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Firm heterogeneity and the activity of Japanese manufacturing multinationals in India

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Abstract

This paper anatomizes the linkage between country/region characteristics and Japanese MNE activity in India from both theoretical and empirical sides. We construct a North-South firm-heterogeneity model with FDI and exchange rate. We use this model to make three contributions: First, we theoretically reveal how country characteristics affect the average sales of the firm in the host country. Secondly, we make clear the state-level characteristics on three main industrialized areas in India using the data from some valuable databases. Thirdly, we estimate determinant factors of average sales of each Japanese affiliate firms in India focusing on regional characteristics derived in the theoretical part using firm-level data. We also construct several proxy variables of determinant factors of average sales in state-level and put into estimated regression equation. This empirical analysis targets at the 1990s and 2000s. Over this period, India enjoyed steady economic growth and it can be linked with increase of FDI inflow and technological spillover from MNEs. We find out that some regional characteristics such as level of human-capital or transportation cost in each state and also exchange rate have a significant effect on average sales of each Japanese affiliate firms in India.

Keywords: Firm heterogeneity, foreign direct investment, India, Japanese multinational enterprises

JEL Classifications: F10, F12, F23, L25, O53, R30

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1. Introduction

Indian economic growth has significantly accelerated in recent three decades. One of the main causes of such rapid Indian growth is an active acceptance of foreign direct investment (FDI). Fig. 1a and 1b illustrate the transition of FDI inflow of 1990s and 2000s in India, respectively.

Fig. 1a

Fig. 1b

Recently, Japanese manufacturing multinational enterprises (MNEs) rapidly accelerate FDI in India because they regard India as a potential investment economy as suggested by Buckley et al (2012). With such drastic increase of Japanese FDI in India as a background, many papers analyzing the activity of Japanese-affiliated firms in India have been presented. Anand and Delios (1996), Siddharthan (1998, 1999) are comparatively early works in this literature. They focus on the Japanese style management and production system of the Japanese MNEs investing India.[1] Buckley et al. (2012) and Sato (2012) make historically and institutional discussions about Japanese FDI in India. They suggest that Japanese FDI in India is concentrated in manufacturing sector. Besides them, many works (e.g., Chatterjee 1990; D' Costa 1995; Humphrey 2003; Okada 2004; Sutton 2004; Bhargava 2010; Horn et al. 2010; Aoki and Kumar 2014) suggest that a transfer of the Japanese style management and production system plays an important role in enhancing the technology in Indian manufacturing (especially in the automobile) sector.[2] In a nod to the current situation and future

[1] Banga (2004, 2006) empirically reveal that Japanese FDI in India contributes to an improvement of productivity in Indian economy, but it has no effect on export from India.

[2] One of the reasons why such research point of view draws concern is attributed to the fact that *Maruti*

potential of Indian economy, a discussion about MNE activity in India has enormous implications. Especially, the linkage between country/region characteristics and the structure of MNE activity in India is an interesting viewpoint. As far as we know, however, there are no works examining the linkage between country/region characteristics and Japanese MNE activity in India from both theoretical and empirical sides.[3]

The aim of our analysis is to anatomize this linkage in detail. This is a scarce paper which reveals it both theoretical and empirical sides. For our analysis, we construct a simple firm-heterogeneity model, which is based on Yeaple (2009).[4] The remarkable features of this model are asymmetric North-South setting, FDI, and exchange rate. We use this model to make three contributions: First, we theoretically reveal how country characteristics affect the average sales of the firm in the host country. We also find out an importance of firm-heterogeneity indicated by the firm-specific productivity in MNE activity in our analysis. Secondly, we make clear the regional (state-level) characteristics on three main industrialized areas in India using the data from some valuable databases. Thirdly, we estimate determinant factors of average sales of each Japanese-affiliated firms in India, especially focus on regional characteristics derived in the theoretical part using firm-level data obtained by *Overseas Japanese Companies Database* published by *Toyo Keizai Inc*.[5]

Suzuki India Limited, a Japanese-affiliated company, is the largest automaker in India.

[3] As for the overseas advancing behavior of Japanese MNEs, numerous works have been presented (e.g., Head and Ries 2003; Tomiura 2007; Hayakawa and Matsuura 2011; Todo 2011; Hayakawa and Tsubota 2014; Wakasugi 2014), but these works do not focus on the MNE activity in India.

[4] This is a pioneer work empirically examines the linkage between country characteristics and the structure of MNE activity using firm-level data for US MNEs on the bases of the theoretical prediction.

[5] As an important previous studies regard to MNEs in India, Görg et al. (2010) analyzed factor of FDI determination focus on German MNEs in India applied Heckman two-step estimation. Similar to our

We also construct several proxy variables of determinant factors of average sales in state-level and put into estimated regression equation. This empirical analysis targets at the 1990s and 2000s, which cover over the transitional period, globalization period, and economic growth period in India. Over this period, India enjoyed steady economic growth and it can be linked with increase of FDI inflow and technological spillover from MNEs. From this point of view, our analysis will give some policy implication to the discussion on how to make a structure of FDI-led economic growth model in India. From our empirics, we find out that some regional characteristics such as level of human-capital or transportation cost in each state and also exchange rate have a significant effect on average sales of each Japanese-affiliated firms in India.

The remainder of this paper is organized as follows. Section 2 presents a theoretical framework with firm-heterogeneity and FDI. Section 3 explains the data and variables. This section also shows the empirical identification and estimation results. Section 4 concludes our analysis.

2. Theoretical framework

We specify the North-South firm-heterogeneity model with FDI and extend it to generate predictions about the linkage between country characteristics and MNE activity in the host country. The north is the higher wage country than the South. Households in each country derive utility from the consumption of the

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analytical framework, they also take in the assumption of firm-heterogeneity to their empirical analysis. However, differ from Görg et al. (2010), we concentrate on Japanese manufacturing affiliate firms in India and also verified influence of regional characteristics on their activities. In addition, we give a micro-foundation to our regression equation in the theoretical part.

differentiated goods, which is supplied by the North producers. Producing firms are divided into three types; domestic, export, and FDI. The domestic firm consists of a domestic plant, which produces goods only for the North market. The export firm entails a domestic plant and an export plant, which produces goods (export goods) for exporting to the South market. The FDI firm is comprised of a domestic plant and an FDI plant, which is a foreign plant to produce and sell FDI goods locally.[6]

2.1 Utility and Demand

A representative consumer has a constant elasticity of substitution (CES) utility function over varieties. As usual in the literature, utility maximization yields the following:

$$x_D(v) = p_D(v)^{-\sigma} P^{\sigma-1} E,\ \ \sigma \equiv \frac{1}{1-\rho} > 1,\ \ 0 < \rho < 1,$$

$$x_h^*(v) = p_h^*(v)^{-\sigma} P^{*\sigma-1} E^*\ \ (h = EX,\ FDI).$$

The subscript denotes a type of plant (D, EX, and FDI show domestic, export, and FDI plant, respectively), an asterisk shows the related variable of the South, x is the demand for the goods, p is its price, $P = \left[\int_{v\in V} p_D(v)^{1-\sigma} dv\right]^{\frac{1}{1-\sigma}}$ and $P^* = \left[\int_{v\in V} p_{EX}^*(v)^{1-\sigma} dv + \int_{v\in V} p_{FDI}^*(v)^{1-\sigma} dv\right]^{\frac{1}{1-\sigma}}$ are price index in the North and South market, respectively, E is the aggregate expenditure, and σ is the elasticity of substitution between any two goods. Suppose that measures of the demand level, $P^{\sigma-1}E$ and $P^{*\sigma-1}E^*$, are taken as

[6] Although we focus on the MNE activity in the host country, the domestic and export firm are incorporated into our model in addition to the FDI firm. This is because the behavior of FDI firm could be influenced by an alteration of the status of the domestic/export firm through a change in intra-industry resources within the firm-heterogeneity framework.

exogenous by firms because each producer is of negligible size relative to the market size.

2.2 Firm behavior

There is a continuum of monopolistically competitive firms with different productivity levels indexed by φ. Homogeneous labor is the only input for production. All workers in each country share the same wage, w and w^*, which are exogenous, respectively. We assume without loss of generality that $0 < w^* < w = 1$. The profit function of each type of plant expressed in the North currency is respectively defined as $\pi_D = p_D x_D - l_D - f_D$; $\pi_{EX} = ep^*_{EX} x^*_{EX} - l_{EX} - f_{EX}$; and $\pi_{FDI} = ep^*_{FDI} x^*_{FDI} - ew^* l^*_{FDI} - f_{FDI}$, where l is the labor input and e is the nominal exchange rate in the North currency. Each type of plant shares the same fixed cost, f_D, f_{EX}, and f_{FDI}, measured in the North currency, respectively.[7] We regard f_D as the product-planning cost of a domestic plant based on market research in the North market. An export plant is required to pay the fixed cost, f_{EX}, of forming a distribution and servicing network in the South market in addition to the product-planning cost. As in Helpman et al. (2004), suppose that FDI plants involve additional fixed cost, f_{FDI}, not borne by export plants, such as the cost of forming a foreign subsidiary. The order of the fixed costs can then be shown as $f_D < f_{EX} < f_{FDI}$. Production function in each type of plant is shown as $x_D(\varphi) = \varphi l_D(\varphi)$, $\tau x^*_{EX}(\varphi) = \varphi l_{EX}(\varphi)$, and $x^*_{FDI}(\varphi) = \varphi l^*_{FDI}(\varphi)$, respectively, where the per-unit transport cost, $\tau > 1$, is modeled on the iceberg formulation. Each firm takes the wage rate as a given, determining the price to maximize the profit. We then obtain $p_D(\varphi) = 1/\rho\varphi$, $p^*_{EX}(\varphi) = \tau/e\rho\varphi$, and $p^*_{FDI}(\varphi) = w^*/\rho\varphi$, so

[7] Although a part of f_{FDI} might be charged in the foreign currency in reality, we assume that f_{FDI} is charged only in the North currency in order to avoid overly complicated setting of the model.

that profit functions denominated in the North currency are represented by

$$\pi_D(\varphi) = \frac{A}{\sigma}\varphi^{\sigma-1} - f_D, \tag{1a}$$

$$\pi_{EX}(\varphi) = \frac{A^*}{\sigma}\tau^{1-\sigma}\varphi^{\sigma-1} - f_{EX}, \tag{1b}$$

$$\pi_{FDI}(\varphi) = \frac{A^*}{\sigma}(ew^*)^{1-\sigma}\varphi^{\sigma-1} - f_{FDI}, \tag{1c}$$

where $A \equiv (\rho P)^{\sigma-1}E$ and $A^* \equiv (\rho e P^*)^{\sigma-1}eE^*$ denote the mark-up adjusted demands expressed in the North currency. We assume that $A > A^*$, i.e., the demand size of the North household is equal to or larger than that in the South.[8]

The profit functions (1a)-(1c) are illustrated in Fig. 2. The slope of π_D is steeper than that of π_{EX} ($\because A \geq A^*\tau^{1-\sigma}$) and the ordinate intercept of π_{EX} is smaller than that of π_D ($\because f_D < f_{EX}$). Each intersection of π_D and π_{EX} with the $\varphi^{\sigma-1}$-axis gives the cutoff and export-cutoff productivity, φ_{Dmin} and φ_{EXmin}, suggesting the lowest productivity of operating firms and export firms, respectively. The ordinate intercept of π_{FDI} is smaller than that of π_{EX} ($\because f_{EX} < f_{FDI}$). The FDI-cutoff level is then determined at the intersection of π_{EX} and π_{FDI} in the first quadrant in the $\varphi^{\sigma-1}$-π plane. Note that, in the case of $f_{EX} < f_{FDI}$, π_{EX} does not intersect with π_{FDI} in the first quadrant, i.e., when the slope of π_{EX} is steeper than π_{FDI}, all firms do not operate as the FDI firm but as the export firm. Therefore, so as to ensure the coexistence of export and FDI firm, we assume the following conditions:[9]

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[8] $A \geq A^*$ is thought of as a plausible assumption in our discussion, because Indian and Japanese GDP (current prices) on 1990, 2000, 2010, and 2017 are about 327 and 3,133, 477 and 4,888, 1,708 and 5,700, and 2,602 and 4,873 billion US dollars, respectively (*International Monetary Fund*, *World Economic Outlook Database*, October 2018).

