the results at all, so we do not report this in detail.

tend to reduce the employment of permanent workers. This is another globalization conduit that we identified. Furthermore, we show that firms are encouraged to hire more temporary workers when their sales increasingly rely on foreign markets (increases in export share), or when their market positions deteriorate (decreases in world share in valued added). These results confirm that firms use more temporary workers as a buffer against output fluctuations from globalized market competition.

6 Conclusions

This paper examined whether economic globalization, such as trade and outsourcing, affects firms' demands for temporary and permanent workers. For this purpose, we developed a simple monopolistic competition model in which firms may use temporary workers as well as permanent workers to evade the firing cost accompanied with permanent workers. Our theoretical model emphasized two features: (i) a firm sets an upper bound for the employment of permanent workers and uses temporary workers to fill the gap between its realized labor demand and this upper bound; and (ii) trade openness and foreign outsourcing intensify product market competition, and facing more elastic product demand, firms tend to increase their relative demand for temporary workers.

Our model also yields interesting insights on the relative demand for temporary in heterogeneous firms. More productive firms tend to have lower proportions of temporary workers than un productive firms. In our open economy setting, increases in the foreign market size or improvement in the foreign country's productivity for differentiated goods raise the relative demand for temporary workers only for exporting firms in the home country. These observations are largely consistent to the trend of the ratio of temporary workers in Japanese manufacturing firms.

The model highlights the role of product market competition: product market competition enlarges the impact of output fluctuations caused by taste shocks by making firms' product demand more elastic, which induces firms to use more temporary workers, resulting in a higher proportion of temporary workers within the same firm. In addition, the model identified that foreign outsourcing functions as inexpensive labor without adjustment costs. By using imported intermediate goods, firms can correct the distortion in the employment of permanent workers for in-house production, which reduces the demand for permanent workers.

We also empirically tested the validity of the model's predictions by constructing an industry-level panel dataset. Our main empirical findings are as follows: First, the world share of value added showed the correct sign: industries tend to decrease the relative demand for permanent workers when losing competitive positions in the world market. Second, increases in outsourcing raise the ratio of temporary workers to total labor input by decreasing the employment of permanent workers. In sum, we conclude that world market competition and outsourcing may explain the structural demand shift toward temporary workers in Japanese manufacturers.

Although the estimation presented plausible results, it needs qualifications. The current empirical analysis is confined to industry-level data, although we reinforced it by presenting the fact that the recent employment shift to temporary workers has mainly occurred among large establishments. Using firm- or establishment-level data with location information can definitely enrich our study in terms of more precisely identifying globalization channels. Due to data limitation, we did not examine the effects of foreign direct investment (FDI), but obviously this does not mean that FDI does not affect the employment of temporary and permanent workers. In theory, vertical FDI should have similar effects on the relative demand for temporary workers as foreign outsourcing, and it would be interesting to test the validity of this conjecture. These issues are left for future research.

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Table 1: Ratios of Temporary Workers in 1999 and 2006 and Their Growth Rates

	Industry	Ratio of Temporary Workers		Annual Growth Rate	
		1999	2006	1999–2006	2004–2006
1	Meat products	0.44	0.50	1.6	−1.3
2	Fish products	0.50	0.54	0.9	−0.9
3	Grain mill products	0.25	0.32	3.4	3.7
4	Other processed food	0.51	0.58	1.8	0.1
5	Prepared animal feeds	0.24	0.31	3.8	6.3
6	Beverages	0.30	0.36	2.4	−1.7
7	Tobacco	0.06	0.09	6.2	30.2
8	Textiles and fabrics	0.30	0.32	1.0	−1.3
9	Wood products	0.17	0.23	3.9	0.6
10	Furniture	0.17	0.25	5.1	3.4
11	Pulp, paper, and paperboard	0.11	0.15	4.0	−1.9
12	Other paper products	0.25	0.30	2.8	−0.4
13	Printing	0.18	0.22	2.4	−1.8
14	Leather products	0.37	0.37	0.2	−2.8
15	Rubber products	0.23	0.33	5.4	3.6
16	Fertilizer	0.13	0.18	4.7	5.2
17	Chemical products	0.13	0.17	4.5	9.9
18	Chemical fiber and textiles	0.13	0.24	9.1	11.3
19	Other chemical products	0.21	0.29	4.5	0.7
20	Pharmaceutical	0.13	0.21	7.1	4.1
21	Refined petroleum products	0.08	0.12	6.4	3.2
22	Coal products	0.16	0.19	2.3	1.7
23	Glass products	0.26	0.38	5.6	4.9
24	Cement and concrete	0.15	0.22	4.8	5.9
25	Ceramics	0.21	0.29	5.0	2.6
26	Other ceramic products	0.15	0.22	5.9	4.8
27	Pig iron and steel	0.13	0.13	−0.6	13.5
28	Other iron and steel products	0.12	0.20	7.4	0.8
29	Non-ferrous metal refining	0.18	0.23	2.9	2.6
30	Non-ferrous metal	0.17	0.24	5.0	1.2
31	Architectural metal products	0.20	0.25	3.6	2.9
32	Other metal products	0.22	0.28	3.3	1.0
33	General industrial machinery	0.14	0.22	6.9	7.5
34	Office machinery	0.26	0.30	2.2	−7.2
35	Heavy electrical machinery	0.20	0.31	6.1	7.8
36	Radio and Television	0.22	0.32	5.2	0.6
37	Accounting and computing machines	0.23	0.33	5.3	2.3
38	Electronic instrument	0.22	0.32	5.2	0.2
39	Electronic parts	0.23	0.32	5.1	0.3
40	Other electrical equipment	0.22	0.33	5.9	6.3
41	Motor vehicle and its parts	0.14	0.29	10.6	5.5
42	Other transport equipment	0.24	0.29	2.8	2.1
43	Precision machinery	0.21	0.29	5.0	1.8
44	Plastic products	0.30	0.38	3.1	−0.1
45	Other manufacturing	0.29	0.33	1.9	−0.3

Notes: Authors' calculation based on the Establishment and Enterprise Census and the JIP database 2009. Growth rates are in percent.

