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## Revisiting Disability Employment and Firm Productivity in Japan\*

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## Abstract

We use high-quality panel data that matched administrative data on the employment of persons with disabilities with financial information on Japanese firms to examine the causal effects of the employment of persons with disabilities on firms' financial indicators and productivity, that is, not only the average effect across firms, but also the heterogeneity across various firm types. First, in most cases, we find that the employment of persons with disabilities does not have a statistically significant effect on firm performance. This result is consistent with the manufacturing literature and we show that these trends also hold true for non-manufacturing firms. Second, we do not find an extensive or intensive margin of employment for persons with disabilities, as the increased employment of persons with disabilities has no impact on firm performance, regardless of whether a firm employed persons with disabilities at the beginning of the period of analysis. Third, we observe the benefit of employing persons with disabilities among medium-sized firms with subsidiaries that specialize in this type of employment. Specifically, sales, operating income, and net income per regular employee increase as the employment of persons with disabilities increases.

Keywords: Disability employment, Employment quota, Productivity

JEL classification: J15, J20, J78, L25

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## 1. Introduction

Disability is not a marginal phenomenon in many countries. Across the Organisation for Economic Co-operation and Development (OECD), one in seven people of working age regard themselves as having a chronic health problem or disability that hampers their daily life; this ratio is above one in five people in countries such as Estonia, Hungary, Denmark, and Finland (OECD, 2010). According to official statistics, the persons with disabilities are more likely to face educational and employment problems and form economically disadvantaged groups in each country (OECD, 2003, 2010).

Many countries have adopted policies to encourage labor demand by prohibiting discrimination in the employment of persons with disabilities and/or requiring companies to employ a certain percentage of persons with disabilities to guarantee income-earning opportunities for this group. Mandatory employment quotas are used in some OECD countries, especially in the east, west, and south of Europe and Asia, to entice employers to retain or hire people with disabilities, or, alternatively, under some regulations, subcontract with companies with a significant share of workers with disabilities (OECD, 2010). A common characteristic among the different quota systems is that employers are required to fill a specific quota or pay a fine in lieu of meeting it. However, quota fulfillment (i.e., level of compliance) is still relatively low in most countries (Lalive et al., 2013).

In a classic study, Welch (1976) discusses the theory of employment quotas in competitive labor markets, which is independent of the cause of discrimination (taste or statistical). If the quota for a certain job (e.g., a high-skilled job) is larger than the minority proportion with qualified skills, the quota system accompanied by an equal pay constraint increases production costs and can reduce employment for skilled individuals. Alternatively, a firm can mitigate costs by hiring unskilled minorities into the skilled category (“skill-bumping”) to be able to hire more skilled workers. In the latter case, the quota system can increase the employment of an unqualified minority, but the firm’s profit will likely decline. Employment quotas are expected to increase the income of disadvantaged groups in exchange for reduced employment opportunities and firm profits for the non-disadvantaged groups. Moreover, the existence of imperfect competition and frictions in labor markets has recently been revealed (Lamadon et al., 2022). In imperfect labor markets, firms may have monopsonic power and equilibrium employment may be inefficiently low (Manning, 2005). Therefore, regardless of the nature of discrimination, employment quotas may lead to increased employment without impairing firm profits (Holzer and Neumark, 2000). In short, the theoretical predictions of employment quotas are ambiguous, meaning that their validity needs to be demonstrated through empirical studies.

However, despite the many theoretical studies, the empirical studies on employment quotas remain limited (for race, Chay, 1998; for race and gender, Griffin, 1992; Miller and Segal, 2012; Miller, 2017; for natives and immigrants, Peck, 2017). A few studies on persons with disabilities examine the impact of employment quotas on the employment promotion of persons with disabilities and find neutral or positive effects (for Austria, Wuellrich, 2010; Lalive et al., 2013; for Japan, Mori and Sakamoto, 2018; for India, Prakash, 2020). Even fewer

studies have examined the impact of the employment of persons with disabilities on firm profits, reporting negative, neutral, or positive effects (Nagae, 2014; Mori and Sakamoto, 2018; Jing et al., 2020). Previous studies have also shown mixed results regarding whether promoting the employment of people with disabilities impairs firm performance. Furthermore, these studies face challenges owing to data availability. Due to the limited availability of data matching the firms' employment status of persons with disabilities with their financial information, previous studies have been limited to specific regions, industries, or time points (Nagae, 2014; Mori and Sakamoto, 2018) or to firms that have voluntarily disclosed information (Jing et al., 2020).

