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Adjustments of regular and non-regular workers to exogenous shocks: Evidence from exchange rate fluctuation*

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Abstract

We investigate the heterogeneous adjustments of regular and non-regular workers exploiting the exchange rate fluctuation and heterogeneous dependence on international trade across firms as a source of exogenous variation. An analysis of panel data of Japanese manufacturers reveals that the appreciation of Japanese Yen spontaneously decreases the sales of exporters and the employment of non-regular workers, but it moderately reduces the employment of regular workers with a time lag. Firms relying heavily on exporting tend to implement more significant adjustments of non-regular employment in response to exchange rate shocks. This finding provides support for the claim that firms are likely to adjust non-regular workers to absorb exogenous shocks and to insulate regular workers from the shocks in an uncertain business environment.

JEL Classification: E24; F16; F31
Keywords: Exchange Rate; Permanent Shocks, Temporary Shocks

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1 Introduction

The surge of non-regular employment (i.e., employment under non-traditional labor contracts) in developed countries is widely documented (OECD 2014). On one hand, the increase of non-regular employment is welcomed as a flexible margin for firms to adjust labor inputs without adjusting regular employment. On the other hand, this very asymmetry of labor adjustment costs between regular and non-regular workers is accused of being a source of the dual structure of the labor market: a market structure that causes social tensions between workers with and without employment security, a career perspective, high wages, and fringe benefits (Saint-Paul 1997). Based on this view of the dual labor market, a group of influential labor economists in Europe advocates the introduction of the single labor contract (Cahuc 2012, Dolado 2016). This opinion advocating the introduction of the single labor contract is echoed in Japan, where the alleged dual labor market structure is as contentious an issue as it is in Southern European countries (Aoyagi and Ganelli 2013).

The discussion on the dual labor market consisting of regular and non-regular workers shares the presumption that non-regular workers function as a buffer to exogenous shocks, because non-regular workers have a lower adjustment cost than regular workers. Indeed, using US firm-level micro data, Houseman (2001) finds that firms facing large output volatility are more likely to hire non-regular workers. Hirsch (2016) finds that permanent workers in establishments with higher fractions of temporary workers tend to enjoy greater employment stability in Germany. Benito and Hernando (2008) estimate the dynamic labor demand function for permanent and temporary workers using Spanish panel data and find that temporary employment is much more pro-cyclical than permanent employment. Except for these studies, most studies in the literature analyze the adjustment of employment based on the macro aggregate. Hunt (2000) examines whether the deregulation of fixed-term contracts in West Germany in the 1980s makes employment more pro-cyclical and finds no significant difference in trends before and after deregulation. In contrast, Holmlund and Storrie (2002) find that non-regular employment is more pro-cyclical to the business cycle than regular employment. Another strand of studies examines the difference of employment

adjustments to a significant exogenous shock by the intensity of the use of non-regular workers in the aggregate economy. Bentolila et al. (2012a) analyze the difference in the increase of the unemployment rate after the Great Recession between France and Spain and attribute the surge of Spains unemployment, which was much greater than that of France, to the laxer rules of temporary contracts. Hijzen et al. (2015) compare the difference of employment adjustments to the 1997 and 2008 financial shocks in Japan and attribute the faster adjustment in 2008 to the increase of non-regular employment.

Little is known, however, about the difference in employment adjustments between regular and non-regular workers, perhaps because of the lack of a credible exogenous shock to the firm. Caballero et al. (1997) estimate the plant's dynamic labor demand by regressing the change of employment on the measurement of labor shortage, approximated by overtime hours. At first glance, this method can be applied to the case of two labor inputs, regular and non-regular employment, but the use of non-regular employment may well reduce the need to use overtime to accommodate the temporal shocks. Like in this example, flexibility at the extensive margin affects the proxy variables of a firm's shock, and thus it is difficult to make a credible causal inference of exogenous shocks on the adjustments of regular and non-regular employment without proper measurement of exogenous shocks experienced by each firm. While Benito and Hernando (2008), drawing on Spanish panel data, estimate the dynamic labor demand for both permanent and temporary workers using the growth in log real sales as a proxy variable for a demand shift, as is the case for other studies on the dynamic labor demand estimation, the source of exogenous shocks to each firm that creates the variation in the growth in log real sales among firms is not clear. Thus, the contribution of our paper over their study is that we exploit more exogenous variation of demand shock generated from the exchange rate fluctuation and heterogeneous dependence on international trade across firms to establish the causality from demand shock to employment adjustments of regular and non-regular workers.

In light of the importance of measuring asymmetric adjustments between regular and non-regular workers and the lack of credible estimates of these adjustments, this paper contributes

to the literature by obtaining a deeper understanding of heterogeneity between regular and non-regular workers and estimating the difference in employment adjustments between the two, using a credible measurement of exogenous shocks experienced by each firm: exchange rate fluctuation and heterogeneous exposure to international trade across firms. In other words, the swing in the exchange rate significantly affects the fluctuation of the output of firms engaging in international trade, while it has little effect on the output of firms not engaging in it.

The current study extracts manufacturing firms from firm-level panel data collected in the Basic Survey of Japanese Business Structure and Activities (2001-2012) conducted by the Ministry of Economy, Trade and Industry. This survey covers all enterprises with 50 or more employees and whose paid-up capital or investment fund is over 30 million Yen, operating in a wide range of industries. This survey records information on each company's level of dependence on foreign trade and the numbers of employees who have different types of contracts.

The empirical analysis reveals that the appreciation of Japanese Yen decreases the sales and the employment of exporting manufacturers. To take a manufacturer that exports 10% of its total sales as an example, a 10% appreciation of Japanese Yen measured in the real effective exchange rate contemporaneously decreases sales by around 0.63% and non-regular employment by about 1.38%. While the shock does not immediately affect regular employment in a statistically significant way, it reduces regular employment by 0.31% with a one-year lag. These findings clearly indicate heterogeneity in employment adjustments between regular and non-regular workers.

2 Background

2.1 The effect of the exchange rate on employment

There is an episode in Japan that epitomizes the impact of exchange-rate fluctuation on employment. In the aftermath of the US financial crisis, which peaked in summer 2008 with the collapse of Lehman Brothers, the Japanese Yen appreciated by more than 25% in a 6-month period, and this appreciation coincided with a surge of the unemployment rate from 4% to 5.5%, as shown in

Figure 1. The average numbers of non-regular workers are all negatively correlated with the real effective exchange rate of Japanese Yen; depreciation increases the non-regular employment, and appreciation decreases the non-regular employment. During this turbulent time, the job loss of non-regular workers attracted much attention from the media and policy makers.

The causal effect of the exchange rate fluctuation on employment outcomes has long attracted researchers, and numerous empirical studies examine the exchange rate fluctuation's effect on employment adjustment. Studies based on industry-level data include Brunello (1990), Dekle (1998), and Tomiura (2003) for Japan, Gourinchas (1999a) and Campa and Goldberg (2001) for the US, and Gourinchas (1999b) for France. Recent studies based on firm-level gross job flow data include Klein et al. (2003) for the US and Moser et al. (2010) for Germany. Klein et al. (2003) report that the exchange rate fluctuation significantly affects net job flow through job destruction in the US, while Moser et al. (2010) find a similar effect on net job flow but through job creation in Germany; for firms in exporting industries, appreciation of own currency destructs jobs in the US, whereas it suppresses job creation in Germany. The difference in results probably reflects the strictness of employment protection legislation across the two countries. The negative labor demand shock created by the exchange rate fluctuation is absorbed by firing existing workers in the US, whereas it is absorbed by suppressing recruitment in Germany. The contrasting results from the US and Germany highlight the significant role of labor-market institutions in the process of labor reallocation during the exchange rate adjustment. All of these studies exploit heterogeneous dependence on international trade across industries for identification.

Nucci and Pozzolo (2010) examine the impact of exchange rate fluctuation on employment adjustment by exploiting firms' heterogeneity in the exposure to international trade. They use unique Italian firm-level panel data that record the costs of foreign purchases and revenues from foreign sales, along with the usual accounting information. They shed light on the impacts of exchange rate fluctuation on employment and working hours across Italian firms, exploiting heterogeneous dependence on exports across firms for identification. They find that the appreciation in Italian Lira increases both employment and hours of importing firms, while it decreases those

of exporting firms. Ekholm et al. (2012) utilize a sharp real appreciation of the Norwegian Krone in the early 2000s to find that both net exporters and import-competing firms were exposed to increased competition due to real appreciation. Both groups reacted by shedding labor, but only the first group experienced increasing labor productivity. Kaiser and Siegenthaler (2016) exploits a similar identification strategy and Swiss manufacturers' data, paying particular attention to labor heterogeneity in terms of workers' skill, defined by educational background. They find that the appreciation of currency increases the demand for skilled labor and decreases that of unskilled labor. These studies, however, do not pay attention to the differential impacts on regular and non-regular workers. Dai and Xu (2017) exploits firm-level heterogeneity of trade partners to create additional exogeneous variation to show that the fluctuation of the exchange rate induces labor reallocation across firms based on Chinese data.

Several studies exploit firm-level variation of trade exposure to examine the effect of exchange rate fluctuation on firms' performance and employment in Japan. Hanagaki and Hori (2015) examine the effect of exchange rate fluctuation on firms' performance, such as sales and return on assets (ROA), exploiting the heterogeneous dependence on international trade and drawing on the same data set as in our study, and they find that Yen depreciation boosts net exporters' performance, on average. They do not pay attention, however, to its effect on employment. Hosono et al. (2015) examine the effect of Japanese Yen appreciation on firms' performance by comparing exporting and non-exporting firms using the same data set as in our study; they find that exporting firms suffer from the sudden appreciation of the Japanese Yen and cut the employment of workers from temporary help agency after the great recession of 2008. Their analysis is limited, however, in terms of target firms and period; their analysis covers 962 firms that they successfully matched with other data sets and the period of the great recession.[1]

[1] In addition to that our sample size is much larger than theirs, Hosono et al. (2015) only examined the impact of export exposure in the pre-crisis period on the change of temporary workers and did not compare the degree of the adjustment with that of permanent workers. Expanding the analysis period and systematically handles currency appreciation and depreciation periods in a single framework, and this is our contribution relative to their work. Another contribution relative to theirs is that we further compare the sizes of adjustment of regular and non-regular workers to an exogenous shock.

2.2 Differences between Regular and Non-regular Workers

There are several plausible reasons why labor adjustment costs differ between regular and non-regular workers in the Japanese context; First, simple occupational heterogeneity between regular and non-regular workers; second, heterogeneity caused by the human resource management practices adopted by many Japanese companies; and last, the asymmetric employment protection legislation applied to regular and non-regular workers.

Asymmetry of employment adjustment between regular and non-regular workers over the sales swing induced by exchange rate fluctuation arises simply because of job heterogeneity between these two groups. If regular workers are likely to be in occupations that are less susceptible to exchange rate fluctuation while non-regular workers are in occupations susceptible to it, then exchange rate fluctuation induces a larger employment adjustment among non-regular workers than among regular workers. Consider an automobile company as an example. It is plausible that mechanical engineers' employment is not susceptible to exchange rate fluctuation, because the job is implemented in the research section of the headquarters, while the production workers' employment is susceptible to exchange rate fluctuation, because exports to the foreign market are affected by the exchange rate. If mechanical engineers are likely to be employed as regular workers while production line workers are likely to be employed as non-regular workers, the difference of susceptibility by occupations explains the difference in the employment adjustments between regular and non-regular workers in response to exchange rate fluctuation.