Table 2: Summary Statistics of Dependent and Explanatory Variables

			Growth Rate	
Dependent & Explanatory Variables	1999	2006	1999–2006	2004–2006
Ratio of temporary workers (RTW)	0.207	0.275	33.1	3.9
	(0.073)	(0.075)	(2.8)	(−7.9)
ln(Permanent)	11.741	11.556	−1.6	0.0
	(0.943)	(0.947)	(0.4)	(1.2)
ln(Temporary)	9.808	9.968	1.6	−0.4
	(1.409)	(1.241)	(−11.9)	(0.5)
	1998	2005	1998–2005	2003–2005
Outsourcing				
Share of imported input	0.061	0.086	40.2	11.4
	(0.044)	(0.076)	(73.8)	(9.0)
Product market competition				
World share of value added	0.151	0.144	−4.3	0.3
	(0.051)	(0.058)	(13.6)	(8.2)
Export share	0.137	0.176	29.0	12.8
	(0.124)	(0.163)	(31.4)	(10.2)
Industry characteristics				
ln(Output)	15.365	15.324	−0.3	0.2
	(0.879)	(1.008)	(14.8)	(4.5)
Capital intensity	28.462	41.036	44.2	13.4
	(41.721)	(61.275)	(46.9)	(13.7)
ln(TFP)	4.744	4.786	0.9	0.6
	(0.206)	(0.302)	(46.8)	(14.4)
IT-Capital share	0.111	0.130	17.2	8.9
	(0.066)	(0.076)	(16.1)	(8.1)
IT-Capital intensity	2.803	4.783	70.6	26.0
	(3.445)	(5.615)	(63.0)	(30.5)
Elderly workers share	0.208	0.249	19.8	3.1
	(0.066)	(0.075)	(14.0)	(3.3)
Female workers share	0.306	0.275	−10.0	−5.5
	(0.117)	(0.108)	(−8.1)	(−4.8)

Source: JIP 2009 and UNIDO Industrial Statistics Database (INDSTAT). The estimated sample excludes two industries: Fish products and Coal products. For these two industries the Japanese share of value added is incredibly high. Standard errors are given in parentheses.

Table 3: Impact of Globalization on the Ratio of Temporary Workers

	(1)	(2)	(3)
Dependent variable	RTW	RTW	RTW
World share of value added	-0.380^{*}		-0.415^{**}
	(0.158)		(0.151)
Share of imported input		0.292^{*}	0.326^{*}
		(0.141)	(0.145)
Export share	0.205^{**}	0.141^{**}	0.139^{*}
	(0.064)	(0.045)	(0.052)
ln(output)	0.059^{**}	0.063^{**}	0.072^{**}
	(0.014)	(0.013)	(0.013)
Capital intensity	-0.000	-0.000^{+}	-0.000^{+}
	(0.000)	(0.000)	(0.000)
ln(TFP)	-0.007	0.015	-0.000
	(0.016)	(0.014)	(0.014)
IT-capital intensity	0.000	-0.001	-0.001
	(0.001)	(0.001)	(0.001)
Elderly worker ratio	-0.002	-0.002	-0.002
	(0.002)	(0.002)	(0.002)
Female worker ratio	0.001	0.002	0.002
	(0.002)	(0.002)	(0.002)
Observations	172	172	172
R^2	0.863	0.861	0.877

Notes: Fixed effects regression with time-specific effects. All regressors related to globalization are lagged by one-year. The heteroskedasticity and autocorrelation robust standard errors are in brackets. + significant at 10%; * significant at 5%; ** significant at 1%.

Table 4: Impact of Globalization on the Employment of Permanent and Temporary Workers

	(1) FE	(2) FE	(3) IV
	ln(Permanent)	ln(Temporary)	ln(Permanent)
World share of value added	2.152^{*}	-1.207^{+}	2.255^{**}
	(0.998)	(0.710)	(0.610)
Share of imported input	-2.960^{**}	-0.455	-3.899^{**}
	(0.647)	(0.740)	(1.345)
Export ratio	0.346	0.961^{**}	0.535
	(0.206)	(0.339)	(0.338)
ln(output)	0.100	0.461^{**}	0.064
	(0.080)	(0.108)	(0.079)
Capital intensity	0.000	-0.000	0.000
	(0.001)	(0.001)	(0.001)
ln(TFP)	-0.029	-0.062	-0.048
	(0.080)	(0.077)	(0.071)
IT-capital intensity	-0.003	0.002	-0.001
	(0.009)	(0.008)	(0.009)
Elderly worker ratio	-0.002	-0.024	-0.002
	(0.009)	(0.015)	(0.007)
Female worker ratio	0.011	0.039^{**}	0.008
	(0.009)	(0.012)	(0.009)
Observations	172	172	172
R^2	0.764	0.679	0.755

Notes: Fixed effects regression with time-specific effects. All regressors related to globalization are lagged by one-year. The heteroskedasticity and autocorrelation robust standard errors are in brackets. + significant at 10%; * significant at 5%; ** significant at 1%. The first stage F-stat is 16.7 in (3).

