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Trade, Wage Premia and Labor Shortages

by

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Abstract. Recent trade theories with heterogeneous firms build upon labor market frictions and search to generate rent sharing between firms and their employees and workforce adjustments following trade liberalization. However, little empirical attention has been paid to potential labor shortages. Using firm-level vacancy data from Thailand's manufacturing sector for 2003-2006, I construct the ratios of vacancies to employment to measure the extent of labor shortages across firms. I find that a cut in input tariffs raises not only wages at firms that use imported intermediates, but also their vacancies to employment ratios relative to firms that only source inputs locally. Importantly, firms with high vacancies to employment ratios pay higher wages, and even more so for importers of intermediate inputs. This evidence is consistent with the hypothesis that labor shortages constitute one empirically documentable mechanism by which importing firms pay higher wages: they search more intensively for workers, suffer more from hiring constraints, and hence increase their wage offers to raise adequately skilled employment following input tariff cuts.

1. Introduction

Given concern over rising wage inequality observed in both developed and developing countries[1], the relationship between globalization and labor market outcomes has gained particular attention from both policy makers and academic researchers. While earlier literature has primarily focused on how international trade affects wages of workers with different levels of skill (between-group)[2], recent theoretical and empirical papers explore how trade impacts wages of workers with similar observed characteristics employed in heterogeneous firms (within-group). To explain the latter, various forms of labor market frictions that feature firm-workers rent sharing have been incorporated into the Melitz (2003) model. Hence, wages vary across firms because: different firms earn different profits and workers demand "fair wages" (Amiti and Davis (2011) and Egger and Kreickemeier (2009)); workers can shirk on the job and firms differ in their monitoring costs such that "efficiency wages" paid to deter shirking vary from firm to firm (Davis and Harrigan (2011)); or search and matching frictions, heterogeneity in worker ability, and generalized Nash-Bargaining over the surplus (Helpman, Itskhoki, and Redding (2010)).

So far, however, existing data sources have not allowed researchers to investigate the firm-level adjustment process and optimization under unemployment and potential skill mismatches directly. In this paper, I provide evidence on one specific underlying mechanism, labor shortage, through which trade can differentially affect wages of globalized firms relative to domestically-oriented firms. How this potential channel operates is consistent with the ideas behind existing theoretical models that combine heterogeneous firms and search frictions. Due to Melitz (2003), the opening of trade will induce within industry reallocations as more productive exporting firms, and arguably importing firms[3], expand and domestic firms shrink or exit[4]. Yet, the expansion process is not immediate. It involves hiring new workers, which is costly and time consuming, and depends significantly on labor market conditions (Fajgelbaum (2011)[5]). So as firms that wish to expand search more intensively for workers, competition in the labor market intensifies such that matching may remain incomplete and opening vacancies cannot be filled[6]. It follows that the opening of trade raises the tightness of the labor market (as in Felbermayr, Prat, and Schmerer (2011) and Helpman, Itskhoki, and Redding (2010)), which in turn increases firms' search costs[7] and hence wage payments necessary to induce the flow of people into job vacancies.

[1]See the survey by Goldberg and Pavcnik (2007).

[2]See, for example, Lawrence and Slaughter (1993), Leamer (1996), and Feenstra and Hanson (1999, 2008).

[3]Exporting and importing firms are larger, more productive, and pay higher wages, as found empirically by Bernard, Jensen, Redding, and Schott (2007).

[4]The selection effect of trade receives a vast empirical support, see, for example, Helpman (2006) and Bernard, Jensen, Redding, and Schott (2007).

[5]Fajgelbaum (2011) studied the the effect of capacity constraining labor market frictions on firm employment growth and export decisions.

[6]The rate at which firms fill their vacancies is a decreasing function of labor market tightness in the theoretical model of Felbermayr, Prat, and Schmerer (2011).

[7]Following the standard Diamond-Mortensen-Pissarides approach, search cost (b) in the theoretical model of Helpman, Itskhoki, and Redding (2010) is assumed to be increasing in labor market tightness (x), whereby $b = \alpha_0 x^{\alpha_1}$. As a solution to the bargaining game, each worker receives a fraction of firm revenue per worker $w(\theta) = \frac{\beta\gamma}{1+\beta\gamma}\frac{r(\theta)}{h(\theta)}$, and due to firm's first-order conditions for the measure of workers sampled $n(\theta) = \frac{\beta\gamma}{1+\beta\gamma}\frac{r(\theta)}{h(\theta)}b^{-1}$, thus wage is in turn a function of search cost $w(\theta) = bn(\theta)$ that is increasing in the tightness of the labor market.

To examine the empirical relevance of the labor shortage channel, I draw on a rich firm-level dataset from the Thailand Productivity and Investment Climate Survey (PICS) for the period 2003 to 2006. During this time, the Thai government unilaterally restructured its tariff regime to reverse an early policy of trade restrictions following the 1997 financial crisis. This led to tariff cuts in over 900 6-digit HS tariff lines. A distinctive feature of the PICS dataset is that the survey's questionnaire asks about vacancies at each firm at year-end, making it possible to construct a firm-specific ratio of the stock of vacancies to current employment ("*vacacy to employment ratio*"). The PICS dataset also offers a small-scale link employer-employee data for a subset of 426 firms from years 2003 and 2006[8], whereby 10 randomly sampled workers from each firm are interviewed face-to-face on a long list of socio-economic characteristics[9]. This information enables me to conduct the analysis at the individual worker-level, in addition to the firm-level, to explicitly control for worker characteristics that could also affect wage outcomes.

While theories emphasize the role played by exporting firms, the large and growing importance of trade in intermediates is now widely recognized. Goldberg, Khandelwal, Pavcnik, and Topalova (2010) show that lower import tariffs lead Indian firms that demand imported inputs to expand by launching new product varieties. Following Amiti and Davis (2011), I consider the separate role of intermediate input tariffs from that of final product tariffs, and discern importers from exporters to capture both cost and demand shocks to firms. The analysis at the firm level confirms previous study findings of wage premia at import-using firms, who benefit from lower input tariffs through cheaper and more accessible intermediate imports. Furthermore, the differential positive effects of a cut in input tariffs on wages between importers and non-importers are present for both skilled and unskilled workers (proxied by production and non-production workers respectively). Analogous to the wage responses, I find evidence that importing firms expand employment across all skill groups, suggesting that the results are not driven just by changes in skill composition (as in Verhoogen (2008)).