To document the heterogeneity of jobs implemented by regular and non-regular workers, Figure 2a reports the fraction of non-regular workers by educational background by gender. The figure shows that non-regular employment is more prevalent among females. Given females' weaker attachment to the labor force, females may well accumulate less human capital and engage in simpler jobs. Furthermore, the figure clearly shows that highly educated workers of both genders are less likely to engage in non-regular employment than their less educated counterparts. Next, Figure 2b tabulates the fraction of non-regular workers by occupations. While non-regular employment is prevalent across occupations, the fraction of non-regular workers is notably low for both genders

in administrative and managerial occupations, which presumably require high skill. These results suggest that regular and non-regular workers engage in different jobs. To summarize, these findings are consistent with the notion that non-regular workers are likely to engage in jobs that require less human capital and peripheral jobs.

While simple job heterogeneity between regular and non-regular employment may explain the differential impacts of exchange rate fluctuation on regular and non-regular workers, we need to consider the reason why firms classify certain classes of workers as regular workers and the rest as non-regular workers. This is where differential human resource management practice applied to regular and non-regular workers plays an important role. Japanese firms, particularly large firms, are known to adopt high-performance human resource management practices to promote the accumulation of firm-specific human capital among their own workers. Moriguchi (2014) succinctly summarizes this feature as a comprehensive system that elicits workers' effort on skill accumulation through committing to implicit employment security, providing a well-designed incentive pay/promotion system, and fostering non-hostile industrial relations enabled by enterprise-based unionism. She notes that this employment practice covers only regular workers. Regular workers can be considered as agents covered by implicit long-term contracts between firms and workers, while non-regular workers are agents excluded from implicit contracts.

High-performance human resource management practices applied only to regular workers aim to encourage regular workers to accumulate firm-specific human capital. Since perfectly disentangling general and firm-specific human capital from observed characteristics is difficult, we instead appeal to the fact that regular workers tend to have more education and are more likely to work in occupations that presumably require higher skill, as we have seen in Figures 2a and 2b. If regular workers are covered by the high-performance human resource management system while non-regular workers are not, then firms attempt to hoard regular workers in an economic downturn, so as not to renege their implicit contracts with their regular workers, but they reduce the employment of non-regular workers without fear of reneging an implicit contract. Furthermore, firms have incentives to hoard regular workers who embody firm-specific human capital, because

skill is not easily procured in the labor market when the economy recovers. Thus, in Section 6.4, we will pay more attention to the difference in skills between regular and non-regular workers and address firms' labor-hoarding behavior. This additional analysis in Section 6.4 will provide us with direct evidence that regular workers and non-regular workers are subject to different wage and hour settings because of the different human resource management systems applied to them.

Japanese labor law does not explicitly provide differential degrees of employment protection between regular and non-regular workers: Court precedents, however, conventionally offer stronger protection for regular employees than for non-regular employees (Asano et al. 2013). The famous court precedent that clearly endows non-regular workers with weaker employment protection over regular workers is the Hitachi Medico Case. In this case, the Supreme Court demonstrated that it is not unreasonable to terminate a worker with a fixed term contract in advance of regular employees when there is economic redundancy (Takeuchi-Okuno 2010). This asymmetric provision of legal employment protection to regular and non-regular workers could result in a difference in the adjustment costs between regular and non-regular workers.

3 Empirical Model

3.1 Model

This section introduces the empirical model to estimate how fluctuation in the exchange rate influences the change in employment of a firm via changes in imports and exports. Similar to Campa and Goldberg (2001), Nucci and Pozzolo (2010), and Kaiser and Siegenthaler (2016), the empirical model for the sales and labor adjustment according to the fluctuation in the exchange rate is as follows:

$$\begin{aligned}\Delta \ln Y_{it} = \beta_0 + \beta_1 Imp_{it-1}\Delta \ln e_t + \beta_2 Exp_{it-1}\Delta \ln e_t + \beta_3 Imp_{it-1} + \beta_4 Exp_{it-1} \\ + \beta_5 Markup_{it-1} + \beta_6 R\&D_{it-1} + d_{jt} + u_{it},\end{aligned} \tag{1}$$

where Y_{it} is the outcome variables, which are total sales and the number of regular or non-regular employees of firm i in industry j in year t. Imp_{it-1} is the share of imported inputs among all intermediate inputs in the previous year, and Exp_{it-1} is the share of export sales among all sales in the previous year. The variable e_t is the real effective exchange rate, the amount of foreign currency units to 100 Yen, and thus its increase corresponds to Yen appreciation. The variable $Markup_{it-1}$ is the lagged markup, calculated as (Total sales$_{it-1}$ - Sales cost$_{it-1}$)/Total sales$_{it-1}$. The variable $R\&D_{it-1}$ is R&D expenditure divided by total sales. The model includes the industry (24 categories within the manufacturing sector) $\times$ year fixed effects, d_{jt}, to control for time-variant industry-specific factors, such as product and input prices. Including these fixed effects is important, because macroeconomic shocks, such as changes of monetary policy by the central banks, which induce a change in the exchange rate, may also affect the demand for certain industries. By including these fixed effects, the effects of exchange rate fluctuation on sales or employment are identified off the firm heterogeneity of trade exposure within an industry $\times$ year cell. The linear term of $\Delta \ln e_t$ is not included, because the effect is captured by the industry $\times$ year fixed effects.

The change in the exchange rate affects the employment of importing and exporting firms, but it does not affect the employment of firms with neither imports nor exports; firms exposed to international trade serve as a treatment group, and firms not exposed to international trade serve as a control group. Thus, the error term u_{it} is not correlated with treatment status, Imp_{it-1} or Exp_{it-1}, if firms with and without international trade exposure share the same unobserved factors determining the employment adjustment. To make this exogeneity assumption plausible, we allow for industry $\times$ year-specific shocks. Thus, the comparison of high-exposure firms and low-exposure firms is made within an industry $\times$ year cell. Given the exogeneity assumption,

$$E(u_{ijt}|Imp_{it-1}, Exp_{it-1}, \Delta \ln e_t, Markup_{it-1}, R\&D_{it-1}, d_{jt}) = 0,$$

the OLS estimator is an unbiased and consistent estimator. Note that firms not involved in international trade may also be affected by exchange rate fluctuation through competition with foreign products in the domestic market, and we will explicitly address this impact in the next subsection.

We first confirm the validity of the specification by using total sales as the dependent variable. The appreciation of Yen – an increase in $\Delta \ln e_t$ – is supposed to increase the total sales of importing firms through cost reduction; thus, we expect β_1 to be positive. In contrast, the appreciation of Yen is supposed to decrease the total sales of exporting firms through an increase of product price; thus we expect the coefficient on β_2 to be negative. After confirming the validity of the specification, we proceed to examine the effect of exchange rate fluctuation on the adjustment of regular and non-regular workers.

The choice of invoice currency has a subtle impact on the estimation, but it does not affect the expected sign of the coefficient. The appreciation of Yen, for example, decreases the total sales of exporting firms through a reduction of export quantity if the invoice currency is Japanese Yen, because the product price in local currency increases, given a positive pass-through. In contrast, the appreciation of Yen decreases the total sales of exporting firms through price reduction if the invoice currency is a foreign one, because the Yen amount received for a foreign currency decreases, again, given a positive pass-through. Ito et al. (2012) document that Japanese firms tend to use US dollars and Euros for trade with the US or European countries, respectively, and they use US dollars as the invoice currency even for trade with Asian countries. According to them, as of the second half of 2008, the share of Yen invoicing is 39.4% in Japanese exports to the world and 20.7% in Japanese imports from the world.

4 Data

4.1 Data construction

This study extracts manufacturing firms from the Basic Survey of Japanese Business Structure and Activities, published by the Ministry of Economy, Trade, and Industry of the Japanese government. The Basic Survey of Japanese Business Structure and Activities is a panel survey of firms conducted each year, covering firms that hire 50 employees or more, hold stated capital (or contribution) of at least 30 million Yen, and operate in the following industries: mining, manufacturing,

public utilities, communication, wholesale and retail, finance and insurance, real estate and leasing, academic research and professional service, lodging and restaurant, daily-living service and leisure, education, and miscellaneous services. The survey was first launched in 1992, but it started asking for the number of workers from temporary help agencies from 2001. Thus, this study uses data from 2001 to 2012, covering the period during which the global financial crisis took place.

We constructed the variables used for this study as follows. The number of employees is the number of executives with compensation and permanent employees. A permanent employee is defined as an employee with a contract period that extends one month or longer, or an employee who worked 18 days or more in each of the past two months. Permanent employees include several classifications of workers, such as *Seishain, Seishokuin, Part, Arubaito, Shokutaku, Keiyakushain*. The number of permanent employees is divided into the number of regular workers (*Seishain* and *Seishokuin*) and part-time workers who work fewer hours per day than regular workers, or workers who works fewer days per week than regular workers. The survey further asks for the number of temporary workers with a contract period that extends less than one month and the number of workers dispatched from temporary help agencies. Some firms do not report values for some worker categories, and we thus treat them as zero values. We define *Seishain* and *Seishokuin* as regular workers who typically work full-time with an indefinite contract, while we define non-regular workers as the sum of part-time workers, temporary workers with contract periods extending less than one month, and workers dispatched from temporary help agencies.[2]

Throughout the analyses, only the manufacturing sector is included, because imports and exports in the manufacturing sector are captured well using the definition in the current data set as the amount of custom clearance. We construct each firm's exposure to international trade by the amount of imports among total purchases and the amount of exports among total sales. The amounts of imports and exports record the respective amounts that the firm directly clears through customs. Some firms do not report import and export amounts, and we treat them as zero volumes.

[2]Non-regular workers are further classified into several categories based on their differences based on the criteria used to define non-regular workers, such as work hours, length of contract period, whether a worker is employed by the workplace or a temporary help agency, and the career-track classification (*Seishain/Seishokuin* or other categories, as pointed out by Kambayashi and Kato (2013) and Asano et al. (2013)).

We calculate market power using the Lerner index: (Total sales−Operating cost)/Total sales.[3] The Lerner index corresponds to the degree of price markup. We construct R&D intensity, R&D expenditure divided by sales, as a measure of firms' competitiveness.

We use a broad index of the real effective exchange rate (REER), constructed with the Bank of International Settlement (BIS) as the measure of the exchange rate. The data frequency is monthly. BIS REER is the geometric average of exchange rates of Yen for a unit of multiple currencies, using the lagged trade volume as the weight. For example, the weight basket for Japan between 2008 and 2010 includes China (29.5%), the US (16.6%), Euro area (14.0%), Korea (5.9%), Chinese Taipei (3.8%), Thailand (3.6%), and Singapore (2.8%), followed by the UK, Canada, and Australia. We draw on the broad index regardless of whether the US dollar or the Euro is the dominant invoice currency, because the exchange rates between local currencies and the invoice currencies eventually determine the trade flows as well. Figure 1 draws the time series of the REER and suggests that foreign exchange fluctuations are sufficiently large throughout the sample period.

The Basic Survey of Japanese Business Structure and Activities had asked about the firm's situation on June 1 until 2006 and on March 31 from 2007. From the monthly time series of the REER, we construct an annual average of the REER prior to the survey month and match it to the survey: The average of the REER between June of year $t-1$ and May of year t is matched until 2006, and it is matched between April of year $t-1$ and March of year t from 2007.

We construct the trend component of change in the exchange rate and estimate the sales and employment responses to a trend change of the exchange rate. Using the predicted value of the MA (12) model, we first elicit the trend component in the monthly series of the exchange rate. The smooth line around the actual exchange rate fluctuation depicted in Figure 1 is the trend component of the exchange rate. Then, the elicited trend component is used as the log change in the exchange rate in (1).

[3] Operating cost includes the cost of sales and services and selling and administrative expenses.