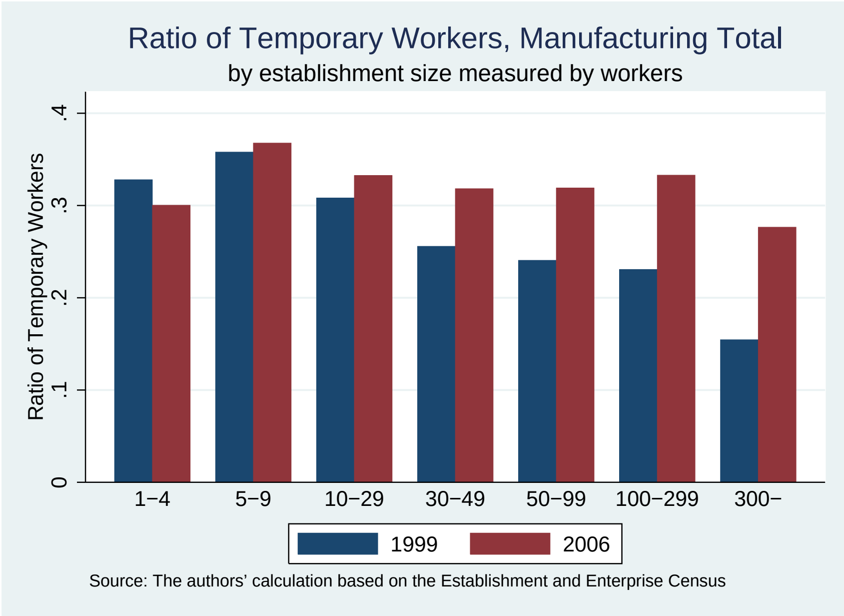

Figure 1: Ratio of Temporary Workers by Establishment Size

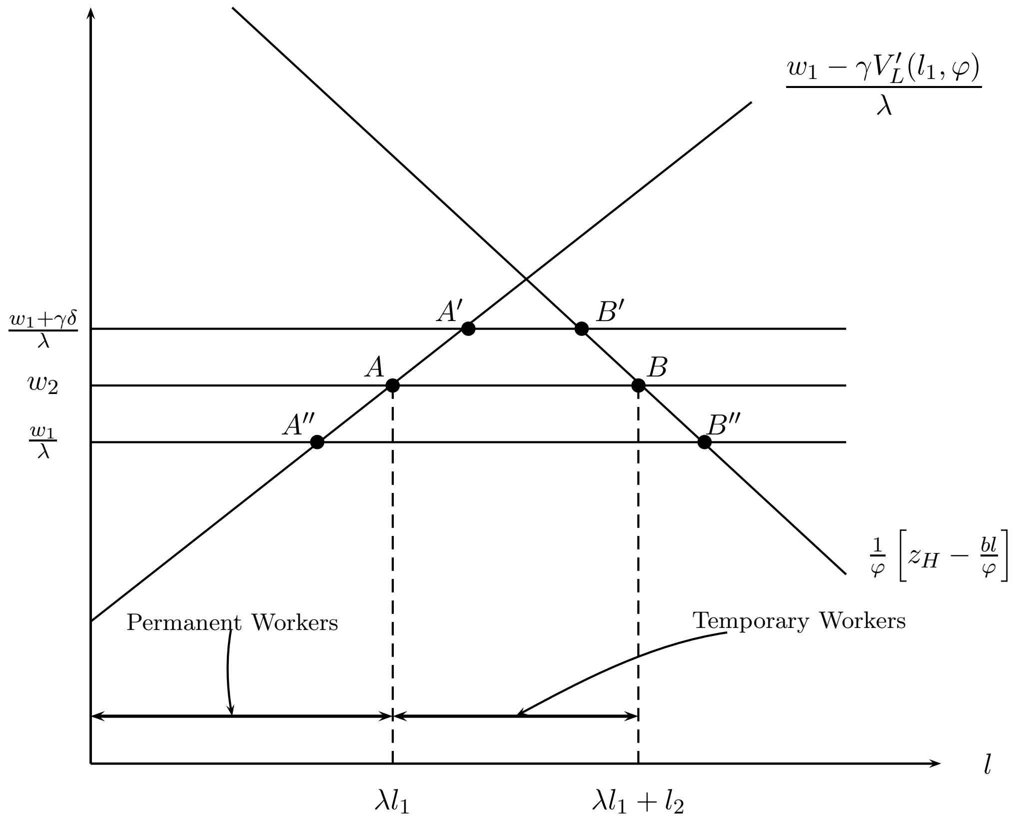

Figure 2: Determination of Employment

A Appendix: Proofs

A.1 Proof of Proposition 1

Partially differentiating the ratio of permanent workers to the total employment with respect to $\bar{z}$ generates

$$z_H - w_2 - z_L - \frac{w_1}{\lambda} + \frac{\rho+\beta}{\gamma}\left(w_2 - \frac{w_1}{\lambda}\right) = b(\lambda l_1 + l_2) - b\lambda l_1 > 0. \tag{A.1}$$

A.2 Proof of Proposition 2

Partially differentiating the ratio of permanent workers to the total employment with respect to φ generates

$$w_2 z_L - (\omega_1 - d) z_H. \tag{A.2}$$

Thus, as long as Assumption 1 holds, the derivative is positive.

A.3 Proof of Proposition 3

Differentiating the average profits prior to entry gives

$$\frac{\partial \bar{\pi}_s(\bar{z})}{\partial \bar{z}} = \pi_s(\bar{z}, \varphi_s)\frac{\partial \varphi_s}{\partial \bar{z}} + \int_0^{\varphi_s(\bar{z})} \frac{\partial \bar{\pi}_s(\bar{z}, \varphi)}{\partial \bar{z}} dG(\varphi) > 0 \tag{A.3}$$

because the first term is zero and the second term is strictly positive (see equations (15) and (16)).

From equations (15) and (16), the partial derivatives of $\bar{\pi}_s$ in terms of L and ζ are straightforward:

$$\frac{\partial \bar{\pi}_s}{\partial L} > 0 \quad \text{and} \quad \frac{\partial \bar{\pi}_s}{\partial \zeta} < 0. \tag{A.4}$$

As for the productivity improvement in the differentiated goods, we consider decreases in the lower bound of the productivity distribution for a given technology $G(\varphi)$. Thus, for $\varphi'_m < \varphi_m$, we have $g(\varphi; \varphi'_m) \geq g(\varphi; \varphi_m)$ for all φ, which implies that

$$\frac{\partial \bar{\pi}_s}{\partial \varphi_m} < 0. \tag{A.5}$$

Therefore, increases in L, decreases in ζ, or decreases in φ_m lower $\bar{z}$:

$$\frac{d\bar{z}}{dL} < 0, \quad \frac{d\bar{z}}{d\zeta}, \quad \text{and} \quad \frac{d\bar{z}}{d\varphi_m} > 0. \tag{A.6}$$

Using Proposition 1, we obtain the results in Proposition 3.

