RIETI Discussion Paper Series 20-E-008

Does It Matter Where You Invest? The Impact of FDI on Domestic Job Creation and Destruction

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The Research Institute of Economy, Trade and Industry
https://www.rieti.go.jp/en/

RIETI Discussion Paper Series 20-E-008

February 2020

Does it matter where you invest? The impact of FDI on domestic job creation and destruction[1]

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Abstract

Firms create new jobs while removing old jobs to achieve optimal performance. During the process, overseas foreign direct investment can play an important role. On the one hand, foreign expansion can reduce the funds available to be spent domestically, which leaves less room for domestic employment. On the other hand, activities of FDI can contribute to more technical progress and higher productivity, which help to create more new jobs or alleviate the destruction of existing jobs. This study uses a unique dataset of Japanese firms' overseas activities to examine the individual effects of outward FDI on domestic job creation (JC) and job destruction (JD) respectively. The results indicate that FDI into Asian countries is associated with an increase in JC while FDI to European and North American countries leads to a decrease in JC; JD decreases regardless of FDI destination. We further show that the reallocation patterns are closely related to different purposes of FDI, namely vertical and horizontal ones, varying across industries and destinations. We then rationalize the findings by applying a search-and-matching model which illustrates the mechanism explaining why vertical and horizontal FDI have different impact on domestic JC and JD. The findings provide evidence that going abroad does not necessarily lead to increasing unemployment at home.

Keywords: Outward FDI, firm-level job creation, job destruction, Japanese manufacturing firms
JEL classification: J21 J23

[1] This study is conducted as a part of the Project "Empirical Studies on Employment, Migration, and Family Issues of Foreigners in Japan" undertaken at the Research Institute of Economy, Trade and Industry (RIETI). It utilises the data based on the "Basic Survey of Japanese Business Structure and Activities" (BSJBSA) which is conducted by the Ministry of Economy, Trade and Industry (METI).

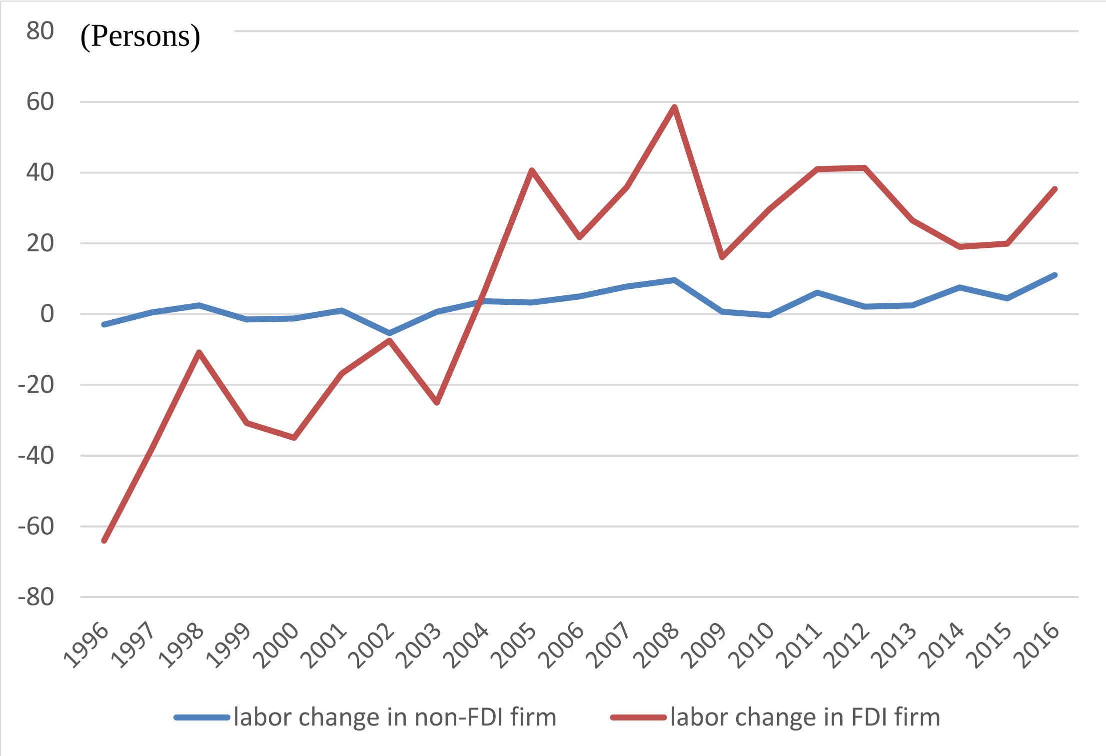
1. Introduction

Expanding abroad in the 1980s and 1990s helped Japanese manufacturing firms develop their core competencies. Outward foreign direct investment (hereafter FDI) from Japan has benefited Asian countries such as China, Thailand, Vietnam, and even Myanmar nowadays, in terms of technology spillovers and employment opportunities. In the meantime, the rapid increase in the amount of resources reallocated to foreign countries has raised concerns because it may reduce domestic employment and lead to the so-called "hollowing-out" of manufacturing industries. Thus, the effects of overseas FDI on domestic employment have drawn much academic and policy interest.

Contrary to most critics' expectations and despite some of the earlier literature identified a negative relationship between outward FDI and domestic operations, more recent studies find that net employment growth in FDI firms is higher than in non-FDI firms (Barba Navaretti et al., 2010; Desai et al., 2009; Hayakawa et al., 2013; Hijzen et al., 2011). This phenomenon can also be verfied in Figure 1. The absolute value of average net employment growth in FDI firms is always larger. And ever since 2004, the level of net employment growth in FDI firms surpassed that in non-FDI firms as well. However, because net employment growth is the difference between total job creation and destruction within a firm, existence of an overall effect does not necessarily reflect job creation and job destruction changes occurring in the same direction. For instance, a positive effect from FDI on net employment growth could have several possibilities: (1) increasing both job creation and job destruction, with a larger scale of the former than the latter; or (2) decreasing both job creation and job destruction, with a smaller scale of the former than the latter, and so on. Deviating from most previous studies that focus on net employment, the current study will explore FDI's impact on job creation and job destruction separately. In contrast to the conventional definition of job creation and destruction in the existing literature, this study defines job creation as the aggregated number of newly added jobs for all divisions[2] within a firm. In a similar manner, job destruction is defined as the aggregated number of newly eliminated jobs for all the divisions. One obvious advantage of such a measurement is that the individual impact of FDI on job creation and destruction can be captured, which helps elucidate firm decision-making from different perspectives.

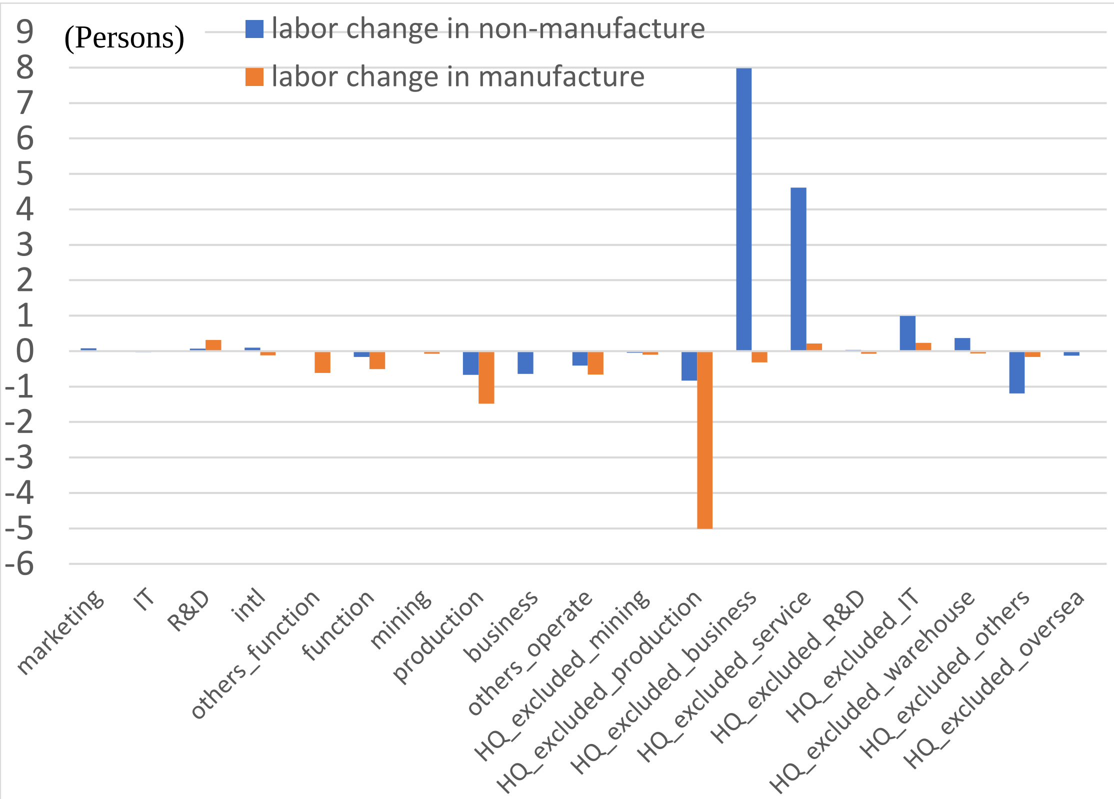
[2] Division here refers to functional department, such as marketing, production, R&D, administration, etc.

Figure 1 Average employment change for Japanese FDI/non-FDI firms



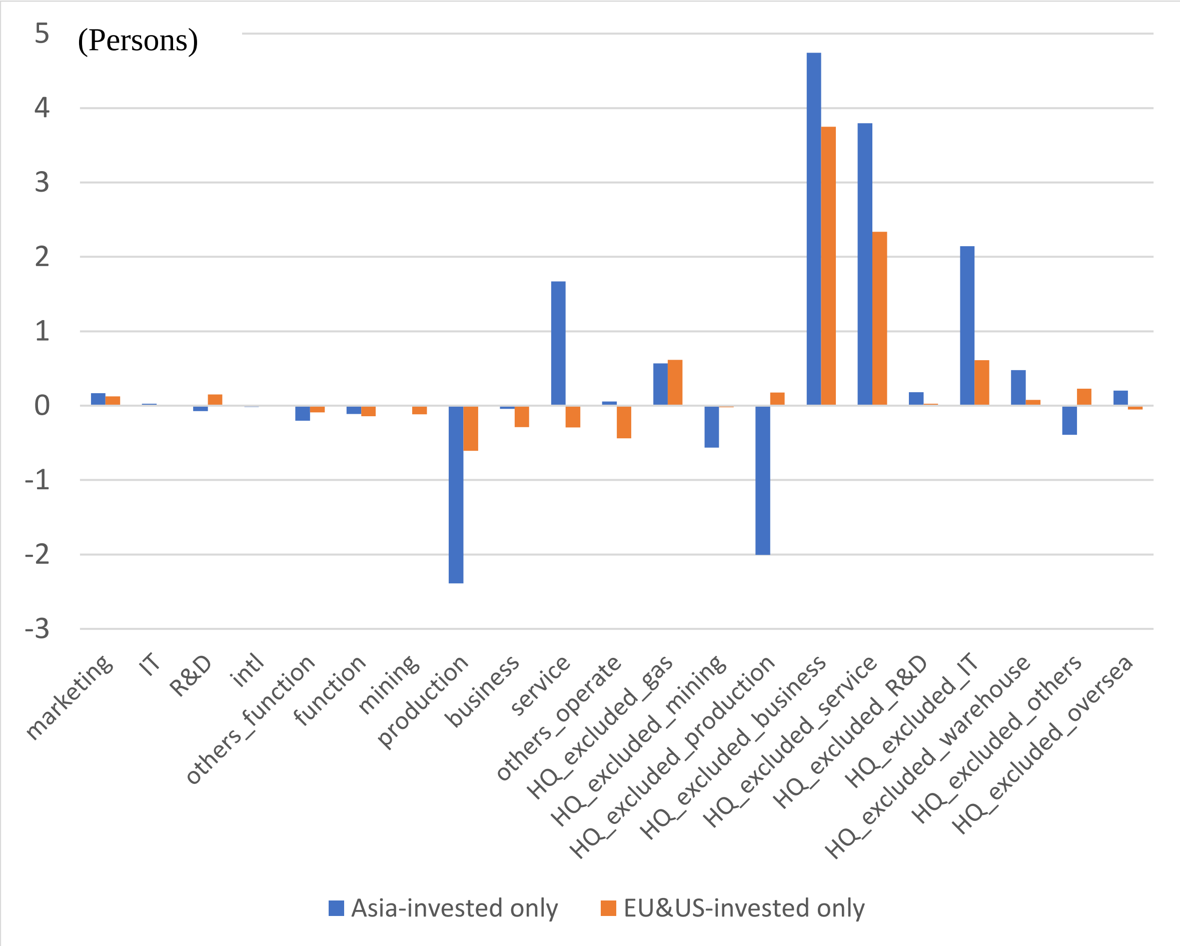
Source: Authors' calculation based on BSJBSA.

Figure 2 Labor change dynamics by division



Source: Authors' calculation based on BSJBSA.

Figure 3 Labor change dynamics by division: Asia-invested v.s. EU&US-invested



Source: Authors' calculation based on BSJBSA.

Notes: We remove the observations that have both affiliates in Asia and EU/US in the same year.

Figure 2 plots the labor dynamics by division and separates manufacturing firms from non-manufacturing ones. The firms report the number of workers in each division, headquarter and non-headquarter based separately, because Japanese firms tend to have multiple branch offices in different cities. As for manufacturing firms, divisions such as production experiences drops whereas business and R&D hire more workers on average. On the other hand, in non-manufacturing firms, production division also witnesses decrease, while business and service are hiring a even larger number of workers than that of manufacturing firms.