[9] For details of the condition (2a) and (2b), see Appendix A.

$$\tau > ew^*, \tag{2a}$$

$$f_{FDI} > \left(\frac{\tau}{ew^*}\right)^{\sigma-1} f_{EX}. \tag{2b}$$

The condition (2a) indicates the case in which transport cost is relatively high compared to the difference in variable costs between countries (note that $ew^* = ew^*/w$ because $w = 1$). Under this condition, the slope of π_{FDI} must be steeper than that of π_{EX}. The condition (2b) suggests the case in which the fixed cost of the FDI plant is much higher than the export plant. This condition ensures a positive profit at an intersection point of π_{EX} and π_{FDI}, i.e., $\pi_{EX}(\varphi_{FDImin}) = \pi_{FDI}(\varphi_{FDImin}) > 0$.

Fig. 2

2.3 Firm entry and exit

Firms draw their productivity, φ, from a common distribution, $g(\varphi)$, that has a continuous cumulative distribution, $G(\varphi)$. We assume the Pareto distribution of the form, $G(\varphi) = 1 - \varphi^{-k}$ and $g(\varphi) = k\varphi^{-1-k}$, where k $(> 1 + \sigma)$ is the shape parameter of this distribution. In contrast to an usual setting of the firm-heterogeneity model followed by Melitz (2003), we do not impose a bad shock and the free entry condition, but instead, assume that the total mass of potential entrants (not the number of producing firms), M, is exogenously fixed.[10] The distribution of the productivity of the producing firm is shown as follows:

$$\mu(\varphi) = \begin{cases} \frac{g(\varphi)}{1-G(\varphi_{Dmin})} = \frac{k}{\varphi}\left(\frac{\varphi_{Dmin}}{\varphi}\right)^k, & if \;\; \varphi \geq \varphi_{Dmin} \\ 0, & otherwise \end{cases}$$

If the firm that draws productivity $\varphi > \varphi_{Dmin}$, it can operate as a domestic firm. In turn, the firm that draws

[10] Berman et al. (2012) also assume that the number of entrepreneurs who get a productivity draw is proportional to a population exogenous in size as in Chaney (2008).

a higher productivity than the export-cutoff level ($\varphi > \varphi_{EXmin}$) can operate as an export firm. These cutoff levels, φ_{Dmin} and φ_{EXmin}, are given by $\pi_D(\varphi_{Dmin}) = 0$ and $\pi_{EX}(\varphi_{EXmin}) = 0$, respectively, as follows:

$$\varphi_{Dmin}{}^{\sigma-1} = \frac{\sigma}{A} f_D, \tag{3a}$$

$$\varphi_{EXmin}{}^{\sigma-1} = \frac{\sigma}{A^*\tau^{1-\sigma}} f_{EX}, \tag{3b}$$

where $\varphi_{Dmin}{}^{\sigma-1} < \varphi_{EXmin}{}^{\sigma-1}$ ($\because A \geq A^*\tau^{1-\sigma}$ and $f_D < f_{EX}$).

The FDI-cutoff level is determined by $\pi_{EX}(\varphi_{FDImin}) = \pi_{FDI}(\varphi_{FDImin})$ as follows:

$$\varphi_{FDImin}{}^{\sigma-1} = \sigma \left[\frac{1}{A^*(ew^*)^{1-\sigma}}\right] \left[\frac{f_{FDI} - f_{EX}}{1-(\tau/ew^*)^{1-\sigma}}\right], \tag{3c}$$

where $A^*(ew^*)^{1-\sigma}$ in the first square parenthesis shows a measure of the scale of operations in the host country and $\varphi_{FDImin}{}^{\sigma-1} > 0$ ($\because f_{FDI} > f_{EX}$ and (2a)). All else being equal, an increase in the mark-up adjusted demand, A^*, or a decrease in the local production cost expressed in the North currency, ew^*, will lower the FDI-cutoff productivity, φ_{FDImin}, inducing the lower productivity firms to invest. The second parenthesis is a measure of an extra fixed cost by opening a local plant in India relative to a measure of a marginal cost saving made possible by opening it. An increase in the local fixed cost, f_{FDI}, or a reduction in the marginal cost savings, $1-(\tau/ew^*)^{1-\sigma}$, will increase the FDI-cutoff level.

From (2a), (2b), (3b), and (3c), we find that $\varphi_{EXmin}{}^{\sigma-1} < \varphi_{FDImin}{}^{\sigma-1}$. Then, the sequence of cutoff levels becomes $\varphi_{Dmin} < \varphi_{EXmin} < \varphi_{FDImin}$.[11]

[11] This sequence is the same as that supposed in Helpman et al. (2004), which is supported by many empirical findings such as Bernard and Jensen (1999), Head and Ries (2003), Girma et al. (2005), and Tomiura (2007).

2.4 The structure of multinational activity

To reveal the relationship between the activity of the foreign affiliates of the North MNE in the South and the country-specific characteristics, we anatomize the sales of local affiliates in Yeaple (2009)'s step. The aggregate sales revenue of FDI plants expressed in the North currency is written as follows:

$$S_{FDI}^{Agg} = [A^*(ew^*)^{1-\sigma}]\left[M_{FDI}\int_{\varphi_{FDImin}}^{\infty}\varphi^{\sigma-1}\mu(\varphi)d\varphi\right].$$

The first and the second square parenthesis suggest the country-specific scale of operations in the South and a measure of the number and the productivity composition of FDI plant, respectively. The number of FDI plants is defined as $M_{FDI} \equiv \chi_{EX}\chi_{FDI}M$, where $0 < \chi_h < 1$ $(h = EX,\ FDI)$, $\chi_{EX} \equiv \frac{1-G(\varphi_{EXmin})}{1-G(\varphi_{Dmin})}$ is the ratio of the total number of export and FDI firms to producing firms, and $\chi_{FDI} \equiv \frac{1-G(\varphi_{FDImin})}{1-G(\varphi_{EXmin})}$ is the ratio of FDI firms to the total number of export and FDI firms.[12] The average sales per FDI plant can be derived as follows:

$$S_{FDI} \equiv \frac{S_{FDI}^{Agg}}{M_{FDI}} = \frac{k}{1+k-\sigma}A^*(ew^*)^{1-\sigma}{\varphi_{FDImin}}^{\sigma-1}. \quad (4)$$

Eq. (4) predicts that the demand size, A^*, and the productivity level, φ_{FDImin}, have a positive relation to S_{FDI}. In addition, (3c) and (4) tell us how country characteristics identified by theoretical analysis (those associated with $A^*(ew^*)^{1-\sigma}$ and $(f_{FDI} - f_{EX})/[1-(\tau/ew^*)^{1-\sigma}]$) link the average sales per FDI plant, S_{FDI}. Combining (3c) and (4), we obtain the solution of S_{FDI} as follows:[13]

$$S_{FDI} = \frac{k\sigma}{1+k-\sigma}\frac{f_{FDI}-f_{EX}}{1-(\tau/ew^*)^{1-\sigma}}, \quad (5)$$

where $\partial S_{FDI}/\partial e > 0$, $\partial S_{FDI}/\partial w^* > 0$, $\partial S_{FDI}/\partial f_{FDI} > 0$, and $\partial S_{FDI}/\partial \tau < 0$. From (5), we find that a rise in exchange rate, e, South (or relative) wage, w^*, and fixed cost of FDI plant, f_{FDI} increases S_{FDI}, whereas

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[12] See Appendix B, for the derivation of χ_{EX} and χ_{FDI}.

[13] See Appendix C, for the derivation of Eq. (5).

a rise in transport cost, τ, decreases S_{FDI}. These results can be interpreted as follows: Exchange rate fluctuation affects S_{FDI} through the following two channels. First, depreciation in North currency (a rise in e) increases the aggregate local sales translated into this currency, hence S_{FDI} receives an increasing pressure. Secondly, a rise in e weakens the competitive condition of the FDI firm relative to the export firm in the South market owing to a decrease in the price of the export goods. Then, the FDI-cutoff, φ_{FDImin}, rises, and the productivity levels of FDI firms are elevated overall, hence the price of the FDI goods is pushed down (see $p^*_{FDI} = w^*/\rho\varphi$). This price decrease stimulates the demand for the FDI goods, and S_{FDI} receives a decreasing pressure. In spite of these opposite pressures on S_{FDI}, the former effect dominates the latter, hence S_{FDI} increases. Taking into consideration that the latter pressure is caused by intra-industry reallocation (a change in φ_{FDImin}), we can recognize that it is unique effect to the firm-heterogeneity framework.

Next, regarding the effect of a change in the Southern wage, we can explain as follows: a rise in w^* decreases the per FDI plant revenue via a rise in the price of the FDI goods, and S_{FDI} receives a decreasing pressure. At the same time, this decrease in per plant revenue worsens the operating condition of the FDI firm relative to the export firm, hence the FDI-cutoff, φ_{FDImin}, rises. Then, S_{FDI} receives an increasing pressure through the channel analogous to the case of a rise in e. This increasing pressure on S_{FDI} dominants the former decreasing one, a rise in w^* increases S_{FDI}.

An increase in the fixed cost of FDI plant, f_{FDI}, directly decreases its profit and worsens the operating condition of the FDI firm. Then, the FDI-cutoff productivity, φ_{FDImin}, rises, hence S_{FDI} increases.

Finally, a rise in transport cost, τ, worsens the operating condition of the export firm relative to the FDI firm, and then, φ_{FDImin} lowers. Therefore, the demand for the FDI goods decreases through a rise in its price. As it turned out, S_{FDI} decreases.