A.4 Proof of Proposition 5

The ratio of permanent workers to the total employment is given by

$$\frac{\bar{z} + \alpha_L - \varphi[\tilde{\omega}_1(\theta) - \theta d]}{\bar{z} + \alpha_H - \varphi \tilde{w}_2(\theta)}. \tag{A.7}$$

Differentiating this ratio with respect to θ yields

$$\underbrace{\frac{\partial \bar{z}}{\partial \theta}\left[(z_H - \varphi\tilde{w}_2) - (z_L - \varphi(\tilde{\omega}_1 - \theta d))\right]}_{\text{market competition effect}} + \underbrace{\varphi d\,(z_H - \varphi\tilde{w}_2)}_{\text{adjustment mitigation effect}}$$
$$+ \underbrace{\varphi(w_2 - p_m)\left[z_L - \varphi(\tilde{\omega}_1 - \theta d)\right] - \varphi(\tilde{\omega}_1 - p_m)\,(z_H - \varphi\tilde{w}_2)}_{\text{productivity gain effect}}. \quad \text{(A.8)}$$

The first term represents the effect of product market competition and the sign is positive. The second term represents the effect that foreign outsourcing reduces the employment distortion in permanent workers and the sign is positive. The last two terms represent the effect of productivity gains from outsourcing. The total sign of the productivity effect is not clear because the productivity gain from outsourcing is always smaller in the low state than in the high state. For example, suppose that $p_m = \omega_1$. Then, the last term disappears, and the sign of the productivity gain effect becomes positive. Thus, as long as the price of imported intermediate goods is not much lower than ω_1, the total sign of the productivity effect will be positive. Thus, the fraction of temporary workers in the total employment is likely to increase as θ falls (more outsourcing).

B Appendix: Technical Notes

B.1 Wage Determination

This appendix explicitly considers a wage determination mechanism. For this purpose, we follow the standard efficiency wage model by Shapiro and Stiglitz (1984), but note that other models of imperfect labor markets could generate similar results. It is assumed that the effort level is discrete such that $e = \{0, \bar{e}\}$ and measured in units of the numeraire goods. Workers with the effort level $\bar{e}$ have relative productivity $\lambda > 1$. Otherwise, workers are less productive and the productivity is normalized to one. As usual, because monitoring workers' effort level is too costly, firms instead offer a wage premium to workers to induce their effort. We argue that long-term labor contracts with high job security can induce workers' effort with less cost than fixed-duration contracts. Thus, the model can predict a dual structure of employment, in which *ex ante* homogenous workers become *ex post* heterogeneous within a sector: some workers enjoy stable jobs with higher wages, whereas others accept unstable jobs with lower wages.

Workers obtain either long-term or fixed-duration labor contracts, and there are no unemployed (because of the homogenous goods sector). We denote by E_k the expected present value of being employed with a long-term contract and not shirk in state $k = H, L$. Likewise, S_k denotes the expected present value of being employed with a long-term contract but shirking, and U is the present value of working as a temporary worker. The value of E_H is given by

$$E_H = (w_{1H} - \bar{e})dt + (1 - \rho dt)\left[(1 - \gamma dt)E_H + \gamma dt\theta E_L + \gamma dt(1 - \theta)U\right], \quad \text{(B.1)}$$

where $\theta \equiv l_{1L}/l_{1H}$ is the probability of being retained when the firm is hit by a bad shock. The first term in the RHS of equation (B.1) represents the flow utility from receiving the wage in the high state and making effort $\bar{e}$. The second term is the expected future value: the worker continues being employed in the high state with probability $(1 - \gamma dt)$, being employed in the low state with probability $\gamma dt\theta$, and being unemployed with probability $\gamma dt(1-\theta)$. Although we have already showed that permanent workers are never dismissed when temporary workers are available, leading to $\theta = 1$, we maintain θ for generality.

The value of being employed with a long-term contract without shirking in the low state, E_L, is simply given by

$$E_L = (w_{1L} - \bar{e})dt + (1 - \rho dt)\left[(1 - \beta dt)E_L + \beta dt E_H\right]. \tag{B.2}$$

If an employed worker is shirking, it will increase their flow utility by $\bar{e}$, but when shirking is detected, the worker will be fired and obtain the value of being a temporary worker, U. As is standard, the firm sets w_{1k} such that workers are indifferent between exerting an effort and shirking: $S_k = E_k$. Letting the flow probability that detection occurs be qdt, the non-shirking condition is given by $\bar{e} = q(E_k - U)$, which implies that

$$E_H = E_L = U + \frac{\bar{e}}{q}. \tag{B.3}$$

Applying (B.3) to equations (B.1) and (B.2) and rearranging a little, efficiency wages for permanent workers can be expressed as

$$w_{1H} = \bar{e} + \rho(U + \bar{e}/q) + \gamma(1-\theta)\bar{e}/q, \tag{B.4}$$

$$w_{1L} = \bar{e} + \rho(U + \bar{e}/q). \tag{B.5}$$

Equations (B.4) and (B.5) imply that when firms are in the high state, firms have to pay a higher wage in the high state than the low state to incentivize permanent workers not to shirk when their jobs are less secure. However, if temporary workers are available, permanent workers will be never dismissed. Thus, $\theta = 1$ and $w_{1H} = w_{1L}$ is the case. We hereafter drop the subscript for the state from the permanent wage unless it causes confusion.

Finally, the value of being employed as a temporary worker is given by

$$U = w_2 dt + (1 - \rho dt)[adtE_k + (1 - adt)U], \tag{B.6}$$

where w_2 is the wage rate for temporary workers and a denotes the probability of finding a position as a permanent worker. Substituting (B.3) into (B.6) leads to

$$U = \frac{w_2 + a\bar{e}/q}{\rho}. \tag{B.7}$$

Substituting (B.7) into (B.4) and (B.5) and using $\theta = 1$, we obtain

$$w_1 = w_2 + \bar{e} + (\rho + a)\bar{e}/q \tag{B.8}$$

The wage for permanent workers is increasing in a, which can be interpreted an index of the tightness of the labor market.

In the employment policy that we consider here, permanent workers are never dismissed. Therefore, substituting $a = 0$, the wage for permanent workers is given by

$$w_1 = w_2 + \tilde{e}, \tag{B.9}$$

where $\tilde{e} \equiv (\rho + q)\bar{e}/q$. The condition of $w_1 < \lambda w_2$ can be expressed as

$$(\lambda - 1)w_2 > \frac{(\rho + q)\bar{e}}{q},$$

and we assume that this condition holds. The wage for temporary workers is given by the labor productivity in the homogenous good sector, and the wage for permanent workers is given by that for temporary workers plus the effort premium.