What if we limit the observations to FDI-only firms? Figure 3 shows us the sketch when we divide Japanese firms into the ones that invest in Asia only and in EU&US only. In our sample, there are firms that invest in both Asia and EU&US. To see the heterogeneity between investing in different regions, we remove these observations. For Asia-invested only firms, service and IT divisions hire more workers, and the magnitude is larger than that of EU&US-invested only firms. Asia-invested only firms decrease the number of the workers in R&D division, whereas EU&US-invested firms increase employment in the same division. It seems that firms adjust the within-firm labor structure in accordance with the oversea FDI decisions. But does the observed correlations represent the causality? Is the adjustment process affected by the investment destinations? How does the influence differ between job creation and job destruction within a firm?

To answer the questions above, we first apply firm-level panel data collected by METI to conduct an empirical analysis. The results indicate that investment in Asian countries has a positive impact on domestic job creation in Japan, whereas investment in European and North American countries has a negative impact. In terms of job destruction, the impact is negative regardless of FDI destination. We then construct a simple theoretical model based on Mortensen and Pissarides (1994), to illustrate the mechanism through which FDI can endogenously affect within-firm job creation and job destruction. We show that the oversea investment into different destinations can affect the distribution of average productivity and return-to-cost ratio, and thus leads to the variation in labor adjustment dynamics.

The rest of the paper is organised as follows. Section 2 reviews prior related literature. Section 3 introduces the data and estimation strategy. Section 4 presents the estimaton results and we rationalize the findings using a general equilibrium framework in Section 5. Section 6 provides the evidence for the theoretical prediction, followed by robustness checks. The final section concludes.

2. Literature review

There is a wide body of literature that has investigated the relationship between outward FDI and employment in the home country. Markusen (1984) and Brainard (1997) show that theoretically, firms with moderate increasing returns should establish affiliates abroad to reduce transportation costs. Such expansion abroad would substitute for exports, and thus foreign labour would substitute for domestic labour. However, at the same time, moving to other markets could increase the headquarter services provided to affiliates and in fact lead to higher domestic employment in the long run. The empirical nature of such issues has motivated numerous studies, however, the results are mixed. Brainard and Riker (2001), Muendler and Becker (2006), Moser at al. (2010), and Hanson, Mataloni, and Slaughter (2003) find that jobs abroad do substitute for jobs at home, but the effect is small. Others such as Amiti and Wei

(2005), Borga (2005), Barba Navaretti et al. (2010), Hijzen et al. (2011), and Desai et al. (2009) all suggest the opposite: expansion abroad stimulates job growth at home. In a more influential study, Harrison and McMillan (2011) use US firm data to indicate that the level of the economic development of the targeting country matters: investment into low-income countries does substitute for domestic employment at home. Nevetheless, when firms make investment in high-income countries, the employment in affiliates generally complements US employment. The heterogeneous impacts can be explained from the perspective of FDI purposes. If it is for cost minimization, the employment in low-income affiliates will be promoted and leads to reduction of labor employed by headquarters. In constrast, if it is for market-targeting, the employment in high-income affiliates will increase, but affects domestic employment in a different way.

When it comes to the case of Japan, thanks to the availability of firm-level data both home and abroad, there is a rising amount of literature to investigate this topic. Hijzen et al. (2007), Fukao and Yamashita (2010), and Tanaka (2012) all find that outward FDI has a positive effect on firms' domestic employment and performance. More recent studies such as those by Ando and Kimura (2015) and Kodama and Inui (2015) focus on gross job creation and job destruction, which are aggregated increases and decreases in firms' net employment changes, respectively. The former paper uses statistics to show that gross changes in domestic employment/operations are much larger than net changes, and that expanding multinational small and medium enterprises tend to increase domestic employment. Kodama and Inui (2015) apply parent–affiliate linked data and use a more rigorous method to show that decreases in net domestic employment mainly arise from firms without foreign subsidiary companies and non-expanding multinational enterprises. Furthermore, domestic employment rises when the number of overseas subsidiaries increases. Finally, job creation and net employment growth rates for small-sized firms are lower than those in large-sized firms.

The main contribution of the current paper lies in its application of a more rigorous approach to separate job creation from job destruction, while taking into account firms' endogenous decision-making regarding overseas expansion. We follow the same approach as in Davis and Haltiwanger (1999) to calculate job creation and job destruction, however, the essential difference is that our calculations are conducted at the division level, which allows us take advantage of the detailed information on labour variation for each division within firms.

Another contribution is that we make further analysis to investigate the different impacts of FDI destinations. Although recent theories of FDI focus on firm heterogeneity, while others hinge upon the distinction between vertical and horizontal FDI, the question of whether the particular destination country of FDI matters in terms of employment in the parent company remains empirically unaddressed. The current study is closest to that of Debaere et al. (2010) in the sense that both focus on how outward FDI affects employment at home and decompose FDI by destination country to investigate the impacts on vertical and horizontal multinational activities, respectively. We take a step further to separate job creation from job destruction, and investigate the possible mechanism of how FDI into different countries can affect JC and JD differently, through both theorectical and empirical lens.

3. Data and methodology

Data

This study uses firm-level data collected through the Basic Survey of Japanese Business Structure and Activities (BSJBSA), which is conducted annually by Ministry of Economy, Trade, and Industry, Japan. The survey covers almost all medium and large firms in Japan; small firms who employ ≥ 50 workers with ≥ 30,000,000 yen worth of capital are also included. The response rate is over 80%, with around 30,000 firms completing the questionnaire each year. The samples of both manufacturing non-manufacturing firms are used for this study, covering the years 1995–2017.

Summary statistics of the data are reported in the Appendix Table A1. We removed outliers such as the firms that report negative R&D or revenue.

Job creation and job destruction

The approach for calculating job creation and destruction is similar to that used by Davis and Haltiwanger (1999); the difference is that, our calculations occur at the division level and thus capture the job creation and destruction within the firm. Job creation in a firm is defined as the sum of all new jobs in the firm's expanding and newly opened divisions, meanwhile job destruction in a firm is defined as the sum of all eliminated jobs in the firm's downsizing or closed divisions. Furthermore, the firm's branches or plants are considered to be similar to divisions. Newly set up and closed firms are excluded; they are not within the scope of this study's objectives because such job creation/destruction instances are quite different from those in existing firms.

First, the magnitude of job creation in firm i in year t is defined as the sum of all new jobs in expanding divisions in firm i in year t, represented as follows (the number of divisions in firm i is d):

$$JC_{i,t} = \sum_{d=1}^{S} \Delta N_{i,d,t}^{C}$$

where

$$\Delta N_{i,d,t}^{C} = N_{i,d,t} - N_{i,d,t-1} \text{ ,}$$

conditioned on

$$N_{i,d,t} - N_{i,d,t-1} < 0$$

In the above equations, S is the number of divisions in firm *i*, $N_{i,d,t}$ is the number of workers employed in division *d* in firm *i* in year *t*.

The magnitude of job destruction in firm *i* in year *t* is defined as the sum of all diminished jobs in diminishing divisions in firm *i* in year *t*, represented as follows (the number of divisions in firm *i* is *d*):

$$JD_{i,t} = \sum_{d=1}^{S} \Delta N_{i,d,t}^{D}$$

where

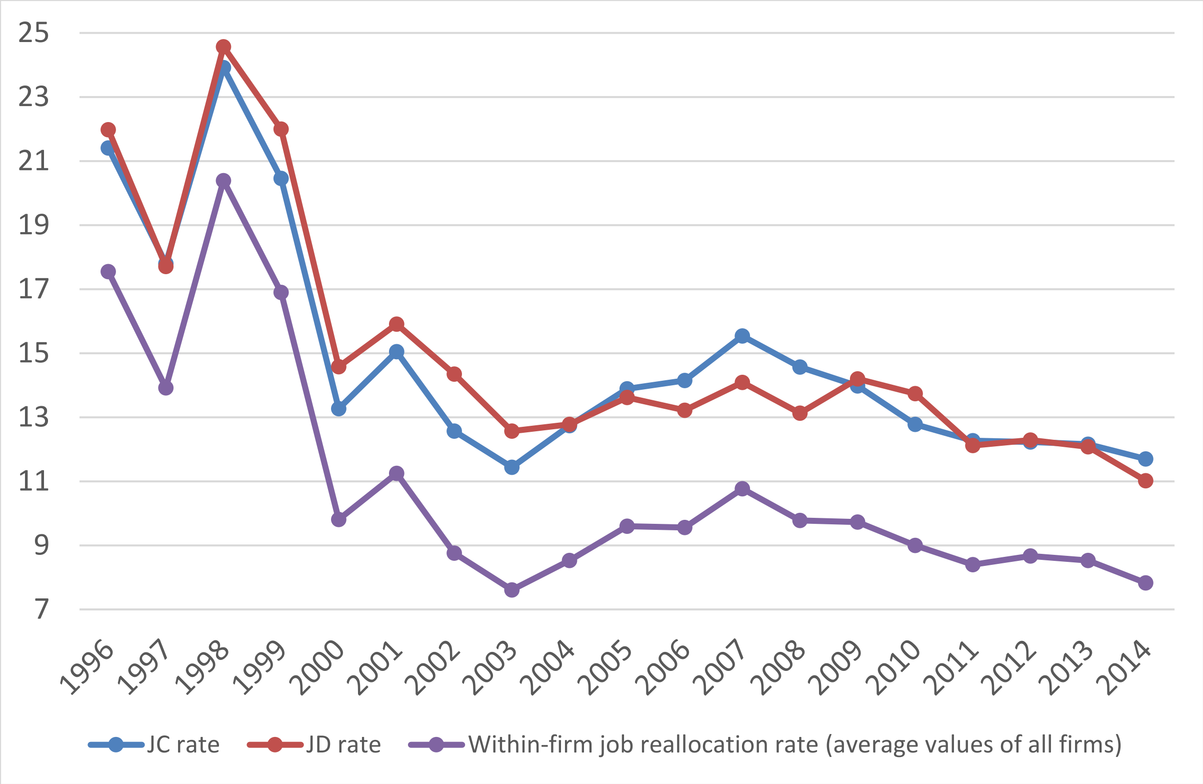
$$\Delta N_{i,d,t}^{D} = -(N_{i,d,t} - N_{i,d,t-1}),$$

conditioned on

$$N_{i,d,t} - N_{i,d,t-1} < 0$$

As shown in Figure 4, in general, JC, JD and within-firm job reallocation rates are decreasing across time. This, to some extent, is in accordance with the trend that the total number of employees in the manufacturing industries in Japan is shrinking. The level of within-firm job reallocation, however, is on average lower than that of JC or JD, indicating the movement from one division to another may not be as intense as the need to create new jobs or removing old jobs alone.

Figure 4 The magnitude of JC, JD and net employment growth rate



Source: Authors' calculation based on BSJBSA.

Estimation strategy

Baseline specifications

Our baseline model takes the following form, which is symmetric in both cases of job creation and job destruction:

$$job\_creation'_{it} = \gamma_1 Asian\_affiliate\_number_{it} + \gamma_2 EU\_NA\_affiliate\_number_{it} + \gamma_3 control\_variables_{it} + \gamma_i + \gamma_t + \varepsilon_{it}^{jc\prime} \quad (1)$$

$$job\_destruction'_{it} = \delta_1 Asian\_affiliate\_number_{it} + \delta_2 EU\_NA\_affiliate\_number_{it} + \delta_3 control\_variables_{it} + \delta_i + \delta_t + \varepsilon_{it}^{jd\prime} \quad (2)$$

where $Asian\_affiliate\_number_{it}$ is the number of Asian affiliates of firm *i* in year *t*, and $EU\_NA\_affiliate\_number_{it}$ is the combined number of affiliates that are located in EU or North American for firm *i* in year *t*. The vector of control variables includes capital/labor ratio, R&D expenditure share with respect to revenue, foreign capital share, firm age, revenue (log) and total factor productivity.[3] Those variables of job creation and destruction follow previous empirical studies on net employment growth, which has provided a reducd- form of estimation on the relationship that "net employment growth = job creation – job destruction". Firm and year fiexed effects are also included.

Endogeneity problem

Endogeneity of our estimation might arise from two sources. First, it might be argued that unobservable factors can also affect firms' decision-making regarding job creation and destruction. For example, a firm's financing situation will influence its capital portfolio and thus affect total employment in the next operating year. If the financing situation is time-variant, a fixed-effects model alone cannot solve the omitted variable problem. Second, firms choose to expand overseas because they are a priori more productive and earn higher profits. As a result, these firms can create more job opportunities due to those other attributes[4]. In other words, firms with more foreign affiliates might "self-select" to change the employment structure more frequently.

To mitigate the bias that might be caused due to the channels mentioned above, we first apply a two-stage instrumental variable method. To be specific, in the first stage, we will regress annual real interest rate[5], the numbers of Asian affiliates and EU/North American affiliates in the previous year on a Japanese headquarter's decision of oversea investment. And in the second stage, we will apply the fitted value obtained in the first stage and predict its impact on firms' JC/JD variation. As suitable instruments, the variables chosen in the first place need to be highly correlated with firms' FDI behavior, but do not directly affect current job creation and destruction levels. Thus, in the estimation results section, we will show whether the critera such as exclusion restriction or weak instrument conditons are satisfied.

Nevetheless, we cannot completely rule out the possibility that these proxies might also be correlated with firms' employment plans. If that is the case, the coefficient estimated using the IV method can still be biased. To further identify the causal impact of foreign activity on job creation/destruction, we apply a quasi-experimental method. Specifically, we use the March 2011 earthquake in Japan as an exogenous economic shock and conduct a difference-

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[3] In the baseline specification, we use the method as in Levinsohn and Petrin (2003). As robustness checks, we apply Olley and Pakes (1996), and stochastic frontier methods as well.

[4] A similar argument can be made concerning job destruction.