From these results, we can recognize that a change in φ_{FDImin} plays a key role on the effect of various exogenous shocks on the activity of the foreign affiliates of MNE. This implies that an introduction of firm-heterogeneity into our analytical framework makes our discussion more fruitful.

3. Empirical verification

In the empirical analysis, we regard the North and South country as Japan and India, respectively. Followed by the equation derived in the theoretical model, we here create the regression equation to identify the mechanism through which country/region characteristics in India affect the activity of the overseas subsidiary of Japanese MNEs. When we make empirics, it should be remembered that India has experienced the structural changes in economy several times: The economic reforms in India started from 1990s; the global financial crisis caused in 2007; and *Make in India* program announced in 2014, by which Prime Minister Modi tries to put India on the world map as a major hub for global manufacturing. These shocks could drastically lead a qualitative change in economy, therefore we have to make empirics paying attention to the analysis period. This study employed annual data from 1989; at the beginning of economic reforms to 2010; shortly after the financial crisis. So this study covers over the transitional period, globalization period and economic growth period just before the structural changes by the global financial crisis.

3.1 Methodology

The latter fraction in the right hand side of (5) suggests the magnitude of fixed cost differential between export and FDI plant, $f_{FDI} - f_{EX}$, relative to the measure of unit cost saving made possible by opening a local affiliation in India, $1-(\tau/ew^{*})^{1-\sigma}$. Suppose that this ratio is related to a vector of observable firm-specific and country-specific characteristics, Z, through the following equation:

$$log\left[\frac{f_{FDI}-f_{EX}}{1-(\tau/ew^{*})^{1-\sigma}}\right] = \alpha\, log\, Z + \varepsilon,$$

where ε is the error-term. This equation and (5) motivate the following econometric specification:

$$log(S_{FDI}) = log\left(\frac{k}{1+k-\sigma}\right) + \alpha\, log\, Z + \varepsilon. \quad (6)$$

We substitute the value of total sales expressed in US dollar in each Japanese-affiliated of manufacturing firms in India, S, to S_{FDI} in the theoretical model as the dependent variable. In the regression model, the values of country-specific characteristics are basically aggregated in regional-level. In case of this study, regional unit coincides with state due to availability of statistics. Regarding the explanatory variables, we specify several factors which influence on economic activities of Japanese-affiliated firms. The explanatory variables are divided into two categories in this regression; firm-specific and regional characteristics, which is shown as $log\, Z$ in (6). As shown in (4), the demand size, A^{*}, and the productivity level, φ_{FDImin}, are important elements of each firm. Therefore, we contain labor productivity ($Prod$) as a proxy variable of φ_{FDImin}, obtained as sales value in each firm divided by the number of employee into the regression equation. We also contain State Domestic Products (SDP), which is a representative variable of scale of economy and market in the region, and labor population in each state ($Worker_{Pop}$) as a proxy variable of A^{*}. Fixed cost of each FDI plant, f_{FDI}, is taken in firm-specific fixed effects in panel regression model. As for an exchange rate, e, we specify real effective exchange rate of Japanese Yen ($Exchange$) as an explanatory variable in the regression equation. State-wise income level ($Income_{Level}$, which is proxy variable of w^*) gives us an important information of economic situation in each region. Transport cost, τ, is represented by Port Dummy ($Port_{Dummy}$) that takes on the value one for Maharashtra and Tamil Nadu and takes zero otherwise[14]. In addition, especially for the study of developing country such as India, the defect rate is very important. As is well-known, this rate in the manufacturing process in developing country is usually high reflecting a poor infrastructure and low-skilled labor and so on.[15] Unreliable industrial and electricity infrastructure and poor-quality employment make it difficult for quality preservation of goods production and shipping, and then, firms are forced to face an additional cost which is difficult to predict. That is, the defect rate can be regarded as a proxy variable of poor-quality education and low level infrastructure. Therefore, we use enrollment ratio of primary school ($Education$) as proxy variable of defect rate. Also, we consider that transport condition might influence to the defect rate, so variable of transportation infrastructure should be necessary to add in the explanatory variable. We specify the ratio of SDP in transportation sector to the total SDP of manufacturing sector as transportation infrastructure ($Transport$), because transport costs are

[14] It is because that these states have two of the largest trading port in India, Mumbai in Maharashtra and Chennai in Tamil Nadu.

[15] For example, Okada (2004) points out that the defect rates among the Indian suppliers in Automobile industry were about fifteen times higher than the Japanese average in the 1990s. Although Sutton (2004) suggests that the supplier defect rates in India and China come close to matching the levels expected of world class suppliers in the US, Europe and Japan, this rate in India is larger than that in Japan after all.

influenced by the condition of public transportation infrastructure. Regression equation is then described in logarithmic form as follows:

$$logS_{it} = \beta_0 + \beta_1 logProd_{it} + \beta_1 logSDP_{jt} + \beta_2 logIncome_{Level\,jt}$$

$$+\beta_3 logWorker_{Pop\,jt} + \beta_4 Transport_{jt} + \beta_5 Education_{jt}$$

$$+\beta_6 logExchange_t + \beta_7 logExchange_t * Port_{Dummy} + \varepsilon_{ijt}, \quad (7)$$

where i and j respectively denotes index of individual firm and of state where firm i is located, β_0 is a constant-term, and ε is the error-term. Estimating (7), we expect the positive sign of coefficients in case of $logProd$, $logSDP$, $logIncome_{Level}$, and $logWorker_{Pop}$, along with our theoretical prediction. Regarding $Transport$ and $Education$, we also expect the positive sign of coefficients, because an improvement of them could expect to increase the sales of the foreign affiliates of Japanese MNEs in India through a decrease in the defect rate. On the other hand, coefficient of $logExchange$ and $Port_{Dummy}$ might takes negative value.[16]

3.2 Data and summary of statistics

This paper utilizes *Overseas Japanese Companies Database* published by *Toyo Keizai Inc.* in order to obtain

[16] Note that exchange rate, e, in our theoretical model is the nominal exchange rate, whereas we use data of the real effective exchange rate in empirics. Therefore, $\partial S_{FDI}/\partial e > 0$ in the theoretical prediction is consistent with the negative value of the coefficient of $logExchange$. In case of $Port_{Dummy}$, easy access to transshipment hub ports may reduce of transportation cost and raises productivity of exporting firm. As a result, cut-off productivity of FDI firms appreciates, thus coefficient of $Port_{Dummy}$ takes negative value.

information of Japanese-affiliated firms in India. *Overseas Japanese Companies Database* includes large sample of Japanese-affiliate firms located in India. We selected only manufacturing firm among the database and create annual panel database. This database covers from 1989, so it is possible to analyze secular change over the economic liberalization period during the 1990s and 2000s, and also make policy suggestion about FDI attraction in India. *Overseas Japanese Companies Database* provide the key indicator of each firm such as total sale, *S*, and the number of employee, *L*, then we constructed unbalanced annual panel database between 1989 and 2010. Regarding the variables of regional characteristics, *SDP* and *Transport* are obtained from *National Account Statistics* published by Central Statistic Organization, Government of India. $Income_{Level}$, $Worker_{Pop}$, and *Education* are acquired from *Indian Time Series* published by Economic and Political Weekly Research Foundation. The information of real effective exchange rate of Japanese Yen is acquired from *Bank of Japan Statistics*.

Here, we illustrate the descriptive statistics of information of the sample firm and variables in the regression equation. Table 1a-1c show the state-wise sample firm distribution during the analysis period. The number of sample firms gradually increases during the 1990s and jumped in the 2000s. Most of the sample firm integrated specific regions such as Delhi Metropolitan area (Delhi, Uttar Pradesh, and Haryana) and southern states (Karnataka and Tamil Nadu) in the 1990s, but the sample distribution diverse all over the India in the 2000s and also the number of sample firm increases constantly.

Table 1a

Table 1b

Table 1c

The state-wise descriptive statistics are shown in Table 2a (firm-level variables) and Table 2b (regional-charactaristic variables) from 1989 to 2010. First of all, each state government of India is generally strongly independent from the central government politically, institutionally and economically, so each state has distinguishing own economic systems and policies. Therefore, a deference and characteristics of states are easily observed from the statistics. From these Tables, the statistical value of each indicator is influenced by regional situation. Especially, it is obvious that there are the huge gaps between the developed state and poor state in case of average number of economic indicators such as *SDP* or $Income_{Level}$. Especially developed states which contain major cities are enjoying relatively high economic performance, large and high range of consumer, such as Delhi, Karnataka which include Bengaluru, Maharashtra which includes Mumbai and Tamil Nadu which includes Chennai. On the other hand, the other hinterland states such as Bihar, Madhya Pradesh, and Rajasthan show low number of each economic indicator. Average number of $Education$ also reveals a gap between higher states and lower states. In contrast to the highly average number of economic indicators, Haryana and Utter Pradesh are categorized to lower group in case of $Education$. It is because that these states include both highly industrial area such as Gurgaon in Haryana and Noida in Utter Pradesh and huge poverty-stricken are in rural side.

Table 2a

Table 2b

Fig. 3 draws time series variation of the number of sample firm and exchange rate ($Exchange$) during the sample period. As a feature of $Exchange$, the value is fluctuated in the short-run, but has been getting stronger through the sample period. Also it is recognized that trade-off correlation between the number of sample firm and $Exchange$.

Fig. 3

3.3 Regional characteristics

In order to capture characteristics of region, especially focus on three main industrialized area in India; North region includes Delhi, Haryana and Utter Pradesh, South region includes Andhra Pradesh, Karnataka and Tamil Nadu, and West region includes Maharashtra, we explore some important economic and social indicators at regional aggregated level.

Regarding the *SDP* shown in Fig. 4a, scale of economies have roughly upward trends through the sample period. Comparing a pattern of SDP growth (box plot) shown in Fig. 4b, feature of SDP growth are quite different by region, particularly West region shows significant economic growth over the 20 years even though the annual growth rate varies widely. Fig. 5 illustrates average income (average of $Income_{Level}$) which is a proxy of the average wage in each region and this figure indicate that it increases constantly and also widen the gap by region through the sample period. Above all, West region indicates extremely higher number in comparison with the other two regions. As shown in Fig. 6, $Worker_{Pop}$ takes large number in case of South region although proportion of population in India. This figure predict that in South region, large proportion of workers are employed by organized sector comparing to North and West region. *Transport* shown in Fig. 7 has quite different feature by region. In North region, the variable has upwards trend but there are no significant changes over the sample period in South and West region. Also the figure shows that gap in the *Transport* between North and West region has been enlarged over the time. *Education* in Fig. 8 is shown also different shapes between North and other two regions. In North region, *Education* take around 0.8 in the 1990s and the satiation has been improved in the 2000s. On the other hand, South and West region, *Education* takes higher rate (almost 100% enrolment rate) over the period. In summary, the Education index predict that significant education gap is observed before the 1990s, but the gap is gradually reduced during the 2000s.

Summarize to the results in above, outstanding regional characteristics are recognized. In case of *SDP*, $Income_{Level}$, or *Transport*, indexes have different tendency by region during the sample period such as and also gaps among the region become enlarged. By contrast, gap in *Education* has been reduced over the time.