B.2 The Derivation of $-\delta \leq V_L'(l_1, \varphi) < 0$

Suppose that $V_L'(l_1, \varphi) > 0$, that is, the marginal benefit from increasing the employment of permanent workers is positive in the low state. If this is the case, the firm would increase the employment of permanent workers in the low state. This cannot be an equilibrium because the firm are willing to increase permanent jobs in the low state.

From equation (11), $V_L'(l_1) = 0$ leads to $z_L/\varphi - b\lambda l_1/\varphi^2 = \omega_1$, which implies that the marginal revenue in the low state equals the wage of permanent workers. This condition is applicable only when permanent workers are not associated with a firing cost.

If temporary workers are unavailable, the firm will change the employment level of permanent workers depending on the state. When the state switches from high to low, the firm will dismiss permanent workers until the marginal benefit for reducing the employment in the low state is equalized to the (marginal) firing cost, namely, $V_L'(l_1, \varphi) = -\delta$.

These observations are illustrated in Figure 3. In the figure, $V_L'(l_1, \varphi)$ is decreasing in l_1. If there is no firing cost for permanent workers, then, the firm would choose the optimal employment level of permanent workers by setting $V_L'(l_1, \varphi) = 0$ (Point A). In contrast, with firing cost δ, the firm would choose the employment of permanent workers such that $V_L'(l_1, \varphi) = -\delta$ (Point B). In the low state, the firm employs too many permanent workers due to the firing cost.

We argue that, if temporary workers are available, the employment of permanent workers in the low state will be somewhere between l_{1L}^* and $\bar{l}_{1L}$ in Figure 3. Equation (10) can be rearranged as follows.

$$V_L'(l_1, \varphi) = -\frac{\lambda w_2 - w_1}{\gamma}. \tag{B.10}$$

Because of $\lambda w_2 > w_1$, we have $V_L'(l_1, \varphi) < 0$. To prove $-\delta \leq V_L'(l_1, \varphi)$, it is sufficient to show that $(\lambda w_2 - w_1)/\gamma \leq \delta$. This condition can be rewritten as

$$\lambda w_2 \leq w_1 + \gamma\delta, \tag{B.11}$$

and the right-hand side is the marginal cost of permanent workers in the high state, given that fixed-duration contracts are unavailable. In the case of the employment policy in the main text (i.e., firms fill new jobs only with temporary workers), the inequality is strict. Thus, we establish $-\delta \leq V_L'(l_1, \varphi) < 0$.

In Figure 3, given that fixed-duration contracts are available, the employment of permanent workers in the low state is depicted at point C, which shows that the availability of temporary workers allows firms to choose a more efficient employment level in the low state.

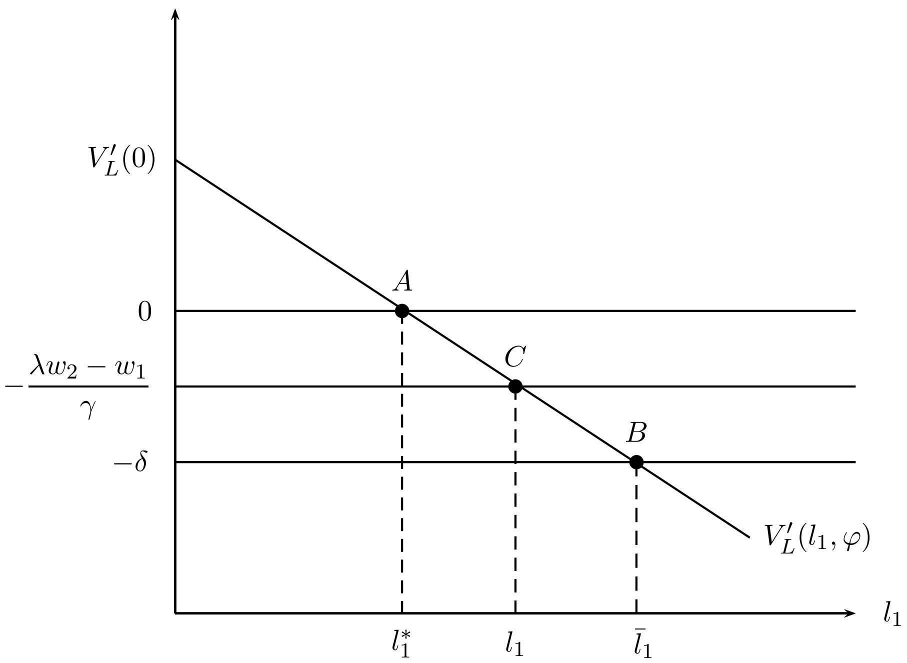

Figure 3: Determination of Employment

B.3 Iso-elastic Demand

This appendix shows that the relative demand for temporary workers to the total employment is neutral with respect to (i) market size and (ii) heterogeneity in firm productivity when we assume an iso-elastic demand for the differentiated goods.

Suppose that the representative consumer's utility function is given by

$$U = q_0^{1-\phi} \left[\int_{i \in \Omega} \alpha_i q_i^{(\sigma-1)/\sigma} di \right]^{\phi\sigma/(\sigma-1)}, \quad \phi \in (0,1), \quad \sigma > 1, \tag{B.12}$$

where q_0 and q_i denote consumption of the homogenous good and variety i of the differentiated goods, respectively, and $a_i > 0$ are taste parameters variable over time. Specifically, α_i are composed of the part that is common and constant across varieties and the variety-specific i.i.d. part, so that $\alpha_i = \bar{\alpha} + \alpha_s$, $s = \{H, L\}$, and α_s follows a two state Markov process that is the same as the one in the main text. Since α_s takes two different values according to state s, we hereafter change the subscript from i to s.

The inverse demand for variety i is

$$p_i = (\alpha_s \phi E)^{1/\sigma} P^{(\sigma-1)/\sigma} q_i^{-1/\sigma}, \tag{B.13}$$

where E is the total income and P is the aggregate price index such that

$$P = \left(\int_{i \in \Omega} \alpha_s^\sigma p_i^{1-\sigma} di \right)^{1/(1-\sigma)}. \tag{B.14}$$

Because a firm's output is $y = l/\varphi$, the firm's revenue can be expressed as

$$r(\varphi) = z_s \varphi^{(1-\sigma)/\sigma} l^{(\sigma-1)/\sigma}, \tag{B.15}$$

where l is the labor input in units of temporary workers, and $z_s \equiv (\alpha_s \phi E)^{1/\sigma} P^{(\sigma-1)/\sigma}$. Note that shocks on α are i.i.d. and the price index P is stable by the law of large numbers and z_s do not depend on firms' productivity φ.