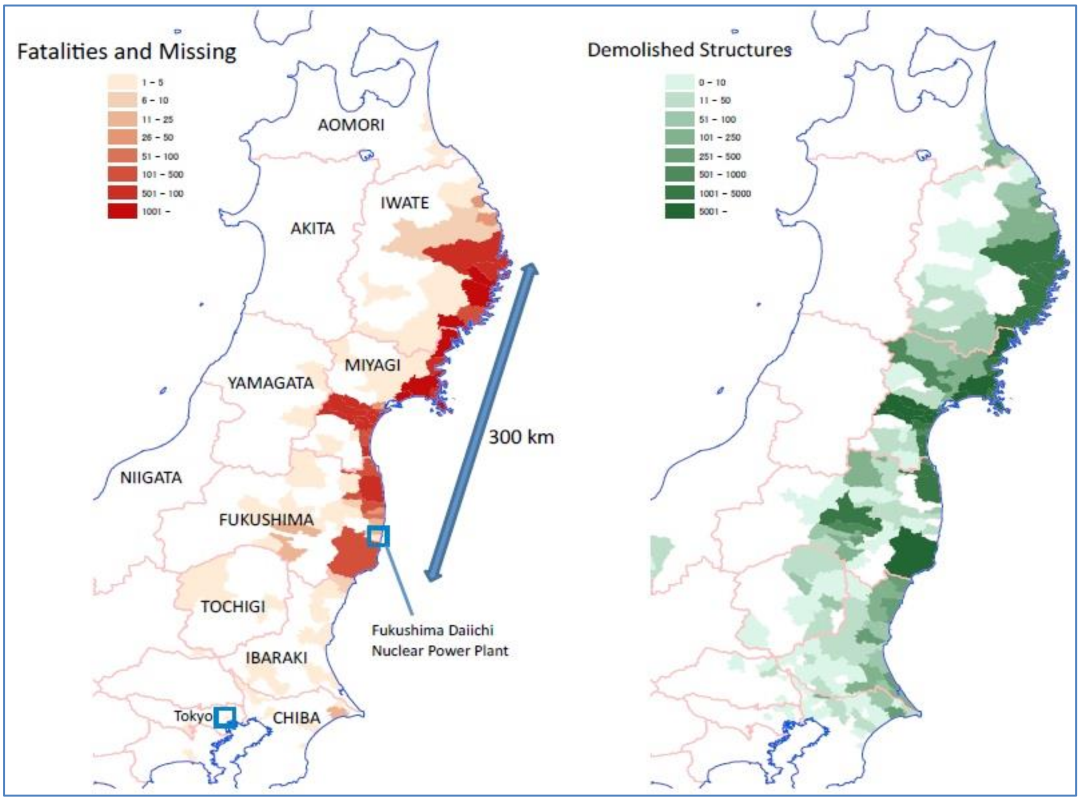
[5] The real exchange rate is the real effective exchange rate, which comes from the Bank of Japan database.

in-difference analysis to explore the extent to which JC/JD can be explained by a firm' overseas expansion. As can be seen from Figure 5, the large-scale destruction caused by the earthquake (followed by a massive tsunami and the failure of the Fukushima Dai-ichi Nuclear Power Plant) exerted a significant negative impact on the economic performance of affected areas, mainly the four coastal counties of Miyagi, Iwate, Fukushima, and Aomori.[6] Thus, we argue that controlling for other characteristics, firms located in these four counties (treatment group) may act differently from those located in the other counties (control group), because this externally caused economic damage will also influence their supply chain in a different way, and leads to the diverging decision-making regarding foreign investment through the cost channel.

Figure 6 provides us with the supportive evidence for such categorization. We plot the average number of foreign affiliates weighted by total employee, since large firms tend to have more foreign activities. The blue bar shows the trend for the firms located in less affected regions, whereas red lines indicate the situation in the most affected regions. There is a clear drop in 2011 for the earthquake-affected regions, but the number in less affected areas keeps growing. Furthermore, the growth paths for the two groups also diverge after the earthquake. It shows the firms in the treatment group and control group are likely to have been affected differently by the earthquake, and their decision-makings on FDI can deviate from the ones before the shock. Controlling for the pre-trend of firms from both groups, we would like use this natural shock to investigate the causality between firms' outward FDI and their JC/JD behavior.

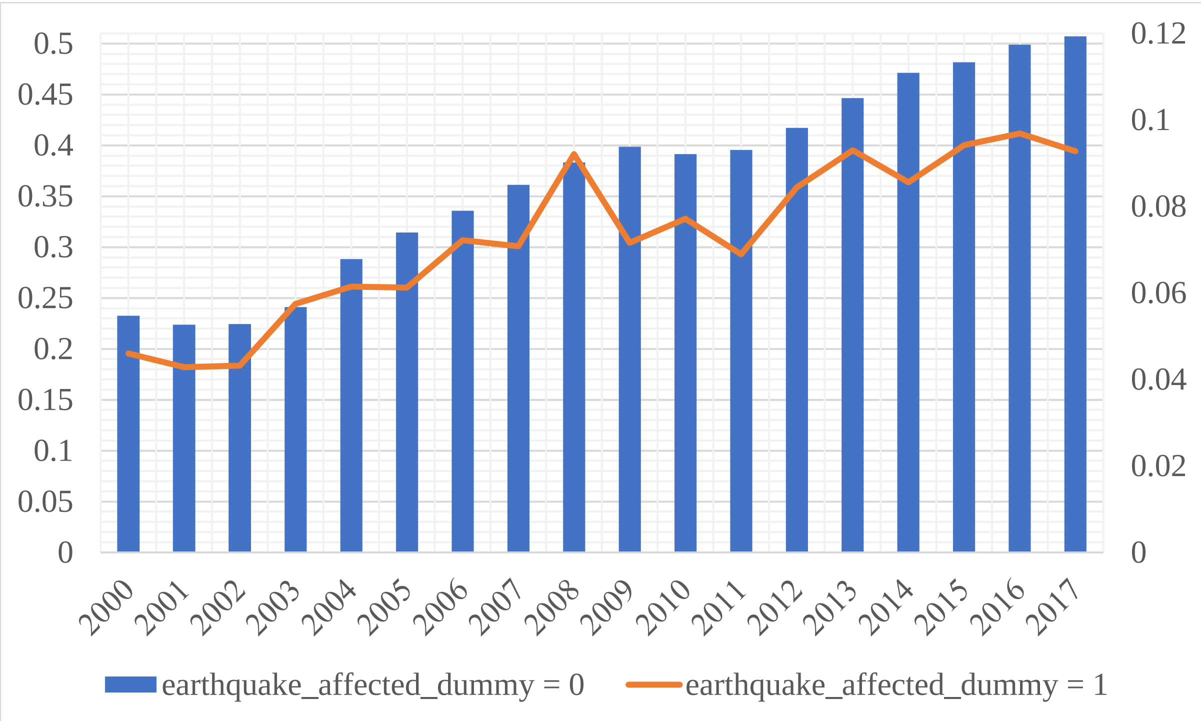
Figure 5 Geographical distribution of losses due to 2011 earthquake

[6] As alternative categorization, we also include the 6 counties that were affected more severely than the others, namely Akita, Yamagata, Ibaraki, Tochigi, Chiba and Tokyo, besides the four aforementioned.



Source: National Research Institute for Earth Science and Disaster

Figure 6 Comparison of the average number of foreign affiliates between earthquake-affected regions and less affected regions



Source: Authors' calculation based on BSJBSA.

Notes: We deflate the number by firm size to control for firm heterogeneity. Thus the vertical axis indicates the average number of foreign affiliates/total employee between two groups.

The 2011 earthquake provides several advantages for identifying a causal relation. First, the earthquake happened suddenly, making it unlikely that firms in our sample could influence the timing and location of the earthquake. Also, the unpredictability of natural disasters excludes the reverse causality issue. In practice, we use the triple-difference method, following the approach used by Bernard et al. (2015). The interaction term will be equal to *industry_average_foreign_affiliate* × *earthquake_affected_dummy* × *post2011*. *industry_average_foreign_affiliate* is the average number of total foreign affiliates for the industry where firm *i* belongs to before the earthquake. In practice, because we differentiate between the firms that make investment only in Asian countries and the ones that invest in EU/North America only, we will construct two sets of such interaction terms using *industry_average_Asia_affiliate* and *industry_average_EU/Northame_affiliate* respectively. *earthquake_affected_dummy* is a dummy variable indicating whether firm *i* is located in the most affected areas by the earthquake, and *post2011* is a dummy to show whether the year of record is after 2011 or not. The assumption here is that controlling for the pre-trend of the average number of foreign affiliates for the industry, which is an indication of how active the industry (of the firm) is in oversea investment, the firms in the treatment group and control group should allocate the wokers in the same way, without the earthquake. Our empirical strategy will be to compare the JC/JD dynamics of FDI-active firms before and after 2011 (1st difference) to that of non-FDI-active firms (2nd difference), and further compare the difference between firms located in counties that are affected by the earthquake and those located elsewhere.

4. Estimation and results

Table 1 demonstrates the baseline estimation results as in Eqs. 1 and 2. It shows that FDI in Asian countries has a positive effect on domestic job creation, but the effect is negative for FDI in EU/North American countries. As indicated in columns (3) and (4), FDI in Asian countries prevents firms from removing the jobs, and so does the investment in EU/North American countries. When we combine these two effects, as presented in columns (5) and (6), FDI in Asia has an overall positive impact on the net employment of Japanese firms, which is easy to follow because the job creation effect is much larger. In the meantime, FDI in EU/North

America is also associated with a net employment growth. If we compare the magnitude of the coefficient of *ln_EU_Northam_affiliate* between the case of JC and JD, it can be concluded that the decrease in JD surpasses that in JC, which leads to the positive net employment.

Table 1 Baseline results

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	JC	JC	JD	JD	Net Δ	Net Δ
ln_number_Asia_affiliate	20.68***	17.24***	-1.204	-1.256	29.27***	25.80***
	(3.627)	(3.633)	(3.712)	(3.719)	(3.653)	(3.662)
ln_number_ EU_Northam_affiliate	-8.457*	-10.44**	-41.34***	-41.55***	50.14***	48.46***
	(4.568)	(4.570)	(4.674)	(4.678)	(4.532)	(4.536)
Capital_labor_ratio	-50.71***	-46.48***	9.713***	11.59***	-68.94***	-66.80***
	(2.809)	(2.856)	(2.874)	(2.924)	(2.903)	(2.954)
R&D share	-8.842	6.761	9.776	7.041	-22.95	1.454
	(18.72)	(18.69)	(19.16)	(19.13)	(20.58)	(20.55)
Foreign_capital_share	-0.0899***	-0.0904***	-0.0976***	-0.0985***	-0.0439*	-0.0413
	(0.0212)	(0.0212)	(0.0217)	(0.0217)	(0.0257)	(0.0257)
Firm_age	-0.00673	-0.00665	-0.00309	-0.00321	-0.00333	-0.00277
	(0.0151)	(0.0151)	(0.0154)	(0.0154)	(0.0223)	(0.0223)
TFP_LP	-2.843		25.15***		-37.98***	
	(4.431)		(4.534)		(4.566)	
ln_Revenue		29.94***		19.25***		5.855
		(3.905)		(3.997)		(4.036)
Observations	151,727	151,727	151,727	151,727	128,763	128,763
R-squared	0.007	0.007	0.006	0.006	0.009	0.009
Number of eternal_no	23,368	23,368	23,368	23,368	20,579	20,579

*** p<0.01, ** p<0.05, * p<0.1; Firm FE, Year FE are included.

Table 2 Results using IV method

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	JC	JC	JD	JD	Net Δ	Net Δ
ln_number_Asia_affiliate	16.46***	12.00**	-13.27**	-13.41**	26.62***	22.12***
	(5.904)	(5.920)	(6.081)	(6.099)	(5.172)	(5.188)
ln_number_ EU_Northam_affiliate	-33.63***	-36.27***	-43.25***	-43.56***	7.003	4.560
	(7.610)	(7.617)	(7.839)	(7.846)	(6.666)	(6.675)
Capital_labor_ratio	-63.71***	-59.34***	5.601	7.462**	-69.96***	-67.20***
	(3.470)	(3.533)	(3.574)	(3.640)	(3.039)	(3.096)
R&D share	-17.71	4.154	5.804	2.879	-18.23	7.259
	(24.69)	(24.65)	(25.43)	(25.39)	(21.63)	(21.60)
Foreign_capital_share	-0.0507	-0.0489	-0.0128	-0.0138	-0.0473*	-0.0445
	(0.0311)	(0.0311)	(0.0320)	(0.0320)	(0.0272)	(0.0272)
Firm_age	0.0313	0.0318	0.0357	0.0357	-0.00137	-0.000969
	(0.0266)	(0.0266)	(0.0274)	(0.0274)	(0.0233)	(0.0233)
TFP_LP	-11.64**		24.52***		-35.45***	
	(5.492)		(5.656)		(4.810)	
ln_Revenue		27.92***		19.35***		10.55**
		(4.869)		(5.016)		(4.267)
Observations	122,578	122,578	122,578	122,578	122,578	122,578
Number of eternal_no	19,254	19,254	19,254	19,254	19,254	19,254

*** p<0.01, ** p<0.05, * p<0.1; Firm FE, Year FE are included.

We use exchange_rate, lags of ln_Asia_affiliate and ln_EU_Northam_affiliate as IVs.

Table 3 Results using triple difference-in-difference

	(1)	(2)	(3)	(4)
Dependent variable	jc	jd	jc	jd
triple_DID	3.153	-2.885		
	(4.695)	(4.644)		
triple_DID_Asia			-10.47	-15.35
			(27.90)	(27.60)
triple_DID_EU/Northam			16.90	6.109
			(24.29)	(24.02)
Capital_labor_ratio	4.698*	-5.953**	4.707*	-5.932**
	(2.687)	(2.658)	(2.687)	(2.658)
R&D share	-33.48*	-14.54	-33.60*	-14.41
	(18.09)	(17.90)	(18.09)	(17.90)
Foreign_capital_ratio	-0.0574***	-0.0344**	-0.0572***	-0.0345**
	(0.0173)	(0.0171)	(0.0173)	(0.0171)
Firm_age	-0.00414	-0.00730	-0.00413	-0.00731
	(0.0118)	(0.0117)	(0.0118)	(0.0117)
TFP_LP	-482.5***	69.67***	-482.2***	69.36***
	(15.17)	(15.01)	(15.17)	(15.01)
ln_Revenue	424.7***	-32.88***	424.2***	-32.49***
	(12.44)	(12.30)	(12.44)	(12.30)
Observations	193,263	193,263	193,263	193,263
R-squared	0.013	0.006	0.014	0.006
Number of eternal_no	23,057	23,057	23,057	23,057

*** p<0.01, ** p<0.05, * p<0.1; Firm FE, County-Year FE, firm controls (same as in the baseline estimation) and other interaction terms are included.