In this study, we use high-quality data to overcome these challenges and examine the effects of promoting the employment of persons with disabilities on firm performance. Our data have several advantages: they contain high-quality information on employment and finance, they are panel data from multiple time points, allowing us to control for unobservable heterogeneity in firms, and they encompass firms from a wide range of industries and regions, allowing us to test whether the effect of employment on persons with disabilities is heterogeneous across production technologies.

The results are as follows. First, in most cases, the employment of persons with disabilities does not have a statistically significant effect on firm performance. This result is consistent with the findings of previous studies on manufacturing firms. We show that these trends also hold true for non-manufacturing firms. Second, we do not find an extensive or intensive margin of employment for persons with disabilities, or any impact of the increased employment of persons with disabilities on firm performance regardless of whether the firm employed persons with disabilities at the beginning of the analysis period. Third, among medium-sized firms with special subsidiaries that employ a large number of people with disabilities and create a suitable work environment for them, there are benefits for the employment of persons with disabilities; specifically, sales, operating income, and net income per regular employee increase as the employment of people with disabilities increases.

This paper is organized as follows. Section 2 outlines the institutional background of the employment of persons with disabilities in Japan. Section 3 describes the analytical methodology and data. Section 4 presents the results and discussion. Finally, Section 5 concludes the paper.

## 2. Institutional background

By nature, "disability" is an ambiguous concept. As such, this study focuses on the employment of persons with physical, intellectual, and mental/developmental disabilities certified under Japan's welfare system for persons with disabilities. Japan's employment policy for persons with disabilities has traditionally used an employment quota approach, whereby private companies with a certain number of employees are required to employ a certain percentage of employees with (officially certified) disabilities under the Act to Facilitate the Employment of Persons with Disabilities, revised in 1976. Initially, only persons with physical disabilities were covered. However, the scope of persons with disabilities subject to the

employment quota was subsequently expanded to include persons with intellectual disabilities in 1987 and those with mental disabilities in 2018.

According to the Ministry of Health, Labour and Welfare (MHLW), the employment quota system for persons with disabilities ensures that individuals with physical, intellectual, and mental disabilities have the same opportunities to become regular workers and at the same level as ordinary workers. This system sets the employment rate of persons with disabilities as a percentage of the number of regular workers (hereinafter, "legal employment rate") and obliges employers to achieve this rate. In counting the number of employees with disabilities, the degree of difficulty of employment varies depending on the type and degree of disability. Specifically, one person with a severe physical or intellectual disability is considered as employing two persons with physical or intellectual disabilities. Additionally, part-time workers (i.e., workers who work 20 hours or more but less than 30 hours per week) with severe physical or intellectual disabilities are counted as one person, and part-time workers with physical disabilities other than severe physical or intellectual disabilities are counted as 0.5 persons.

Under the employment quota system, the legal employment rate is set at least every five years by considering the changes in the ratio of the workforce with disabilities to the total workforce, as to guarantee employment opportunities for persons with disabilities. Table 1 shows the changes in the legal employment rate and size of the applicable business establishment since 2010, which is also the period analyzed in this study. By March 2021, the legal employment rate had increased to 2.3% for private companies, 2.6% for national and local governments, and 2.5% for prefectural boards of education. Private companies with 43.5 or more employees were obliged to employ at least one person with a disability.<sup>1</sup>

Table 1. Changes in the employment quota system since 2010

Year	Legal employment rate for private firms (%)	Minimum firm size subject to the obligation to employ persons with disabilities (persons)	Minimum firm size eligible to pay the levy and receive the grant (persons)	Other changes
2010	1.8	56	More than 200 (July)	A short-term worker (20–30 hours) is counted as 0.5 of a regular employee.
2011	1.8	56	More than 200	
2012	1.8	56	More than 200	
2013	2.0	50	More than 200	
2014	2.0	50	More than 200	

<sup>1</sup> In practice, for industries where it is difficult to employ persons with disabilities due to the nature of the work, a certain percentage is deducted when calculating the number of employees, thereby reducing the obligation to employ such persons.