4.2 Characteristics of Firms Involved in International Trade

Table 1 reports the descriptive statistics of the firm-level panel data. The average import share – the fraction of imports among all purchases – is about 5%, with a standard deviation of about 15%. The average export share – the fraction of exports among total sales – is about 4%, with a standard deviation of 12%. Among all firm-year observations, 32% record a positive export share and 28% record a positive import share. The distributions of import and export shares are drawn in Figure 3, given positive shares. Both distributions have a long right tail: Many firms do not engage in international trade at all, but a few firms actively engage in it. This heterogeneity of exposure to international trade corroborate with the findings of recent literature that only a fraction of firms within an industry have access to international trade (Melitz and Redding 2014) and assures the validity of the estimation strategy employed in this paper. The correlation coefficient of import and export shares is 0.262; firms engaging in import trade are more likely to engage in export trade. The average market power approximated by the Lerner index, (Total sales - Operating cost)/Total sales, is about 4%, whereas its standard deviation is about 5%. Average R&D intensity defined by R&D expenditure divided by total sales is about 1%, with a standard deviation of about 5%.

Decomposing firms into four types by their involvement in import and export activities sheds light on the heterogeneity of firms among types: firms involved in neither imports nor exports, only in imports, only in exports, and in both imports and exports. Firms that report positive imports or exports at any point in the panel period are classified as importers or exporters, so that the classification applied to any single firm does not change over time. According to Table 1, firms involved in international trade are larger in terms of sales, operating cost, and regular employment size, and this tendency applies more to exporting firms than to importing firms. Market power, approximated by (Total sales - Operating cost)/Total sales, is higher among exporting firms than other firms; the evidence is consistent with empirical regularities found in existing studies that firms with high productivity tend to export. R&D intensity is also higher among firms that are involved in international trade. Those firms involved in international trade, particularly exporting, tend to rely less on non-regular employment. In sum, firms involved in international trade tend to

be large in terms of sales, operating cost, and employment and have features associated with high productivity, such as high profit rate, high R&D intensity, and high regular employment ratio.

To understand the characteristics of importers and exporters further, Table A1 tabulates the industry composition of the four categories of firms. A comparison of the industrial composition of all the firms and each category reveals that food and textile manufacturers are more likely to be purely domestic businesses or only involved in imports. In contrast, production machinery, transportation equipment, and chemical and allied products manufacturers are more export-oriented. These export-oriented industries are more likely to be involved in both import and export activities. In sum, firms in "light" manufacturing industries tend to be domestic or import-oriented, and firms in "heavy" manufacturing industries tend to be export- (and import-) oriented.

Eventually, we will exploit the variation of import and export shares across firms within industry-year cells to identify the impact of exchange rate shocks on employment adjustments. Thus, characterizing importers and exporters within industry-year cells is useful to understand our estimates better. Table A2 tabulates the OLS estimates from the regressions of import/export shares on firms' characteristics, controlling for industry-year fixed effects. The regression results for import share (=import/total purchase) indicate that those firms with larger sales, higher price-cost margin, and higher R&D intensity are more likely to exhibit a higher import share. Given the sales amount, firms with larger numbers of employees and a higher fraction of regular workers exhibit smaller import shares. The regression results for export share (=export/total sales) indicate that those firms with larger sales, higher price-cost margin, and higher R&D intensity are more likely to exhibit a higher export share. To summarize, those firms with larger sales and higher market power, approximated by price-cost margin and R&D intensity, are more likely to be involved in international trade. These results confirm the received wisdom shared by trade economists (Melitz and Redding 2014).

We next focus on the effect of exchange rate fluctuation on the flow of employment, picking up the period between 2008 and 2009, when Yen appreciated more than 25%, as an example. Figure 4 shows the cumulative density functions of the percentage change in regular workers and

non-regular workers from 2008 to 2009 in exporting firms and non-exporting firms. By restricting the sample period to the appreciation period, we can extract only the impact of appreciation on the employment of exporters and non-exporters. According to the figure on the right-hand side of Figure 4, the cumulative density function for exporters increases faster than that for non-exporters within the region where the percentage change in the number of non-regular workers takes a negative value. This means that during the appreciation period, exporters reduce the employment of non-regular workers more than non-exporters. The Kolmogorov-Smirnov test shows that the two distributions are statistically distinct.

5 Basic Regression Results

Table 2 shows the regression results looking at the impact of exchange-rate fluctuation on the percentage changes in total sales, regular employment, and non-regular employment. The coefficients of interest pertain to the two interaction terms between the percentage change in the exchange rate and the import and export shares in the previous year. The result reported in the first column shows that the coefficient of the interaction between exchange rate fluctuation and import share is not statistically significant. This means that Japanese Yen appreciation does not increase the total sales of importing firms. The reason for this is not clear, but we speculate that importing firms do not expand production in response to cost reduction, because either they face inelastic domestic product demand or non-importing firms similarly benefit from the decrease of purchase cost. We should note that the estimated coefficients are identified off the variation within the industry-year cell. Thus, if an importing industry as a whole benefits from appreciation, the effect is captured by the industry-year fixed effects. One might think that the effect of exchange rate fluctuation cancels out in the case of firms involved in both import and export activities. To address this concern, we implement a subsample analysis that excludes exporting firms, but we find that Yen appreciation does not affect sales even in the subsample that excludes exporting firms.

Japanese Yen appreciation reduces the total sales of exporters as the negative coefficient for the

interaction term of the exporting share and the increase of the exchange rate. A 10% appreciation of Yen reduces total sales by 0.630% for firms that export 10% of total sales, according to the estimate reported in the first column; the estimated coefficient is statistically significant even at the 1% level.[4] The finding that appreciation reduces the sales of exporters is consistent with the finding by Ito et al. (2016) that appreciation reduces the stock price of exporters. The contrasting results on the effects of exchange rate fluctuation on sales between importers and exporters are not surprising, because the effect of the exchange rate on sales among importers is through the production cost reduction, and thus it is not as direct as the effect among exporters, where the exchange rate directly affects sales through price or quantity channels.

The second column in Table 2 reports the effects on the percentage change of regular employment. Appreciation increases the regular employment of importers and decreases the regular employment of exporters, but neither effect is statistically significant. Despite the fact that the appreciation decreases the sales of exporters in a statistically significant way, it does not reduce the exporters' employment of regular workers. This finding is consistent with the notion that regular workers in exporting firms are insulated from exchange rate shocks.

The third column in Table 2 reports the results for non-regular employment. The result indicates that appreciation reduces non-regular workers of exporters in a statistically significant way, while its effect on the employment of non-regular worker of importers in not statistically significant. A 10% appreciation of Japanese Yen decreases the non-regular employment by 1.376% of firms that export 10% of total sales. These results indicate that exporters significantly adjust non-regular employment in response to exchange rate shocks.

The signs of the estimated coefficients from the employment regressions are consistent with the signs of the total sales regression; Japanese Yen appreciation does not affect the sales of importers but reduces that of exporters. A 10% appreciation of Japanese Yen decreases sales by 0.630% and the number of non-regular workers by 1.376% among firms that export 10% of total sales. Thus, elasticity for non-regular employment is twice as large as elasticity for sales.

[4]This is calculated as 0.1 of export share $\times$10% increase in exchange rate(-0.630) (coefficient)=0.630%.

Although Nucci and Pozzolo (2010) and Kaiser and Siegenthaler (2016) do not pay attention to the differential impacts on regular and non-regular workers, and hence the results are not directly comparable to ours, the obtained results are surprisingly close to their results. As stated above, in our results, to take a manufacturer that exports 10% of its total sales as an example, a 10% appreciation of Japanese Yen measured in the real effective exchange rate contemporaneously decreases non-regular employment by about 1.376%, while it is 1.217% in Nucci and Pozzolo (2010) and 0.925% in Kaiser and Siegenthaler (2016). Note that the dependent variables are the log of total employment for these two studies, not the log of the number of non-regular workers, as in our study. Since the magnitude of the decline in employment is close to our estimates (even though our estimates here are only about non-regular workers, not about all workers), the employment adjustment of non-regular workers in Japan is comparable to the employment adjustment of all workers in Italy or Switzerland. Even with so many differences in dependent variables, country, periods, data, and control variables, the sign and significance seem relatively similar and consistent with those of previous studies, which implies that the magnitude of our estimate is realistic and valid in comparison with other studies as well.

We also add an extensive margin analysis for non-regular employment using dummy variables indicating the start/resume hiring of non-regular workers and the stop hiring of regular workers in the fourth and fifth columns of Table 2. According to Columns 4 and 5, results on the extensive margin are all insignificant. Exchange rate fluctuation apparently does not affect firms' decisions regarding whether to start hiring (or resume) non-regular workers or to begin firing non-regular workers down to zero.

6 Extensions

6.1 Dynamic effects

Adjustment of labor inputs to exogenous shocks may take time, and our econometric specification that assumes a spontaneous employment adjustment to an exogenous shock may fail to capture

the proper dynamic responses. The dynamic aspect of labor adjustment is particularly relevant in the Japanese labor market, where about 5% of total job separations is due to mandatory retirement and about 15% of job entry occurs through the hiring of fresh school graduates. Those reaching retirement age typically leave firms at the end of March, and the fresh school graduates join firms at the beginning of April. Thus, the chance of regular worker adjustment is arguably concentrated around the spring season. Furthermore, large firms typically finish the recruiting process of fresh graduates by the summer of the previous year. This annual recruitment and retirement cycle may well create a time lag in labor adjustment, particularly that of regular workers.

To allow for the lagged adjustment, we include two additional lagged variables, Import Share$_{it-2}$ $\times\Delta$Log(e_{t-1}) and Export Share$_{it-2}\times\Delta$Log(e_{t-1}), to explain the change in sales and employments between $t-1$ and t. The estimation results are reported in Table 3. Due to the serial correlation in the exchange rate fluctuation and the resulting multicollinearity, none of the coefficients associated with exchange rate fluctuation is statistically significant, but we continue to confirm that the appreciation reduces the total sales of exporters spontaneously. Indeed, the size of the coefficient for Export Share$_{it-1}\times\Delta$Log(e_t), which is -0.600, is quite comparable to the corresponding coefficient (-0.630) previously reported in Table 2, while the associated standard error increases. This negative impact of the appreciation on sales is transmitted to regular employment with a one-year lag, as reported in the second column of Table 3. The estimated coefficient, -0.312, is statistically significant. This result indicates the importance of allowing for the lagged effect of the exogenous shock on employment.

The dynamic adjustment of non-regular workers, reported in the third column, is also intriguing. As already found in Table 2, the appreciation spontaneously reduces non-regular employment, and the size of the coefficient (-2.024) increases by about 50 percentage points compared with the coefficient (-1.376) from the specification without the lagged effect of exchange rate fluctuation.[5] In contrast, lagged appreciation increases non-regular employment by almost the same amount. A 10% appreciation of Japanese Yen spontaneously decreases the number of non-regular workers

[5]This is calculated as 2.024/1.376=1.47.

by 2.024% among firms that export 10% of total sales, but it increases the number of non-regular workers by 2.191% in the following year. The estimated dynamic pattern implies that an exporter that experiences a temporal appreciation absorbs the shock by decreasing non-regular employment, but once the exchange rate becomes stable, the firm loads up on the non-regular employment to prepare for another shock. Furthermore, the estimates imply that an exporter that experiences the same magnitude of appreciation in two consecutive years decreases non-regular employment in the first year but does not decrease it any further in the second year. Thus, the dynamic adjustment of non-regular workers is consistent with the notion that non-regular workers are used to absorb temporal shocks.

Table 4 represents an estimation that includes the lagged dependent variable among the explanatory variables. The embedded auto-regressive process of employment adjustment allows for the lagged impact of exogenous shocks other than exchange rate fluctuation, as well as a long-term dynamic adjustment process. The lagged dependent variable Δy_{it-1} is necessarily correlated with the error term Δu_{it} as y_{it-1} and u_{it-1} is correlated by construction. To address this endogeneity, we use Δy_{it-2} as the instrumental variable, assuming that u_{it} is not serially correlated. The negative coefficient for the lagged dependent variable observed in all columns suggests that sales and employment growth, respectively, are mean-reverting processes. Conditional on this mean-reversion, the coefficients on Export Share$_{it-1}\times$ ΔLog(e_t) are now all negative for sales, regular employment, and non-regular employment in statistically significant ways. All the negative coefficients are significant at the 1% significance level, and exporters even reduce regular workers when the Yen appreciates, but the magnitude of the coefficients for regular workers is less than 10% of that of non-regular workers'.[6] Thus, our main results are preserved even after controlling for the adjustment processes.