Going beyond the wage analysis, I examine how the same tariff cuts affect labor shortage at the firm level. I find that import-using firms, who appear to try and expand their workforce, suffer more from unfilled vacancies relative to firms that do not import following input tariff cuts. This particular result parallels Holzner and Larch (2011)'s model prediction that "With trade the number of vacancies per firm is lower than in autarky for low-productivity firms, but higher for high productivity firms, because additional revenues from import and export allow high productivity firms to create more vacancies so as to increase their labor input in response to additional demand from abroad." More importantly, firms with hiring constraints, in particular importers, do indeed pay higher wages. This evidence is consistent with the hypothesis that labor shortage is an

[8]Matched employer-employee datasets are more readily available for advanced countries, such as Denmark (Munch and Skaksen (2008)), Germany (Klein, Moser, and Urban (2010) and Baumgarten (2010)), Sweden (Davidson, Heyman, Matusz, Sjöholm, and Zhu (2011)), and for some developing countries, such as Brazil (Menezes-Filho, Muendler, and Ramey (2008), Krishna, Poole, and Senses (2011), and Helpman, Itskhoki, Muendler, and Redding (2011)) and Mexico (Frías, Kaplan, and Verhoogen (2009)).

[9]Other than general demographic questions, e.g., age, sex, education, past and current work related information, the PICS dataset also offers many more interesting variables, such as computer usage, bank account and credit card ownership, and online purchase transaction.

important mechanism for higher wage premia at import-using firms, who search more intensively for workers, suffer more from hiring constraints, and hence offer higher wages arguably to attract additional employment.

To test whether the documented labor shortage channel is robust to controlling for observed worker characteristics, I perform a Mincer regression of log worker wages using the small-scale linked employer-employee data from PICS that are available for a subsample of firms. At the worker level, I find consistent result of higher wage payments for the 10 randomly sampled workers employed by importing firms, which experience hiring constraints, relative to workers employed by firms that do not import inputs. Moreover, I test if there is a differential wage effect between newly hired and incumbent workers, hypothesizing that newly hired workers are better able to take advantage of a tighter labor market. By exploiting detailed information on worker tenure at the firm, I show that the importer wage premium is significant throughout and somewhat stronger for newly hired compared to incumbent workers. An intuitive and consistent explanation of this result may be that not only do incoming workers bargain more strongly, but existing workers ask for a wage renegotiation and command a pay raise possibly by threatening to leave. In addition, individual wage with controls for skill mismatches shows that the increases prevalence of vacancies is likely to be accompanied by a skill mismatch, i.e., the hiring of an under qualified worker into a skill-intensive position. Hence, an alternative interpretation for the evident wage premium is an excess wage paid conditional on what the worker would earn otherwise based on his qualification in a market environment without search frictions and mismatches.

This study falls into a line of research that focuses on the firm component of wages. Recent empirical papers using matched employer-employee data provide evidence on the significance contribution of both wage premia and unobserved worker heterogeneity toward the overall firm wage component (see for example Schank, Schnabel, and Wagner (2007), Munch and Skaksen (2008), Frías, Kaplan, and Verhoogen (2009), Davidson, Heyman, Matusz, Sjöholm, and Zhu (2011), Krishna, Poole, and Senses (2011), and Baumgarten (2010)). Helpman, Itskhoki, Muendler, and Redding (2011) develop and estimate a structural model that accounts for the link between trade and wage dispersion between firms within sector-occupations, allowing for the firm effect to change over time and vary with export status. Unlike earlier studies that estimate the determinants of wage differences across firms, this paper seeks to identify the transmission mechanism of tariff shocks that give rise to wage premia, to understand and to provide evidence on the firm level adjustment of labor, and to explain why globalized firms pay higher wages to workers with similar observables compared to domestic firms following tariff cuts.

The remainder of the paper is organized as follows. Section 2 describes the data and discusses Thai's trade policy and labor market. Section 3 presents the estimation strategy and results from the firm-level analyses of tariff cuts on wages, employment, and vacancies to employment ratio. In section 4, I test for the wage responses at the individual worker-level, compare marginal wages to average wages, and examine the extent to which the quality of worker-job assignment, i.e., "skill-mismatch" influences wage outcomes. Section 5 concludes.

2. Data and variable description

2.1. **Sample and sources.** This paper uses firm level data from Thailand's manufacturing sector. The data come from the 2004 and 2007 rounds of the National Productivity and Investment Climate Survey (PICS), conducted by the Foundation of the Thailand Productivity Institute (FTPI) in collaboration with the World Bank and Thailand's Ministry of Industry (MOI). The survey samples the universe of registered firms following a stratified random sampling methodology under 3 criteria: sector, location, and size. In order for the World Bank to keep comparability across countries for which similar surveys are conducted[10], two manufacturing industries are selected in all medium and large economies. For this reason, the two manufacturing industries automatically selected for Thailand, a lower middle-income country, are food processing and garments.

The 2007 round of the PICS covers 1,043 randomly sampled Thai firms, spanning 34 ISIC 4-digit industries for the period between 2003-2006. A distinctive feature of the Thai PICS dataset is the availability of firm level data on vacancies at year-end, allowing for direct observation of firm-specific labor shortage that is particularly important for testing how tariff cuts will lead to change in labor market tightness, which in turn influences wage outcomes. Another special feature of this dataset is that it offers detailed information on 10 randomly sampled workers from each firm, making it a small-scale linked employer employee dataset that allows me to take into account both firm and worker heterogeneity in analyzing wage determination and changes.

Each worker is interviewed face-to-face on a variety of quantitative and qualitative questions. For example, variables of interest include hourly wages of workers (in Thai Baht), working hours, age, gender, education, occupation, labor market experience, and tenure at the firm. In addition, the qualitative questionnaire covers workers' opinions about their jobs. One of the questions asks "According to you, what is the most appropriate level of education for the work you are doing?", which I exploit in the construction of the skill-mismatch variables. A worker is categorized as "over qualified" ("under qualified") if his highest level of educational attainment[11] is higher (lower) than the level required for his current position[12]. This worker-level information is, however, available only for year 2006. To complement this, I turn to the first round of the survey in which worker-level information for year 2003 is available on the same 426 firms that are interviewed in both rounds. As a result, the individual worker level analysis with controls for both firm and worker heterogeneity is carried out using these firms for year 2003 and 2006[13].

2.2. **Thailand: trade policy and labor market.**

2.2.1. *Thai trade policy.* Tariffs are the main barriers to trade in Thailand, especially for manufacturing sector which accounts for over three quarters of total exports. Raw materials and intermediates are Thailand's number one import category, taking up almost half of total annual imports

[10]The World Banks Enterprise Surveys (ES): http://enterprisesurveys.org

[11]There are 6 educational categories, namely Degree, Por Wor Sor (vocational), Por Wor Shor (upper secondary), Lower secondary, Primary, and Non (illiterate).

[12]For example, if a person with a Por Wor Shor (upper secondary education) answers that he actually needs a Por Wor Sor (vocational education) to perform his skilled production job, then a worker is identified as "under qualified".

[13]The firm-level analysis using average hourly wage, instead of average wage, as the dependent variable is based on the reduced sample as used in the individual worker level analysis.