Triple_DID=Industry_average_totalforeign_affiliate*earthquake_affected_dummy*post2011

Triple_DID_Asia=Industry_average_Asia_affiliate*earthquake_affected_dummy*post2011

interaction_Asia_post =Industry_average_Asia_affiliate* post2011

We have similar results when two-stage intrumental variable method is applied, as in Table 2. The signs and significance for the major variables are almost the same as in the baseline estimations. FDI in Asian countries still positively affects domestic job creation, whereas the effect turns negative when FDI is aimed for EU/North American countries. FDI in both regions pulls down job destruction, and the magnitudes are even larger than those in the baseline specifications. Net employment inceases accordingly no matter where the firms make the investment.

The results using triple difference-in-difference are shown in Table 3. Remember that we use Triple_DID=Industry_average_foreign_affiliate*earthquake_affected_dummy*post2011 as our key variable of interest. We include different interaction terms in various specifications, namely triple_DID (based on all obs.), triple_DID_asia (based on obs. that invest in Asia only) and triple_DID_EU/North America (based on obs. that invest in EU/North America only). We also include other interaction terms such as interaction_foreign_post =Industry_average_foreign_affiliate* post2011 and interaction_earthequake_affected_post = earthquake_affected_dummy*post2011. Though not significant, the signs of these variables of interest offer us additional evidence to explore the causality between FDI destination and labor dynamics at home. *triple_DID*, as shown in the first 2 columns of Table 3, positively affects job creation but negatively affects job destruction. This indicates that when we control the pre-trend of FDI activeness, a firm located in the most severely affected region will hire relative more workers at home after the earthquake, in comparison to the firm located in less affected region. The possible reason is that due to the earthquake, firms that were affected the most will reduce the oversea investment, so that the saved cost/capital can be used to hire more domestic workers. Meanwhile, when we include the interaction terms by both regions, i.e. using observations that invest in Asia only v.s. those invest in EU/North America only, the results in columns (3)-(4) indicate that *triple_DID_asia* always has a negative impact on job creation and job destruction, suggesting that firms who actively invest in Asia and are located in the most affected areas will be refrained from tuning domestic job than their counterparts in other areas. The intuition is as follows: as we find in the previous investigation, firms that make FDI in Asian areas seem to allocate the labor more frequently at home, compared to the firms that invest in EU/North America. Given the fact that the decrease in the number of foreign affiliates due to the earthquake will be mainly concentrated in Asian countries, firms that are located in the most affected regions will experience a larger loss and thus cut their investment in Asia. This will in turn reduce the profitability, as we are about to illustrate in the next section, and lead to a negative impact on the domestic labor reallocation. *triple_DID_euamerica*, on the other hand, positively affects JC and JD. This indicates that the firms who make FDI in EU/North America only are not affected as much as the Asia-invested firms.

Combining the results above, we can draw a quick conclusion that FDI does affect job creation and job destruction at home, and the impact differs depending on where the investment goes. However, through what channels does the investment by destination affect JC and JD in a different way? Does it fit into a substitution/complement framework that focuses on resource allocation? A sophisticated theoretical model is needed to better understand the potential mechanism aforementioned, and help us unlock the "blackbox".

5. Theoretical model

We will provide a simple model to explain the empirical findings on the effect of FDI on domestic job creation destruction. The base model is a search-and-matching model with endogenous job destruction developed by Mortensen and Pissarides (1994). Detailed derivations are relegated to Theory Appendix.

Setting

Firms and workers form a match to produce a good and make sales of px, where p denotes a general productivity parameter and x an idiosyncratic one. When an idiosyncratic shock arrives at Poisson rate λ, the productivity of the job changes from the initial value x to some new value x'. The job productivity follows a cumulative distribution function $G(x)$ with support in the rage $x \in [0,1]$. The job is destroyed if x falls below a reservation productivity x_R, which is determined endogeneously. Search-and-matching process occurs in continuous time. Since we focus mainly on steady states, the notation for time will be suppressed unless otherwise noted.

Let u be the number of unemployed workers as a fraction of the labor force and v be the number of vacant jobs as a fraction of the labor force. The vacancy-unemployment ratio is denoted by $\theta = v/u$, which captures the labor-market tightness. The probability of a vacancy filled is $q(\theta) = m(v,u) \,/\, v$, where $m(v,u)$ is a constant-returns-to-scale matching function.[7] Because of $q(\theta) = m(1, u \,/\, v) = m(1, 1 \,/\, \theta)$, we see $q'(\theta) = -(1 \,/\, \theta^2)\partial m \,/\, \partial\theta < 0$. The probability of a worker finding a job is $\theta q(\theta) = m(v,u) \,/\, u = m(v \,/\, u, 1) = (v \,/\, u)m(1, u \,/\, v)$, which increases with θ because of $[\theta q(\theta)]' = [m(\theta, 1)]' = \partial m/\partial\theta > 0$.

We assume that FDI decision by a firm is independent of its decision on domestic activity. The impact of FDI on domestic employment is modelled in two ways. First, letting k_i be the level of FDI to destination $i \in \{1, \dots, n\}$, the firm incurs costs related to FDI c that increases with k_i: $c_i = \partial c(k_1, \dots, k_n)/\partial k_i > 0$. As long as the firm operates in domestic

[7] We here assume that one firm employs one worker. Even if firms are allowed to employ multiple workers (the so-called "large-firm" setting), our results would be unchanged as long as the marginal product of labor is constant (see Chapter 3 of Pissarides, 2000).

market, it has to pay (a portion of) costs for FDI from its domestic profit. Second, FDI raises the general productivity p: $p_i = \partial p(k_1, \dots, k_n)/\partial k_i > 0$ through e.g., technological spillovers and resource reallocation within firms. Some empirical studies find a learning effect of FDI, i.e., the positive effect of starting FDI on firm productivity (Borin and Mancini, 2016; Hayakawa et al., 2012 for a survey).

Denote $J(x)$ the present-discounted value of expected profit from an occupied job with productvity x and V the present-discounted value of expected profit from a vacant job. Letting r be the discount rate, V satisfies

$$rV = -c + \lambda[J(1) - V]\,, \tag{3}$$

where the new job starts from the maximum productivity $x' = 1$. V can be interpreted as the "asset" value of a vacant job. The flow value rV consists of the per-period cost of holding a vacancy (cost for FDI) c, i.e., "income gain/loss," and the expected net return from changing state $\lambda[J(1) - V]$, i.e., "capital gain/loss." Free entry implies that all rents from new vacancy creation are exhausted:

$$V = 0. \tag{4}$$

Analogously, the flow value of a filled job $rJ(x)$ satisfies

$$rJ(x) = px - w(x) - c + \lambda\left[\int_{x_R}^{1} J(x')\, dG(x') - J(x)\right], \tag{5}$$

where $w(\cdot)$ is the wage. Since the firm has to incur cost for FDI regardless of job being filled or not, c appears in both Eqs. (3) and (5).

The flow value of a matched worker $rW(x)$ and the flow value of an unmatched worker rU are respectively expressed as

$$rW(x) = w(x) + \lambda\left[\int_{x_R}^{1} W(x')\, dG(x') + UG(x_R) - W(x)\right], \tag{6}$$

$$rU = z + \theta q(\theta)[W(1) - U]\,, \tag{7}$$

where z is the unemployed benefit including the value of leisure.

The wage is derived from the generalized Nash bargaining, resulting in the following sharing rule of surplus generated by a filled job:

$$W(x) - U = \beta[W(x) + J(x) - U - V]\,, \tag{8}$$

where $\beta \in (0,1)$ is worker's share of the total surplus.

Job creation and job destruction

Using Eqs. (3) to (8), we get two key equations. The first is the job creation condition:

$$\frac{(1-\beta)p(1-x_R)}{r+\lambda}=\frac{c}{q(\theta)}, \tag{9}$$

where a firm is indifferent between posting a new vacancy and not entering. Noting that a newly filled job starts from $x = 1$, Eq. (9) states that the expected profit from the new job, the left-hand side, is equal to the expected hiring cost, the right-hand side. In the (θ, x_R) plane, the job creation condition exhibits a downward-sloping curve, as shown in Figure 6. At higher x_R, low productive jobs are less likely to survive, reducing the asset value of a filled job $J(x)$. This discourages firms to enter and thus lowers θ.

The second is the job destruction condition:

$$\frac{c[1+\beta(\theta-1)]}{p(1-\beta)}+\frac{z}{p}=x_R+\frac{\lambda}{r+\lambda}\int_{x_R}^{1}(x'-x_R)dG(x') \tag{10}$$

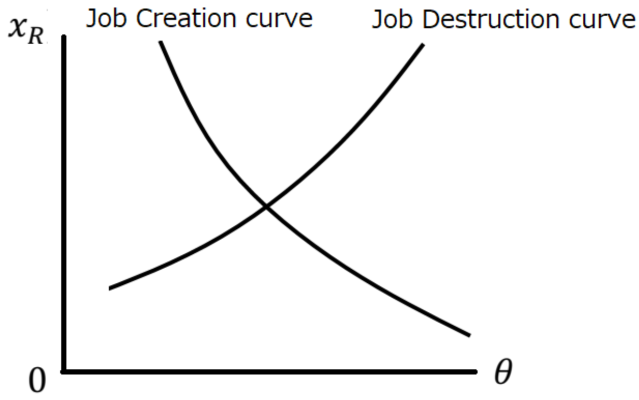
where both a matched firm and a matched worker are indifferent between carrying on and destroying the match. The left-hand and the right-hand sides respectively represent expected cost and the expected sales to the firm from continuing the match, both of which are adjusted by the general productivity p.[8] In the (θ, x_R) plane, the job destruction condition exhibits an upward-sloping curve, as shown in Figure 6. At higher θ, workers easily find a new job so that they require a higher wage to continue the current match, reducing the asset value of a filled job $V(x)$. Thus only high productive jobs are likely to continue their match with workers, resulting in higher x_R.

[8] A more intuitive expression of the job destruction condition is

$$px_R - w(x_R) - c + \lambda\int_{x_R}^{1} J(x')dG(x') = rV,$$

where $V = 0$ from the free entry condition (4). If a firm with productivity x_R continues the match, it obtains $px_R - w(x_R) - c$ of profits today and the integral term of expected profits in the future. The left-hand side thus represents the value of continuing the match. The job destruction condition requires that this value must be equal to the value of breaking the match and posting a new vacancy. We here concentrate on the firm's decision, but we can also analyze the worker's decision because job destruction is a mutual decision of the two parties. See Theory Appendix for more details.

Figure 6 Job creation and job destruction curves



The job creation condition (9) and the job destruction condition (10) jointly determine the steady-state equilibrium values of θ and x_R. The labor market tightness θ is in turn determined at the point where the law of motion governing the unemployed workers stops:

$$(\dot{uL}) = \lambda G(x_R)(1-u)L - \theta q(\theta)uL = 0 \tag{11}$$

where the dot represents the time derivative and L is the total workforce. $\lambda G(x_R)(1-u)L \equiv JD$ is the number of destructed jobs, while $\theta q(\theta)uL \equiv JC$ is the number of created jobs. They are the theoretical counterparts of the empirical analysis.

The FDI decision affects both JC and JD through changes in the general productivity p and the cost for FDI c. To derive clear theoretical predictions, we assume two conditions: (A1) $1 + \beta(\theta - 1) > 0$; (A2) $\beta q(\theta) + q'(\theta)[1 + \beta(\theta - 1)] < 0$; and (A3)$\min_i \varepsilon_i^p / \varepsilon_i^c > \gamma \equiv [1 + \beta(\theta - 1)]/[1 + \beta(\theta - 1) + (1 - \beta)z/c]$, where γ is smaller than one and $\varepsilon_i^p \equiv \frac{\partial p/p}{\partial k_i/k_i} > 0$ and $\varepsilon_i^c \equiv \frac{\partial c/c}{\partial k_i/k_i} > 0$ are respectively the elasticity of productivity and the elasticity of FDI cost with respect to FDI to destination $i \in \{1, \dots, n\}$. (A1) and (A2) are satisfied under reasonable parameter values in the literature.[9] (A3) states that the benefit from an increase in outward FDI (ε_i^p) relative to the cost from it (ε_i^c) in terms of elasticity must not to be too small.

[9] Suppose that the matching function takes the Cobb-Douglas form: $m(v,u) = m_0\, v^{1-\alpha}u^{\alpha} = m_0\theta^{-\alpha}$ with the matching elasticity $\alpha \in [0,1]$. (A2) reduces to $\theta < \alpha(1-\beta)\,/\,[\beta(1-\alpha)]$. Following empirical studies on the Japanese labor market (Kano and Ohta, 2005; Lin and Miyamoto, 2014), we set α to 0.6 and the worker's bargaining power β to 0.37 and obtain $\alpha(1-\beta)\,/\,[\beta(1-\alpha)] \simeq 2.6$. An empirical counterpart of θ, the active job openings-to-applicants ratio, has been around 0.48 to 1.44 in recent years, which is below 2.6, according to the *Report on Employment Service* published by Ministry of Health, Labour and Welfare, Employment Security Bureau (see the website of the Japan Instuite for Labor Policy and Traning: https://www.jil.go.jp/english/jwl/2016-2017/04.html for details, accessed on Nov. 13th, 2019). It can be readily checked that (A1) is also satisfied.

Effects of FDI

FDI may affect job destruction either positively or negatively. As is clear from the left-hand side of the job destruction condition defined in Eq. (10), an increase in p caused by FDI lowers the unemployment benefit adjusted by the general productivity z/p. That is, with higher general productivity, the matched worker's outside opportunities become relatively less attractive and she accepts lower wages, thereby reducing the expected cost of continuing the match. On the other, FDI increases c and may thus raise the expected cost. As long as (A1) to (A3) hold, given θ, the former negative effect of FDI dominates so that the reduced expected cost enables firms with low productive jobs to carry on and lowers the reservation productivity x_R. This implies a downward shift of the job destruction curve, as shown in Figure 7(b).