In the long run, the exchange rate shift affects the sales of domestic firms through import substitution; a firm targeting the domestic market in an industry with a high import penetration rate should face fierce competition with foreign products when the Yen appreciates. For ex-

[6]The coefficient is -0.263 for regular workers, while it is -3.360 for non-regular workers.

ample, a firm that sells textile products to the domestic market may well suffer from competition with products made in China when the Yen appreciates and Chinese products in Japan become cheaper. To capture this import substitution effect, we introduce a triple interaction term, $(1-\text{Export Share}_{it-1})\times\text{Import Penetration Rate}_j\times\Delta\text{Log}(e_t)$, where $(1-\text{Export Share}_{it-1})$ captures the domestic orientation of firm i in year $t-1$, and $\text{Import Penetration Rate}_j$ is the import coefficient of the 2005 Input-Output table of industry j. This term captures how a domestically oriented firm in an industry with a high import penetration rate is affected by Yen appreciation. Note that although we also include an interaction term $(1-\text{Export Share}_{it-1})\times\text{Import Penetration Rate}_j$, we do not include $\text{Import Penetration Rate}_j\times\Delta\text{Log}(e_t)$, because it is captured by the state and year fixed effects.

The estimation results with the import competition effect are reported in the last 3 columns in Table 4. The significantly negative coefficients for the triple interaction term, $\text{Import Penetration Rate}_j\times\Delta\text{Log}(e_t)$ are in line with our prior expectations that a domestically oriented firm in an industry with high import penetration reduces sales and employment when the Yen appreciates. What is notable here is the stability of other estimated coefficients; the specifications with and without the import penetration effect render virtually identical estimates.

Overall, the analysis of this subsection shows that considering the dynamic effect and the import substitution effect does not change our conclusion that Yen appreciation reduces the sales and employment of exporters.

6.2 Shrinking Foreign Demand as an Alternative Explanation

In this subsection, we consider the shrinkage of foreign demand as an alternative explanation. More concretely, it is possible that our estimates suffer from an omitted variable bias, as the Yen is allegedly a safe asset in a global economic crisis and movements in the Yen could be correlated with the global business cycle and hence firms' foreign demand. For example, on the eve of the 2008 financial crisis, the world economy shrank and the demand from foreign countries decreased when the Yen was purchased as a safe asset. In this scenario, Yen appreciation is negatively

associated with exporters' sales, not because of the increase of product prices faced by foreign consumers but because of foreign demand shrinkage. This does not essentially alter our argument, because our focus is on the effect of exogenous sales decline on employment; as far as sales decline being caused by Yen appreciation either through price increase or demand shrinkage, we successfully establish the causal impact of sales decline on employment.

It is true, however, that the channel through which Yen appreciation affects firms' labor demand is an interesting issue to address. Thus, to consider the possibility of the impact of shrinking foreign demand, Table 5 controls for a trade-weighted average of the GDP of the main export destination countries of each Japanese firm. Our data set records the amount of trade exposure by destination for five regions (Asia, the Middle East, Europe, North America, and others). Using this information, we construct the weighted average of trade partners' GDP as a proxy for foreign demand. The estimation results show that, except for a few cases, the interaction terms of the change in trade partners' GDP and trade exposure are neither statistically significant nor stable. These results do not support the alternative explanation that the shrinkage of world demand, potentially correlated with Yen appreciation, caused the sales and employment declines of exporters. More importantly, our main result, that exporters reduce non-regular employees when the exchange rate appreciates, holds even when considering the possible effect of shrinking foreign demand. This implies the robustness of our main results.

6.3 Wage and Hours Adjustment

In the face of negative labor demand shock, firms may adjust hours or wage margins instead of employment. Adjustment of hours and wage margins could be important absorbing mechanisms that enable firms to hoard workers with firm-specific human capital. In this section, we examine the adjustment of wages and hours to absorb business cycle fluctuation and explore the possibility that firms adjust employment of regular and non-regular workers differently because wage and hours adjustments of regular workers could be more flexible than those of non-regular workers. The difference of the adjustment margins between regular and non-regular workers suggests the

reason why the employment adjustment of regular workers is more sluggish than that of non-regular workers.

We implement an analysis of the exchange rate effects on the average wage of regular workers and the average wage of non-regular workers using the current model, as is done by Nucci and Pozzolo (2014), who indeed find a substantial pass-through of exchange rate shocks into workers' wages. Our data set, the Basic Survey of Japanese Business Structure and Activities, however, does not distinguish the wage bill paid to regular workers from that paid to non-regular workers. To overcome this data limitation, we supplement our analysis by using an alternative source, the Basic Survey on Wage Structure (BSWS), which enables us to distinguish each wage component between part-time and full-time workers. The caveat here is that the BSWS does not distinguish between regular and non-regular workers before 2005, and thus we need to use the full-time / part-time distinction instead.

Figure 5a contrasts the time series of monthly pay, annual bonus divided by 12, and its sum for full-time and part-time workers. The figure indicates that bonus payment is almost exclusively received by full-time workers and that the fraction of bonuses among all annual earnings is on average 0.16 for full-time workers and 0.04 for part-time workers. The figure for full-time workers also demonstrates that both monthly pay and bonus payment are pro-cyclical; pay is negatively correlated with the unemployment rate. In contrast, the pay of non-regular workers is almost constant and does not respond to the business cycle. While previous studies demonstrate that Japanese regular workers tend to receive payment in the form of bonus payment because its determination is more flexible (Hashimoto 1979, Kawaguchi and Ohtake 2007, Kato 2016, Kawaguchi et al. 2017), the time series of pay depicted in Figure 5a indicates that the monthly payment is as flexible as the bonus payment. Overall, wages are adjusted in response to the business cycle among full-time workers, but it is not adjusted among part-time workers.

Firms may also use the hours margin to absorb labor demand shock, so we also explore the differential adjustment of hours worked between full-time and part-time workers. Figure 5b also uses the BSWS data and compares the time series of scheduled hours and overtime hours of full-time

and part-time workers. The left graph shows that scheduled hours are almost constant regardless of the business cycle among full-time workers, whereas their overtime hours are procyclical (average overtime becomes shorter when the unemployment rate increases). Overall, the average hours worked by full-time workers is procyclical because of the overtime margin. In contrast, part-time workers rarely work overtime, but their scheduled hours are apparently more flexible and procyclical, which is quite understandable considering their flexible labor contract. In total, we cannot claim that the hours of full-time workers are more flexible than those of part-time workers. At least, however, we can say that regular workers have some flexible hour adjustment margin, particularly because they work more overtime.

Basically, the results drawing on axially wage and hours data from the BSWS indicate that wages of full-time workers are more pro-cyclical than those of part-time workers. While the distinction of full-time/part-time does not exactly overlap with the regular and non-regular distinction, these results corroborate the notion that firms attempt to hoard regular workers during the economic downturn by adjusting their wages. Simple job heterogeneity between regular and non-regular workers explains the heterogeneity in employment adjustments, but does not explain the heterogeneity in hoarding behavior by firms between regular and non-regular workers. It is conceivable that firms set up an institution of wage adjustment for regular workers, so that they do not have to fire regular workers during the economic downturns. Combined with the worker's characteristics mentioned in Section 2.2, a probable reason why firms prefer to hoard regular workers is that regular workers have higher skill than non-regular workers that is at least partially firm specific and difficult to procure from the labor market.

6.4 Differential Adjustment by the Importance of Firm-specific Human Capital

This subsection attempts to further substantiate the claim that the differential employment adjustments between regular and non-regular workers are partially due to the difference in the degree of firm-specific human capital that they have accumulated. To attain the goal, we conduct a sub-

sample analysis by industry to determine for which industries firm-specific human capital is more important. To identify the industries in which firm-specific human capital is important, we draw on the Basic Survey of Wage Structure, which records years of firm tenure of individual workers. In the industry where firm-specific human capital is important, we expect a longer average tenure, given workers' age, and a steeper tenure-wage profile. We calculate several measures that approximate the importance of firm-specific human capital, such as average tenures, average tenures adjusted for workers' age, and slopes of tenure-wage profiles evaluated at the 0, 5, 10, and 15 years of job tenure for each of the 24 manufacturing industries. To calculate the slopes of tenure-wage profiles, we regress the natural logarithm of annual earnings, including overtime pay and bonus payment, on the education category dummy variables, potential experience, its squared, tenure, and its squared by industry, using full-time regular workers as the analysis sample.

The proxy variables for the importance of firm-specific human capital vary substantially across industries. For example, average years of tenure by industry range from 17.7 years in the petroleum and coal product manufacturing industry to 12.2 years in the plastic product industry. The ordering essentially does not change when we order the regression residual of the tenure of each worker on the age dummy variables. Tenure-wage profile is steeper in industries where the average years of tenure are than we would expect. For example, the slope of the profile at 5 years of tenure is 0.037 in the petroleum and coal product manufacturing industry, whereas it is 0.025 in the plastic product industry. Thus, it is tempting to compare the petroleum and coal product manufacturing industry and the plastic product industry, but it is not appropriate, because these two industries have substantially different international trade exposure. The average export rate is 2.479% in the petroleum and coal product manufacturing industry, while it is 4.643% in the plastic product industry. The corresponding standard deviations are 8.364 and 10.371. This difference in the variation of trade exposure affects the accuracy of the estimated employment sensitivity to the exchange rate fluctuation. To circumvent this issue, we attempt to pick up two industries that differ in the importance of firm-specific human capital while sharing similar trade exposure.

We pick the petroleum and coal product manufacturing industry and the leather tanning, leather

products and fur skins manufacturing industry as the two contrasting industries. Both industries are similarly exposed to international trade; the mean import rate of the former industry is 3.9%, while it is 3.8% for the latter industry, and the mean export rates are 2.7% and 2.5%, respectively. The two industries are apparently different, however, in terms of the importance of firm-specific human capital; the average years of tenure is 17.7 years in the petroleum and coal product manufacturing industry, whereas it is 13.5 years in the leather tanning, leather products and fur skins manufacturing industries. The slope of the tenure-wage profile at 5 years of tenure is 0.037 in the former industry, whereas it is 0.015 in the latter industry.[7] We separately estimate the basic model, whose result is reported in Table 2, using these two industries as sub-samples.

The first two columns of Table 6 are the results for all firms, which come from Table 2. The next two columns are the results for the petroleum and coal product manufacturing industry, and the last two columns are the results for the leather tanning, leather products and fur skins manufacturing industry. Similar to the aggregate results from Table 2, the appreciation reduces the sales of exporters in both industries, while the estimates are not very precise, with relatively large standard errors. Appreciation does not affect the employment of regular workers in the petroleum and coal product manufacturing industry, while it reduces the regular employment in the leather tanning, leather products and fur skins manufacturing industry, though the estimate is not precise and statistically not significant. Appreciation differently affects exporters' employment adjustment of non-regular workers across the two industries. While exporters in the petroleum and coal product manufacturing industry aggressively reduce non-regular employment when the Yen appreciates, exporters in the leather tanning, leather products and fur skins manufacturing industry do not reduce it. Overall, exporters' employment adjustments of regular and non-regular employment to appreciation are asymmetric in the petroleum and coal product manufacturing industry, where firm-specific human capital is important, but the adjustments are symmetric in the leather tanning, leather products and fur skins manufacturing industry.