(Source: Thailand Ministry of Commerce). During the period under consideration, the Thai government restructured its tariff regime, commencing in June 2003, which led to tariff cuts in over a third of the tariff lines (The WTO (2007)). The tariff reductions reversed an early policy of trade restrictions following the 1997 financial crisis, which prompted the Thai government to discourage demand for imported goods, to increase tariff revenues, and to meet budget surplus agreed to the International Monetary Fund (IMF) as part of the bailout package requirements. The tariff restructuring between 2003-2006 involved more than 900 6-digit HS tariff lines (Kohpaiboon (2007)). Under the so-called three-rate program: import duties were cut to 1% on raw materials (from an average of 7%), (ii) to 5% on intermediate products (from an average of 12.1%) and (iii) to 10% on finished products (from an average of 20.3%) (The WTO (2007)). Importantly, as these changes were influenced by foreign policy ambitions of a newly elected government under the leadership of prime minister Thaksin Shinawatra (Sally (2007)), most of the tariff changes were not a result of broad-based domestic lobbying by firms and might considered to be unanticipated policy changes from the perspective of firms and workers (The WTO (2007)). To construct product tariffs, I map SITC 4-digit Rev.3 tariffs into firm's product code at ISIC 4-digit, using a correspondence table developed by Affendy, Lau, and Madono (2010)[14]. To construct input tariffs, I use cost shares from Thailand's Input-Output table available through OECD STAN[15] to compute the weighted average tariffs on intermediate inputs faced by Thai importers.

2.2.2. *Thai labor market.* Although a large portion of labor force is employed in agricultural sector, the labor force structure is changing as more workers shift into manufacturing and services sectors. Within manufacturing, Thai firms report that their operations are still hindered by three major constraints: a heavy regulatory burden, deficient infrastructure especially outside Bangkok, and shortage of laborers (The World Bank (2008)). The same survey reports that it takes firms 5.2 weeks to find a suitable skilled production worker and 2.2 weeks to find an unskilled production worker. Out of 66 countries for which similar data are available, Thailand is relatively closer to the average country, which takes 3.8 weeks to fill skilled and 2 weeks to fill unskilled positions, compared to Indonesia that takes 2 weeks to fill skilled and 1 week to fill unskilled positions. So it is worth keeping in mind that Indonesia, arguably a flexible economy being analyzed in Amiti and Davis (2011), is quite distinct from Thailand in terms of labor market environment such that the origin of the wage premium could as well be differ. As an example, in the early 2006 Seagate, a US-based manufacturer of hard-disk drives, was reported to consider an investment in a new 40-billion Baht high-tech magnetic media facility in Thailand. In the end, Seagate chose to split the investment between two other locations: a substrate plant in Johor, Malaysia and an additional media facility in Singapore. Seagate cited the proximity of the two locations and its existing operation in Singapore as reasons for the choice, but many sources reported that limited labor availability in Thailand was a leading factor in this decision (Bangkok Post (2006)).

[14]The proxy is done using SITC Rev.2-SITC Rev.3 correspondence table and SITC Rev.3-ISIC Rev.3 correspondence table. Mapping matches more than 98 percent of commodities under SITC Rev.3. For the remaining commodities in which industrial category cannot be matched directly, the identification is done based on the closest code.
[15]www.oecd.org/sti/inputoutput/

3. Firm-Level Analysis

3.1. **Wage Premia.** I begin by inspecting how wages vary by type of firm. Using domestically oriented firm as the omitted category, the result in column (1) of Table 1 shows that exporters that do not import and importers that do not export pay around 16 percent higher wages. Firms that both import and export, accounting about one third of the sample[16] and presumably the most productive group of firms, pay 32 percent higher wages. Additional controls for skill share (the ratio of non-production workers to total employment) and employment size in columns (2)-(4) leave wage premia at importing and exporting firms roughly unaffected. These wage differentials across firms with different levels of exposure to trade persist when the analyses are performed separately for production and non-production wages in Table 2. In addition, I find similar premia for employment, value added, total factor productivity, and capital stock at globalized firms as reported in Table 3, suggesting that importers and exporters are on average larger, more efficient, and more capital intensive compared to domestic firms. This evidence is similar to that from many other countries.

3.2. **Tariff Cuts and Wages.** I proceed by examining the impact of input and output tariff reductions on average wages at the firm level and by testing whether there are heterogeneous responses across firms with different import and export participation. The following equation is estimated using OLS with industry fixed effects and year fixed effects or interacted industry-year fixed effects, to control for unobserved industry-level heterogeneity, time variations, and industry specifics that might vary overtime. The standard errors are clustered at the industry level.

$$\begin{aligned}(1)\quad \ln(\text{wage})_{i,j,t} = {} & \alpha_j + \alpha_t + \alpha_{j,t} + \beta_1 \text{output tariff}_{j,t} + \beta_2 \text{output tariff}_{j,t} * \text{EX}_{i,j} \\ & + \beta_3 \text{input tariff}_{j,t} + \beta_4 \text{input tariff}_{j,t} * \text{IM}_{i,j} + \text{EX}_{i,j} + \text{IM}_{i,j} + Z_{i,j,t}\Gamma + \varepsilon_{i,j,t}\end{aligned}$$

The dependent variable is the logarithm of average wage of firm i in industry j at time t. Product tariff and input tariff denote the level of protections in industry j in which firm i operates on final goods and intermediate inputs respectively. EX is an indicator variable equal to one if firm i is an exporter and zero otherwise. IM indicates whether firm i imports any of its intermediate inputs. The vector Z includes firm-level controls, such as firm's productivity, employment and capital stock.

To estimate the impact of tariff cuts on wages, I allow for separate effects of changes in incentive to export final products and changes in costs of imported inputs. I interact product tariffs with an export dummy to capture the differential effect of a reduction in product tariffs between exporters and non-exporters. Similarly, I interact input tariffs with an import dummy to capture the differential effect of reducing input tariffs between importers and non-importers. Theories of rent sharing suggest that a fall in product tariffs will reduce wages of any firm due to increased import competition ($\beta_1 > 0$), but potentially increase wages of exporting firms relative to domestic

[16]Although firms that export and import generally account for a small fraction of all firms in a standard firm-level dataset, a relatively high percentage of firms that do both activities in the PICS sample could be partly due to the dropping of firms with missing data or zero values for employment and wages, which tend to be firms that are smaller in size and do not participate in the global market.

firms ($\beta_2 < 0$) if exporting activity is favored by heightened foreign competition i.e., the general equilibrium effect outweighs the loss in profits due to the direct effect. So the overall wage impact of a decline in product tariffs on exporters is equal to $\beta_1 + \beta_2$. Likewise, theories of rent sharing suggest that lower input costs will raise profits and hence wages at any firm ($\beta_3 < 0$), and increase wages at firms that rely on imported inputs particularly strongly ($\beta_4 < 0$), with the overall effect on importers equal to $\beta_3 + \beta_4$.