The wage for temporary workers is determined by the competitive wage in the numeraire goods sector,and the wage for permanent workers is given by the wage for temporary workers plus the constant efficiency premium as in the main text. The total employment in state H is derived from the standard first-order condition:

$$\lambda l_1 + l_2 = \left(\frac{z_H \eta}{w_2} \right)^{\sigma}, \tag{B.16}$$

where $\eta \equiv (\sigma - 1)/\sigma \cdot \varphi^{(1-\sigma)/\sigma}$.

Following the same procedure in the main text, the employment of permanent workers is given by

$$\lambda l_1 = \left(\frac{z_L \eta}{\omega_1 - d} \right)^{\sigma}. \tag{B.17}$$

The ratio of temporary workers to the total employment is given by

$$\begin{aligned} \frac{\lambda l_1}{\lambda l_1 + l_2} &= 1 - \left(\frac{z_L}{z_H} \cdot \frac{w_2}{\omega_1 - d} \right)^{\sigma} \\ &= 1 - \frac{\alpha_H}{\alpha_L} \left(\frac{w_2}{\omega_1 - d} \right)^{\sigma}. \end{aligned} \tag{B.18}$$

Thus, the ratio of temporary workers under iso-elastic demand is constant and does not depend on firm productivity φ. For CES demand, changes in the market size are reflected in the price index P. However, the price index P is neutral with respect to the relative demand for temporary workers.

B.4 Closed Economy Equilibrium

A firm's optimal output in the high and low states is given by

$$q_H(\bar{z}, \varphi) = \frac{L}{2\zeta} \left[\bar{z} + \alpha_H - \varphi w_2 \right] \quad \text{and} \quad q_L(\bar{z}, \varphi) = \frac{L}{2\zeta} \left[\bar{z} + \alpha_L - \varphi \left(\omega_1 - d \right) \right], \tag{B.19}$$

respectively, and where $b = 2\zeta/L$ and $z_j = \bar{z} + \alpha_s$ are used.

The profit maximizing prices p_s, mark-ups μ_s defined by the difference between the price and the marginal cost, and revenues r_s are given by

$$p_H(\bar{z}, \varphi) = \frac{1}{2} \left(\bar{z} + \alpha_H + \varphi w_2 \right), \qquad p_L(\bar{z}, \varphi) = \frac{1}{2} \left[\bar{z} + \alpha_L + \varphi \left(\omega_1 - d \right) \right], \tag{B.20}$$

$$\mu_H(\bar{z}, \varphi) = \frac{1}{2} \left(\bar{z} + \alpha_H - \varphi w_2 \right), \qquad \mu_L(\bar{z}, \varphi) = \frac{1}{2} \left[\bar{z} + \alpha_L - \varphi \left(\omega_1 - d \right) \right], \tag{B.21}$$

$$r_H(\bar{z}, \varphi) = \frac{L}{4\zeta} \left[\left(\bar{z} + \alpha_H \right)^2 - \left(\varphi w_2 \right)^2 \right], \quad r_L(\bar{z}, \varphi) = \frac{L}{4\zeta} \left[\left(\bar{z} + \alpha_L \right)^2 - \varphi^2 \left(\omega_1 - d \right)^2 \right]. \tag{B.22}$$

As usual, productive firms have lower prices, higher mark-ups, and higher revenues than unproductive firms in both states. In addition, prices, markups, and revenues are lower in the low state than in the high state.

An operating firm's profits in the low and high states are given by

$$\begin{aligned}\pi_H(\varphi) &= r_H(\varphi) - w_1 l_1(\varphi) - w_2 l_2(\varphi)\\ &= \frac{1}{2b}\left[(z_H)^2 - (\varphi w_2)^2\right] - w_1 l_1 - w_2\left[\frac{\varphi(z_H - \varphi w_2)}{b} - \lambda l_1\right]\\ &= \frac{1}{2b}\left[(z_H)^2 - (\varphi w_2)^2\right] + (\lambda w_2 - w_1) l_1 - \frac{\varphi w_2}{b}(z_H - \varphi w_2)\\ &= \frac{1}{2b}(z_H - \varphi w_2)^2 + \varphi(w_2 - \omega_1) q_L(\varphi),\end{aligned} \tag{B.23}$$

and

$$\begin{aligned}\pi_L(\varphi) &= r_L(\varphi) - w_1 l_1(\varphi)\\ &= \frac{1}{2b}\left[(z_L)^2 - \varphi^2(\omega_1 - d)^2\right] - w_1 \cdot \frac{\varphi}{\lambda b}\left[z_L - \varphi(\omega_1 - d)\right]\\ &= \frac{1}{2b}\left[(z_L - \varphi\omega_1)^2 - (\varphi d)^2\right].\end{aligned} \tag{B.24}$$

Solving equations (7) and (8) for V_j, we obtain

$$V_H(\varphi) = \frac{1}{\rho(\rho+\beta+\gamma)}[\gamma\pi_L(\varphi) + (\rho+\beta)\pi_H(\varphi)] \tag{B.25}$$

$$V_L(\varphi) = \frac{1}{\rho(\rho+\beta+\gamma)}[(\rho+\beta)\pi_L(\varphi) + \beta\pi_H(\varphi)]. \tag{B.26}$$

Denoting the average profits prior to entry by $\bar{\pi}_j = \int_0^{\varphi_j} \pi_j(\varphi) dG(\varphi)$, the expected firm value prior to entry is given by

$$\bar{V} = h\bar{V}_H + (1-h)\bar{V}_L = \frac{h\bar{\pi}_H + (1-h)\bar{\pi}_L}{\rho}, \tag{B.27}$$

where $h \equiv \beta/(\beta+\gamma)$. Thus, the free entry condition is expressed by

$$h\bar{\pi}_H + (1-h)\bar{\pi}_L = \rho f_e, \tag{B.28}$$

which is interpreted as meaning that free entry depletes the return from investment of a firm down to the level of the return from the safe asset.