[7]Indeed, the leather tanning, leather products and fur skins manufacturing industry is stably categorized into the bottom 5 industries for all the measures used to approximate the importance of firm-specific human capital, while the petroleum and coal product manufacturing industry is always the top 1 industry for all the measures.

While not definitive, the results based on a sub-sample analysis by industry corroborate the claim that firm-specific human capital is a source of asymmetric employment adjustments of regular and non-regular workers, which is caused by exporters who manage to accommodate themselves to the shocks caused by appreciation.

6.5 Various Definitions of Non-regular Workers

In the analyses so far, the definition of non-regular workers covers part-time workers (workers who work shorter hours/days than standard workers), temporary workers with contract periods extending less than one month, and workers dispatched from temporary help agencies. All non-regular workers in our definition work under fixed term contracts, because part-time workers are typically employed under fixed term contracts, while some of them experience repetitive renewals of the contracts. Thus, their employment is less protected than regular workers'. Among non-regular workers, workers dispatched from temporary help agencies could be more susceptible to a demand shock, because their contract period is clearly agreed upon between temporary help agencies and the worker-accepting firms. In contrast, when the contracts of fixed-term workers are renewed repeatedly, the Japanese legal system considers the fixed-term contract as a *de facto* permanent contract in certain situations (Labor Contract Act, Article 19). Accordingly, some claim that the degree of employment protection could be different even among non-regular workers. Indeed, Hosono et al. (2015) find that the negative demand shock after the 2008 financial shock reduced the employment of workers dispatched from temporary help agencies.

To examine whether the employment responses differ among non-regular workers, we divide non-regular workers into three categories: part-time workers, temporary workers with contract periods extending less than one month, and workers dispatched from temporary help agencies. The estimation results are reported in Table 7. The first column repeats the result already reported in Column 3 of Table 2 for reference. The basic result that exporters reduce non-regular employees when the exchange rate appreciates holds across the three categories but only the result for dispatched workers is statistically significant. In addition to the statistical significance, the size of

coefficient is also significantly larger for dispatched workers. The finding that appreciation makes exporting firms reduce the employment of workers dispatched from temporary help agencies is consistent with the results obtained by Hosono et al. (2015).

While we find a certain heterogeneity in responses across various categories of non-regular workers, we would argue that the difference is not as stark to claim that the result is driven only by dispatched workers, as we obtain similar results across categories, at least in terms of the sign of the coefficients, with less precision. This could be interpreted as evidence that firms use these various categories of non-regular employment interchangeably to absorb temporary exchange rate shocks, but at least, we can say that the results in this section do not substantially change our argument that non-regular workers are more susceptible to negative demand shock, as they accumulate less firm-specific human capital and work under fixed-term contracts.

7 Conclusion

We identify the impact of exchange rate fluctuation on employment adjustment, using unique firm-level panel data of manufacturers that record accurate employment information and measures of each firm's exposure to international trade. We first confirm that the appreciation of Yen decreases the total sales of exporting firms, suggesting that exporters are more susceptible than importers to exchange rate fluctuation. The appreciation decreases the regular employment of exporters with a one-year lag. The appreciation makes exporters spontaneously decrease non-regular workers, but exporters load up on non-regular workers once the exchange rate stabilizes, to prepare for the next shock. Due to differences in skills, occupations, and institutions between regular and non-regular workers, firms are likely to adjust non-regular workers to absorb exogenous shocks.

We contribute to the literature in several ways. First, we show that stabilizing the exchange rate contributes to stabilizing employment, particularly that of non-regular workers. Credible evidence on the effect of exchange-rate fluctuation on employment while relying on firms' heterogeneous dependence on international trade had been limited, except for the results based on firm-level panel

data by Nucci and Pozzolo (2010) and Kaiser and Siegenthaler (2016), who do not distinguish between regular and non-regular workers. Even with this challenging background, we have provided credible evidence and new findings on this topic. Second, we identify the difference of adjustments between regular workers and non-regular workers, using exchange rate fluctuation as a credible exogenous source of a labor-demand shifter. This finding provides support for the claim that firms are likely to adjust non-regular workers to absorb exogenous shocks.

The estimation results suggest a moderate effect of exchange rate stabilization on employment stabilization: To take a firm that exports 10% of total sales as an example, a 10% appreciation of Japanese Yen decreases regular employment of the firm by 0.312% with a one-year lag and non-regular employment by 2.024% spontaneously. Although the average impacts seem moderate, given the large heterogeneity in the exposure to international trade, the impacts are quite different across firms. Moreover, the effect of exchange rate fluctuation creates a significant fluctuation of non-regular employment. Therefore, policy makers should pay careful attention to the heterogeneous impacts of exchange rate fluctuation on employment across firms and workers.

As described in the introduction section, Benito and Hernando (2008) find that temporary employment is much more pro-cyclical than permanent employment, which is similar to our results. We believe that this similarity of the results may come from the dual labor market that exists both in Japan and Spain, although how the dual structure has been formed differs between the two countries.[8] Then, our findings could raise important implications, especially for European countries, such as Spain, where a dual structure of the labor market is an important characteristic of the economy (Bentolila et al. 2012b).

[8]We need to be careful about an important difference in the source of the dual structure of labor markets between Japan and Europe: In Europe, labor policies, which have been given exogenously to those inside the labor market, have created the dual structure of labor markets. In contrast, in Japan, employment practice, which has not been 'forced' from outside but has developed by itself, has created the dual structure.

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Table 1: Descriptive Statistics for Each Firm Category, 2001-2012

Firm Category	(1) *All*	(2) *Neither Import nor Export*	(3) *Only Import*	(4) *Only Export*	(5) *Import and Export*
Total Sales (million yen)	21,629	7,894	13,396	23,421	43,190
	(150,738)	(49,426)	(76,972)	(134,123)	(239,496)
Import/Sales (%)	4.788	0.000	9.780	0.000	11.970
	(14.542)	(0.000)	(20.879)	(0.000)	(20.711)
Export/Sales (%)	4.484	0.000	0.000	6.199	11.634
	(12.489)	(0.000)	(0.000)	(14.422)	(17.903)
Total Employee	421	230	283	432	733
	(1,706)	(820)	(752)	(1,777)	(2,559)
% of Non-regular Workers within Each Firm	14.963	16.293	17.193	11.933	13.409
	(17.316)	(19.542)	(18.475)	(13.808)	(13.970)
% of Non-regular Workers within Each Firm	17.828	20.008	20.176	14.387	15.317
(among Firms with Non-regular Worker)	(17.498)	(19.865)	(18.448)	(13.949)	(13.918)
Firm without Non-regular worker=1 (o/w =0)	0.161	0.186	0.148	0.171	0.125
Operating Cost (million yen)	20,771	7,639	12,810	22,426	41,430
	(145,415)	(47,353)	(72,067)	(130,959)	(231,059)
Market Power (%)	3.874	3.208	3.558	4.809	4.629
	(4.693)	(4.069)	(4.364)	(5.614)	(5.122)
R&D Expenditure/Sales (%)	1.104	0.417	0.825	1.319	2.109
	(4.814)	(4.620)	(5.857)	(3.815)	(4.893)
Observations	153,044	73,384	13,184	16,029	50,447

Notes: Standard deviations are in parentheses. The import share is calculated by dividing the purchase turnover (total value of overseas purchase) by the purchase turnover (total transaction value). The export share is calculated by dividing the sales amount (total value of direct exports) by another variable: the sales amount (total transaction value). Operating cost is calculated from cost of sales and services + selling and administrative expenses. Market power is calculated using the Lerner index: (Total sales - Operating cost)/Total sales. Because the number of employed regular workers is not directly recorded before 2006, it is calculated by the number of total permanent employees minus the number of part-time workers. The number of non-regular workers is the sum of the numbers of part-time workers, temporary workers whose contract period is less than one month, and workers dispatched from temporary help agencies. The employee shares are calculated by dividing the numbers of employees in the functional department, the operations department, and other than headquarters by the number of total employees. The sample is limited to the manufacturing industry.

Table 2: Impact of the Exchange Rate Fluctuation

Dependent Variable	(1) Δ*Log of Total Sales*$_{it}$	(2) Δ*Log of the Number of Regular Workers*$_{it}$	(3) Δ*Log of the Number of Non-regular Workers*$_{it}$	(4) *Start or Resume Hiring Non-regular Workers*$_{it}$	(5) *Stop Hiring Non-regular Workers*$_{it}$
Import Share$_{it-1}\times\Delta\text{Log}(e_t)$	-0.025	0.062	0.163	0.086	0.049
	(0.092)	(0.055)	(0.336)	(0.079)	(0.068)
Export Share$_{it-1}\times\Delta\text{Log}(e_t)$	-0.630***	-0.031	-1.376***	-0.058	-0.014
	(0.129)	(0.064)	(0.400)	(0.093)	(0.090)
Import Share$_{it-1}$	-0.005	-0.006*	-0.009	-0.011**	-0.0002
	(0.005)	(0.003)	(0.015)	(0.005)	(0.004)
Export Share$_{it-1}$	-0.013	-0.001	-0.026	-0.019***	-0.008
	(0.009)	(0.004)	(0.019)	(0.007)	(0.006)
Market Power$_{it-1}$	-0.115***	0.242***	-0.010	-0.029**	-0.030**
	(0.016)	(0.011)	(0.047)	(0.014)	(0.013)
R&D Share$_{it-1}$	0.419***	-0.011	-0.011	-0.073**	-0.060
	(0.125)	(0.012)	(0.082)	(0.031)	(0.044)
Industry-year Fixed Effect	Yes	Yes	Yes	Yes	Yes
R-squared or Log-pseudo-likelihood	0.175	0.017	0.046	-18,183.547	-15,957.884
Observations	102,682	102,682	82,947	102,342	102,474

Notes: Standard errors robust against firm-level clustering are reported in parentheses. The dependent variable of Column 4 is a dummy variable taking one if a firm hired non-regular worker(s) at time t but did not hire a non-regular worker at time $t-1$. The dependent variable of Column 5 is a dummy variable taking one if a firm did not hire non-regular worker at time t but hired some non-regular worker(s) at time $t-1$. In Columns 4 and 5, marginal effects evaluated at the mean of the covariates and the log-pseudo-likelihood instead of R-squared are reported. The term e is the Real Effective Exchange Rate (REER). We calculate the trend component of the exchange rate using MA(12). The sample is limited to the manufacturing industry. *** p<0.01, ** p<0.05, * p<0.1.