Alongside the benchmark regression on full sample, I also report the estimation results using log average hourly wage, instead of log average wage, as the dependent variable. The use of this alternative definition of wages serves as a robustness check that variation in wages across firms is not just reflecting change in over-time hours from existing workers. This additional analysis is based on the subsample of firms from years 2003 and 2006 for which data on hours worked are available. In the first column of Table 4, I find that a decrease in product tariffs has no significant impact on wages of exporting firms and firms serving only the domestic market. A potential explanation for this insignificant effect is that our baseline specification (1), following Amiti and Davis (2008), captures only the contemporaneous effect of tariff changes. However, it might take some time for surge in import and competition to take effect on local producers, and possibly even longer time required for an adjustment of the real exchange rate to restore trade balance so as to create new profit opportunities for exporters.

Next, I test for the effects of reducing input tariffs on wages at import-using firms and non-importers in column (2). The negative and significant coefficient on the interaction term between input tariff and firm's import status indicates that a fall in input tariffs raises wages at import using firms relative to firms that only source inputs locally. This finding is in line with the positive effect of lower import tariffs on importing firms in India found by Goldberg, Khandelwal, Pavcnik, and Topalova (2010). They show that importers benefit from lower prices and more accessible imported intermediates, which lead them to expand by launching new product varieties[17]. The same conclusions hold when I include both input and product tariffs in column (3). That is, I find a significant effect only for the interaction term between input tariff and an import dummy, suggesting that importing firms that experience a cut in their input costs pay higher wages relative to those that do not import inputs. All regressions include controls for firm productivity (TFP), capital stock and size. More productive firms and more capital-intensive firms pay higher wages. Conditional on productivity, larger firms pay lower wages, consistent with the later interpretation that firms with labor shortages pay wage premia (large unconstrained firms pay discount). The empirics in columns (5) and (6) from using log average hourly wage to account for possible changes in hours worked, which might also explain the negative relationship between input tariffs and importer interaction term and wages, confirm the results in the first part of the table using log average wage. These results are also robust to introducing industry-year fixed effects (columns (4) and (6)).

[17]Goldberg, Khandelwal, Pavcnik, and Topalova (2010) also find that lower input tariffs improve firm performance in other dimensions, including output, TFP, and research and development (R&D) activity.

In Table 4, I rerun equation (1) separately for production and non-production wages in order to test whether the differential impacts of input tariffs are present for both types of workers. An increase in wages at importing firms seems to be largely shared across production and non-production, but non-production workers command somewhat stronger increase in their premium. These results show that wage premia at importers happen at all skill levels.

As theory predicts that the selection effect of trade will trigger expansion at high productivity firms, I next test whether there is an employment growth that matches up with the pattern of wages, especially at importing firms where wage premia are evident. The results in Table 6 suggest that importing firms expand their employment opportunities by hiring both production and non-production workers. Thus, access to cheaper foreign inputs leads firms to expand by demanding more workers, and thereby potentially pushes up wages at importing firms following input tariff cuts.

3.3. **Tariff Cuts and Vacancies to Employment.** Similar to other countries, I show in the previous section that firm level heterogeneity matters for how wages and employment respond to lower tariffs in Thailand. I now analyze how the same tariff cuts affect labor market conditions, particularly with respect to the costs of adjusting labor force across firms with different demands for workers. I repeat the wage analysis but replace the left hand side variable with firm's vacancies to employment ratio to investigate the extent to which employer suffers from labor shortage. I show in Table 7 that the result of vacancies to employment mirrors the results of wages and employment documented in the previous section. As before, I find no significant differential impact of reducing product tariffs on vacancies to employment between exporting and non-exporting firms.

In column (2), the coefficient of the interaction term between vacancies to employment and importer status is significantly negative, consistent with the hypothesis that importers try to expand their workforce but experience labor shortages following a cut in input tariffs. Again, the same conclusions emerge when I include both product and input tariffs (column (3)) and introduce industry-year fixed effects (column (4)). This finding confirms Felbermayr, Prat, and Schmerer (2011) and Helpman, Itskhoki, and Redding (2010) models' predictions that the tightness of the labor market increases following the opening of trade. Interestingly, I find that the coefficient on the TFP term is negative and significant. This implies that highly productive firms typically face lower vacancies to employment ratios, consistent with their capacity to pay higher salaries out of their rents and to offer more generous compensation than low productivity ones. Therefore, this exercise shows that not only are wages affected in a heterogeneous way by tariff cuts, but so are firm-specific vacancies.

3.4. **Tariff Cuts, Vacancies to Employment and Wages.** So far, I have documented that lower input tariffs lead to higher wages at import-using firms relative to firms that do not import inputs (section 3.2). I have also shown that these importers try to expand by increasing employment across all skill groups, but at the same time suffer more from unfilled vacancies relative to non-importers (section 3.3). So one possible way for importers to achieve their optimal size facing labor shortages is to raise their wage offers in order to induce the flow of workers into opening positions. To test this hypothesis, I reestimate equation (1) by including the vacancies to employment ratio

and its interactions with import and export status as well as input and output tariff as additional explanatory variables. In doing so, I can test whether firms with higher vacancies to employment ratios, in particular importers where hiring constraints are severe, are also firms that are willing to pay higher wages to fill otherwise unfilled vacancies.

The first two columns of Table 8 report the estimation results drawn on the full sample using average wages. The latter half shows the estimates when the same analysis is carried out using the reduced sample with average hourly wage as the dependent variable. A significantly positive coefficient estimate of the vacancies to employment ratio in column (1) suggests that firms with high vacancies to employment are also high wage firms. In the next column, I find that unfilled vacancies at exporters do not result in higher wage payments but unfilled vacancies at importers do. More specifically, a significantly positive coefficient on the interaction term between vacancies to employment and importer status suggests that importing firms that have significantly higher incidence of labor shortages do indeed pay higher wages. These results are robust to using hourly wages (columns (3) and (4)) and interactive industry-year fixed effects (columns (2) and (4)). Therefore, consistent with the labor shortage mechanism, a joint examination of tariff cuts, vacancies to employment, and wages reveals that firms that find vacancies more costly, especially importers who try to expand their workforce but are restricted by a capacity constrained labor market, offer higher wages.

4. Worker-level analysis

4.1. **Mincer wage regression with firm controls.** Having provided some evidence on the empirical relevance of the labor shortage channel at the firm level, I now proceed onto the individual worker level to explicitly account for observable worker characteristics that could also affect vacancy and wage outcomes. I conduct the analysis using detailed information from the small-scale linked firm-workers data on a sub-sample of firms available for years 2003 and 2006.

In table 9, I perform a Mincer regression for log worker hourly wage to test whether the findings at the firm level still hold. I begin with the main specification (1) using the same set of firm controls plus worker observables. I find that the 10 randomly sampled workers employed at importing firms are paid higher hourly wages relative to workers employed at firms that rely only on domestic inputs. The estimates of the returns to worker characteristics are as expected. Highly educated and more experienced workers earn significantly higher hourly wages. Female workers are paid less relative to male workers, in line with the findings in other developing countries[18]. Furthermore, there might be a stigma associated with past unemployment experience as suggested by a significantly negative coefficient on the "ever unemployed" variable.