It is evident that π_s is increasing in $\bar{z}$ and the left-hand side (LHS) of equation (B.28) is monotonically increasing in $\bar{z}$. Therefore, assuming that $h\bar{\pi}_H(0) + (1-h)\bar{\pi}_L(0)$ is sufficiently small relative to ρf_e, equation (B.28) uniquely determines a $\bar{z}$ that satisfies $\varphi_H(\bar{z}) < \varphi_m$.

With the Pareto distribution $G(\varphi) = (\varphi/\varphi_m)^k,\ \varphi \in [0, \varphi_m]$, the average productivity of operating firms in each state is given by

$$\tilde{\varphi}_s(\bar{z}) = \frac{1}{G(\varphi_s(\bar{z}))}\int_0^{\varphi_s(\bar{z})} \varphi dG(\varphi) = \frac{k}{k+1}\varphi_s(\bar{z}), \tag{B.29}$$

where $\varphi_s(\bar{z})$ for $s = \{H, L\}$ is the threshold productivity.

Using equations (B.20), the average prices of operating firms in each state are given by

$$\tilde{p}_s(\bar{z}) = \frac{2k+1}{2(k+1)} z_s(\bar{z}), \quad s = \{H, L\}, \tag{B.30}$$

which leads to an average price of operating firms such that

$$\tilde{p}(\bar{z}) = \frac{2k+1}{2(k+1)} \bar{z}. \tag{B.31}$$

As $\bar{z} \equiv (\eta N \bar{p} + \bar{\alpha}\zeta)/(\eta N + \zeta)$, the mass of firms is given by

$$N(\bar{z}) = \frac{2(k+1)\zeta(\bar{\alpha} - \bar{z})}{\eta \bar{z}}, \tag{B.32}$$

which is decreasing in $\bar{z}$.

Letting N_E denotes the mass of entrants, the mass of surviving firms N is given by

$$N = hN_E G(\varphi_H) + (1-h)N_E G(\varphi_H)\frac{G(\varphi_L)}{G(\varphi_H)}. \tag{B.33}$$

Hence, using the Pareto distribution, the mass of entrants is

$$N_E = \frac{N(\varphi_m)^k}{h(\varphi_H(\bar{z}))^k + (1-h)(\varphi_L(\bar{z}))^k}. \tag{B.34}$$

Applying the average productivity in equation (B.29) to the output in equation in (B.19), the average output in each state is given by

$$\tilde{q}_s(\bar{z}) = \frac{(\bar{z} + \alpha_s)L}{2\zeta(k+1)}, \quad \text{for} \quad s = \{H, L\} \tag{B.35}$$

Hence, the sector average of the ratio of temporary workers to total workers is given by

$$\widetilde{RWT}(\bar{z}) = 1 - \frac{\tilde{\varphi}_L \tilde{q}_L G(\varphi_L)}{\tilde{\varphi}_H \tilde{q}_H G(\varphi_H)} = 1 - \left(\frac{w_2}{\omega_1 - d}\right)^{k+1} \left(\frac{\bar{z} + \alpha_L}{\bar{z} + \alpha_H}\right)^{k+2}, \tag{B.36}$$

which is decreasing in $\bar{z}$.

The average profits prior to entry in each state are given by

$$\bar{\pi}_H(\bar{z}) = \frac{L\left[(w_2)^2(\varphi_H(\bar{z}))^{k+2} + k\,(w_2 - \omega_1)\,(\omega_1 - d)\,(\varphi_L(\bar{z}))^{k+2}\right]}{2\zeta(k+1)(k+2)(\varphi_m)^k}, \tag{B.37}$$

and

$$\bar{\pi}_L(\bar{z}) = \frac{L\,(\omega_1 - d)\,[\omega_1 - (k+1)d]\,(\varphi_L(\bar{z}))^{k+2}}{2\zeta(k+1)(k+2)(\varphi_m)^k}. \tag{B.38}$$

Substituting equations (B.37) and (B.38) into (17), we obtain

$$A\left(\frac{\bar{z} + \alpha_H}{w_2}\right)^{k+2} + B\left(\frac{\bar{z} + \alpha_L}{\omega_1 - d}\right)^{k+2} = \frac{2\zeta(k+1)(k+2)(\varphi_m)^k \rho f_e}{L}, \tag{B.39}$$

where $A \equiv h(w_2)^2$ and $B \equiv (\omega_1 - d)\,[(1-h)\,[\omega_1 - (k+1)d] + hk\,(w_2 - \omega_1)]$. Hence, as the economy size increases ($L \uparrow$), the differentiated goods become more substitutable with each other ($\zeta \downarrow$), the productivity in the differentiated goods sector increases ($\varphi_m \downarrow$), or the entry cost decreases ($f_e \downarrow$), the average upper bound price $\bar{z}$ will decrease.

B.5 Open Economy Equilibrium

The optimized output, prices, mark-ups, revenues, and profits for exports are analogous to those in the closed economy and given by

$$q_{XH} = \frac{L^*}{2\zeta}\left[z_H^* - \tau^*\varphi w_2\right], \qquad q_{XL} = \frac{L^*}{2\zeta}\left[z_L^* - \tau^*\varphi\left(\omega_1 - d\right)\right], \tag{B.40}$$

$$p_{XH} = \frac{1}{2}\left[z_H^* + \tau^*\varphi w_2\right], \qquad p_{XL} = \frac{1}{2}\left[z_L^* + \tau^*\varphi\left(\omega_1 - d\right)\right], \tag{B.41}$$

$$\mu_{XH} = \frac{1}{2}\left[z_H^* - \tau^*\varphi w_2\right], \qquad \mu_{XL} = \frac{1}{2}\left[z_L^* - \tau^*\varphi\left(\omega_1 + d\right)\right], \tag{B.42}$$

and

$$r_{XH} = \frac{L^*}{4\zeta}\left[(z_H^*)^2 - (\tau^*\varphi w_2)^2\right], \qquad r_{XL} = \frac{L^*}{4\zeta}\left[(z_L^*)^2 - (\tau^*\varphi(\omega_1 - d))^2\right], \tag{B.43}$$

respectively.