Fig. 4a

Fig. 4b

Fig. 5

Fig. 6

Fig. 7

Fig. 8

3.4 Estimation results

Table 3a and 3b report the results of regressions. We conducted two types of regressions, with $Port_{Dummy}$

and without $Port_{Dummy}$. In addition to an estimate of the non-lag model, we also conducted estimation with one-year lag to deal with the simultaneous problems with S and explanatory variables. By doing so, we make sure the robustness of coefficients.

First of all, we specify the most appropriate result from three kind of regression. The results of model specification tests are almost same in each regression model. Comparing to the estimation parameter of fixed-effect model and random-effect model, the results of hausman test rejects in the 1% of critical value for the null hypothesis which the estimation parameter is same both the results of fixed-effect model and random-effect model. Therefore, we regard that the results of fixed-effect model are more adequate than random-effect model. We also compare the results of fixed-effect model and pooled OLS by the F-test. Following the result of F-test that null hypothesis is rejected in the 1% of critical value, we focus on the result of fixed-effect model in both case.

To be mentioning the coefficients of expletory variables, firm-specific characteristics; $logProd$ is positive and significant. So in the firm level, highly labor productivity firms tend to produce the large volume of total sales. In the state-level, some of the coefficients of regional characteristics, such as $logSDP$ and $Education$, are positively significant. On the other hand, the coefficients of $logIncome_{Level}$ and $logWorker_{Pop}$ take positive number but statistically not significant. As for the other important variables, the coefficient of $logExchange$ takes negative value and statistically significant. Also the coefficient of $Port_{Dummy}$ is significant and takes negative value. In regard to $Transport$, the sign of the coefficients are positive in the both model but is not statistically significant at the 10% level. Summarizing the results in above, even though significance of coefficients of $Transport$ are affected by the presence or absence of $Port_{Dummy}$ in the regression equation, there are not significant differences the result among all of the regressions we conducted.

Next, we give interpretation to the results of estimation above. The coefficient of $logSDP$ implies that size of regional economies and market is highly related to activity of Japanese-affiliated firms in India. Also the coefficient of $Port_{Dummy}$ predicts that transport cost must be one of the crucial factor to have on effect on the economic activity of Japanese-affiliated firms in India. As the other important finding, the coefficient of $Education$ shows the positive relationship with total sales. Also, exchange rate is one of the crucial factors to influence the total sales. Although some of the explanatory variables are not recognized statistically significant, the results of our estimation are mostly consistent with our predictions in the theoretical part. It may give important information for the argument to the factors of determination in heterogeneous Japanese firms' choice of location in India. Especially, results of our estimation indicate that human capital index such as *Prod* or *Education* has positive impact on location choice of Japanese firms. Considering the fact of regional inequality of educational opportunities in India, results of our estimation imply that encouraging investment in the area of human capital may have effect on FDI attraction.

Table 3a

Table 3b

4 Concluding remarks

This paper demonstrates the activity of Japanese MNEs theoretically using the North-South model with the heterogeneity of firm productivity and FDI. The theoretical analysis predicts the determination factors the MNE activity in the host country. We also conducted empirical analyses based on the theoretical model in India through the 1990s and 2000s which cover over the transitional period, globalization period and economic growth period, as a whole, the economic liberalization period in India. In the empirical regression, we utilized unbalanced firm-level panel data of Japanese manufacturing affiliates operating in India. The results of empirical analyses are mostly consistent to our theoretical findings and also explain the linkage between regional characteristics and activity of Japanese manufacturing affiliates in India. Following the results of our studies, we point out the importance of enhancing human capital and infrastructure for local governments so as to attract FDI from Japan and the other advanced countries.

Appendix A: Conditions (2a) and (2b)

As noted in the body text, for the coexistence of the export and FDI firms, π_{EX} has to intersect with π_{FDI} in the first quadrant of $\varphi^{\sigma-1}$-π plane. So as to ensure such intersection under $f_{EX} < f_{FDI}$, two conditions are needed; (A) the tangent slope of π_{FDI} is steeper than π_{EX} and (B) the profit level at the intersection of π_{EX} and π_{FDI} is positive. Regarding the condition (A), from (1b) and (1c), we find that the magnitude relation between the tangent slope of π_{EX} and π_{FDI} depends on that between τ and ew^*. If $\tau > ew^*$ (condition (2a)), the slope of π_{FDI} is steeper than π_{EX} ($\because \sigma > 1$). Next, if $\pi_{EX}(\varphi_{FDImin}) = \pi_{FDI}(\varphi_{FDImin}) > 0$, the condition (B) is satisfied. Substituting (3c) into (1c), we have

$$\pi_{FDI}(\varphi_{FDImin}) = \frac{A^*}{\sigma}(ew^*)^{1-\sigma}\ \ \sigma\left[\frac{1}{A^*(ew^*)^{1-\sigma}}\right]\left[\frac{f_{FDI}-f_{EX}}{1-(\tau/ew^*)^{1-\sigma}}\right] - f_{FDI}$$

$$= \left[\frac{f_{FDI}-f_{EX}}{1-(\tau/ew^*)^{1-\sigma}}\right] - f_{FDI} = f_{EX}\frac{(f_{FDI}/f_{EX})-(\tau/ew^*)^{\sigma-1}}{(\tau/ew^*)^{\sigma-1}-1}.$$

Taking into consideration that $(\tau/ew^*)^{\sigma-1} - 1 > 0$ ($\because$ condition (2a)), we find that if $(f_{FDI}/f_{EX}) > (\tau/ew^*)^{\sigma-1}$ (condition (2b)), then $\pi_{FDI}(\varphi_{FDImin}) > 0$.

Appendix B: Derivations of χ_{EX} and χ_{FDI}

Using (3a)-(3c) and considering $G(\varphi) = 1 - \varphi^{-k}$, χ_{EX} and χ_{FDI} can be derived as follows:

$$\chi_{EX} \equiv \frac{1-G(\varphi_{EXmin})}{1-G(\varphi_{Dmin})} = \left(\frac{\varphi_{Dmin}}{\varphi_{EXmin}}\right)^k = \left(\frac{A^*}{A}\frac{1}{\tau^{\sigma-1}}\frac{f_D}{f_{EX}}\right)^{\frac{k}{\sigma-1}} > 0,$$

$$\chi_{FDI} \equiv \frac{1-G(\varphi_{FDImin})}{1-G(\varphi_{EXmin})} = \left(\frac{\varphi_{EXmin}}{\varphi_{FDImin}}\right)^k = \left[\left\{\left(\frac{\tau}{ew^*}\right)^{\sigma-1} - 1\right\}\frac{f_{EX}}{f_{FDI}-f_{EX}}\right]^{\frac{k}{\sigma-1}} > 0.$$

Considering $\chi_{EX} = (\varphi_{Dmin}/\varphi_{EXmin})^k$, $\chi_{FDI} = (\varphi_{EXmin}/\varphi_{FDImin})^k$, and the sequence of three cutoffs, i.e., $\varphi_{Dmin} < \varphi_{EXmin} < \varphi_{FDImin}$, we find that $0 < \chi_{EX} < 1$ and $0 < \chi_{FDI} < 1$.

Appendix C: Derivation of (5)

The aggregate sale of FDI plants is shown as follows:

$$S_{FDI}^{Agg} = \int_{\varphi_{FDImin}}^{\infty} ep_{FDI}^*(\varphi)x_{FDI}^*(\varphi)M\mu(\varphi)d\varphi.$$

Using (3c) and the optimal levels of x_{FDI}^* and p_{FDI}^*, and considering Pareto distribution, we derive

$$S_{FDI}^{Agg} = \int_{\varphi_{FDImin}}^{\infty} A^*(ew^*)^{1-\sigma}\varphi^{\sigma-1}M\frac{1-G(\varphi_{EXmin})}{1-G(\varphi_{Dmin})}\frac{1-G(\varphi_{FDImin})}{1-G(\varphi_{EXmin})}\frac{g(\varphi)}{1-G(\varphi_{FDImin})}d\varphi$$

$$= A^*(ew^*)^{1-\sigma}M_{FDI}\int_{\varphi_{FDImin}}^{\infty}\varphi^{\sigma-1}\frac{g(\varphi)}{1-G(\varphi_{FDImin})}d\varphi\ \ (\because M_{FDI} \equiv \chi_{EX}\chi_{FDI}M)$$

$$= M_{FDI}\frac{k}{1+k-\sigma}A^*(ew^*)^{1-\sigma}{\varphi_{FDImin}}^{\sigma-1}$$

$$= M_{FDI} \frac{k\sigma}{1+k-\sigma} \frac{f_{FDI}-f_{EX}}{1-(\tau/ew^*)^{1-\sigma}}.$$

Dividing it by the number of the FDI plant, M_{FDI}, we obtain (5).

References

Anand, J., & Delios, A. (1996) Competing globally: How Japanese MNCs have matched goals and strategies in India and China. Columbia Journal of World Business, 31, 50-62.

Aoki, K., & Kumar, M. (2014) Kaizen initiative through vertical supply networks in emerging economies. Academy of Management Proceedings, 2014(1), 1-40.

Banga, R. (2004) Impact of Japanese and US FDI on productivity growth: A firm-level analysis. Economic and Political Weekly, 39(5), 453-460.

Banga, R. (2006) The export-diversifying impact of Japanese and US foreign direct investments in the Indian manufacturing sector. Journal of International Business Studies, 37(4), 558-568.

Berman, N., Martin, P., & Mayer, T. (2012) How do different exporters react to exchange rate changes. Quarterly Journal of Economics, 127(1), 437-492.

Bernard, A. B., & Jensen, J. B. (1999) Exceptional exporter performance: Cause, effect, or both? Journal of International Economics, 47(1), 1-25.

Bhargava, R. C. (2010) The Maruti story: How a public sector company put India on wheels. Noida: Collins.

Buckley, P. J., Adam, R. C., & Horn, S. A. (2012) Japanese foreign direct investment in India: An institutional theory approach. Business History, 54(5), 657-688.

Chaney, T. (2008) Distorted gravity: The intensive and extensive margins of international trade. American Economic Review, 98(4), 1707-1721.

Chatterjee, B. (1990) Japanese management: Maruti and the Indian experience. New Delhi: Sterling Publishers.

D'Costa, A. P. (1995) The restructuring of the Indian automobile industry: Indian state and Japanese capital. World Development, 23, 485-502.

Girma, S., Kneller, R., & Pisu, M. (2005) Export versus FDI: An empirical test. Review of World Economies, 141(2), 193-281.

Görg, H., Mühlen, H., & Nunnenkamp, P. (2010) FDI liberalisation, firm heterogeneity and foreign ownership: German firm decisions in reforming India. Journal of Development Studies, 46(8), 1367-1384.

Hayakawa, K., & Matsuura, T. (2011) Complex vertical FDI and firm heterogeneity: Evidence from East Asia. Journal of the Japanese and International Economies, 25(3), 273-289.