In addition to a full set of firm and worker characteristics, I include firm's vacancies to employment ratio into the Mincer log worker wage regression in column (2). I find a significantly positive association between workers' hourly wages and their firm's vacancies to employment ratio. This implies that workers employed at a firm that suffered more from labor shortage are being paid relatively higher hourly wages. A significantly positive coefficient on the vacancies to employment

[18]See The Global Gender Gap report, World Economic Forum for further detail.

and importer status interaction term in the last column suggests that workers employed at an importing firm, which suffers more from hiring constraint, do receive significantly higher hourly wages compared to their peers with the same observable characteristics. These findings at the worker-level further confirm the importance of the labor shortage channel. A tightening of the labor market following tariff cuts pushes up wages at hiring-constrained firms so as to increase the attractiveness of and to fill the opening vacancies.

4.2. **Mincer wage regression by tenure.** I next illustrate the effect of trade reform on hourly wages of workers by tenure at the firm. The idea is that unfilled vacancies should affect marginal wages for the last hires, not just average wages i.e., firm's most recently filled vacancies. I perform the analysis by restricting the sample to workers with tenure of one year or less and run the same mincer wage regression as in the previous section to measure the wage effect of marginal workers. I then repeat the same analysis drawing on the sample of workers with tenure of greater than one year to examine the effect on existing workers.

Estimation results are reported in Table 10. I find that the importer wage premium is significant throughout and somewhat stronger for newly employed compared to incumbent workers. Although the plain vacancies to employment term is not significant on its own, the interaction term between vacancies to employment and firm's import status is positive and significant, and again stronger for newly hired workers. A possible explanation for this is that new entrants have direct impact on wages at importing firms that severely suffered from hiring constraints following lower input tariffs. This is because, in a tightening labor market environment full of vacancies, potential workers know that their marginal product is quite high and hence bargain strongly. As a result, importing firms in need of workers are forced to pay excess wages in order to increase the probability of filling their vacancies. Additionally, the significantly positive effect of the same interaction term for tenured workers suggests that they also ask for a wage renegotiation and command a pay raise possibly by threatening to leave. "A higher wage offer attracts more workers from not only unemployed but also firms paying lower wages" Fajgelbaum (2011). Therefore, this exercise shows that firms facing difficulties hiring pay higher wages to workers at all tenure levels, to keep incumbent workers from leaving for higher pay jobs as well as to attract new workers into vacant positions.

4.3. **Mincer wage regression with "skill mismatch".** In a tightening labor market environment in which expanding firms compete with one another for workers, firms that are desperate to fill vacancies may be willing to hire less qualified applicants to staff the positions rather than bearing the costs of unfilled vacancies, especially when the opportunity cost of not hiring is high. So in this last section, I explore how potential labor shortages affect the quality of matches, which in turn influences wage outcomes. In doing so, it can help strengthen our understanding of costly search: not only on what happen to wages when more productive firms try to expand on the extensive margin and there is an insufficient number of workers, but also what happen to the quality of matches when there is an inadequate quality of individuals available to firms. This is to control for the discrepancies between the qualities of workers which firms wish to employ for given vacancy characteristics and the actual job placements, and how that translate into wages.

With the same firm and worker controls as before, I include two additional mismatch variables and their interactions with firm's vacancies to employment ratio on the right hand side of the mincer wage regression. An "over-qualified" and an "under-qualified" represent whether workers possess higher skills than they needed or lower skills than their jobs required as described in the data section. I find statistically significant effects on both variables, however with opposite signs, negative for the over-qualified but positive for the under-qualified workers. These results suggest that the over-qualified workers receive wage discounts because they are appointed to lower positions compared to their peers with the same skills such that their marginal products are lower. Conversely, if the under qualified workers fill more skill intensive jobs than their observable skills, then they command premiums compare to the same skill counterparts.

The skill mismatch and firm's vacancy to employment interaction terms test whether or not the over (under) qualified workers who work at a hiring-constrained firm receive wage discounts (premiums). The interaction terms appear significant only at the under-qualified margin, implying that an alternative interpretation for the origin of the wage premia evident at importing firms might be as follows. In addition to paying higher wages because of labor shortages, firms may have also filled vacancies by hiring people who are actually under-qualified for jobs, which is usually unobserved otherwise to the researchers. As less qualified workers fill positions that have higher productivity than what they would have attained otherwise in a normal market environment, part of the wage premia documented, hence, is possibly an extra wage paid conditional on characteristics. The inclusion of the skill mismatches and their interactions with firm's vacancies to employment ratio slightly lowers the magnitude of the key coefficient of interest i.e., the interaction term between input tariff and import status. Therefore, in the presence of labor shortages, part of the differential positive effect of tariff cuts on wages found for importing firms could be explained by excess wages paid conditional on the qualifications of workers.

5. Conclusion

Recent theories of firm heterogeneity and trade incorporate imperfect labor markets that feature firm-workers rent sharing to explain wage premia and differential wage responses of exporters, importers, and domestic firms following trade liberalization. There is, however, far less documentation of the mechanism involved. This paper sheds light on one particular channel, labor shortage, through which trade shocks are transmitted to wages. I show empirical support for this mechanism with the firm-level vacancy data from Thailand's manufacturing sector which experienced unilateral home tariff reductions during 2003-2006.

I find that labor shortage matters, both quantitatively and qualitatively, in determining hiring and wage outcomes. A decline in input tariffs is associated with rising wages as well as vacancies to employment ratios at firms that use imported intermediates relative to firms that source inputs locally. Firms with high vacancies to employment ratios pay high wages, and in particular expanding importers of intermediate inputs pay even higher wages compared to non-importers. These findings provide a compelling empirical evidence in support of the insights from search theory emphasized

in Helpman, Itskhoki, and Redding (2010), Felbermayr, Prat, and Schmerer (2011), and Holzner and Larch (2011).

This paper's results also point to an additional gain from trade reform that could be realized in a capacity constraint-free labor market environment. In the presence of costly search, firms cannot immediately match with the needed skills, thereby restricting their capability to expand and inhibiting them from reaping the full benefits of lower input tariffs. Appropriate policy measures, such as educational and training policies, that would encourage more efficient matches and help reducing search costs should therefore be implemented in conjunction with liberalization policy.

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TABLE 1. Wages, Importers and Exporters

Dependent variable: log Wage	(1)	(2)	(3)	(4)
Exporter without Imports	0.158***	0.143***	0.194***	0.148***
	(0.031)	(0.031)	(0.030)	(0.030)
Importer without Exports	0.167***	0.145***	0.181***	0.138***
	(0.043)	(0.043)	(0.041)	(0.042)
Exporter and Importer	0.324***	0.296***	0.350***	0.290***
	(0.026)	(0.027)	(0.025)	(0.026)
log Employment		0.029***		0.054***
		(0.009)		(0.008)
Skill share			1.764***	1.443***
			(0.097)	(0.094)
Year effects	Yes	Yes	Yes	Yes
Industry effects	Yes	Yes	Yes	Yes
Observations	3,700	3,700	3,700	3,700
R squared	0.159	0.161	0.212	0.229

Notes: * significant at 10%; ** significant 5%;*** significant at 1%.
Skill share is the ratio of non-production workers to total employment.