Table 3: Dynamic Impact of the Exchange Rate Fluctuation

Dependent Variable	(1) Δ*Log of Total Sales*$_{it}$	(2) Δ*Log of the Number of Regular Workers*$_{it}$	(3) Δ*Log of the Number of Non-regular Workers*$_{it}$	(4) *Start or Resume Hiring Non-regular Workers*$_{it}$	(5) *Stop Hiring Non-regular Workers*$_{it}$
Import Share$_{it-1}\times\Delta\text{Log}(e_t)$	-0.076	0.052	0.257	0.092	0.016
	(0.135)	(0.086)	(0.518)	(0.130)	(0.109)
Import Share$_{it-2}\times\Delta\text{Log}(e_{t-1})$	0.240	-0.017	-1.693*	0.084	0.070
	(0.244)	(0.199)	(0.964)	(0.304)	(0.256)
Export Share$_{it-1}\times\Delta\text{Log}(e_t)$	-0.600***	0.030	-2.024***	-0.164	0.060
	(0.200)	(0.093)	(0.666)	(0.160)	(0.129)
Export Share$_{it-2}\times\Delta\text{Log}(e_{t-1})$	0.029	-0.312*	2.191**	0.188	-0.044
	(0.349)	(0.183)	(1.021)	(0.320)	(0.259)
Import Share$_{it-1}$	-0.006	0.012	0.051	-0.003	-0.009
	(0.014)	(0.010)	(0.052)	(0.015)	(0.014)
Import Share$_{it-2}$	-0.008	-0.021	-0.081	-0.013	0.0002
	(0.017)	(0.014)	(0.063)	(0.019)	(0.017)
Export Share$_{it-1}$	0.026	0.001	0.075	-0.024	-0.012
	(0.033)	(0.022)	(0.116)	(0.026)	(0.023)
Export Share$_{it-2}$	-0.040	0.005	-0.085	0.010	-0.025
	(0.037)	(0.024)	(0.129)	(0.029)	(0.025)
Market Power$_{it-1}$	-0.117***	0.227***	0.019	-0.030*	-0.022
	(0.018)	(0.012)	(0.057)	(0.017)	(0.016)
R&D Share$_{it-1}$	0.341***	-0.017	0.040	-0.056	-0.130***
	(0.076)	(0.016)	(0.088)	(0.037)	(0.042)
Industry-year Fixed Effect	Yes	Yes	Yes	Yes	Yes
R-squared or Log-pseudo-likelihood	0.210	0.017	0.052	686,558.61	688,123.27
Observations	69,468	69,468	57,209	69,163	69,186

Notes: Standard errors robust against firm-level clustering are reported in parentheses. The dependent variable of Column 4 is the dummy variable taking one if a firm hired non-regular worker(s) at time t but did not hire a non-regular worker at time $t-1$. The dependent variable of Column 5 is the dummy variable taking one if a firm did not hire non-regular workers at time t but hired some non-regular worker(s) at time $t-1$. In Columns 4 and 5, marginal effects evaluated at the mean of the covariates and the log-pseudo-likelihood instead of R-squared are reported. The term e is the Real Effective Exchange Rate (REER). We calculate the trend component of the exchange rate using MA(12). The lagged variables of Import share$_{it-2}\times\Delta\text{Log}(e_{t-1})$, Export share$_{it-2}\times\Delta\text{Log}(e_{t-1})$, Import share$_{it-2}$, and Export share$_{it-2}$ are used as the instrument variables for these variables. The sample is limited to the manufacturing industry. *** p<0.01, ** p<0.05, * p<0.1.

Table 4: Impact of the Exchange Rate Fluctuation with a Lagged Dependent Variable

Dependent Variable	(1) Δ*Log of Total Sales*$_{it}$	(2) Δ*Log of the Number of Regular Workers*$_{it}$	(3) Δ*Log of the Number of Non-regular Workers*$_{it}$	(4) Δ*Log of Total Sales*$_{it}$	(5) Δ*Log of the Number of Regular Workers*$_{it}$	(6) Δ*Log of the Number of Non-regular Workers*$_{it}$
Δy_{it-1}	-0.013	-0.151***	-0.149***	-0.016	-0.152***	-0.152***
	(0.010)	(0.014)	(0.007)	(0.010)	(0.014)	(0.007)
Import Share$_{it-1}\times\Delta$Log(e_t)	-1.575***	-0.081	-1.694***	-1.533***	-0.081	-1.689***
	(0.144)	(0.077)	(0.478)	(0.144)	(0.077)	(0.477)
Export Share$_{it-1}\times\Delta$Log(e_t)	-3.873***	-0.255***	-3.344***	-3.845***	-0.256***	-3.332***
	(0.206)	(0.076)	(0.535)	(0.205)	(0.076)	(0.533)
Import Share$_{it-1}$	0.008	0.002	0.097*	0.009	0.002	0.099*
	(0.016)	(0.009)	(0.054)	(0.016)	(0.009)	(0.054)
Export Share$_{it-1}$	-0.019	0.004	0.085	-0.001	0.002	0.131
	(0.035)	(0.016)	(0.111)	(0.035)	(0.016)	(0.115)
Market Power$_{it-1}$	-1.767***	0.141***	-1.467***	-1.763***	0.143***	-1.416***
	(0.068)	(0.032)	(0.157)	(0.068)	(0.032)	(0.156)
R&D Share$_{it-1}$	1.006***	0.002	-0.157	1.002***	0.001	-0.185
	(0.369)	(0.018)	(0.119)	(0.369)	(0.018)	(0.114)
(1$-$Export Share$_{it-1}$)$\times$	–	–	–	0.113*	-0.012	0.259
Import Penetration Rate$_j$				(0.058)	(0.033)	(0.210)
(1$-$Export Share$_{it-1}$)$\times$	–	–	–	-0.823***	-0.158**	-7.164***
Import Penetration Rate$_j\times\Delta$Log(e_t)				(0.084)	(0.069)	(0.396)
Observations	84,720	84,720	62,731	84,720	84,720	62,731

Notes: Standard errors robust against firm-level clustering are reported in parentheses. The term Δy_{t-1} indicates the lagged dependent variable. The terms Δy_1, Δy_2,..., Δy_{t-2} are used as instrument variables for the lagged dependent variable. The term e is the Real Effective Exchange Rate (REER). We calculate the trend component of the exchange rate using MA(12). The sample is limited to the manufacturing industry. The import penetration rate is the import coefficient from the Input-Output Table in 2005. *** p<0.01, ** p<0.05, * p<0.1.

Table 5: Impact of the Exchange Rate Fluctuation with Weighted GDP

Weight Used to Construct Weighted GDP	(1)	(2)	(3)	(4)	(5)	(6)
	Calculated at the Firms' Export Destination Level			*Calculated at the Industry Level*		
Dependent Variable	*ΔLog of Total Sales$_{it}$*	*ΔLog of the Number of Regular Workers$_{it}$*	*ΔLog of the Number of Non-regular Workers$_{it}$*	*ΔLog of Total Sales$_{it}$*	*ΔLog of the Number of Regular Workers$_{it}$*	*ΔLog of the Number of Non-regular Workers$_{it}$*
Import Share$_{it-1}$×ΔLog(e_t)	-0.029	0.063	0.163	-0.024	0.060	0.148
	(0.092)	(0.055)	(0.336)	(0.092)	(0.055)	(0.338)
Export Share$_{it-1}$×ΔLog(e_t)	-0.584***	-0.034	-1.383***	-0.614***	-0.035	-1.370***
	(0.129)	(0.064)	(0.403)	(0.130)	(0.064)	(0.403)
Import Share$_{it-1}$	-0.005	-0.003	-0.008	-0.007	-0.002	0.030
	(0.006)	(0.004)	(0.017)	(0.009)	(0.006)	(0.039)
Export Share$_{it-1}$	-0.060***	0.003	-0.019	-0.075***	0.016**	-0.047
	(0.014)	(0.006)	(0.036)	(0.018)	(0.008)	(0.050)
Market Power$_{it-1}$	-0.114***	0.242***	-0.010	-0.114***	0.242***	-0.009
	(0.016)	(0.011)	(0.047)	(0.016)	(0.011)	(0.047)
R&D Share$_{it-1}$	0.418***	-0.012	-0.011	0.417***	-0.010	-0.012
	(0.126)	(0.012)	(0.083)	(0.125)	(0.012)	(0.082)
ΔLog(Weighted GDP)	0.569***	0.008	-0.031	-3.432**	1.431	-12.551*
	(0.137)	(0.065)	(0.470)	(1.452)	(1.562)	(6.704)
ΔLog(Weighted GDP)×	-0.033	-0.307**	-0.178	0.151	-0.373	-3.754
Import Share$_{it-1}$	(0.278)	(0.152)	(0.847)	(0.797)	(0.573)	(3.531)
ΔLog(Weighted GDP)×	0.107	-0.034	-0.077	5.945***	-1.591**	2.015
Export Share$_{it-1}$	(0.241)	(0.120)	(0.782)	(1.436)	(0.664)	(4.550)
Industry-year Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.175	0.017	0.046	0.175	0.017	0.046
Observations	102,682	102,682	82,947	102,682	102,682	82,947

Notes: Standard errors robust against firm-level clustering are reported in parentheses. The term e is the Real Effective Exchange Rate (REER). We calculate the trend component of the exchange rate using MA(12). The sample is limited to the manufacturing industry. We calculate the weighted average of GDP for each year. The country GDP data, GDP (current US$), are obtained from the World Bank. For the GDP data, we are able to use the aggregated GDP for the following regions: East Asia & Pacific; Middle East & North Africa; Euro area; North America; and Latin America & Caribbean. To construct the weighted GDP data, we calculate the weight using the Basic Survey of Japanese Business Structure and Activities. In the survey, we have the information of the amount of export by export destination region for each firm. The export destination regions are similar to the regions in the GDP data: Asia, Middle East, Euro area, North America, and others. For Columns 1 to 3, the weight is calculated at the firm-export destination level. We calculate the export share for each destination by firm, take the product of the export share by destination and log change in regional GDP, and then take the summation of the product. For Columns 4 to 6, the weight is calculated at the industry level. First, we calculate the total amount of exports and sales by industry and region and the total export share in the total sales by industry and region. Second, by industry, we take the product between the industry-region export share and the log change in regional GDP. Finally, we calculate the geometric average of the product, using the number of firms in each industry as a weight. *** p<0.01, ** p<0.05, * p<0.1.

Table 6: Impact of the Exchange Rate Fluctuation by Industry

Industry:	(1) *All Manufacturing Industries*	(2)	(3) *Petroleum and Coal Product Manufacturing Industry*	(4)	(5) *Leather Tanning, Leather Products and Fur Skins Manufacturing Industry*	(6)
Dependent Variable	Δ*Log of the Number of Regular Workers*$_{it}$	Δ*Log of the Number of Non-regular Workers*$_{it}$	Δ*Log of the Number of Regular Workers*$_{it}$	Δ*Log of the Number of Non-regular Workers*$_{it}$	Δ*Log of the Number of Regular Workers*$_{it}$	Δ*Log of the Number of Non-regular Workers*$_{it}$
Import Share$_{it-1}\times\Delta\text{Log}(e_t)$	0.062	0.163	-0.033	0.944	0.183	-0.532
	(0.055)	(0.336)	(0.204)	(1.691)	(0.245)	(2.191)
Export Share$_{it-1}\times\Delta\text{Log}(e_t)$	-0.031	-1.376***	0.120	-6.560***	-0.581	1.290
	(0.064)	(0.400)	(0.290)	(2.084)	(0.492)	(2.065)
Import Share$_{it-1}$	-0.006*	-0.009	-0.022	-0.091	-0.014	-0.091
	(0.003)	(0.015)	(0.015)	(0.057)	(0.013)	(0.098)
Export Share$_{it-1}$	-0.001	-0.026	0.004	0.031	-0.040	-0.005
	(0.004)	(0.019)	(0.017)	(0.114)	(0.036)	(0.114)
Market Power$_{it-1}$	0.242***	-0.010	0.341***	0.420**	0.376***	-0.183
	(0.011)	(0.047)	(0.046)	(0.205)	(0.070)	(0.249)
R&D Share$_{it-1}$	-0.011	-0.011	0.017	0.291	0.231*	1.761**
	(0.012)	(0.082)	(0.073)	(0.269)	(0.139)	(0.889)
Fixed Effect	Industry-year	Industry-year	Year	Year	Year	Year
R-squared	0.017	0.046	0.017	0.024	0.026	0.030
Observations	102,682	82,947	5,829	5,009	3,799	2,645