Hayakawa, K., & Tsubota, K. (2014) Location choice in low-income countries: evidence from Japanese investments in East Asia. Journal of Asian Economics, 33(C), 30-43.

Head, K., & Ries, J. (2003) Heterogeneity and the FDI versus export decision of Japanese manufactures. Journal of Japanese and International Economies, 17(4), 448-467.

Helpman, E., Melitz, M. J., & Yeaple, S. R. (2004) Export versus FDI with heterogeneity firms. American Economic Review, 94(1), 300-316.

Horn, S. A., Forsans, N., & Cross, A. R. (2010) The strategies of Japanese firms in emerging markets: The case of the automobile industry in India. Asian Business & Management, 9, 341-378.

Humphrey, J. (2003) Globalisation and supply chain networks: The auto industry in Brazil and India. Global Networks, 3, 121-141.

Melitz, M. J. (2003) The impact of trade on intra-industry reallocations and aggregate industry productivity. Econometrica, 71(6), 1695-1725.

Okada, A. (2004) Skills development and interfirm learning linkages under globalization: Lessons from the Indian automobile industry. World Development, 32(7), 1265-1288.

Sato, T. (2012) Economic relations between India and Japan. Eurasian Geography and Economics, 53(4), 457-478.

Siddharthan, N. S. (1998) Differential behaviour of the Japanese affiliates in the Indian automobile sector. Japan and the World Economy, 10(1998), 97-109.

Siddharthan, N. S. (1999) European and Japanese affiliates in India: Differences in conduct and performance. Economic & Political Weekly, 34(22), 97-109.

Sutton, J. (2004) The auto-component supply chain in China and India: A benchmark study. Discussion Paper, EI/34, Suntory and Toyota International Centres for Economics and Related Disciplines, London School of Economics and Political Science, London, UK.

Todo, Y. (2011) Quantitative evaluation of the determinants of export and FDI: Firm-level evidence from Japan. World Economy, 34(3), 355-381.

Tomiura, E. (2007) Foreign outsourcing, exporting and FDI: A productivity comparison at the firm level.

Journal of International Economics, 72(1), 113-127.

Wakasugi, R. (ed.) (2014) Internationalization of Japanese firms: Evidence from firm-level data. Tokyo: Springer.

Yeaple, S. R. (2009) Firm heterogeneity and the structure of U.S. multinational activities. Journal of International Economics, 78(2), 206-215.

Table 1a Sampling distribution (state-level)

Year	Andhra Pradesh		Bihar		Delhi		Gujarat		Goa		Haryana	
	Number	Share(%)	Number	Share(%)	Number	Share(%)	Number	Share(%)	Number	Share(%)	Number	Share(%)
1989	2	8.7	1	4.35	5	21.74	3	13.04		0		0
1990	2	7.14	1	3.57	8	28.57	3	10.71		0	1	3.57
1991	2	6.67	1	3.33	8	26.67	3	10		0	1	3.33
1992	2	6.67		0	9	30	2	6.67		0	2	6.67
1993	2	6.45		0	7	22.58	2	6.45		0	4	12.9
1994	2	6.9		0	6	20.69	2	6.9		0	4	13.79
1995	3	8.82	1	2.94	6	17.65	1	2.94		0	4	11.76
1996	2	5.56	1	2.78	8	22.22	1	2.78		0	3	8.33
1997	1	3.13	1	3.13	6	18.75	1	3.13		0	3	9.38
1998	1	2.86	1	2.86	4	11.43	1	2.86		0	3	8.57
1999	1	2.44	1	2.44	5	12.2	1	2.44		0	6	14.63
2000	1	2.13	1	2.13	7	14.89	1	2.13		0	8	17.02
2001	1	1.92	1	1.92	5	9.62		0	2	3.85	8	15.38
2002		0		0	8	13.56		0	2	3.39	8	13.56
2003		0		0	11	18.33		0		0	12	20
2004		0		0	10	16.95		0		0	12	20.34
2005		0		0	11	18.64		0		0	10	16.95
2006	1	1.56		0	9	14.06		0		0	12	18.75
2007	1	1.52		0	9	13.64		0		0	13	19.7
2008		0		0	8	13.33		0		0	12	20
2009		0		0	14	20		0		0	16	22.86
2010		0		0	20	22.99	1	1.15		0	17	19.54
Total	24	2.33	10	0.97	184	17.83	22	2.13	4	0.39	159	15.41

Table 1b Sampling distribution (state-level)

Year	Himachal Pradesh		Karnataka		Kerala		Maharashtra		Madhya Pradesh	
	Number	Share(%)	Number	Share(%)	Number	Share(%)	Number	Share(%)	Number	Share(%)
1989		0	3	13.04	2	8.7	3	13.04	1	4.35
1990		0	3	10.71	2	7.14	4	14.29	1	3.57
1991		0	3	10	3	10	5	16.67	1	3.33
1992		0	3	10	3	10	4	13.33	1	3.33
1993		0	2	6.45	4	12.9	4	12.9	1	3.23
1994		0	2	6.9	3	10.34	4	13.79	1	3.45
1995		0	4	11.76	3	8.82	4	11.76	1	2.94
1996		0	5	13.89	2	5.56	6	16.67	1	2.78
1997		0	5	15.63	2	6.25	7	21.88	1	3.13
1998	1	2.86	6	17.14	2	5.71	7	20	1	2.86
1999	1	2.44	5	12.2	1	2.44	7	17.07	1	2.44
2000	1	2.13	6	12.77	1	2.13	7	14.89	1	2.13
2001	1	1.92	9	17.31	1	1.92	12	23.08		0
2002	1	1.69	10	16.95	1	1.69	15	25.42		0
2003	1	1.67	10	16.67	1	1.67	15	25		0
2004	1	1.69	9	15.25	1	1.69	15	25.42		0
2005	1	1.69	12	20.34	1	1.69	14	23.73		0
2006		0	12	18.75	1	1.56	18	28.13		0
2007		0	12	18.18	1	1.52	15	22.73		0
2008		0	8	13.33	1	1.67	16	26.67		0
2009		0	8	11.43	1	1.43	15	21.43		0
2010		0	9	10.34	1	1.15	17	19.54		0
Total	8	0.78	146	14.15	38	3.68	214	20.74	12	1.16

Table 1c Sampling distribution (state-level)

Year	Punjab		Rajastan		Tamil Nadu		Uttar Pradesh		West Bengal		Total Number
	Number	Share(%)	Number	Share(%)	Number	Share(%)	Number	Share(%)	Number	Share(%)	
1989		0		0	2	8.7		0	1	4.35	23
1990		0		0	2	7.14		0	1	3.57	28
1991		0		0	2	6.67		0	1	3.33	30
1992		0		0	3	10		0	1	3.33	30
1993		0		0	4	12.9	1	3.23			31
1994		0		0	4	13.79	1	3.45			29
1995		0		0	6	17.65	1	2.94			34
1996		0		0	6	16.67	1	2.78			36
1997		0		0	4	12.5	1	3.13			32
1998		0		0	5	14.29	3	8.57			35
1999		0		0	8	19.51	4	9.76			41
2000	1	2.13		0	7	14.89	5	10.64			47
2001	1	1.92		0	7	13.46	4	7.69			52
2002	1	1.69		0	8	13.56	5	8.47			59
2003	1	1.67		0	7	11.67	2	3.33			60
2004	1	1.69		0	6	10.17	4	6.78			59
2005	1	1.69		0	4	6.78	5	8.47			59
2006		0		0	4	6.25	6	9.38	1	1.56	64
2007		0		0	8	12.12	6	9.09	1	1.52	66
2008		0		0	8	13.33	6	10	1	1.67	60
2009		0		0	10	14.29	5	7.14	1	1.43	70
2010		0	2	2.3	12	13.79	6	6.9	2	2.3	87
Total	6	0.58	2	0.19	127	12.31	66	6.4	10	0.97	1032

Table 2a Descriptive statistics (firm-specific variables)

	Total Sales (S)		*Number of Employee (L)*	
	Mean	(Standard Deviation)	Mean	(Standard Deviation)
Andhra Pradesh	6,529	(5369)	417	(409)
Bihar	15,683	(3511)	70	(10)
Delhi	56,837	(190925)	488	(1043)
Gujarat	148,331	(221674)	1,221	(1978)
Goa	14,676	(5153)	75	(46)
Haryana	8,226	(12311)	185	(311)
Himachal Pradesh	38	(17)	5	(0)
Karnataka	12,295	(19811)	249	(298)
Kerala	9,140	(9241)	148	(108)
Maharashtra	10,010	(19455)	285	(574)
Madhya Pradesh	64,603	(22229)	136	(225)
Punjab	7,802	(3557)	235	(167)
Rajastan	1,670	(978)	34	(39)
Tamil Nadu	13,159	(28381)	398	(682)
Uttar Pradesh	11,096	(14041)	726	(1421)
West Bengal	13,049	(14721)	313	(473)
Total	22,331	(91849)	353	(774)

Table 2b Descriptive statistics (regional-characteristic variables)

	SDP		*Income* $_{Level}$		*Worker* $_{Pop}$		*Transport*		*Education*	
	Mean	(Standard Deviation)	Mean	(Standard Deviation)	Mean	(Standard Deviation)	Mean	(Standard Deviation)	Mean	(Standard Deviation)
Andhra Pradesh	8904266	(3939236)	35173	(16267)	780134	(114838)	0.49	(0.09)	0.94	(0.08)
Bihar	3403124	(1373041)	54842	(17920)	165506	(46420)	0.39	(0.08)	0.82	(0.25)
Delhi	4225736	(2405533)	60095	(11341)	94366	(13920)	0.60	(0.06)	0.93	(0.19)
Gujarat	8983016	(4545819)	1567	(9703)	614156	(133328)	0.22	(0)	1	(0.06)
Goa	417042	(187155)	65064	(9785)	22343	(9326)	0.54	(0.13)	0.92	(0.16)
Haryana	3639130	(1671075)	52655	(4488)	244669	(83365)	0.29	(0.05)	0.83	(0.06)
Himachal Pradesh	818789	(370135)	49337	(7143)	41202	(24616)	0.23	(0.04)	0.98	(0.04)
Karnataka	7121739	(3360054)	55935	(7235)	395557	(102220)	0.27	(0)	1	(0.06)
Kerala	4013043	(1668234)	30844	(4233)	256399	(37121)	0.69	(0.05)	0.95	(0.2)
Maharashtra	17900000	(8548966)	79475	(10943)	912738	(107522)	0.26	(0)	1	(0.03)
Madhya Pradesh	6395652	(1511014)	53258	(9394)	240972	(68643)	0.38	(0.04)	0.98	(0.08)
Punjab	4230435	(1469828)	35190	(3266)	321581	(65482)	0.26	(0.09)	0.86	(0.03)
Rajastan	5617391	(2304275)	48808	(3960)	204608	(45309)	0.32	(0.09)	0.92	(0.04)
Tamil Nadu	9269565	(4074358)	39902	(4371)	960986	(249612)	0.31	(0.01)	1	(0.06)
Uttar Pradesh	12300000	(4131581)	46758	(6030)	541539	(113664)	0.39	(0.17)	0.78	(0.09)
West Bengal	8947826	(4007705)	49277	(4307)	523276	(84599)	0.48	(0.05)	0.97	(0.13)
Total	6634498	(5474151)	47253	(15032)	398766	(314636)	0.39	(0.1)	0.93	(0.18)