TABLE 2. Wages by Occupation, Importers and Exporters

Dependent variable: log Wage	Production		Non-Production	
	(1)	(2)	(3)	(4)
Exporter without Imports	0.163***	0.133***	0.251***	0.235***
	(0.037)	(0.037)	(0.042)	(0.042)
Importer without Exports	0.225***	0.180***	0.145**	0.121**
	(0.051)	(0.051)	(0.058)	(0.058)
Exporter and Importer	0.401***	0.343***	0.301***	0.272***
	(0.031)	(0.032)	(0.035)	(0.036)
log Employment		0.061***		0.031***
		(0.010)		(0.012)
Year effects	Yes	Yes	Yes	Yes
Industry effects	Yes	Yes	Yes	Yes
Observations	3,700	3,700	3,700	3,700
R squared	0.131	0.139	0.079	0.081

Notes: * significant at 10%; ** significant 5%;*** significant at 1%.

TABLE 3. Characteristics, Importers and Exporters

Dependent variable:	log Labor	log VA	TFP	log Capital
	(1)	(2)	(3)	(4)
Exporter without Imports	0.843***	0.074*	0.369***	1.379***
	(0.050)	(0.041)	(0.044)	(0.095)
Importer without Exports	0.805***	0.219***	0.385***	1.141***
	(0.068)	(0.057)	(0.060)	(0.129)
Exporter and Importer	1.521***	0.359***	0.693***	2.475***
	(0.041)	(0.034)	(0.036)	(0.078)
Year effects	Yes	Yes	Yes	Yes
Industry effects	Yes	Yes	Yes	Yes
Observations	3,700	3,700	3,700	3,700
R squared	0.357	0.176	0.229	0.326

Notes: * significant at 10%; ** significant 5%;*** significant at 1%.
Total factor productivity (TFP) is computed using the superlative index number by Caves, Christensen, and Diewert (1982).

TABLE 4. Wages and Tariffs

Dependent variable:	**A.** log Wage				**B.** log Hourly Wage	
	(1)	(2)	(3)	(4)	(5)	(6)
Output Tariff	0.274		0.279		0.825	
	(0.317)		(0.331)		(0.525)	
Output Tariff*Exporter	-0.110		-0.027	-0.037	-0.402	-0.501
	(0.152)		(0.156)	(0.158)	(0.366)	(0.364)
Input Tariff		-0.078	-0.217		0.412	
		(0.625)	(0.660)		(1.288)	
Input Tariff*Importer		-0.358***	-0.354***	-0.350***	-0.936***	-0.851***
		(0.128)	(0.131)	(0.132)	(0.318)	(0.319)
Exporter	0.114***	0.094***	0.099***	0.100***	0.025	0.052
	(0.036)	(0.021)	(0.037)	(0.037)	(0.084)	(0.085)
Importer	0.057**	0.135***	0.134***	0.132***	0.425***	0.416***
	(0.022)	(0.036)	(0.036)	(0.037)	(0.094)	(0.095)
TFP	0.402***	0.402***	0.402***	0.403***	0.343***	0.337***
	(0.014)	(0.014)	(0.014)	(0.014)	(0.035)	(0.035)
log Employment	-0.268***	-0.269***	-0.269***	-0.269***	-0.235***	-0.235***
	(0.012)	(0.012)	(0.012)	(0.012)	(0.031)	(0.031)
log Capital Stock	0.178***	0.178***	0.178***	0.178***	0.135***	0.133***
	(0.009)	(0.009)	(0.009)	(0.009)	(0.018)	(0.018)
Year effects	Yes	Yes	Yes		Yes	
Industry effects	Yes	Yes	Yes		Yes	
Industry-year effects				Yes		Yes
Observations	3,682	3,682	3,682	3,682	692	692
R squared	0.504	0.505	0.505	0.507	0.421	0.428

Source: **A.** Thai PICS data (full-sample), 2003-2006. **B.** Thai PICS data (sub-sample), 2003&2006
Note: Standard errors are clustered at the industry level; * significant at 10%; ** significant at 5%; *** significant at 1%.

TABLE 5. Wages by occupational groups

Dependent variable: log Wage	Production		Non-Production	
	(1)	(2)	(3)	(4)
Output Tariff	0.454		-0.060	
	(0.408)		(0.533)	
Output Tariff*Exporter	0.070	0.062	0.370	0.357
	(0.202)	(0.205)	(0.264)	(0.268)
Input Tariff	-0.225		0.101	
	(0.884)		(1.155)	
Input Tariff*Importer	-0.333*	-0.329*	-0.583**	-0.575**
	(0.176)	(0.179)	(0.230)	(0.234)
Exporter	0.062	0.063	0.027	0.030
	(0.047)	(0.048)	(0.062)	(0.063)
Importer	0.157***	0.155***	0.133**	0.132**
	(0.047)	(0.047)	(0.061)	(0.062)
TFP	0.405***	0.405***	0.238***	0.239***
	(0.013)	(0.013)	(0.017)	(0.017)
log Employment	-0.229***	-0.229***	-0.145***	-0.146***
	(0.013)	(0.013)	(0.017)	(0.018)
log Capital Stock	0.184***	0.184***	0.116***	0.116***
	(0.007)	(0.007)	(0.009)	(0.009)
Year effects	Yes		Yes	
Industry effects	Yes		Yes	
Industry-year effects		Yes		Yes
Observations	3,682	3,682	3,682	3,682
R squared	0.412	0.416	0.149	0.151

Source: Thai PICS data (full-sample), 2003-2006. Firm-level observation.
Note: Standard errors are clustered at the industry level; * significant at 10%; ** significant at 5%; *** significant at 1%.

TABLE 6. Employment by occupational groups

Dependent variable: log Employment	Production		Non-Production	
	(1)	(2)	(3)	(4)
Output Tariff	0.112		0.480	
	(0.527)		(0.470)	
Output Tariff*Exporter	0.493	0.495	-0.261	-0.267
	(0.261)	(0.265)	(0.233)	(0.236)
Input Tariff	-0.822		-1.147	
	(1.141)		(1.017)	
Input Tariff*Importer	-0.455**	-0.452*	-0.333**	-0.332**
	(0.228)	(0.231)	(0.166)	(0.168)
Exporter	0.262***	0.261***	0.366***	0.367***
	(0.061)	(0.062)	(0.054)	(0.055)
Importer	0.364***	0.363***	0.335***	0.335***
	(0.060)	(0.061)	(0.053)	(0.054)
TFP	0.122***	0.122***	0.221***	0.221***
	(0.016)	(0.017)	(0.015)	(0.015)
log Capital Stock	0.257***	0.257***	0.234***	0.234***
	(0.007)	(0.007)	(0.007)	(0.007)
Year effects	Yes		Yes	
Industry effects	Yes		Yes	
Industry-year effects		Yes		Yes
Observations	3,682	3,682	3,682	3,682
R squared	0.638	0.639	0.610	0.610

Source: Thai PICS data (full-sample), 2003-2006. Firm-level observation.
Note: Standard errors are clustered at the industry level; * significant at 10%; ** significant at 5%; *** significant at 1%.