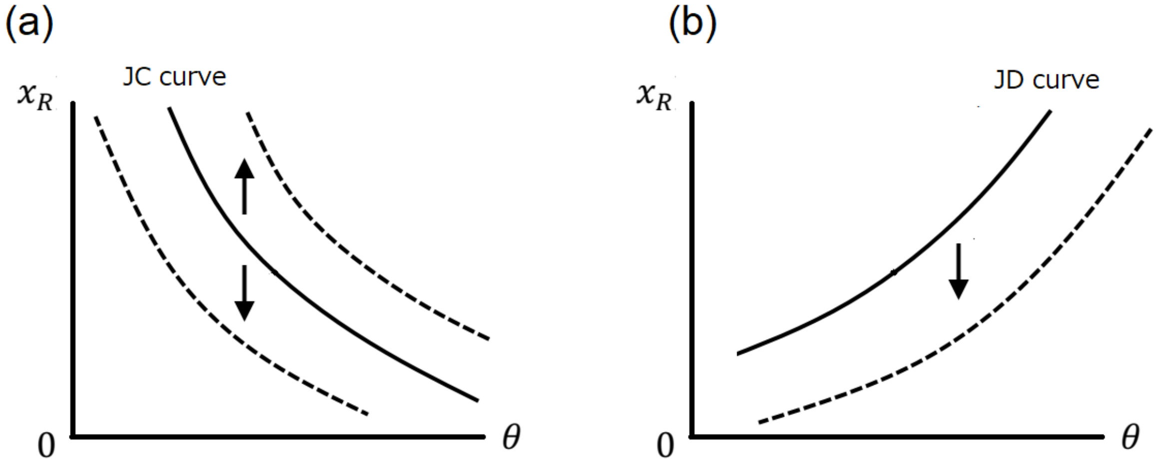
Similarly, there are positive and negative effects of FDI on job creation. However, which effect dominates is unclear. As the left-hand side of the job creation condition defined in Eq. (9) suggests, given x_R, FDI raises the general productivity p and thereby encourages more entry, i.e., higher labor-market tightness θ. The right-hand side of Eq. (9), on the other tells that FDI increases the cost of holding a vacant job and leads to fewer entry, i.e., lower θ. An increase in FDI may shift the job creation curve either up or down depending on the magnitude of the two effects, as shown in Figure 7(a).

It can be checked that if the elasticity of general productivity ε_i^p is greater than that of FDI cost ε_i^c (i.e., $\varepsilon_i^p/\varepsilon_i^c > 1$), FDI shifts the job creation curve up and shifts the job destruction curve down. These shifts always increase θ but may increase or decrease x_R. Since the beneficial effect of the lower productivity-adjusted unemployment benefit z/p is large, the (absolute level of) shift of job destruction curve is larger than the shift of job creation curve. This results in more entry (higher θ) and making the existing match longer (lower x_R).

If ε_i^p is smaller than ε_i^c(i.e., $\varepsilon_i^p/\varepsilon_i^c < 1$), on the other, FDI shifts both the job creation curve and the job destruction curve down. As a result of these shifts, x_R unambiguously decreases but θ may increase or decrease. To determine the effect on θ, we need a closer inspection on the magnitude of the two elasticities.

If in addition ε_i^p is not too small compared with ε_i^c (i.e., $\varepsilon_i^p \,/\, \varepsilon_i^c > \delta$ for a positive $\delta < 1$) the beneficial effect of lower z/p still dominates so that the (absolute level of) shift of job destruction curve is larger than the shift of job creation curve. This results in a higher θ and a lower x_R. If ε_i^p is much smaller than ε_i^c (i.e., $\varepsilon_i^p/\varepsilon_i^c < \delta$), the shift of job destruction curve is smaller. This implies that the higher expected hiring cost discourages firm entry (lower θ) and the higher expected cost of continuing a match leads to a shorter life span of match (higher x_R).

Figure 7 The effect of FDI on (a) job creation curve and (b) job destruction curve.



The above discussions are reflected in the following comparative statistics:

$$\frac{dx_R}{dk_i} < 0,$$

$$\frac{d\theta}{dk_i}\begin{cases} \geq 0 & \text{if } \varepsilon_i^p/\varepsilon_i^c \geq \delta \\ < 0 & \text{if } \varepsilon_i^p/\varepsilon_i^c < \delta \end{cases}.$$

where $1 > \delta \equiv \frac{[r+\lambda G(x_R)]/q(\theta)+1+\beta(\theta-1)}{[r+\lambda G(x_R)]/q(\theta)+1+\beta(\theta-1)+(1-\beta)z/c} > \gamma$ and conditions (A1) to (A3) are assumed. The effect of FDI on job continuation is always positive and leads to a lower x_R. On the other, the positive effect of FDI on firm entry dominates and leads to a higher θ, only if the elasticity of productivity relative to the elasticity of FDI cost is high enough.

In a transition path where the unemployment rate u is fixed, $JC = \theta q(\theta)uL$ increases with θ and $JD = \lambda G(x_R)(1-u)L$ increases with x_R. Therefore, an increase in FDI always decreases JD, while it increases (or decrease) JC only if $\varepsilon_i^p/\varepsilon_i^c \geq \delta$ (or $\varepsilon_i^p/\varepsilon_i^c < \delta$) holds.

Figure 8 The effect of FDI to Asia on (a) the steady state and (b) the transition path.

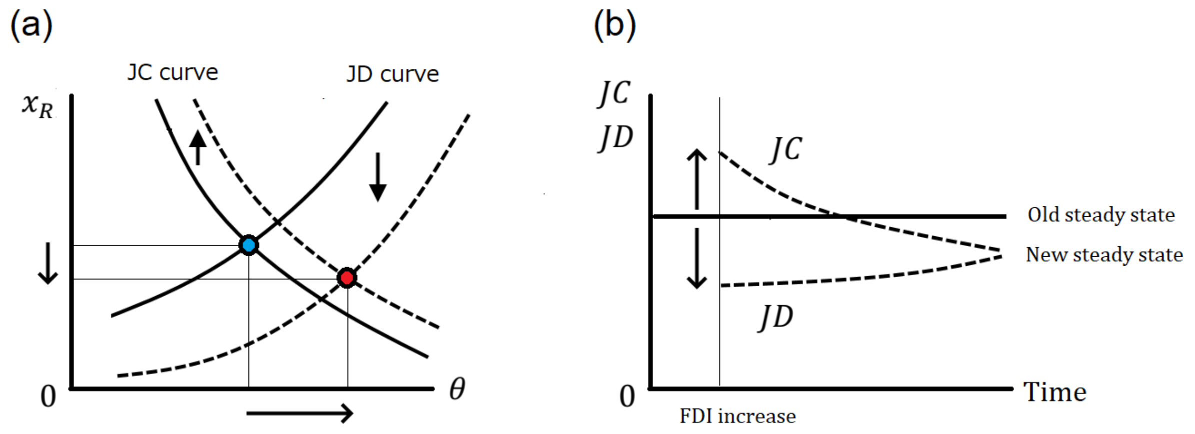
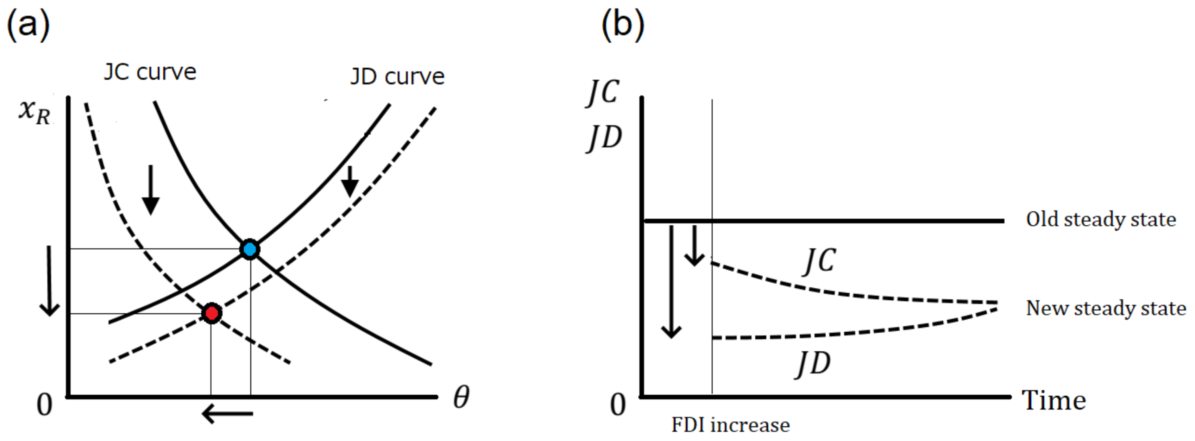


Figure 9 The effect of FDI to Europe/North America on (a) the steady state and (b) the transition path.



These theoretical predictions can be related with our empirical findings as follows. The extra benefit of FDI to Asia for domestic jobs is large relative to the extra cost of it, so that an increase in FDI to Asia immediately raises JC and reduces JD, as shown in Figure 8. On the other, the relative extra benefit to Europe/North America for domestic jobs is small, reducing both JC and JD, as shown in Figure 9.

The presumption that $\varepsilon_i^p/\varepsilon_i^c \geq \delta$ for $i = Asia$ seems plausible in the context of Japanese multinationals. Subsidiaries in Asia may engage in totally different activities from those conducted in Japan (such as simple assembly of parts). Their activities may be complementary to those of the headquarters in Japan and may thus lead to a higher $\varepsilon_i^p/\varepsilon_i^c$. By contrast, activities of subsidiaries in Europe/North America may be similar to those in Japan (such as R&D), considering the similarities of income level between Japan and these regions. FDI to Europe thus may substitute domestic jobs in Japan, making $\varepsilon_i^p/\varepsilon_i^c < \delta$ hold for $i = Europe/North\ America$. Our presumptions are partly supported by Hayakawa et al. (2013), who examine the impact of outward FDI on firm productivity using Japanese firm-level data.

They find that the effect of FDI to developing countries on firm productivity is significantly positive (corresponding to $\varepsilon_i^p > 0$ for $i = Asia$), but the effect of FDI to developed countries is not statistically significant ($\varepsilon_i^p = 0$ for $i = Europe/North\ America$).

6. Further evidence and robustness checks

Evidence of the mechanism

To further explore the possible channels that have been modeled in our theoretical framework, we go back to the data. We already show that FDI into different regions have heterogeneous impact on JC because $\varepsilon_i^p/\varepsilon_i^c$ may take different threshold values. To verify this point, we run two additional equations:

$$log(Productivity)_{ft} = \varepsilon_i^p logFDI_{fit} + \gamma_f + \gamma_t + u_{ft} \tag{12}$$

$$log(Cost\ for\ FDI)_{ft} = \varepsilon_i^c logFDI_{fit} + \gamma_f + \gamma_t + v_{ft} \tag{13}$$

$\log(\text{Productivity})_{ft}$ in Eq. (12) stands for the log of average productivity of firm *f* at time *t*. $\log FDI_{fit}$ is the indicator for firm f's FDI in region *i* at time *t*, in which *i* can be Asia or EU/North America. In practice, it is equivalent to log $(Region\_affiliate\_number)_{it}$ in Eq. (1). $\log(\text{Cost for FDI})_{ft}$ in Eq. (13) is the cost related to FDI behaviour, which we use the information of a firm's total oversea investment on affiliated firms (in value) to proxy for. Because in both specifications, we use the log-log estimators, which means that the coefficient of $\log FDI_{fit}$ obtained will be equal to the elasticity of productivity and FDI cost respectively. In accordance with our theoretical predictions, we would expect that $(i)\varepsilon_i^p > 0, \varepsilon_i^c > 0$, for all i; $(ii)\varepsilon_{ASIA}^p/\varepsilon_{ASIA}^c > \varepsilon_{EU}^p/\varepsilon_{EU}^c$.

Table 4 The impact of FDI destination on firm labor productivity and oversea investment

VARIABLES	(1) ln_revenue/total labor	(2) ln_oversea_investment
ln_number_Asia_affiliate	0.0383***	0.789***
	(0.00240)	(0.0159)
ln_number_EU_Northam_affiliate	0.00563*	0.234***
	(0.00336)	(0.0208)

Year dummy	Yes	Yes
Firm FE	Yes	Yes
Observations	268,781	144,707
R-squared	0.029	0.298
Number of eternal_no	31,196	23,494

*** p<0.01, ** p<0.05, * p<0.1; Robust standard errors in parentheses.

As shown in Table 4, investment in both regions has significantly positive impact on the labor productivity and oversea investment of the headquarter. We then calculate $\varepsilon^{p}_{ASIA}/\varepsilon^{c}_{ASIA} \simeq 0.049 > \varepsilon^{p}_{EU}/\varepsilon^{c}_{EU} \simeq 0.024$, which is the same as our expectation.[10] The numerical practice verifies the tractability of our model, and makes clear the channel through which FDI in different destinations can affect within-firm labor dynamics differently. An intuitive explanation is that FDI is associated with a higher productivity for the domestic headquarters (Borin and Mancini, 2016; Hayakawa et al., 2012), however, this comes with a price that firms need to reduce the capital or resources that they can allocate domestically. In the short run, keeping other conditions constant, firms would spend less capital if they choose to invest in Asian countries than in EU/North American countries, because of the nature of jobs (e.g. assembly v.s. R&D). Given the fact that the majority of the manufacturing firms are capital intensive than non-manufacturing firms in Japan (the average capital-labor ratio is 2.16 for manufacturing firms vs. 1.98 for non-manufacturing firms), it is reasonable to predict that the productivity gain against the FDI cost would be larger for the investment in Asian regions. This lends support to our presumptions, as described in section 4.

The impact on division-level labor variation

In this part, we take a step further to investigate how the investment into different destinations might affect the labor change in each division. Since the information on the division-level characteristics is not available except for the number of workers, we can only control for the year dummies, the vector of firm-level charateristics and division-level fixed effects. We repeat this practice for each division. The results for the major divisons of the Japanese headquarters are summarized in Table 5.[11] From columns (1) and (3), we can observe

[10] We also verified that the elasticity of firm productivity with respect to FDI cost is larger for firms that make investment in Asian countries only than in EU/North American countries only.