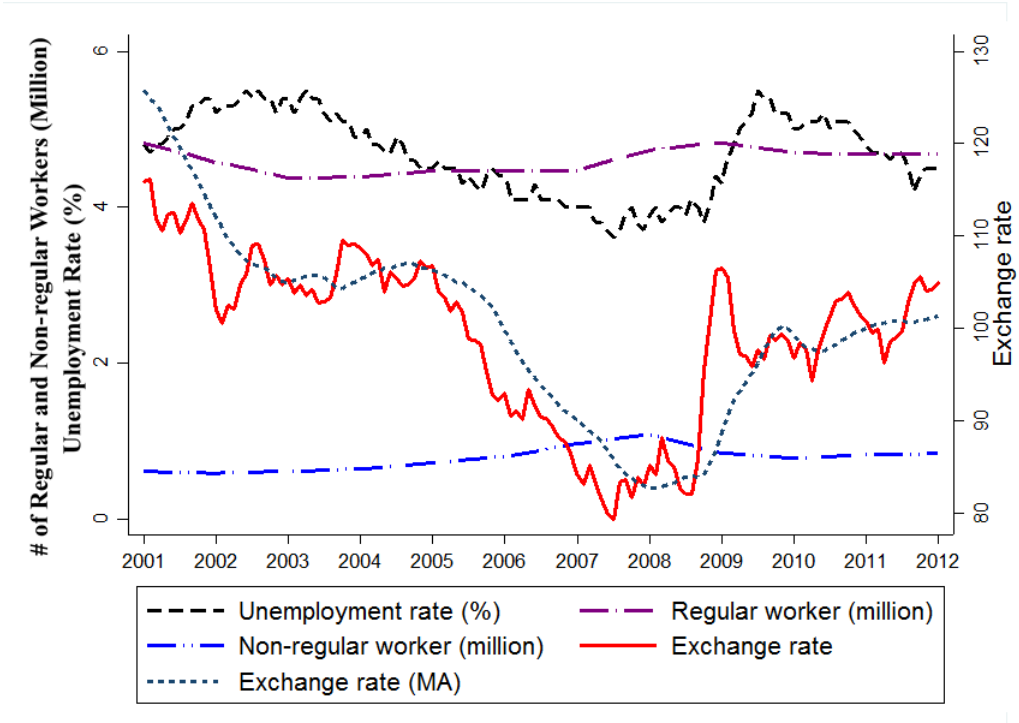
Notes: Standard errors robust against firm-level clustering are reported in parentheses. The term e is the Real Effective Exchange Rate (REER). We calculate the trend component of the exchange rate using MA(12). *** p<0.01, ** p<0.05, * p<0.1.

Table 7: Effects on Part-time Workers, Dispatched Workers, and Day Laborers

Dependent Variable	(1) Δ*Log of the Number of Non-regular Workers*$_{it}$	(2) Δ*Log of the Number of Part-time Workers*$_{it}$	(3) Δ*Log of the Number of Dispatched Workers*$_{it}$	(4) Δ*Log of the Number of Day laborer*$_{it}$
Import Share$_{it-1}\times\Delta$Log(e_t)	0.163	0.069	0.412	-1.126
	(0.336)	(0.318)	(0.469)	(1.711)
Export Share$_{it-1}\times\Delta$Log(e_t)	-1.376***	-0.564	-2.181***	-0.874
	(0.400)	(0.379)	(0.576)	(3.033)
Import Share$_{it-1}$	-0.009	-0.021	0.018	0.040
	(0.015)	(0.016)	(0.024)	(0.087)
Export Share$_{it-1}$	-0.026	-0.009	-0.056*	-0.089
	(0.019)	(0.019)	(0.029)	(0.129)
Market Power$_{it-1}$	-0.010	0.073*	-0.193***	-0.159
	(0.047)	(0.043)	(0.072)	(0.300)
R&D Share$_{it-1}$	-0.011	-0.230***	0.206**	0.330
	(0.082)	(0.068)	(0.091)	(0.836)
Industry-year Fixed Effect	Yes	Yes	Yes	Yes
R-squared	0.046	0.009	0.093	0.067
Observations	82,947	68,133	42,353	3,959

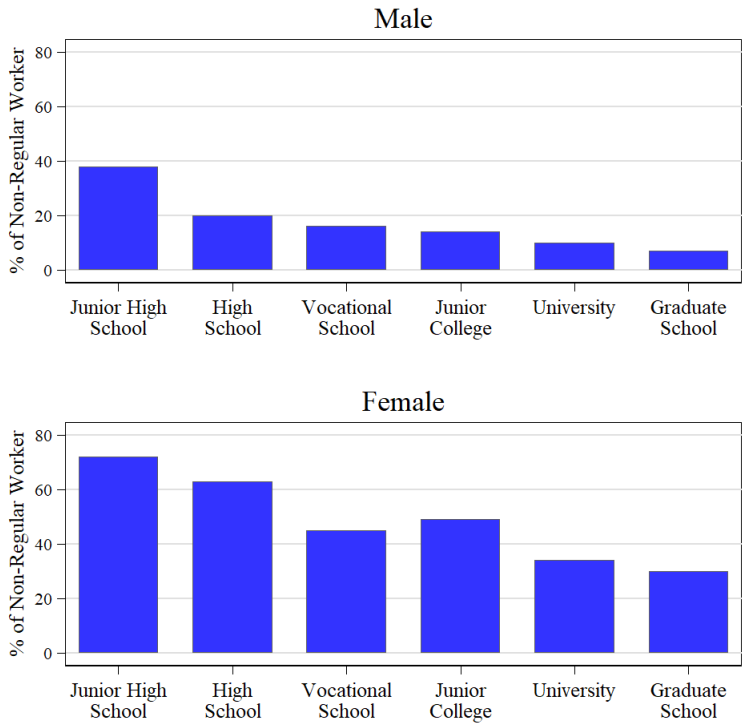
Notes: Standard errors robust against firm-level clustering are reported in parentheses. The term e is the Real Effective Exchange Rate (REER). We calculate the trend component of the exchange rate using MA(12). The sample is limited to the manufacturing industry. Since the dependent value takes the log change of the number of workers from each category, if a firm at time t and $t-1$ does not have any workers from some categories, its dependent value becomes a missing value. That is why the number of observation varies among worker categories. *** p<0.01, ** p<0.05, * p<0.1.

Figure 1: The Real Effective Exchange Rate and the Unemployment Rate



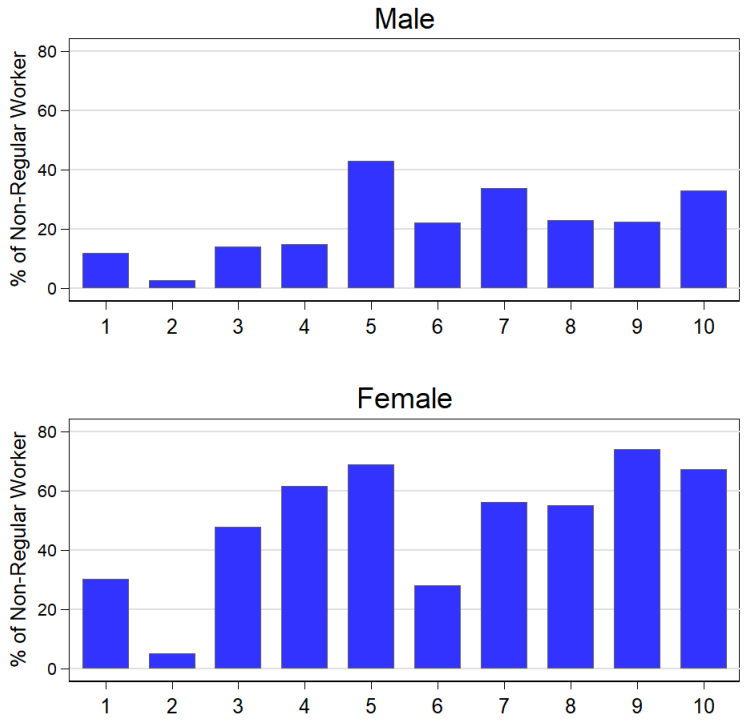
Source: The real effective exchange rate is from the Bank for International Settlements. The unemployment rate is from the Labour Force Survey by the Ministry of Internal Affairs and Communication. The numbers of regular and non-regular worker are from the Basic Survey of Japanese Business Structure and Activities.
Notes: Because of the Great East Japan Earthquake, the unemployment rate is calculated using Supplementary-estimated figures by the Ministry of Internal Affairs and Communication for some months. We calculate the trend component of the exchange rate using MA(12). The sample is restricted to the manufacturing industry.

Figure 2a: Fraction of Non-regular Workers by Educational Attainment



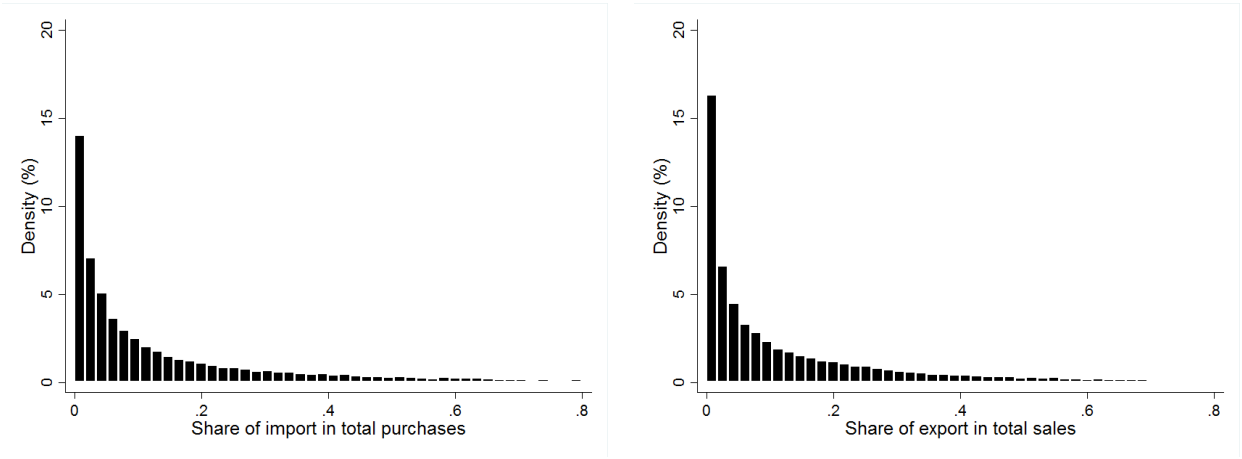
Source: Data are from the Employment Status Survey 2007. The fraction of non-regular workers by educational attainment is calculated as the number of non-regular workers with each educational attainment divided by the total number of workers with the educational attainment. All industries are covered in this figure.

Figure 2b: Fraction of Non-regular Workers by Occupation



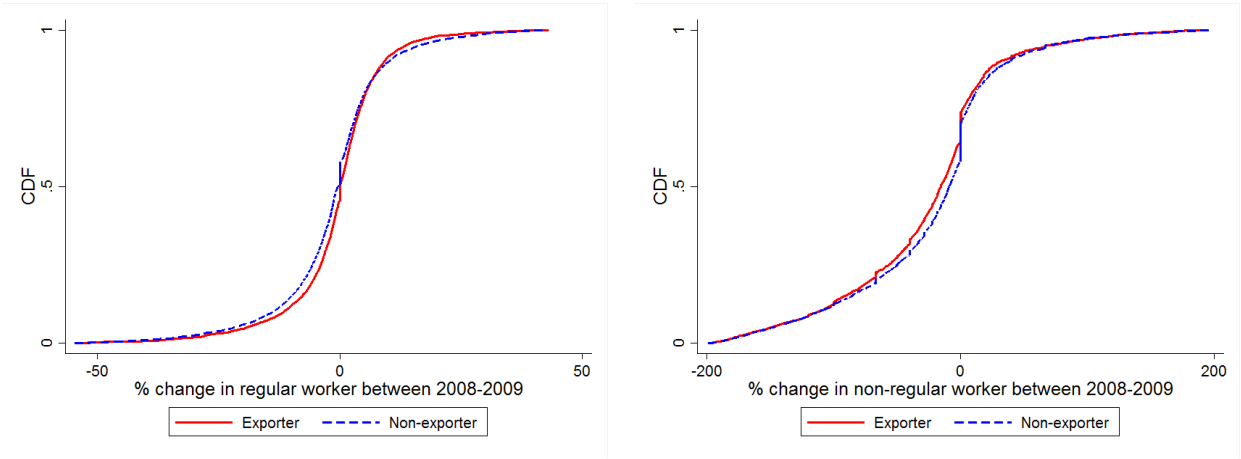
Source: Data are from the Employment Status Survey 2007.
Notes: Each number in Figure 2b corresponds to the following occupations: 1. Specialist and Technical, 2. Administrative and Managerial, 3. Clerical, 4. Sales, 5. Service, 6. Security, 7. Agricultural, 8. Transport and Communication, 9. Production Process, and 10. Not Classifiable. The fraction of non-regular workers by occupation is calculated as the number of non-regular workers in each occupation divided by the total number of workers in the occupation. All industries are covered in this figure.