The export profits in the high state are given by

$$\pi_{XH}(\varphi) = \frac{L^*}{4\zeta}\left[z_H^* - \tau^*\varphi w_2\right]^2 + I(\varphi)\cdot\tau^*\varphi\left(w_2 - \omega_1\right)q_{XL}(\varphi), \tag{B.44}$$

where $I(\varphi)$ is an indicator variable that takes 1 for $\varphi \in [0, \varphi_{XL})$ and 0 for $\varphi \in [\varphi_{XL}, \varphi_{XH}]$. The export profits in the low state are given by

$$\pi_{XL}(\varphi) = \frac{L^*}{4\zeta}\left[\left(z_L^* - \tau^*\varphi\omega_1\right)^2 - \left(\tau^*\varphi d\right)^2\right]. \tag{B.45}$$

Holding other things constant, an increase in τ^* lowers exports and raises the export price in both states. However, the price increases are not sufficient to cover the declines of output, and the revenues and profits decrease in both states:

$$\begin{aligned}
\frac{\partial \pi_{XH}}{\partial \tau^*} &= -\varphi\left[w_2 q_{XH} - \left(w_2 - \omega_1\right)q_{XL}\right] - \frac{L^*}{2\zeta}\tau^*\varphi\left(w_2 - \omega_1\right)\left(\omega_1 - d\right) < 0,\\
\frac{\partial \pi_{XL}}{\partial \tau^*} &= -\frac{L^*}{2\zeta}\left[\left(z_L - \tau^*\varphi\omega_1\right)\varphi\omega_1 + \tau^*(\varphi d)^2\right] < 0.
\end{aligned}$$

As home firms and foreign firms exporting to the home country face the same upper-bound price in the home country, the price distributions of the home firms and foreign exporters are the same. Thus, the average product prices $\tilde{p}_s(\bar{z})$ and the mass of operating firms N take the same forms as the those in the closed economy (equations (B.30) and (B.32)).

In the open economy setting, N consists of home firms and foreign firms exporting to the home country. Denoting the mass of entrants in the home country by N_E, the mass of home firms N_D is given by

$$N_D = hN_E G(\varphi_H) + (1-h)N_E G(\varphi_H)\frac{G(\varphi_L)}{G(\varphi_H)} = \left[hG(\varphi_H) + (1-h)G(\varphi_L)\right]N_E. \tag{B.46}$$

Likewise, the mass of foreign firms exporting to the home country N_X^* are obtained by

$$N_X^* = \left[hG(\varphi_{XH}^*) + (1-h)G(\varphi_{XL}^*)\right]N_E^* \tag{B.47}$$

where N_E^* denote the mass of entrants in the foreign country. We obtain N_E and N_E^* by solving $N_D + N_X^* = N$ and its counterpart equation in the foreign country simultaneously:

$$N_E(\bar{z}, \bar{z}^*) = \frac{1}{1 - \tau^{-k}(\tau^*)^{-k}} \left[\frac{(\varphi_m)^k N(\bar{z})}{A(\bar{z})} - \frac{\tau^{-k}(\varphi_m^*)^k N^*(\bar{z}^*)}{A(\bar{z}^*)} \right] \tag{B.48}$$

$$N_E^*(\bar{z}, \bar{z}^*) = \frac{1}{1 - \tau^{-k}(\tau^*)^{-k}} \left[\frac{(\varphi_m^*)^k N^*(\bar{z}^*)}{A(\bar{z}^*)} - \frac{(\tau^*)^{-k}(\varphi_m)^k N(\bar{z})}{A(\bar{z})} \right], \tag{B.49}$$

where $A(\bar{z}) \equiv h(\varphi_H(\bar{z}))^k + (1-h)(\varphi_L(\bar{z}))^k$. Therefore, the mass of home firms N_D is

$$\begin{aligned} N_D(\bar{z}, \bar{z}^*) &= A(\bar{z})(\varphi_m)^{-k} N_E \\ &= \frac{1}{1 - \tau^{-k}(\tau^*)^{-k}} \left[N(\bar{z}) - \frac{A(\bar{z})(\varphi_m^*)^k}{A(\bar{z}^*)(\varphi_m)^k} \tau^{-k} N^*(\bar{z}^*) \right], \end{aligned} \tag{B.50}$$

and the mass of foreign firms exporting to the home country is

$$N_X^*(\bar{z}, \bar{z}^*) = \tau^{-k} A(\bar{z})(\varphi_m)^{-k} N_E^* = \frac{\tau^{-k}}{1 - \tau^{-k}(\tau^*)^{-k}} \left[\frac{A(\bar{z})(\varphi_m^*)^k}{A(\bar{z}^*)(\varphi_m)^k} N^*(\bar{z}^*) - (\tau^*)^{-k} N(\bar{z}) \right]. \tag{B.51}$$

Because $\partial N/\partial \bar{z} < 0$ ($\partial N^*/\partial \bar{z}^* < 0$) and $\partial A(\bar{z})\ \partial \bar{z} > 0$ ($\partial A(\bar{z}^*)/\partial \bar{z}^* > 0$),

$$\frac{\partial N_E}{\partial \bar{z}} < 0, \quad \frac{\partial N_E}{\partial \bar{z}^*} > 0 \tag{B.52}$$

$$\frac{\partial N_D}{\partial \bar{z}} < 0, \quad \frac{\partial N_D}{\partial \bar{z}^*} > 0 \tag{B.53}$$

$$\frac{\partial N_X^*}{\partial \bar{z}} > 0, \quad \frac{\partial N_X^*}{\partial \bar{z}^*} < 0. \tag{B.54}$$

For example, suppose that L^* increases. Then, while $\bar{z}^*$ declines, $\bar{z}$ is unaltered. Therefore, in the home country, the mass of home firms decreases and the mass of foreign firms exporting to the home country increases without changing the total mass of operating firms in the home country, N.

As a special case, when the home and foreign countries are symmetric, N_D and N_X^* become

$$N_D = \frac{2\zeta(k+1)}{\eta\left[1+\tau^{-k}\right]} \left[\frac{(\bar{\alpha} - \bar{z})}{\bar{z}} \right] = \frac{N}{1+\tau^{-k}} \tag{B.55}$$

$$N_X^* = \frac{2\zeta(k+1)\tau^{-k}}{\eta\left[1+\tau^{-k}\right]} \left[\frac{(\bar{\alpha} - \bar{z})}{\bar{z}} \right] = \frac{\tau^{-k} N}{1+\tau^{-k}}. \tag{B.56}$$