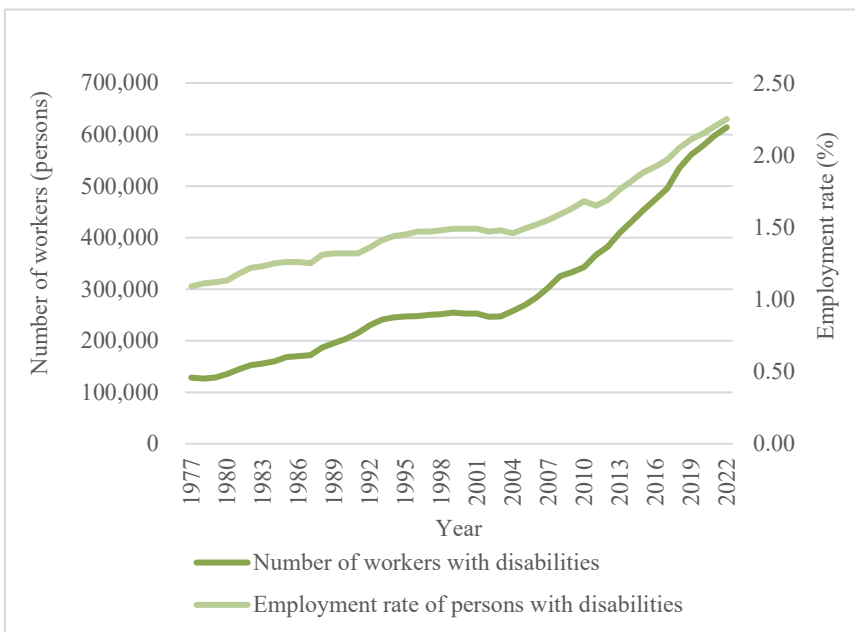
2015	2.0	50	More than 100 (April)	
2016	2.0	50	More than 100	The implementation of the Act for Eliminating Discrimination against Persons with Disabilities and the revised Act to Facilitate the Employment of Persons with Disabilities
2017	2.0	50	More than 100	
2018	2.2	45.5	More than 100	Added people with mental disabilities to the calculation base of the legal employment rate
2019	2.2	45.5	More than 100	
2020	2.2	45.5	More than 100	
2021	2.3	43.5	More than 100	
2022	2.3	43.5	More than 100	

Source: Compiled based on the websites of the Ministry of Health, Labour and Welfare (MHLW) of Japan ([https://www.mhlw.go.jp/stf/seisakunitsuite/bunya/koyou\\_roudou/koyou/shougaihakoyou/index.html](https://www.mhlw.go.jp/stf/seisakunitsuite/bunya/koyou_roudou/koyou/shougaihakoyou/index.html), last accessed November 17, 2023) and the Japan Organization for Employment of the Elderly, Persons with Disabilities, and Job Seekers (<https://www.jeed.go.jp/disability/koyounohu/index.html>, last accessed November 17, 2023).

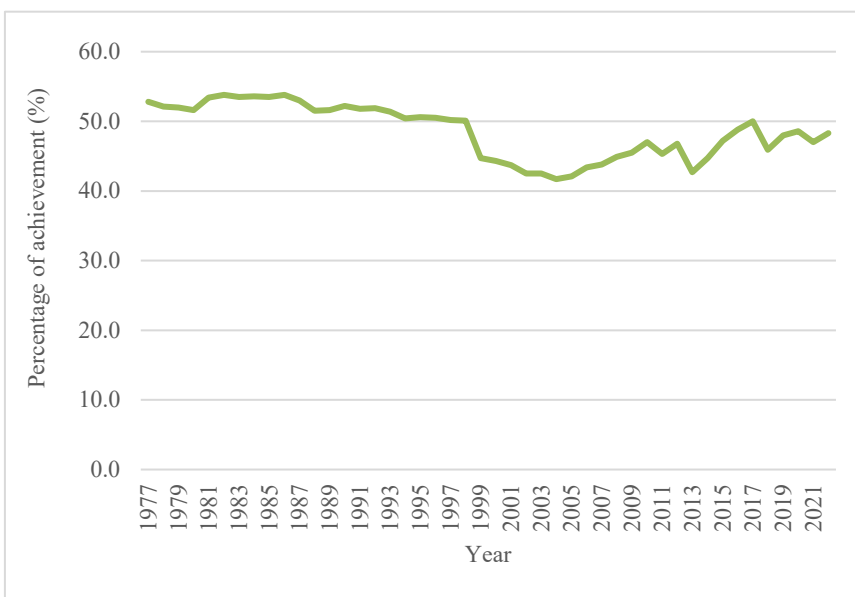
Figure 1 shows the employment status of persons with disabilities in private sector establishments subject to the employment rate system as of June 1 of each year. The number of employees with disabilities has tripled, from 200,000 in the late 1980s to more than 600,000 in recent years. Since the number of employees in Japan also increased during this period, the increase in the actual employment rate has been relatively slow. However, at present, the rate is slightly below the legal employment rate (2.3%) at 2.25%.