TABLE 7. Vacancies to Employment (V/E) and Tariffs

Dependent variable: V/E	(1)	(2)	(3)	(4)
Output Tariff	0.005		0.004	
	(0.017)		(0.016)	
Output Tariff*Exporter	0.009		0.012	0.012
	(0.008)		(0.009)	(0.009)
Input Tariff		0.019	0.002	
		(0.073)	(0.070)	
Input Tariff*Importer		-0.010**	-0.012**	-0.012**
		(0.005)	(0.005)	(0.005)
Exporter	-0.013	0.014*	-0.020	-0.019
	(0.025)	(0.008)	(0.025)	(0.025)
Importer	0.015***	0.012	0.017	0.017
	(0.005)	(0.014)	(0.015)	(0.015)
TFP	-0.013***	-0.013***	-0.013***	-0.013***
	(0.003)	(0.003)	(0.003)	(0.003)
log Employment	-0.009***	-0.009**	-0.009***	-0.009**
	(0.004)	(0.004)	(0.004)	(0.004)
log Capital Stock	0.007***	0.007***	0.007***	0.007***
	(0.002)	(0.002)	(0.002)	(0.002)
Year effects	Yes		Yes	
Industry effects	Yes		Yes	
Industry-year effects		Yes		Yes
Observations	3,682	3,682	3,682	3,682
R squared	0.041	0.041	0.042	0.050

Source: Thai PICS data (full-sample), 2003-2006. Firm-level observation.
Note: Standard errors are clustered at the industry level; * significant at 10%; ** significant at 5%; *** significant at 1%.

TABLE 8. Wages, Vacancies to Employment (V/E) and Tariffs

Dependent variable:	**A.** log Wage		**B.** log Hourly Wage	
	(1)	(2)	(3)	(4)
V/E	0.123**	0.215	0.238*	0.366
	(0.055)	(0.193)	(0.127)	(0.379)
V/E*Exporter		0.133		0.147
		(0.143)		(0.353)
V/E*Importer		0.491***		0.796***
		(0.167)		(0.366)
V/E*Output Tariff		-0.698		-0.847
		(0.664)		(1.321)
V/E*Input Tariff		-0.835		-1.273
		(0.576)		(1.624)
Output Tariff	0.159		0.804	
	(0.363)		(0.524)	
Output Tariff*Exporter	-0.211	-0.220	-0.438	-0.565
	(0.173)	(0.177)	(0.364)	(0.364)
Input Tariff	-0.089		0.497	
	(0.761)		(1.289)	
Input Tariff*Importer	-0.342**	-0.335**	-0.923***	-0.869***
	(0.150)	(0.152)	(0.318)	(0.320)
Exporter	0.213***	0.206***	0.037	0.062
	(0.042)	(0.044)	(0.084)	(0.089)
Importer	0.183***	0.213***	0.420***	0.496***
	(0.040)	(0.041)	(0.094)	(0.097)
TFP	0.362***	0.363***	0.343***	0.341***
	(0.016)	(0.016)	(0.035)	(0.035)
log Employment	-0.268***	-0.268***	-0.233***	-0.233***
	(0.012)	(0.012)	(0.031)	(0.031)
log Capital Stock	0.178***	0.178***	0.135***	0.133***
	(0.009)	(0.009)	(0.018)	(0.017)
Year effects	Yes		Yes	
Industry effects	Yes		Yes	
Industry-year effects		Yes		Yes
Observations	3,682	3,682	692	692
R squared	0.506	0.508	0.423	0.440

Source: **A.** Thai PICS data (full-sample), 2003-2006. **B.** Thai PICS data (sub-sample), 2003 and 2006. Firm-level observation.
Note: Standard errors are clustered at the industry level; * significant at 10%; ** significant at 5%; *** significant at 1%.

TABLE 9. Mincer regression for log worker hourly wages

Dependent variable: log Hourly Wage	Worker-level		
	(1)	(2)	(3)
V/E		0.157***	0.234*
		(0.051)	(0.129)
V/E*Exporter			0.042
			(0.115)
V/E*Importer			0.424***
			(0.115)
V/E*Output Tariff			-0.165
			(0.471)
V/E*Input Tariff			-0.465
			(0.502)
Output Tariff*Exporter	-0.119	-0.107	-0.101
	(0.106)	(0.106)	(0.106)
Input Tariff*Importer	-0.223**	-0.205**	-0.188**
	(0.090)	(0.090)	(0.090)
Exporter	0.028	-0.001	0.000
	(0.025)	(0.024)	(0.024)
Importer	0.106***	0.098***	0.092***
	(0.026)	(0.025)	(0.025)
TFP	0.044***	0.043***	0.044***
	(0.007)	(0.007)	(0.007)
log Employment	0.000	-0.000	0.000
	(0.007)	(0.007)	(0.007)
log Capital Stock	0.011***	0.011***	0.011***
	(0.003)	(0.003)	(0.003)
Schooling	0.091***	0.091***	0.091***
	(0.002)	(0.002)	(0.002)
Experience	0.035***	0.035***	0.035***
	(0.002)	(0.002)	(0.002)
Experience^2	-0.000**	-0.000**	-0.000**
	(0.000)	(0.000)	(0.000)
Female	-0.097***	-0.096***	-0.095***
	(0.012)	(0.012)	(0.012)
Ever unemployed	-0.088***	-0.087***	-0.088***
	(0.013)	(0.013)	(0.013)
Occupation	Yes	Yes	Yes
Industry-year effects	Yes	Yes	Yes
Observations	7,128	7,128	7,128
R squared	0.534	0.535	0.536

Source: Thai PICS data (sub-sample), 2003&2006. Worker-level obs.
Note: Standard errors are clustered at the industry level;
* significant at 10%;** significant at 5%; *** significant at 1%.