Table 3a Estimation results (non-lag model)

	Fixed Effect Model	Random Effect Model	Pooled OLS	Fixed Effect Model	Random Effect Model	Pooled OLS
$logProd_{ijt}$	0.522 (0.017)***	0.549 (0.017)***	0.708 (0.024)***	0.516 (0.017)***	0.545 (0.017)***	0.708 (0.024)***
$logSDP_{jt}$	0.986 (0.17)***	0.715 (0.17)***	-0.187 (0.222)	1.089 (0.173)***	0.765 (0.171)***	-0.212 (0.222)
$logIncome_{Leveljt}$	0.15 (0.267)	-0.03 (0.263)	-0.276 (0.316)	0.294 (0.271)	0.084 (0.266)	-0.135 (0.329)
$logWorker_{Popjt}$	0.085 (0.184)	0.02 (0.174)	0.26 (0.206)	0.06 (0.183)	0.078 (0.175)	0.382 (0.22)
$Transport_{jt}$	0.621 (0.466)	0.497 (0.461)	0.474 (0.556)	0.498 (0.466)	0.411 (0.462)	0.574 (0.559)
$Education_{jt}$	2.248 (0.534)***	1.732 (0.535)***	1.310 (0.712)*	2.269 (0.532)***	1.891 (0.537)***	1.558 (0.73)**
$logExchange_{t}$	-0.864 (0.272)***	-1.025 (0.281)***	-0.105 (0.49)	-0.734 (0.275)***	-0.892 (0.285)***	0.091 (0.507)
$Port_{Dummy}$				-0.193 (0.068)***	-0.12 (0.052)**	-0.058 (0.038)
Constant	-10.536 (3.39)***	-2.747 (3.259)	7.222 (4.007)*	-13.672 (3.55)***	-6.056 (3.539)*	3.399 (4.72)
R-Square	0.6067	0.5961	0.4752	0.6105	0.6004	0.4759
F-Statistic	183.78***		134.37***	163.2***		118.02***
Wald-Statistic		1257.29***			1269.92***	
	Hausman-test: $\chi^2(7)$=97.89***			*Hausman-test*: $\chi^2(8)$=145.71***		
	Breusch-Pagan test: $\chi^2(1)$=1247.23***			*Breusch-Pagan test*: $\chi^2(1)$=1237.69***		
	F-Test: *F-Statistic* =24.45***			*F-Test*: *F-Statistic* =24.63***		
	Number of Observation =1032					
	Number of Groupes =191					

Note: Standard errors are in parentheses.

***Statistical significance at the 1% level.

**Statistical significance at the 5% level.

*Statistical significance at the 10% level.

Table3b Estimation results (with one-year lag)

	Fixed Effect Model	Random Effect Model	Pooled OLS	Fixed Effect Model	Random Effect Model	Pooled OLS
$logProdij_{t-1}$	0.524 (0.017)***	0.551 (0.017)***	0.711 (0.024)***	0.518 (0.017)***	0.819 (0.151)***	0.71 (0.024)***
$logSDP_{jt-1}$	1.05 (0.149)***	0.772 (0.15)***	-0.138 (0.203)	1.153 (0.152)***	0.068 (0.272)	-0.18 (0.205)
$logIncome_{Leveljt-1}$	0.11 (0.270)	-0.108 (0.262)	-0.278 (0.301)	0.368 (0.281)	0.042 (0.159)	-0.095 (0.322)
$logWorker_{Popjt-1}$	0.07 (0.146)	-0.029 (0.157)	0.231 (0.19)	0.069 (0.163)	0.419 (0.445)	0.38 (0.212)*
$Transport_{jt-1}$	0.633 (0.45)	0.48 (0.445)	0.466 (0.548)	0.519 (0.45)	1.832 (0.525)***	0.636 (0.599)
$Education_{jt-1}$	2.43 (0.529)***	1.6 (0.518)***	0.894 (0.668)	2.568 (0.528)***	-0.76 (0.285)***	1.127 (0.684)
$logExchange_{t-1}$	-0.72 (0.268)***	-0.933 (0.276)***	0.096 (0.48)	-0.511 (0.275)*	-0.123 (0.054)**	0.285 (0.495)
$Port_{Dummy}$				-0.213 (0.007)***	0.548 (0.017)***	-0.062 (0.04)
Constant	-11.709 (3.655)***	-2.370 (3.427)	6.300 (3.942)	-16.79 (3.998)***	-6.761 (3.899)*	1.99 (4.8)
R-Square	0.6056	0.594	0.4737	0.61	0.5988	0.4745
F-Statistic	182.95***		133.57***	162.85***		117.35***
Wald-Statistic		1245.75***			1258.49***	
	Hausman-test: $\chi^2(7)$=120.65***			*Hausman-test*: $\chi^2(8)$=170.66***		
	Breusch-Pagan test: $\chi^2(1)$=1228.82***			*Breusch-Pagan test*: $\chi^2(1)$=1217.72***		
	F-Test: *F-Statistic* =24.45***			*F-Test*: *F-Statistic* =24.67***		
	Number of Observation=1032					
	Number of Groupes=191					

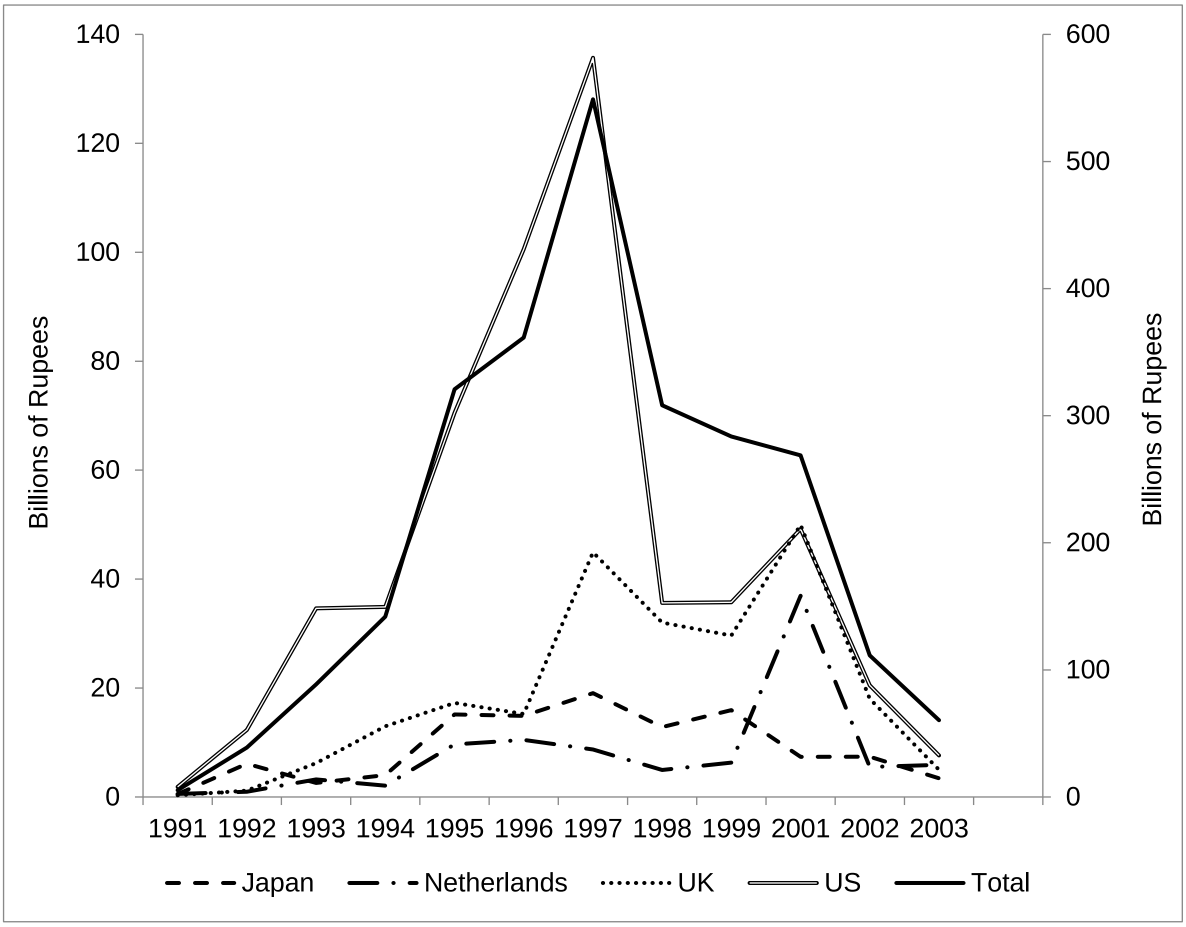
Note: Standard errors are in parentheses.

***Statistical significance at the 1% level.

**Statistical significance at the 5% level.

*Statistical significance at the 10% level.