Figure 1. Employment situations of persons with disabilities

(i) Number and employment rate of persons with disabilities



(ii) Proportion of companies achieving the legal employment rate



Source: Ministry of Health, Labour and Welfare (2022)

Another feature of the employment situation of persons with disabilities is that many companies, mainly small- and medium-sized ones, have not achieved the legal employment rate. Moreover, approximately half of the companies subject to the employment rate system have not achieved the legal employment rate at any given time (see Figure 1(ii)). This may be because the employment rate system for persons with disabilities is designed to achieve a certain number of employees with disabilities in the society as a whole, allowing each

company to adjust the number of employees with disabilities according to its own industry and characteristics as long as this objective is achieved (Tsuchihashi and Oyama, 2008).

Japan's employment quota system imposes an obligation on companies above a certain size to employ a certain percentage of people with disabilities. Employers who have not yet achieved the legal employment rate are required to pay a levy (*Nohukin*) in proportion to the number of persons with disabilities they are short on, whereas employers that employ persons with disabilities in excess of the employment rate are entitled to receive a grant (*Choseikin*) in proportion to the excess.<sup>2</sup> We refer to this as the levy–grant system. The number of levies and grants as well as the scale of establishments to which the system applies have changed over time. Under the current system, the levy amount is 50,000 yen per month for each disabled person below the quota, and the grant amount is 27,000 yen (29,000 yen from April 1, 2023) per month for each disabled person above the quota. The size of the establishments to which the levy–grant system was applied changed from more than 300 workers until 2010 to more than 200 workers after 2010, followed by more than 100 workers after 2015.<sup>3</sup>

Therefore, the levy–grant system, which imposes a tax on employers who fall below the legal employment rate and subsidizes employers who exceed it, has been evaluated as a type of income redistribution among employers (Morozumi, 2017) or as an adjustment of the economic burden between firms that comply with the employment rate and those that do not (Tsuchihashi and Oyama, 2008). Therefore, each firm may realize the optimal amount of employment of persons with disabilities from the perspective of profit maximization under the levy–grant system and considering their own production technology.

In principle, the Japanese employment quota system also includes measures that consider company characteristics. For example, under the system, a large company with many employees is obliged to employ more disabled employees. Therefore, if a company establishes a subsidiary that gives special consideration to the employment of persons with disabilities and meets certain requirements, it can calculate its actual employment rate by deeming persons with disabilities employed by the subsidiary to be employed by the parent company as a special exception (special subsidiary system).<sup>4</sup> Such a special subsidiary must meet the following requirements: (1) employ five or more persons with disabilities, accounting for 20% or more of all employees; (2) employ 30% or more persons with severe physical, intellectual, or mental disabilities; and (3) have sufficient ability to properly manage the employment of persons with disabilities by improving facilities for persons with disabilities or by assigning full-time instructors. Owing to these requirements, the number of special subsidiaries is small. According to the "Employment Status of Persons with Disabilities," published by the MHLW,

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<sup>2</sup> Additionally, small companies that are obligated to employ persons with disabilities but are not required to comply with the legal employment rate may receive a Reward (*Hoshokin*) based on the number of employees with disabilities they employ in excess of a certain number.

<sup>3</sup> For companies with less than 100 regular workers to which the grant does not apply, the reward will be paid according to the actual number of employees with disabilities. Specifically, if the annual total number of persons with disabilities employed in a month exceeds a certain number (4% of the annual total number of regular workers in a month or 72 persons, whichever is greater), a reward of 21,000 yen will be paid for each person with disabilities in excess of that number.

<sup>4</sup> For a description of special subsidiaries, see MHLW, "Outline of the 'Special Subsidiary' System" (<https://www.mhlw.go.jp/content/11600000/000523775.pdf>, last accessed January 15, 2024).



the number of special subsidiaries in 2022 (June 1) was 579, and the number of persons with disabilities employed by these subsidiaries was 43,857.

According to the MHLW, the advantages of special subsidiaries include the following: (1) they can secure jobs and create a work environment that considers the characteristics of disabilities, thereby fully drawing out the abilities of persons with disabilities; (2) they can increase the workplace retention rate, improve productivity, and centralize capital investment when accepting persons with disabilities; and (3) they can set different working conditions from those of the parent company, thereby enabling flexible employment management. This suggests that, for companies with special subsidiaries, the employment of persons with disabilities may have a positive impact on performance in terms of productivity and employment costs.