TABLE 10. Mincer regression for log worker hourly wages by tenure

Dependent variable: log Wage	Tenure <=1 (year)			Tenure >1 (years)		
	(1)	(2)	(3)	(4)	(5)	(6)
V/E		0.024	-0.068		0.176***	0.301**
		(0.126)	(0.309)		(0.055)	(0.142)
V/E*Exporter			0.155			-0.080
			(0.300)			(0.124)
V/E*Importer			0.752**			0.377***
			(0.310)			(0.124)
V/E*Output Tariff			-0.356			-0.131
			(0.488)			(0.552)
V/E*Input Tariff			-0.643			-0.434
			(0.552)			(0.515)
Output Tariff*Exporter	-0.178	-0.185	-0.180	-0.091	-0.077	-0.071
	(0.270)	(0.271)	(0.270)	(0.115)	(0.115)	(0.115)
Input Tariff*Importer	-0.447*	-0.395*	-0.391*	-0.200**	-0.186*	-0.165*
	(0.236)	(0.236)	(0.236)	(0.098)	(0.098)	(0.098)
Exporter	0.159**	0.114*	0.112*	0.006	-0.021	-0.020
	(0.064)	(0.061)	(0.061)	(0.028)	(0.026)	(0.026)
Importer	0.141**	0.133**	0.132**	0.101***	0.093***	0.084***
	(0.069)	(0.066)	(0.066)	(0.029)	(0.028)	(0.027)
TFP	0.023	0.023	0.021	0.048***	0.048***	0.048***
	(0.017)	(0.017)	(0.017)	(0.007)	(0.007)	(0.007)
log Employment	0.014	0.013	0.015	-0.002	-0.002	-0.002
	(0.019)	(0.019)	(0.019)	(0.008)	(0.008)	(0.008)
log Capital Stock	0.003	0.002	0.002	0.012***	0.012***	0.012***
	(0.009)	(0.009)	(0.009)	(0.004)	(0.004)	(0.004)
Schooling	0.096***	0.096***	0.096***	0.091***	0.090***	0.090***
	(0.004)	(0.004)	(0.004)	(0.002)	(0.002)	(0.002)
Experience	0.032***	0.032***	0.032***	0.035***	0.035***	0.035***
	(0.007)	(0.007)	(0.007)	(0.002)	(0.002)	(0.002)
Experience^2	-0.000	-0.000	-0.000	-0.000**	-0.000**	-0.000**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Female	-0.037	-0.036	-0.034	-0.107***	-0.106***	-0.104***
	(0.031)	(0.031)	(0.031)	(0.013)	(0.013)	(0.013)
Ever unemployed	-0.075**	-0.073**	-0.076**	-0.086***	-0.085***	-0.085***
	(0.031)	(0.031)	(0.032)	(0.015)	(0.015)	(0.015)
Occupation	Yes	Yes	Yes	Yes	Yes	Yes
Industry-year effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	958	958	958	6,168	6,168	6,168
R squared	0.545	0.545	0.549	0.534	0.534	0.536

Source: Thai PICS data (sub-sample) from years 2003 and 2006. Worker-level observation.
Note: Standard errors are clustered at the industry level; * significant at 10%; ** significant at 5%; *** significant at 1%.

TABLE 11. Mincer regression for log worker hourly wages with "skill mismatch"

Dependent variable: log Hourly Wage	Worker-level			
	(1)	(2)	(3)	(4)
Over-qualified		-0.144***		-0.119***
		(0.010)		(0.010)
V/E*Over-qualified		0.046		0.008
		(0.064)		(0.066)
Under-qualified			0.125***	0.105***
			(0.009)	(0.009)
V/E*Under-qualified			0.109*	0.123*
			(0.064)	(0.065)
V/E	0.234*	0.253**	0.305**	0.330**
	(0.129)	(0.129)	(0.129)	(0.130)
V/E*Exporter	0.042	0.072	0.046	0.081
	(0.115)	(0.113)	(0.114)	(0.113)
V/E*Importer	0.424***	0.404***	0.455***	0.428***
	(0.115)	(0.113)	(0.113)	(0.112)
V/E*Output Tariff	-0.165	-0.188	-0.071	-0.098
	(0.471)	(0.464)	(0.465)	(0.460)
V/E*Input Tariff	-0.465	-0.554	-0.591	-0.619
	(0.502)	(0.494)	(0.495)	(0.490)
Output Tariff*Exporter	-0.101	-0.095	-0.106	-0.090
	(0.106)	(0.105)	(0.105)	(0.105)
Input Tariff*Importer	-0.188**	-0.185**	-0.174*	-0.152*
	(0.090)	(0.089)	(0.089)	(0.088)
Exporter	0.000	0.021	0.029	0.023
	(0.024)	(0.025)	(0.025)	(0.025)
Importer	0.092***	0.098***	0.097***	0.092***
	(0.025)	(0.026)	(0.026)	(0.026)
TFP	0.044***	0.044***	0.042***	0.043***
	(0.007)	(0.007)	(0.007)	(0.007)
log Employment	0.000	-0.001	-0.001	-0.002
	(0.007)	(0.007)	(0.007)	(0.007)
log Capital Stock	0.011***	0.009***	0.010***	0.009***
	(0.003)	(0.003)	(0.003)	(0.003)
Schooling	0.091***	0.093***	0.098***	0.098***
	(0.002)	(0.002)	(0.002)	(0.002)
Experience	0.035***	0.033***	0.034***	0.032***
	(0.002)	(0.002)	(0.002)	(0.002)
Experience^2	-0.000**	-0.000*	-0.000***	-0.000**
	(0.000)	(0.000)	(0.000)	(0.000)
Female	-0.095***	-0.096***	-0.086***	-0.089***
	(0.012)	(0.012)	(0.012)	(0.012)
Ever unemployed	-0.088***	-0.082***	-0.084***	-0.080***
	(0.013)	(0.013)	(0.013)	(0.013)
Occupation	Yes	Yes	Yes	Yes
Industry-year effects	Yes	Yes	Yes	Yes
Observations	7,128	7,128	7,128	7,128
R squared	0.536	0.552	0.550	0.560

Source: Thai PICS data (sub-sample) from years 2003 and 2006.
Note: Standard errors are clustered at the industry level; * significant at 10%; ** significant at 5%; *** significant at 1%.

TABLE 12. Descriptive Statistics

	Mean
A. Full Sample	
Firm Characteristics	
log Wage	11.56
log Employment	4.71
log Capital Stock	15.91
Vacancies per Employment	0.075
Production Workers	
log Wage	11.34
log Employment	4.53
Non-production Workers	
log Wage	12.22
log Employment	2.63
No of Firms	925
No of Observations	3,700
B. Reduced Sample	
Firm Characteristics	
log Hourly Wage	3.54
log Employment	4.95
log Capital Stock	16.16
Vacancies per Employment	0.071
No of Firms	421
No of observations	842
Worker Characteristics	
log Hourly Wage	5.12
Years of Schooling	11
Years of Experiences	12
% of Female	58.2
% of Previously Unemployed	24.3
No of Workers	7,656

Source: **A.** Thai PICS data (full-sample), 2003-2006. **B.** Thai PICS data (sub-sample), 2003 and 2006.
Note: Production workers are skilled and unskilled blue collar. Non-production workers are professional and managerial, skilled and unskilled white collar.