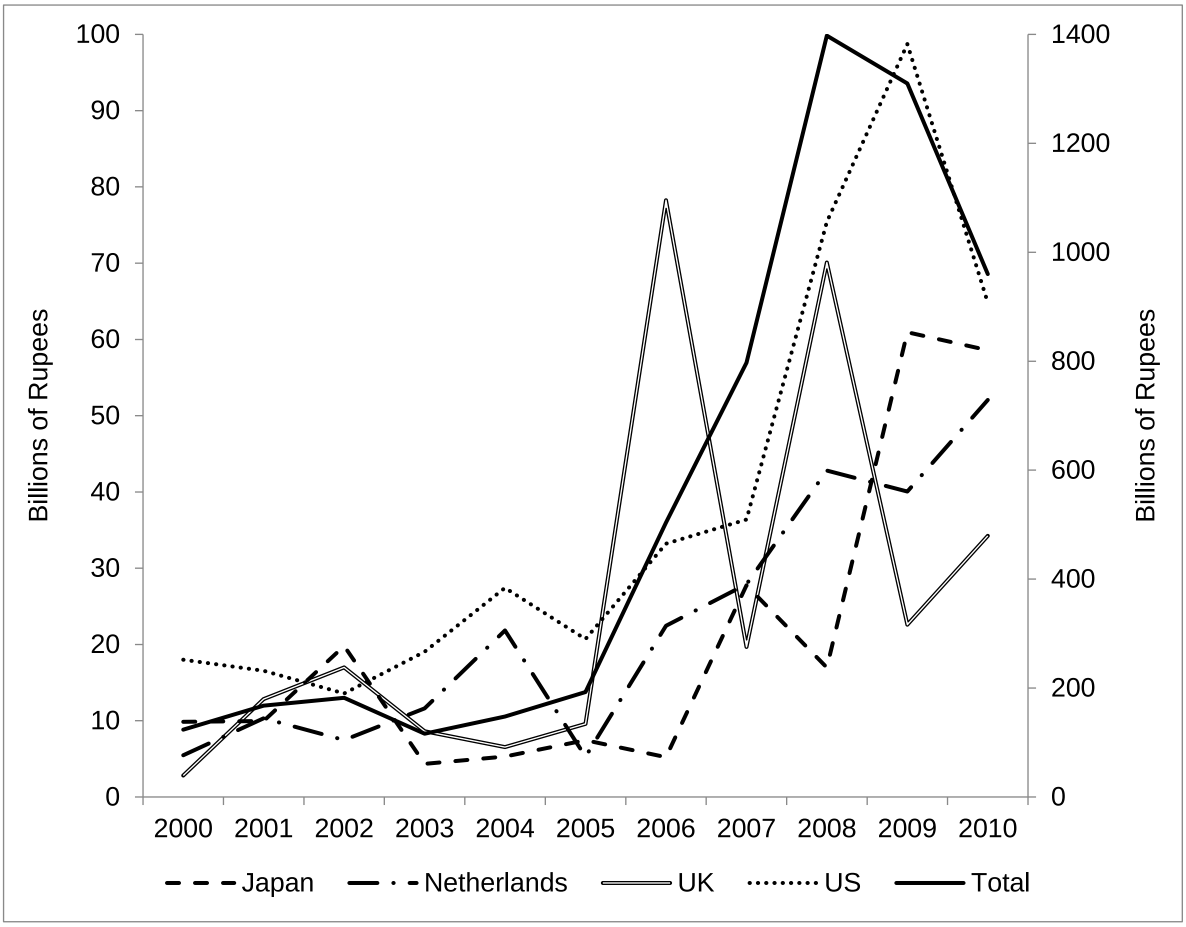
Fig. 1a FDI inflow in India: 1990s



Source: Secretariat of Industrial Assistance Newsletter, Ministry of Commerce

Notes: Fig. 1a indicates annual FDI inflows into India calculated based on approved value (Not coincide with actual value of FDI inflows). This figure has Japan, Netherlands, UK, and US on the left ordinate and Total on the right ordinate. We do not illustrate FDI inflows from large tax heavens in neighboring region (Singapore and Mauritius) as a line graph by countries but include them in Total.

Fig. 1b FDI inflow in India: 2000s



Source: Secretariat of Industrial Assistance Newsletter, Ministry of Commerce

Notes: This figure indicates annual FDI inflows into India through Secretariat of Industrial Assistance and Foreign Investment Promotion Board. Therefore, value of FDI inflows in Fig.1a and Fig1b are not continues. This figure has Japan, Netherlands, UK, and US on the left ordinate and Total on the right ordinate. We do not illustrate FDI inflows from large tax heavens in neighboring region (Singapore and Mauritius) as a line graph by countries but include them in Total.

Fig. 2 Profit functions

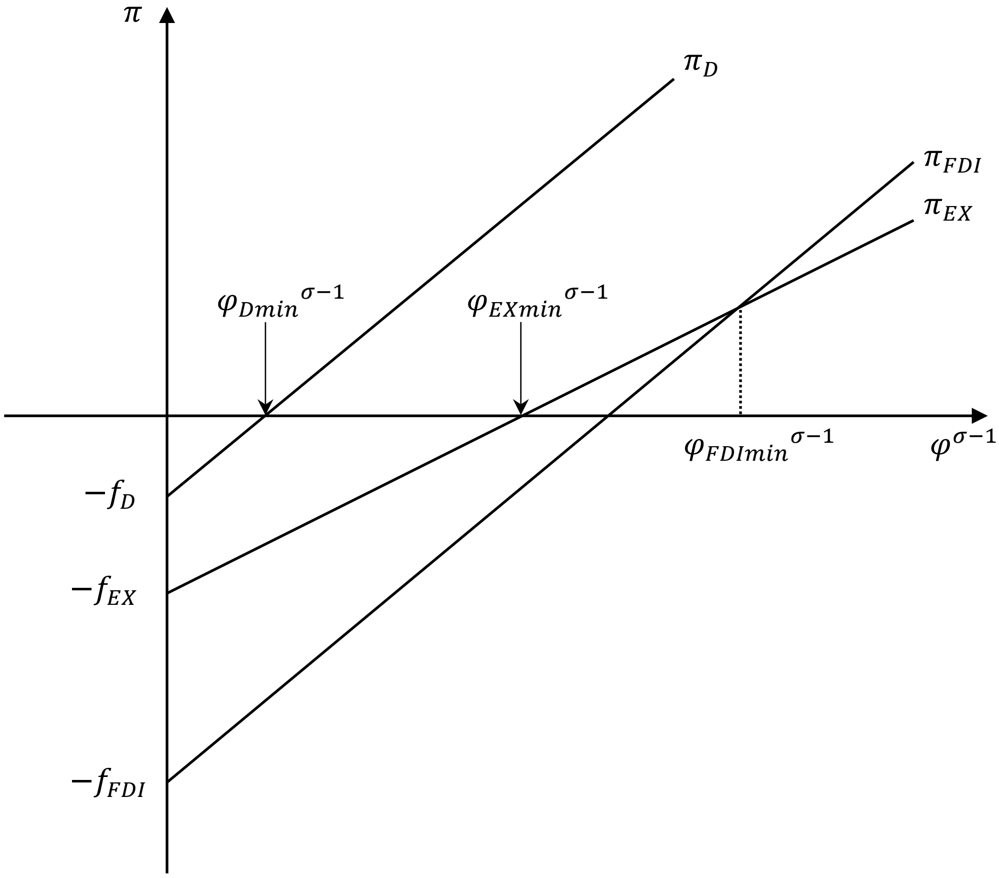


Fig. 3 Time series variation of the number of sample firm and real effective exchange rate

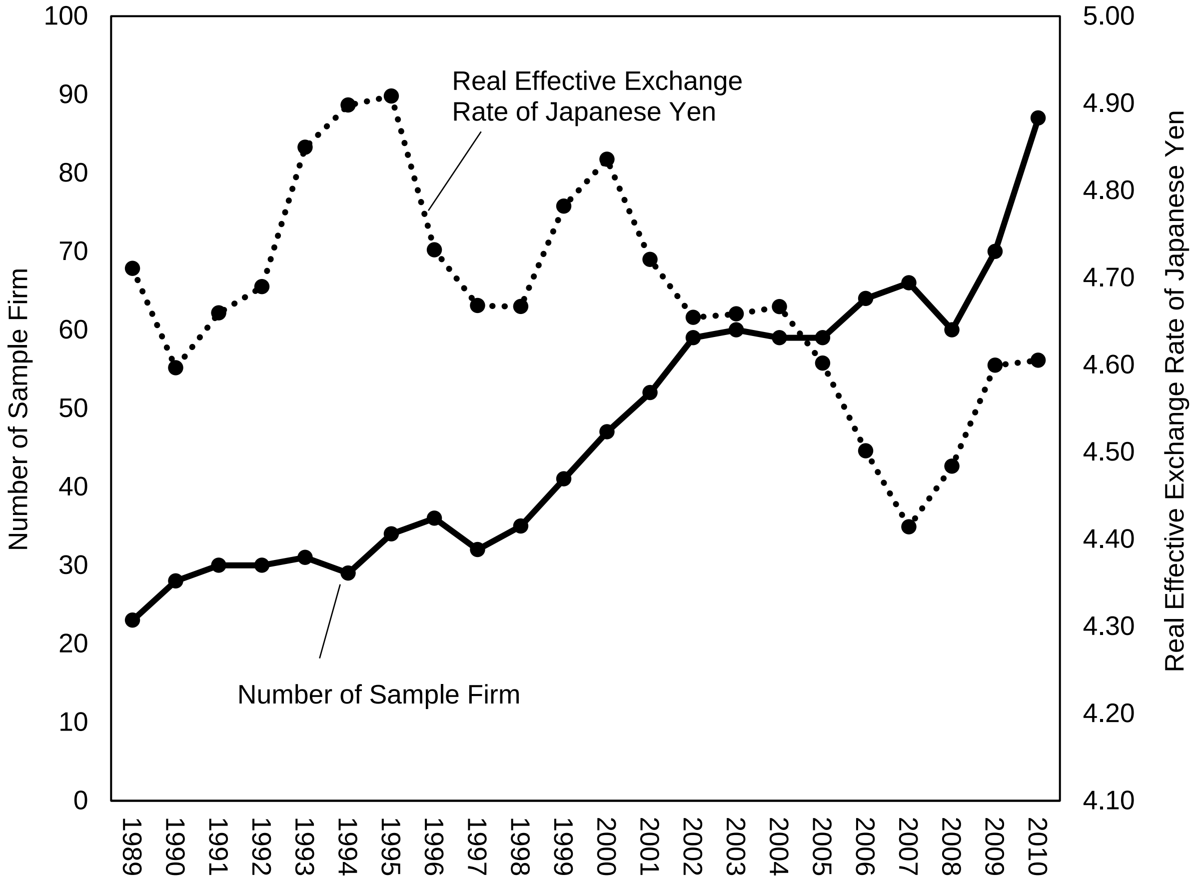


Fig. 4a SDP (regional-level)

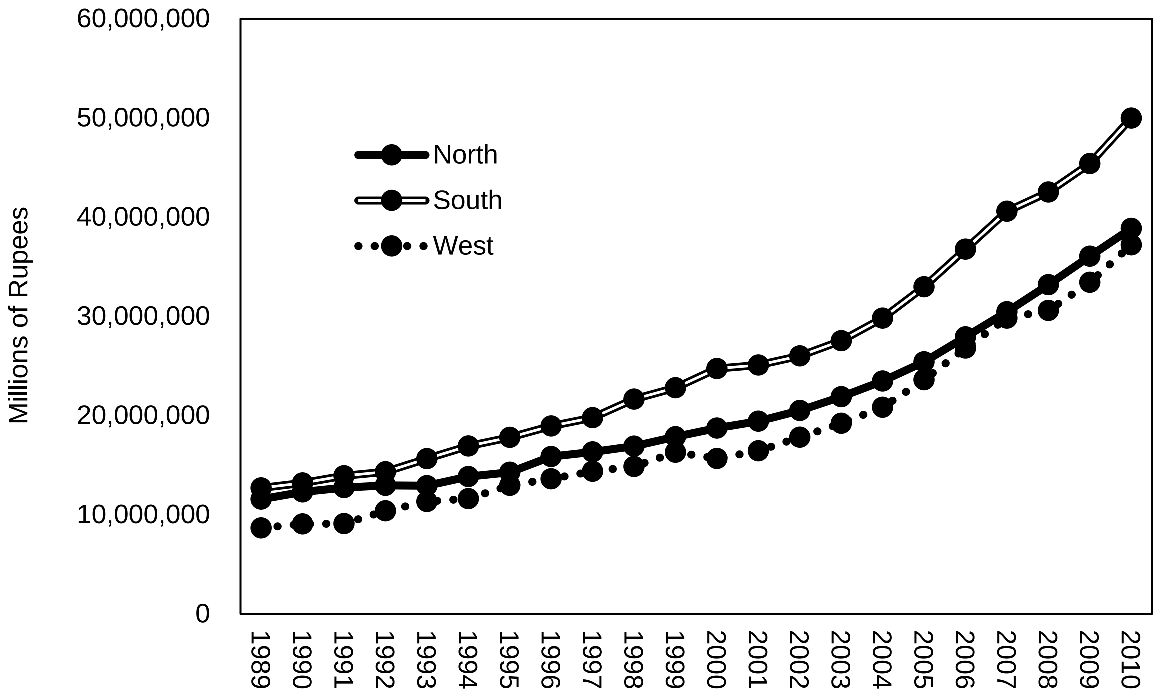


Fig. 4b SDP growth rate (regional-level)