[11] Apart from the divisions investigated here, we also find that FDI in Asia leads to larger decrease for

that the Japanese headquarters tend to increase workers in R&D division no matter where they make FDI, and the impact from Asian FDI is larger than that from EU/North American FDI. Meanwhile, FDI in Asia leads to decrease of workers in the production division at home, but not for FDI in EU/North America. This to some extent is consistent with the conventional notion regarding outward FDI' negative impact on domestic employment, but also provides evidence for our argument in the previous section. When a firm chooses to make investment in Asia, it takes advantage of the cheap labor and outsources more of its unskilled tasks. As a result, it will reduce the number of workers in the same division—the production division at home. On the other hand, both the investment in Asia and EU/North America will promote the productivity at home, thus increase the firm's capacity to hire more skilled labor. But because the return-to-cost in the short-term is higher for the investment in Asia, as aforementioned, FDI in Asia will contributes more to the labor increase in the divisions that need skilled labor, such as R&D division. This is in accordance with our theoretical predictions as well. [12]

Table 5 The impact of FDI destination on division-level labor dynamics

	(1)	(2)	(3)	(4)
Division name	R&D	production	R&D	production
Dependent variable	number of worker	number of worker	number of worker	number of worker
ln_number_Asia_affiliate	7.804***	-8.670***	7.129***	-8.267***
	(0.849)	(1.165)	(1.092)	(1.390)
ln_number_EU_Northam_affiliate	2.879***	1.343	2.482*	2.127
	(1.065)	(1.462)	(1.291)	(1.644)
Oversea_invest_cost	No	No	Yes	Yes
Firm controls	Yes	Yes	Yes	Yes
Year dummy	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Observations	142,885	142,885	106,570	106,570
R-squared	0.006	0.016	0.008	0.015
Number of eternal_no	22,877	22,877	20,118	20,118

*** p<0.01, ** p<0.05, * p<0.1; Robust standard errors in parentheses.

The firm controls are the same as in the baseline specification.

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marketing division (HQ) that FDI in EU does. Also, FDI in EU leads to increase in international and business division, but not for FDI in Asia.

[12] To further verify the mechanism based on labor skill, we divide the divisions following Autor and Dorn (2013) into the ones that hire relatively high-skilled workers and low-skilled workers. We repeat the practice as in the previous section. The results are shown in Appendix A2.

Our findings can also be related to the horizontal/vertical FDI framework applied in the international trade literature, such as Hayakawa et al. (2013). In their paper, they define the types of FDIs based on destination country: the FDIs in developed countries are regarded as HFDIs, and those in developing countries as VFDIs, which is in analogous to our categorizations. We can simply think of the FDI into Asia as VFDIs whereas the FDI into EU/North America as HFDIs. Contrary to their results, we find that VFDI (FDI in Asia) does have a significantly negatively impact on the number of production workers at home, indicating a strong substitution effect, whereas they show a positive relationship between these two variables. On the other hand, they argue that VFDI does not increase non-production workers, however, as shown in our practice above, VFDI promotes the employment in the non-production divisions, such as R&D and service. A more profound theoretical explanation will be needed to support the empirical results.

7. Conclusion

This study used a unique dataset of Japanese firms' overseas activities to examine the individual effects of outward FDI on firm-level job creation and destruction, respectively. We found that investment in Asian countries has a positive impact on domestic job creation in Japan, whereas the impact of investment in European and North American countries is negative. When it comes to job destruction, the impact is negative regardless of FDI destination, suggesting that fewer jobs are destroyed when carrying out FDI in Asian or EU/North American countries. We use a search and match framework, embedded with FDI decision to better illustrate the mechanism, arguing that average productivity and return-to-investment are the two major channels through which FDI affects the within-firm labor reallocation.

Our results are in sharp contrast with that of Harrison and McMillan (2011). However, our findings are consistent with those in Navaretti et.al. (2009), who found that outward FDI to less developed countries can have a positive long-term effect on value added and employment in Italy, as well as a positive effect on the size of domestic output and employment in France. In Japan, it is commonly recognised that Japanese multinationals establish operations in Asian countries to exploit cheap labour and minimise production costs. Thus, although more jobs may be eliminated domestically due to such a substitution effect, these losses might be limited to "blue collar" jobs. As Higuchi and Genda (1999) indicate, even though outward FDI by Japanese firms leads to a larger loss of blue-collar employment, the number of white collar (regular employee) jobs has been increasing. One possible explanation is that as more low-skilled jobs are outsourced to Asian countries, this will create more room for employment of highly skilled workers. We verify this phenomenom by conducting the division-level analysis, and relate our findings to the standard horizontal/vertical FDI framework.

The limitation of this study is that the data do not include very small firms who employ <50 workers or with < 30,000,000 yen worth of capital. Most firms in this category could be immature firms or ventures, whose behaviours and FDI effects could differ from that of large and mature firms. Thus, the findings are only limited to median-sized and large firms in Japan. Furthermore, detailed FDI activities and motivation of foreign investment are unavailable in the current data. Future studies using alternate data will be conducted to tackle those issues.

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Appendix

Table A1 Summary statistics

Variable	Obs	Mean	Std.Dev.	Min	Max
Job creation (person)	607269	48.15	387.77	0	126237
Job destruction (person)	607269	45.14	359.14	0	99996
Net employment (person)	515174	3.75	398.62	-99691	126132
Job creation rate	515174	0.14	0.25	0	2.89
Job destruction rate	515174	0.14	0.25	0	3.06
Revenue (million yen)	607269	23309.74	181585.30	1	1.59E+07
R&D expense/revenue	269397	0.01	0.17	0	57.10
Firm age	607267	44.50	98.87	0	2005
Total regular employee (person)	607269	436.07	1802.39	50	153405
Foreign capital share (100%)	607193	0.56	5.35	0	100
Capital/labor ratio (log)	607269	-0.28	1.22	-7.34	7.96
TFP_LP (log)	607269	6.72	1.12	-1.74	13.28
Total number of affiliate	268781	2.99	18.66	0	1346
Total number of oversea affiliate	268781	2.36	18.58	0	1327
Number of Asian affiliate	268781	1.31	7.08	0	524
Number of European affiliate	268781	0.39	4.63	0	360
Number of North American affiliate	268781	0.43	5.67	0	735
Exchange rate	607269	97.80	15.93	71.28	130.91

Table A2-a Analysis by high skilled and low skilled divisions using IV method: main results without industry controls

VARIABLES	(1) jc_high	(2) jc_low	(3) jd_high	(4) jd_low	(5) Net Δ _high	(6) Net Δ _low
ln_number_Asia_affiliate	0.878	9.892*	-2.869	-15.37***	3.747	25.26***
	(2.346)	(5.049)	(2.264)	(5.150)	(3.327)	(5.578)
ln_number_ EU_Northam_affiliate	5.085*	-31.30***	-1.651	-26.93***	6.736	-4.374
	(3.015)	(6.489)	(2.910)	(6.620)	(4.276)	(7.169)
Capital_labor_ratio	-5.610***	-46.44***	-2.409*	9.960***	-3.201	-56.40***
	(1.398)	(3.008)	(1.349)	(3.069)	(1.982)	(3.324)
R&D share	3.087	1.584	-0.0678	2.221	3.155	-0.637
	(9.287)	(19.99)	(8.964)	(20.39)	(13.17)	(22.08)
Foreign_capital_ratio	-0.0173	-0.0228	0.0145	0.0132	-0.0318*	-0.0359
	(0.0122)	(0.0263)	(0.0118)	(0.0268)	(0.0173)	(0.0290)
Firm_age	-0.00231	0.00681	-0.00392	0.0442**	0.00161	-0.0373
	(0.0102)	(0.0219)	(0.00982)	(0.0223)	(0.0144)	(0.0242)
Ln_Revenue	7.102***	20.18***	0.0971	15.47***	7.005**	4.711
	(1.920)	(4.133)	(1.854)	(4.216)	(2.723)	(4.566)
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	114,479	114,479	114,479	114,479	114,479	114,479
Number of eternal_no	18,786	18,786	18,786	18,786	18,786	18,786

Standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1
IVs are the same as in Table 2.

Table A2-b Analysis by high skilled and low skilled divisions using IV method: other results without industry controls

VARIABLES	(1) jc_high	(2) jc_low	(3) jd_high	(4) jd_low	(5) Net Δ _high	(6) Net Δ _low	(7) jc_high	(8) jc_low	(9) jd_high	(10) jd_low	(11) Net Δ _high	(12) Net Δ _low
ln_number_Asia_affiliate	0.270	4.051	-3.279	-14.00***	3.549	18.05***	-0.0502	3.945	-3.283	-14.08***	3.233	18.02***
	(2.351)	(5.046)	(2.270)	(5.162)	(3.334)	(5.572)	(2.348)	(5.052)	(2.272)	(5.165)	(3.334)	(5.574)
ln_number_EU_Northam_affiliate	4.388	-38.01***	-2.122	-25.36***	6.510	-12.65*	5.030*	-37.59***	-2.088	-25.35***	7.118*	-12.24*
	(3.020)	(6.481)	(2.915)	(6.629)	(4.283)	(7.156)	(3.017)	(6.489)	(2.918)	(6.635)	(4.282)	(7.160)
Capital_labor_ratio	-2.036	-12.06***	0.00467	1.900	-2.040	-13.96***	-1.325	-9.421***	-0.835	-4.717	-0.490	-4.704
	(1.551)	(3.329)	(1.497)	(3.405)	(2.199)	(3.675)	(1.596)	(3.434)	(1.544)	(3.511)	(2.266)	(3.789)
R&D share	-0.436	-32.30	-2.447	10.17	2.011	-42.46*	0.228	-29.28	-3.372	2.196	3.600	-31.48
	(9.308)	(19.98)	(8.985)	(20.43)	(13.20)	(22.06)	(9.299)	(20.00)	(8.995)	(20.45)	(13.20)	(22.07)
Foreign_capital_ratio	-0.0188	-0.0374	0.0135	0.0166	-0.0323*	-0.0540*	-0.0191	-0.0370	0.0134	0.0146	-0.0324*	-0.0516*
	(0.0122)	(0.0262)	(0.0118)	(0.0268)	(0.0173)	(0.0290)	(0.0122)	(0.0262)	(0.0118)	(0.0268)	(0.0173)	(0.0289)
Firm_age	-0.00230	0.00691	-0.00392	0.0441**	0.00161	-0.0372	-0.00240	0.00633	-0.00360	0.0456**	0.00121	-0.0392
	(0.0102)	(0.0218)	(0.00982)	(0.0223)	(0.0144)	(0.0241)	(0.0101)	(0.0218)	(0.00982)	(0.0223)	(0.0144)	(0.0241)
Ln_Revenue	0.890	-39.56***	-4.098*	29.48***	4.988	-69.04***	48.13***	385.3***	19.06***	-112.3***	29.07***	497.6***
	(2.236)	(4.799)	(2.159)	(4.909)	(3.171)	(5.299)	(7.521)	(16.18)	(7.275)	(16.54)	(10.68)	(17.85)
Ln_total regular employee	15.21***	146.3***	10.27***	-34.30***	4.938	180.6***						
	(2.843)	(6.101)	(2.744)	(6.241)	(4.032)	(6.737)						
Ln_TFP_LP							4.597*	16.53***	-4.655**	-40.69***	9.252***	57.22***
							(2.406)	(5.175)	(2.327)	(5.291)	(3.415)	(5.710)
Year dummy							-50.92***	-437.6***	-19.68**	172.7***	-31.24**	-610.3***
Firm FE							(9.122)	(19.62)	(8.824)	(20.06)	(12.95)	(21.65)
Observations	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of eternal_no	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1
IVs are the same as in Table 2.

Table A2-c Analysis by high skilled and low skilled divisions using IV method: with industry controls

VARIABLES	(1) jc_high	(2) jc_low	(3) jd_high	(4) jd_low	(5) Net Δ _high	(6) Net Δ _low	(7) jc_high	(8) jc_low	(9) jd_high	(10) jd_low	(11) Net Δ _high	(12) Net Δ _low
ln_number_Asia_affiliate	0.885	9.797*	-2.877	-15.39***	3.762	25.19***	0.604	6.862	-2.484	-18.15***	3.088	25.01***
	(2.346)	(5.050)	(2.265)	(5.151)	(3.327)	(5.579)	(2.379)	(5.080)	(2.296)	(5.176)	(3.373)	(5.642)
ln_number_EU_Northam_affiliate	5.098*	-31.48***	-1.667	-26.97***	6.765	-4.510	5.391*	-26.18***	-1.436	-19.48***	6.827	-6.702
	(3.016)	(6.492)	(2.911)	(6.622)	(4.277)	(7.172)	(3.044)	(6.498)	(2.938)	(6.622)	(4.315)	(7.218)
Capital_labor_ratio	-5.613***	-46.40***	-2.406*	9.969***	-3.207	-56.37***	-5.582***	-46.25***	-2.047	11.32***	-3.535*	-57.57***
	(1.398)	(3.009)	(1.349)	(3.069)	(1.982)	(3.324)	(1.408)	(3.007)	(1.359)	(3.064)	(1.997)	(3.339)
R&D share	3.080	1.683	-0.0591	2.243	3.139	-0.560	4.717	-2.412	0.438	3.433	4.279	-5.844
	(9.287)	(19.99)	(8.964)	(20.39)	(13.17)	(22.08)	(9.308)	(19.87)	(8.984)	(20.25)	(13.20)	(22.07)
Foreign_capital_ratio	-0.0173	-0.0227	0.0145	0.0132	-0.0318*	-0.0359	-0.0170	-0.0195	0.0145	0.0189	-0.0315*	-0.0384
	(0.0122)	(0.0263)	(0.0118)	(0.0268)	(0.0173)	(0.0290)	(0.0123)	(0.0263)	(0.0119)	(0.0268)	(0.0175)	(0.0292)
Firm_age	-0.00231	0.00675	-0.00393	0.0441**	0.00162	-0.0374	0.000669	0.00774	-0.00375	0.0450**	0.00442	-0.0373
	(0.0102)	(0.0219)	(0.00982)	(0.0223)	(0.0144)	(0.0242)	(0.0102)	(0.0218)	(0.00984)	(0.0222)	(0.0145)	(0.0242)
Ln_Revenue	7.094***	20.29***	0.106	15.49***	6.988**	4.793	7.616***	20.71***	0.314	19.23***	7.302***	1.477
	(1.921)	(4.134)	(1.854)	(4.217)	(2.724)	(4.567)	(1.964)	(4.194)	(1.896)	(4.273)	(2.785)	(4.658)
Industry_number_employee	1.74e-07	-2.30e-06	-2.00e-07	-5.05e-07	3.74e-07	-1.79e-06						
	(7.74e-07)	(1.67e-06)	(7.47e-07)	(1.70e-06)	(1.10e-06)	(1.84e-06)						
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No	No	No
Industry*Year dummy	No	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	114,479	114,479	114,479	114,479	114,479	114,479	114,479	114,479	114,479	114,479	114,479	114,479
Number of eternal_no	18,786	18,786	18,786	18,786	18,786	18,786	18,786	18,786	18,786	18,786	18,786	18,786

Standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

IVs are the same as in Table 2.