Figure 3: Distributions of Import Share and Export Share



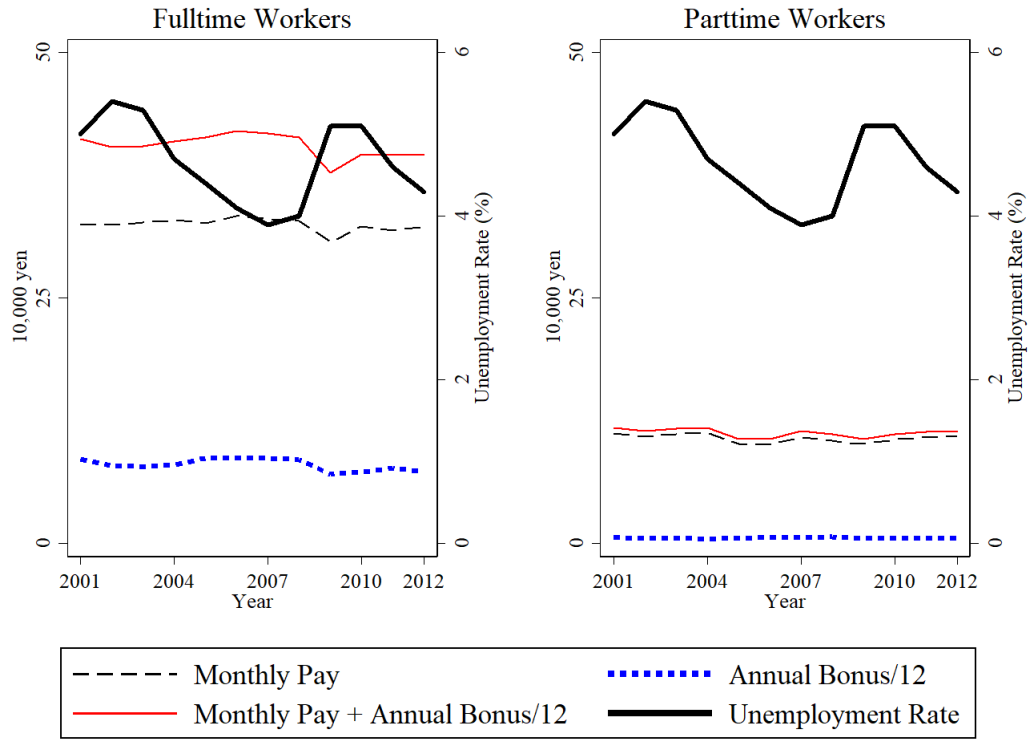
Notes: The import share is calculated by dividing the purchase turnover (total value of overseas purchase) by the purchase turnover (total transaction value). The export share is calculated by dividing the sales amount (total value of direct exports) by another variable: the sales amount (total transaction value). The import share has a mean value of 4.788% and a standard deviation of 14.542. The export share has a mean value of 4.484% and a standard deviation of 12.489. 32% of firm-year observations records positive exports and 28% records positive imports. The correlation between the import share and the export share is 0.262. The number of observations is 153,044. The graphs draw the distributions of import and export shares, given positive numbers. The sample is limited to the manufacturing industry.

Figure 4: Cumulative Density Functions of Percentage Change in Regular and Non-Regular Workers



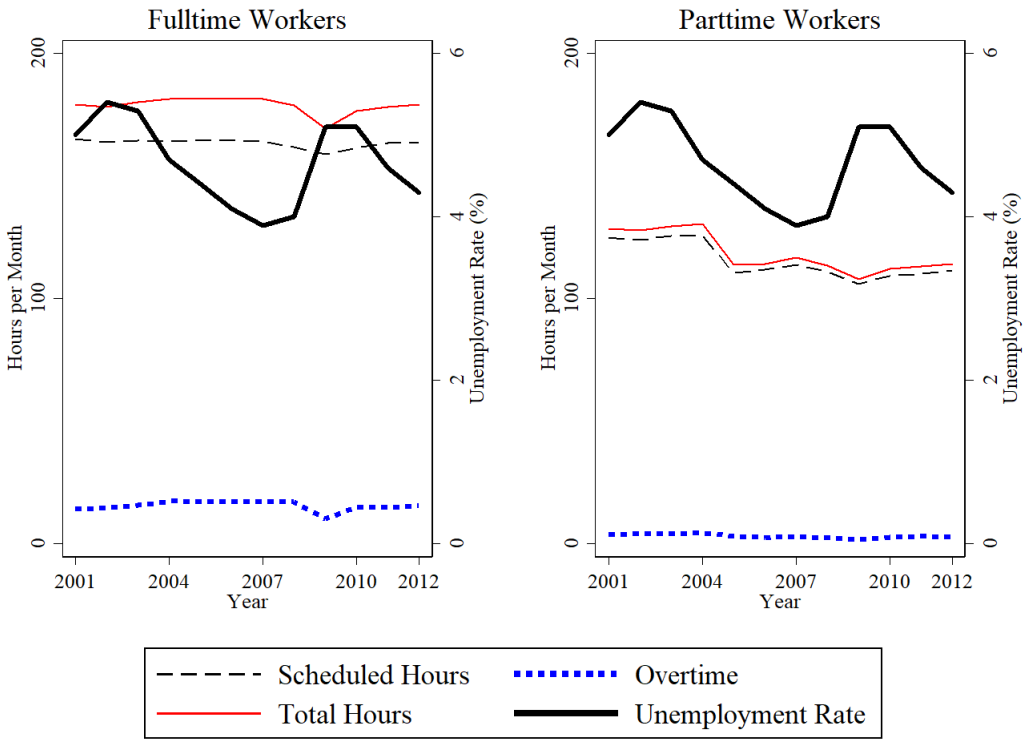
Notes: The figures show the cumulative density functions of the percentage change in regular worker and non-regular workers from 2008 to 2009 in exporting firms and non-exporting firms. The sample is limited to the manufacturing industry. The Kolmogorov-Smirnov test for the percentage change in regular worker shows that the maximum difference between exporters and non-exporters is 0.07 and gives 0.00 for the p-value, meaning that the two distributions are not identical and that exporters have a smaller percentage change in regular workers than non-exporters. The Kolmogorov-Smirnov test for the percentage change in non-regular workers shows that the two distributions are not identical and that exporters have a larger percentage change in non-regular worker than non-exporters.

Figure 5a: Wages and Unemployment by Worker Type



Source: Data are from the Basic Survey on Wage Structures (BSWS).
Notes: The average values of "Fraction of Bonus" (=Bonus/(Monthly Pay$\times$12+Bonus)) are 0.16 for full-time workers and 0.04 for part-time workers, respectively. The sample consists of only working people from the manufacturing industry (2001-2012).

Figure 5b: Work Hours and Unemployment by Worker Type



Source: Data are from the Basic Survey on Wage Structures (BSWS).
Notes: The average values of "Fraction of Overtime" (=Overtime/(Scheduled Hours+Overtime)) are 0.07 for full-time workers and 0.02 for part-time workers, respectively. The sample consists of only working people from the manufacturing industry (2001-2012).

Table A1: Industrial Composition of Sample Firms, 2001-2012

All	%	*Neither Import nor Export*	%	*Only Import*	%	*Only Export*	%	*Import and Export*	%
Food	11.091	Food	16.624	Food	16.384	Production machinery	10.837	Chemical and allied products	11.386
Transportation equipment	9.185	Transportation equipment	9.201	Textile products	7.137	Transportation equipment	10.681	Production machinery	9.551
Fabricated metal products	7.695	Fabricated metal products	8.833	Electrical machinery, equipment and supplies	6.682	Chemical and allied products	9.976	Transportation equipment	9.475
Chemical and allied products	7.209	Printing and allied industries	8.340	Fabricated metal products	6.546	Fabricated metal products	8.784	Electrical machinery, equipment and supplies	8.863
Electrical machinery, equipment and supplies	6.761	Plastic products, except otherwise classified	5.674	Transportation equipment	6.167	General-purpose machinery	7.493	General-purpose machinery	7.897
Production machinery	6.240	Electrical machinery, equipment and supplies	5.376	Chemical and allied products	5.878	Electrical machinery, equipment and supplies	6.557	Electronic parts, devices and electronic circuits	7.794
Electronic parts, devices and electronic circuits	5.598	Textile products	5.022	Plastic products, except otherwise classified	5.810	Food	5.833	Business oriented machinery	6.496
Plastic products, except otherwise classified	5.580	Ceramic, stone and clay products	4.824	Electronic parts, devices and electronic circuits	4.202	Iron and steel	5.802	Fabricated metal products	5.992
General-purpose machinery	5.396	Electronic parts, devices and electronic circuits	4.509	Production machinery	4.164	Plastic products, except otherwise classified	4.929	Plastic products, except otherwise classified	5.590
Printing and allied industries	4.720	Pulp, paper and paper products	4.501	Furniture and fixtures	4.141	Electronic parts, devices and electronic circuits	4.823	Information and communication electronics equipment	3.897

Notes: Standard deviations are in parentheses. The sample is limited to the manufacturing industry. The classification is based on the Japan Standard Industrial Classification. There are 24 major groups in the manufacturing division.

Table A2: Determinants of Import and Export Shares

	(1)	(2)
Dependent Variable	*Import Share*$_{it}$	*Export Share*$_{it}$
Log(Total Sales)$_{it}$	0.024***	0.022***
	(0.002)	(0.002)
Log(Total Employee)$_{it}$	-0.019***	-0.001
	(0.002)	(0.002)
R&D Share$_{it}$	0.233***	0.423***
	(0.040)	(0.089)
Market Power$_{it-1}$	0.080***	0.157***
	(0.022)	(0.022)
Industry-year Fixed Effect	Yes	Yes
R-squared	0.066	0.158
Observations	124,413	124,413

Notes: Standard errors robust against firm-level clustering are reported in parentheses. The sample is limited to the manufacturing industry. *** p<0.01, ** p<0.05, * p<0.1.

Table A3: Determinants of the Fraction of Non-regular Workers

	(1)	(2)	(3)
Dependent Variable	*Fraction of Non-regular Workers*$_{it}$		
Import Share$_{it}$	0.005	0.035***	0.040***
	(0.006)	(0.007)	(0.006)
Export Share$_{it}$	-0.093***	-0.086***	-0.027***
	(0.007)	(0.008)	(0.008)
Log(Total Sales)$_{it}$	–	-0.069***	-0.068***
		(0.002)	(0.002)
Log(Total Employee)$_{it}$	–	0.102***	0.094***
		(0.003)	(0.003)
Market Power$_{it-1}$	–	-0.093***	0.002
		(0.019)	(0.019)
R&D Share$_{it-1}$	–	-0.278***	-0.224***
		(0.054)	(0.044)
Fixed effect	Year	Year	Industry-year
R-squared	0.014	0.104	0.238
Observations	153,044	124,413	124,413

Notes: Standard errors robust against firm-level clustering are reported in parentheses. The sample is limited to the manufacturing industry. *** p<0.01, ** p<0.05, * p<0.1