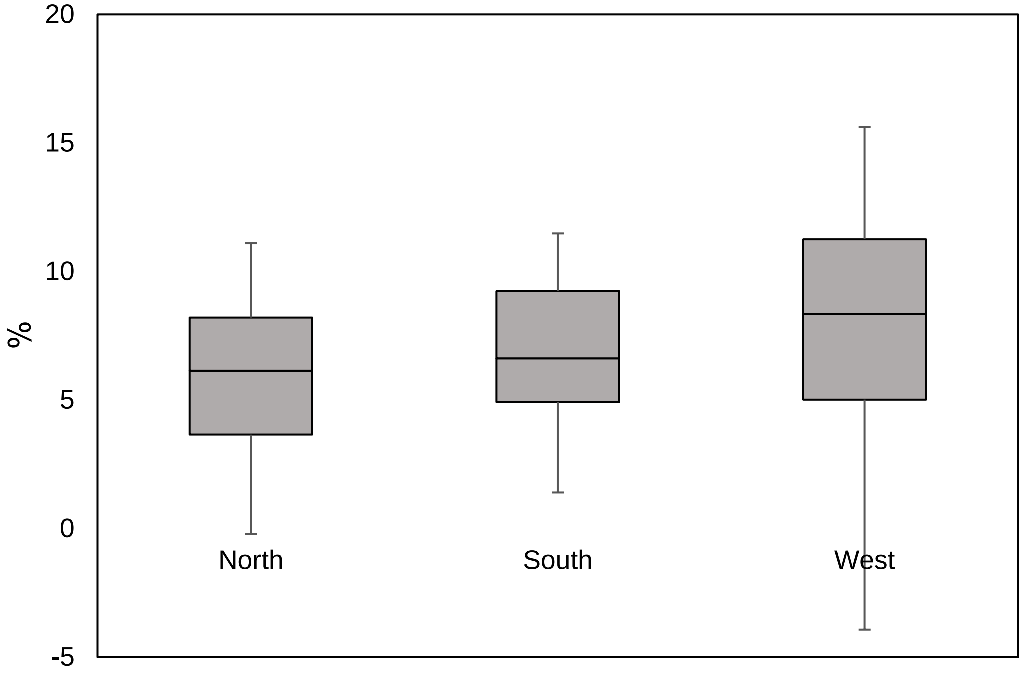


Fig. 5 Average income level (regional-level)

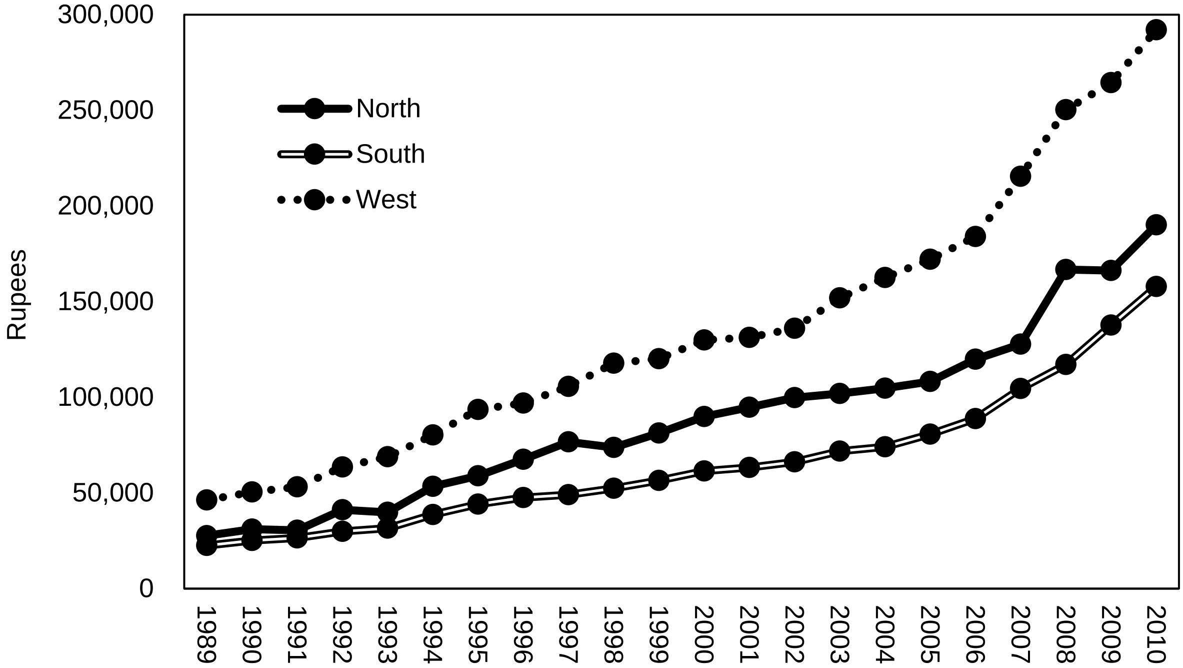


Fig. 6 Worker population (regional-level)

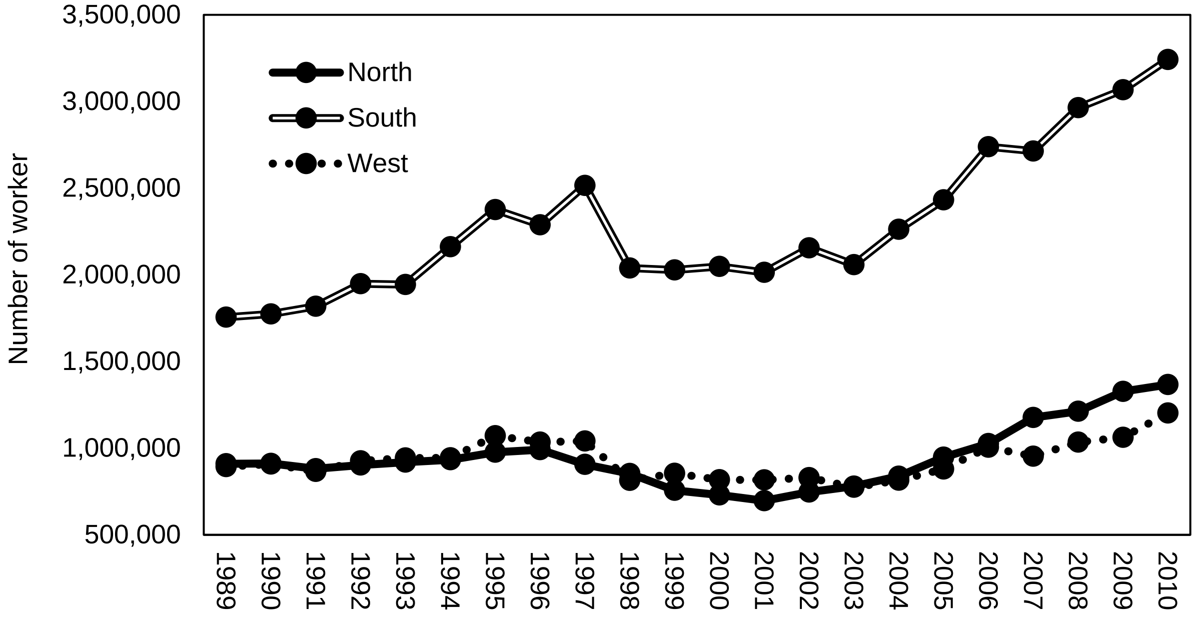


Fig.7 Transport (regional-level)

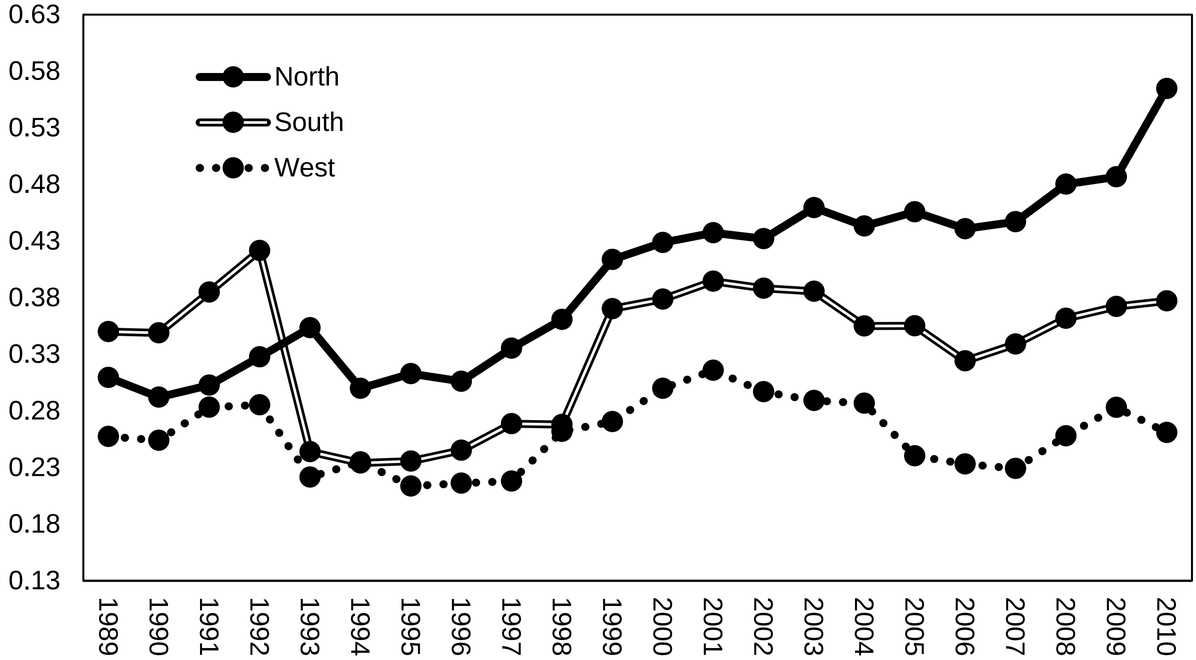


Fig. 8 Education (regional-level)