We also use the combinations of ln_l, ln_cost_performance, ln_tfp_lp in the control variables. The results are similar to what we obtain here.

Theory Appendix to "Does it matter where you invest? The impact of FDI on domestic job creation and destruction"

Bin Ni Hayato Kato Yang Liu
January 19, 2020

1 Model of endogenous job creation and destruction

We provide detailed derivations for the theoretical model presented in the main text.

1.1 Setup

The asset value of an occupied job J and the asset value of a vacant job V are respectively,

$$rJ(x) = px - w(x) - c + \lambda \left[\int_0^1 \max \left\{ J(x').V \right\} dG(x') - J(x) \right], \tag{1}$$

$$rV = -c + q(\theta) \left[J(1) - V \right], \tag{2}$$

Free entry drives rents from a vacant job to zero:

$$\begin{aligned} &V = 0, \\ &\to J(1) = \frac{c}{q(\theta)}. \end{aligned} \tag{3}$$

The reservation productivity x_R is defined as the productivity that makes entry and exit indifferent:

$$J(x_R) = V = 0. \tag{4}$$

We use the above free entry condition to rewrite Eq. (1):

$$rJ(x) = px - w(x) - c + \lambda \left[\int_{x_R}^1 J(x')dG(x') - J(x) \right], \tag{5}$$

Note that we here assume that $J(x)$ increases with x_R, which will be confirmed later.

Analogously, the value of an employed worker $W(x)$ and the value of an unemployed worker U

are

$$
\begin{aligned}
rW(x) &= w(x) + \lambda \left[\int_0^1 \max\{W(x'), U\} dG(x') - W(x) \right], \\
&= w(x) + \lambda \left[\int_{x_R}^1 W(x') dG(x') + \int_0^{x_R} U dG(x') - W(x) \right], \\
&= w(x) + \lambda \left[\int_{x_R}^1 W(x') dG(x') + UG(x_R) - W(x) \right], \qquad (6) \\
rU &= z + \theta q(\theta)[W(1) - U], \qquad (7)
\end{aligned}
$$

where $W(x)$ is assumed to increase with x_R and we will later check that this assumption indeed holds.

The wage determined by the Nash bargaining between an employer and an employee results in

$$
w(x) = \text{argmax}[W(x) - U]^{\beta}[J(x) - V]^{1-\beta}.
$$

The first-order maximization condition gives

$$
\begin{aligned}
&\beta[W(x) - U]^{\beta-1} J(x)^{1-\beta} - (1-\beta)[W(x) - U]^{\beta} J(x)^{-\beta} = 0, \\
&\to \beta J(x) - (1-\beta)[W(x) - U] = 0, \\
&\to W(x) - U = \frac{\beta}{1-\beta} J(x). \qquad (8)
\end{aligned}
$$

1.2 Job creation and job destruction

1.2.1 Wage equation

We will first derive an equation that determines wage. From Eq. (6), we have

$$
\begin{aligned}
rW(x) &= w(x) + \lambda \left[\int_{x_R}^1 \{W(x') - U\} dG(x') + \int_{x_R}^1 U dG(x') + UG(x_R) - W(x) \right], \\
&= w(x) + \lambda \left[\int_{x_R}^1 \{W(x') - U\} dG(x') - \{W(x) - U\} \right] \\
&= w(x) + \frac{\beta\lambda}{1-\beta} \left[\int_{x_R}^1 J(x') dG(x') - J(x) \right] \qquad \because \text{Eq. (8)} \\
\to r(1-\beta)W(x) &= (1-\beta)w(x) + \beta\lambda \left[\int_{x_R}^1 J(x') dG(x') - J(x) \right]. \qquad (9)
\end{aligned}
$$

On the other, from Eq. (5), we have

$$
r\beta J(x) = \beta[px - w(x) - c] + \beta\lambda \left[\int_{x_R}^1 J(x') dG(x') - J(x) \right], \qquad (10)
$$

Subtracting Eq. (10) from Eq. (9) gives

$$\begin{aligned}
&r[(1-\beta)W(x)-\beta J(x)] = w(x)-\beta(px-c),\\
&\to r\left[(1-\beta)\left\{\frac{\beta}{1-\beta}J(x)+U\right\}-\beta J(x)\right] = w(x)-\beta(px-c), \qquad \because \text{Eq. (8)}\\
&\to r(1-\beta)U = w(x)-\beta(px-c),\\
&\to w(x) = r(1-\beta)U+\beta(px-c). \qquad (11)
\end{aligned}$$

We evaluate Eq. (8) at $x=1$ to get

$$\begin{aligned}
W(1)-U &= \frac{\beta}{1-\beta}J(1)\\
&= \frac{\beta}{1-\beta}\frac{c}{q(\theta)}.
\end{aligned}$$

Substituting this into Eq. (7) yields

$$\begin{aligned}
rU &= z+\theta q(\theta)\cdot\frac{\beta}{1-\beta}\frac{c}{q(\theta)}\\
&= z+\frac{\beta c\theta}{1-\beta},\\
\to r(1-\beta)U &= (1-\beta)z+\beta c\theta. \qquad (12)
\end{aligned}$$

From Eqs. (11) and (12), we get the wage equation:

$$\begin{aligned}
w(x) &= (1-\beta)z+[\beta c\theta+\beta(px-c)]\\
&= (1-\beta)z+\beta[px+c(\theta-1)]. \qquad (13)
\end{aligned}$$

1.2.2 Job creation condition

We evaluate Eq. (5) at $x=x_R$ to get

$$\begin{aligned}
&px_R-w(x_R)-c+\lambda\int_{x_R}^{1}J(x')dG(x') = (r+\lambda)J(x_R)=0, \qquad \because \text{Eq. (4)}\\
&\to \lambda\int_{x_R}^{1}J(x')dG(x') = w(x_R)+c-px_R.
\end{aligned}$$

Substituting this back into Eq. (5) yields

$$
\begin{aligned}
(r+\lambda)J(x) &= px - w(x) - c + \lambda \int_{x_R}^{1} J(x')dG(x') \\
&= px - w(x) - c + [w(x_R) + c - px_R] \\
&= p(x - x_R) - [w(x) - w(x_R)] \\
&= p(x - x_R) - [(1-\beta)z + \beta\{px + c(\theta - 1)\} - (1-\beta)z - \beta\{px_R + c(\theta-1)\}] \qquad \because \text{Eq. (13)} \\
&= (1-\beta)p(x - x_R), \\
\to J(x) &= \frac{(1-\beta)p(x-x_R)}{r+\lambda}. \qquad (14)
\end{aligned}
$$

Clearly, $J(x)$ increases with x. It follows from Eq. (8) that $W(x)$ also increases with x.

We evaluate Eq. (14) at $x = 1$ and combine it with Eq. (3) to get

$$
\frac{(1-\beta)p(1-x_R)}{r+\lambda} = J(1) = \frac{c}{q(\theta)}. \qquad (15)
$$

This is the job creation condition where the expected profit of a new job must be equal to the expected hiring cost.

1.2.3 Job destruction condition

Substituting Eq. (14) into Eq. (5) gives

$$
\begin{aligned}
&(r+\lambda)J(x) = px - w(x) - c + \lambda \int_{x_R}^{1} J(x')dG(x'), \\
&\to (r+\lambda)\cdot\frac{(1-\beta)p(x-x_R)}{r+\lambda} = px - w(x) - c + \lambda \int_{x_R}^{1} \frac{(1-\beta)p(x'-x_R)}{r+\lambda} dG(x'), \\
&\to (1-\beta)p(x-x_R) = px - [(1-\beta)z + \beta\{px + c(\theta-1)\}] - c + \frac{p\lambda(1-\beta)}{r+\lambda}\int_{x_R}^{1}(x'-x_R)dG(x'), \\
&\to (1-\beta)p(x-x_R) = (1-\beta)(px - z) - c[1+\beta(\theta-1)] + \frac{p\lambda(1-\beta)}{r+\lambda}\int_{x_R}^{1}(x'-x_R)dG(x'), \\
&\to p(x-x_R) = px - z - \frac{c[1+\beta(\theta-1)]}{1-\beta} + \frac{p\lambda}{r+\lambda}\int_{x_R}^{1}(x'-x_R)dG(x').
\end{aligned}
$$

We evaluate this at $x = x_R$ to get

$$
\frac{c[1+\beta(\theta-1)]}{p(1-\beta)} + \frac{z}{p} = x_R + \frac{\lambda}{r+\lambda}\int_{x_R}^{1}(x'-x_R)dG(x'). \qquad (16)
$$

This is the job destruction condition where both the matched employer and the matched employee agree on separation.

Using Eqs. (13) and (14), we can rewrite Eq. (16) in a more intuitive way:

$$px_R - w(x_R) - c + \lambda \int_{x_R}^{1} [J(x') - V] dG(x') = rV,$$

noting that $V = 0$ from the free entry condition. The left-hand side is the sum of the per-period value at the reservation productivity and the net asset value of continuing the match. The right-hand side is the flow value of posting a new vacancy. At x_R, the firm is indifferent between continuing and breaking the match.

Furthermore, we add rU to the both sides of the above equation and use Eqs. (8) and (11) to obtain

$$w(x_R) + \lambda \int_{x_R}^{1} [W(x') - U] dG(x') = rU,$$

which can be interpreted analogously.

1.3 Effects of FDI

Let k_i be the value of FDI to destination $i \in \{1, \ldots, n\}$. The general productivity parameter p and the fixed cost of FDI c depend on the level of FDI: $p = p(k_1, \ldots, k_n)$; $c = c(k_1, \ldots, k_n)$, and they increase with FDI: $dp/dk_i \equiv p_i > 0$; $dc/dk_i \equiv c_i > 0$. Since the job creation condition defined in Eq. (15) holds for any level of FDI k_i, we can differentiate the both sides of it with respect to k_i:

$$\begin{aligned}
&\frac{(1-\beta)(1-x_R)}{r+\lambda} = \frac{c}{pq(\theta)}, \qquad \forall \{k_i\}_{i=1}^{n}, \\
\rightarrow\ & -\frac{1-\beta}{r+\lambda}\frac{dx_R}{dk_i} = \frac{c_i pq(\theta) - c\left[p_i q(\theta) + pq'(\theta)\dfrac{d\theta}{dk_i}\right]}{[pq(\theta)]^2} \\
&\qquad\qquad\qquad = -\frac{p_i c - pc_i}{p^2 q(\theta)} - \frac{cq'(\theta)}{pq(\theta)^2}\frac{d\theta}{dk_i} \\
\rightarrow\ & \frac{cq'(\theta)}{pq(\theta)^2}\frac{d\theta}{dk_i} - \frac{1-\beta}{r+\lambda}\frac{dx_R}{dk_i} = -\frac{p_i c - pc_i}{p^2 q(\theta)}. \qquad (17)
\end{aligned}$$

Analogously, we differentiate the both sides of the job destruction condition defined in Eq. (16)

with respect to k_i:

$$
\begin{aligned}
&\frac{c[1+\beta(\theta-1)]}{p(1-\beta)}+\frac{z}{p}=x_R+\frac{\lambda}{r+\lambda}\int_{x_R}^{1}(x'-x_R)dG(x'), \qquad \forall\{k_i\}_{i=1}^{n},\\
&\to \frac{1}{1-\beta}\frac{\left[c_i\{1+\beta(\theta-1)\}+c\beta\dfrac{d\theta}{dk_i}\right]p+c[1+\beta(\theta-1)]p_i}{p^2}-\frac{p_i z}{p^2}\\
&\qquad =\frac{dx_R}{dk_i}+\frac{r}{r+\lambda}\left[\frac{d1}{dk_i}(1-x_R)-\frac{dx_R}{dk_i}(x_R-x_R)+\int_{x_R}^{1}\frac{d(x'-x_R)}{dk_i}dG(x')\right],\\
&\to \frac{c\beta}{p(1-\beta)}\frac{d\theta}{dk_i}-\frac{[1+\beta(\theta-1)](p_i c-pc_i)}{p^2(1-\beta)}-\frac{p_i z}{p^2}=\frac{dx_R}{dk_i}-\frac{\lambda}{r+\lambda}\frac{dx_R}{dk_i}\int_{x_R}^{1}dG(x')\\
&\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad =\frac{r+\lambda G(x_R)}{r+\lambda}\frac{dx_R}{dk_i},\\
&\to \frac{c\beta}{p(1-\beta)}\frac{d\theta}{dk_i}-\frac{r+\lambda G(x_R)}{r+\lambda}\frac{dx_R}{dk_i}=\frac{[1+\beta(\theta-1)](p_i c-pc_i)}{p^2(1-\beta)}+\frac{p_i z}{p^2}.
\end{aligned} \tag{18}
$$

Eqs. (17) and (18) are summarized in a matrix form:

$$
\begin{aligned}
&\begin{bmatrix} a_{11} & a_{12}\\ a_{21} & a_{22}\end{bmatrix}\begin{bmatrix}\dfrac{d\theta}{dk_i}\\ \dfrac{dx_R}{dk_i}\end{bmatrix}=\begin{bmatrix} d_1\\ d_2\end{bmatrix},\\
&a_{11}\equiv\frac{cq'(\theta)}{pq(\theta)^2},\qquad a_{12}\equiv-\frac{1-\beta}{r+\lambda},\qquad d_1\equiv-\frac{p_i c-pc_i}{p^2 q(\theta)},\\
&a_{21}\equiv\frac{c\beta}{p(1-\beta)},\qquad a_{22}\equiv-\frac{r+\lambda G(x_R)}{r+\lambda},\qquad d_2\equiv\frac{[1+\beta(\theta-1)](p_i c-pc_i)}{p^2(1-\beta)}+\frac{p_i z}{p^2}.
\end{aligned}
$$

We solve this to see the effect of FDI on the labor market tightness θ and on the reservation productivity x_R:

$$
\begin{aligned}
&\frac{d\theta}{dk_i}=\frac{a_{22}d_1-a_{12}d_2}{\Delta},\qquad \frac{dx_R}{dk_i}=\frac{a_{11}d_2-a_{21}d_1}{\Delta},\\
&\Delta\equiv a_{11}a_{22}-a_{12}a_{21}=\frac{cq'(\theta)}{pq(\theta)^2}\cdot\left[-\frac{r+\lambda G(x_R)}{r+\lambda}\right]-\left(-\frac{1-\beta}{r+\lambda}\right)\frac{c\beta}{p(1-\beta)}\\
&\quad=\frac{c}{p(r+\lambda)}\left[\beta-\frac{q'(\theta)\{r+\lambda G(x_R)\}}{q(\theta)^2}\right].
\end{aligned}
$$

Because of $q'(\theta)<0$, we see that $\Delta>0$.

Our interest here is on the sign of the derivative, so that we only have to know

$$
\operatorname{sign}\left\{\frac{d\theta}{dk_i}\right\}=\operatorname{sign}\left\{a_{22}d_1-a_{12}d_2\right\}, \tag{19}
$$

$$
\operatorname{sign}\left\{\frac{dx_R}{dk_i}\right\}=\operatorname{sign}\left\{a_{11}d_2-a_{21}d_1\right\}. \tag{20}
$$

The sign of dx_R/dk_i is determined by

$$a_{11}d_2 - a_{21}d_1 = \frac{cq'(\theta)}{pq(\theta)^2} \cdot \left[\frac{[1+\beta(\theta-1)](p_i c - pc_i)}{p^2(1-\beta)} + \frac{p_i z}{p^2}\right] - \frac{c\beta}{p(1-\beta)} \cdot \left[-\frac{p_i c - pc_i}{p^2 q(\theta)}\right]$$
$$= \underbrace{\frac{c}{p^3 q(\theta)(1-\beta)}}_{>0} \underbrace{\left[(p_i c - pc_i)\{\beta q(\theta) + q'(\theta)(1+\beta(\theta-1))\} + (1-\beta)q'(\theta)p_i z\right]}_{\gtreqless 0}.$$

To avoid the taxonomy of results, we assume the following:

$$\beta q(\theta) + q'(\theta)[1+\beta(\theta-1)] < 0, \tag{A1}$$
$$\min_i \varepsilon_i^p/\varepsilon_i^c > \gamma \equiv \frac{1+\beta(\theta-1)}{1+\beta(\theta-1)+(1-\beta)z/c}, \tag{A2}$$
$$\text{where} \quad \varepsilon_i^p \equiv \frac{\partial p/p}{\partial k_i/k_i} > 0, \qquad \varepsilon_i^c \equiv \frac{\partial c/c}{\partial k_i/k_i} > 0.$$

Ineq. (A1) is satisfied under reasonable parameter values in the literature (see the main text). Ineq. (A2) states that the benefit from an increase in outward FDI must not be small compared to the cost from it in terms of elasticity.[1]

The sign of $a_{11}d_2 - a_{21}d_1$ depends on

$$(p_i c - pc_i)\{\beta q(\theta) + q'(\theta)(1+\beta(\theta-1))\} + (1-\beta)q'(\theta)p_i z$$
$$= p_i c[\beta q(\theta) + q'(\theta)\{1+\beta(\theta-1)\}]\left[\left(1 - \frac{pc_i}{p_i c}\right) + A\right]$$
$$= \underbrace{p_i c[\beta q(\theta) + q'(\theta)\{1+\beta(\theta-1)\}]}_{<0}\left[\left(1 - \frac{\varepsilon_i^c}{\varepsilon_i^p}\right) + A\right],$$
$$\text{where} \quad A \equiv \frac{(1-\beta)q'(\theta)z}{c[\beta q(\theta) + q'(\theta)\{1+\beta(\theta-1)\}]} > 0.$$

As (A1) is assumed, we have $dx_R/dk_i < 0$ if $1 + A - \varepsilon_i^c/\varepsilon_i^p > 0$, or $\varepsilon_i^p/\varepsilon_i^c > 1/(1+A)$. We can check that this inequality holds as long as (A2) holds:

$$\varepsilon_i^p/\varepsilon_i^c > \gamma \equiv \frac{1+\beta(\theta-1)}{1+\beta(\theta-1)+(1-\beta)z/c} > \frac{\beta q(\theta) + q'(\theta)[1+\beta(\theta-1)]}{\beta q(\theta) + q'(\theta)[1+\beta(\theta-1)+(1-\beta)z/c]} = \frac{1}{1+A},$$
$$\to \beta(1-\beta)q(\theta)z/c > 0.$$

[1] Ineq. (A2) exactly comes from the condition that given θ, an increase in FDI shifts the job destruction curve downward. To see this, we differentiate the both sides of Eq. (16) with respect to k_i while holding θ fixed:

$$\frac{1+\beta(\theta-1)}{1-\beta} \cdot \frac{c_i p - cp_i}{p^2} - \frac{p_i z}{p^2} = \frac{r+\lambda G(x_R)}{r+\lambda}\frac{dx_R}{dk_i},$$
$$\to \frac{c_i}{p}\left[\frac{1+\beta(\theta-1)}{1-\beta}\left(1 - \frac{\varepsilon_i^p}{\varepsilon_i^c}\right) - \frac{\varepsilon_i^p}{\varepsilon_i^c}\frac{z}{c}\right] = \frac{r+\lambda G(x_R)}{r+\lambda}\frac{dx_R}{dk_i}.$$

Ineq. (A2) ensures that the square bracket term in the left-hand side is negative, leading to $dx_R/dk_i < 0$.

We rearrange this to get $\beta(1-\beta)q(\theta)z/c > 0$, which holds true because of $\beta \in (0,1)$.

The sign of $d\theta/dk_i$ is determined by

$$\begin{aligned}
a_{22}d_1 - a_{12}d_2 &= -\frac{r+\lambda G(x_R)}{r+\lambda} \cdot \left[-\frac{p_i c - pc_i}{p^2 q(\theta)}\right] - \left(-\frac{1-\beta}{r+\lambda}\right) \cdot \left[\frac{\{1+\beta(\theta-1)\}(p_i c - pc_i)}{p^2(1-\beta)} + \frac{p_i z}{p^2}\right] \\
&= \frac{1}{p^2(r+\lambda)}\left[(p_i c - pc_i)\{(r+\lambda G(x_R))/q(\theta) + 1 + \beta(\theta-1)\} + (1-\beta)p_i z\right] \\
&= \underbrace{\frac{p_i c}{p^2(r+\lambda)}}_{>0} \underbrace{\left[(1-\varepsilon_i^c/\varepsilon_i^p)\{(r+\lambda G(x_R))/q(\theta) + 1 + \beta(\theta-1)\} + (1-\beta)z/c\right]}_{\gtreqless 0}.
\end{aligned}$$

This is positive if the following holds:

$$\begin{aligned}
&(1-\varepsilon_i^c/\varepsilon_i^p)\underbrace{[\{r+\lambda G(x_R)\}/q(\theta) + 1 + \beta(\theta-1)]}_{>0} + \underbrace{(1-\beta)z/c}_{>0} > 0, \\
&\to 1 - \varepsilon_i^c/\varepsilon_i^p > -B, \\
&\to \varepsilon_i^p > \varepsilon_i^c/(1+B), \\
&\text{where} \quad B \equiv \frac{(1-\beta)z/c}{[r+\lambda G(x_R)]/q(\theta) + 1 + \beta(\theta-1)}.
\end{aligned}$$

We can check that $1/(1+B) > \gamma$:

$$\frac{1}{1+B} = \frac{[r+\lambda G(x_R)]/q(\theta) + 1 + \beta(\theta-1)}{[r+\lambda G(x_R)]/q(\theta) + 1 + \beta(\theta-1) + (1-\beta)z/c} > \frac{1+\beta(\theta-1)}{1+\beta(\theta-1) + (1-\beta)z/c} \equiv \gamma,$$

which reduces to $(1+\beta)(z/c)[r+\lambda G(x_R)]/q(\theta) > 0$, which unambiguously holds true.

In sum, assuming (A1) and (A2), the effects of FDI on the reservation productivity and the labor market tightness are

$$\begin{aligned}
&\frac{dx_R}{dk_i} < 0, \\
&\frac{d\theta}{dk_i}\begin{cases} \geq 0 & \text{if } \varepsilon_i^p/\varepsilon_i^c \geq \delta \\ < 0 & \text{if } \varepsilon_i^p/\varepsilon_i^c < \delta \end{cases}, \\
&\text{where} \quad \delta \equiv \frac{[r+\lambda G(x_R)]/q(\theta) + 1 + \beta(\theta-1)}{[r+\lambda G(x_R)]/q(\theta) + 1 + \beta(\theta-1) + (1-\beta)z/c}.
\end{aligned}$$

We can interpret these comparative statistics using the diagram as in the main text. Suppose that the economy is in the equilibrium point (θ^*, x_R^*) at which the job-creation and the job-destruction curves meet. Consider then the effect of an increase in k_i on x_R^*, while keeping θ fixed at θ^*. We differentiate the job creation condition (15) with respect to k_i to get

$$\left.\frac{dx_R}{dk_i}\right|_{\theta=\theta^*} = \frac{c(r+\lambda)}{k_i p(1-\beta)q(\theta^*)}(\varepsilon_i^p - \varepsilon_i^c).$$

It implies that if $\varepsilon_i^p > \varepsilon_i^c$, the job creation curve moves up, while it moves down if $\varepsilon_i^p < \varepsilon_i^c$.

Similarly, we differentiate the job destruction condition (16) with respect to k_i to get

$$\left.\frac{dx_R}{dk_i}\right|_{\theta=\theta^*} = \frac{c(r+\lambda)}{k_i p(1-\beta)[r+\lambda G(x_R^*)]}\left[\{1+\beta(\theta^*-1)\}\varepsilon_i^c - \{1+\beta(\theta^*-1)+(1-\beta)z/c\}\varepsilon_i^p\right],$$

which is negative as long as (A2) holds.

We can confirm that if $\varepsilon_i^p > \varepsilon_i^c$, given $\theta = \theta^*$, the (absolute level of) shift of job destruction curve is larger than that of job creation curve. Noting that the initial equilibrium point (θ^*, x_R^*) is in between the job creation and the job destruction curves after the increase in k_i, we see that the following inequality holds:

$$-\frac{c(r+\lambda)}{k_i p(1-\beta)[r+\lambda G(x_R^*)]}\left[\{1+\beta(\theta^*-1)\}\varepsilon_i^c - \{1+\beta(\theta^*-1)+(1-\beta)z/c\}\varepsilon_i^p\right] > \frac{c(r+\lambda)}{k_i p(1-\beta)q(\theta^*)}(\varepsilon_i^p - \varepsilon_i^c),$$
$$\rightarrow [(1-\beta)z/c + 1 + \beta(\theta^*-1) - \{r+\lambda G(x_R^*)\}/q(\theta^*)]\varepsilon_i^p > [1+\beta(\theta^*-1) - \{r+\lambda G(x_R^*)\}/q(\theta^*)]\varepsilon_i^c,$$

which holds true because of $\varepsilon_i^p > \varepsilon_i^c$ and $1+\beta(\theta^*-1) - [r+\lambda G(x_R^*)]/q(\theta^*) > 0$. The result is shown in Figure A1(a).

If $\varepsilon_i^p < \varepsilon_i^c$, both curves move down. We can check that if $\delta\varepsilon_i^c < \varepsilon_i^p < \varepsilon_i^c$, given $\theta = \theta^*$, the (absolute level of) shift of job destruction curve is still larger than that of job creation curve, which is not shown in Figure A1. If $\varepsilon_i^p > \delta\varepsilon_i^c$, on the other, the (absolute level of) shift of job destruction curve is smaller than that of job creation curve, as shown in Figure A1(b).

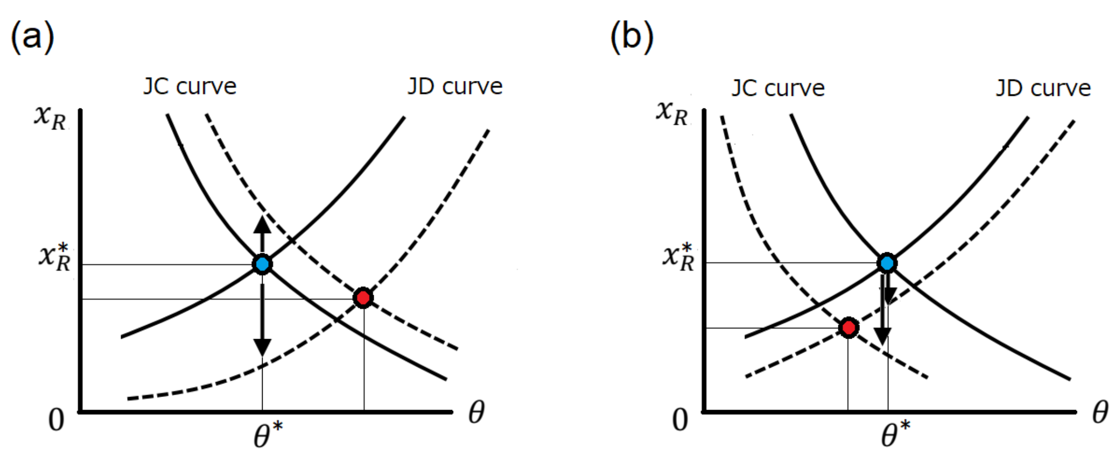

Figure A1 Effects of FDI.