Based on this employment system for persons with disabilities in Japan, some studies use firm microdata to examine the relationship between the employment of persons with disabilities and corporate profits. For instance, Nagae (2014) uses financial data and the number of employees with disabilities from listed companies whose headquarters were located in Tokyo from 2003 to 2010. The results show that, when a firm achieves the legal employment rate for persons with disabilities, its productivity does not change significantly, while its operating profit ratio declines compared to when it does not achieve this rate. Nagae (2014) concludes that the current levy and grant amounts are insufficient and do not equalize the burden of hiring people with disabilities across companies. Mori and Sakamoto (2018) analyze the Employment Status of Persons with Disabilities in manufacturing firms in 2008 using disclosure and firm financial data. Their results show that the levy–grant system contributes to the promotion of the employment of disabled workers and that the number of employees with disabilities has no statistically significant relationship with firm profits, regardless of whether the levy and grant are considered. Therefore, they conclude that employment of persons with disabilities does not necessarily decrease firms' profits.

However, the results of previous studies are limited to specific industries and time points, such as Nagae (2014) for listed companies whose headquarters are located in Tokyo and Mori and Sakamoto (2018) for the manufacturing industry at one point in time (2008). In other words, these studies did not examine the heterogeneity of the effect of the employment of persons with disabilities according to industry, firm size, or the actual employment of persons with disabilities. As such, we use high-quality panel data: administrative data collected based on Japan's employment policy for persons with disabilities and financial information from credit surveys of private firms. In principle, administrative data cover all firms that are obligated to employ persons with disabilities. Financial information merged with administrative data cover a wide range of companies, including unlisted companies. Therefore, this study examines not only the average effect of the employment of persons with disabilities on Japanese firms, but also the heterogeneity of the effect by type of firm, such as industry and size, as well as the effect of special subsidiaries that specialize in the employment of persons with disabilities.

### 3. Analytical methods and data

#### 3.1 Analytical methods

Our analytical framework follows that of the empirical studies that examine the impact of specific worker compositions, such as the ratio of workers by age, on firm output (Crépon et al., 2002; Mahlberg et al., 2013). First, we assume that a firm's production technology can be represented by the Cobb–Douglas production function in Eq. (1):

$$Q_i = AK_i^\alpha L_i^{*\beta}, \quad (1)$$

where firm  $i$  combines its capital input ( $K_i$ ) and labor input ( $L_i$ ) with given technology level  $A$  to produce output  $Q_i$ . Next, we decompose total labor input  $L_i^*$  of a firm into the weighted sum of two types of employees: employees without disabilities,  $L_{i0}$ , and employees with disabilities,  $L_{i1}$ . That is, we assume  $L_i^* = \lambda_{i0}L_{i0} + \lambda_{i1}L_{i1}$ , with  $\lambda_{i0}$  and  $\lambda_{i1}$  denoting the individual productivity parameters. Rearranging the terms yields the following expression for the total labor input:

$$L_i^* = \lambda_{i0}L_{i0} + \lambda_{i1}L_{i1} = \lambda_{i0}L_i \left(1 + \left(\frac{\lambda_{i1}}{\lambda_{i0}} - 1\right) \frac{L_{i1}}{L_i}\right).$$

Taking the logarithm of both sides, we obtain:

$$\ln(L_i^*) = \ln(\lambda_{i0}) + \ln(L_i) + \ln\left(1 + \gamma_i \frac{L_{i1}}{L_i}\right), \quad (2)$$

where  $\lambda_{i0}$  indicates the productivity of the non-disabled and  $\gamma_i = \lambda_{i1}/\lambda_{i0} - 1$  the relative productivity difference between employees with disabilities and those without disabilities. We further assume the productivity differential to be constant across firms, that is,  $\gamma_i \equiv \gamma$  and assume constant returns to scale,  $\alpha + \beta = 1$ . By taking the logarithms of Eq. (1) and substituting  $\ln(L_i^*)$  (in Eq. (2)) into Eq. (1) yields:

$$\begin{aligned} \ln(Q_i) &= \alpha \ln(K_i) + (1 - \alpha) \ln(\lambda_{i0}) + (1 - \alpha) \ln(L_i) \\ &\quad + (1 - \alpha) \ln\left(1 + \gamma \frac{L_{i1}}{L_i}\right) + \ln(A). \end{aligned} \quad (3)$$

Letting  $\ln(\lambda_{i0})$  be constant term  $c$ , subtracting  $\ln(L_i)$  from both sides, and applying the approximation  $\ln(1 + x) \approx x$ , which holds with  $x \ll 1$ , the output per employee for each firm is given by:

$$\ln\left(\frac{Q_i}{L_i}\right) = c + \alpha \ln\left(\frac{K_i}{L_i}\right) + (1 - \alpha)\gamma \left(\frac{L_{i1}}{L_i}\right).$$

Our empirical analysis uses longitudinal data on firms. Therefore, the structural model introducing observation point  $t$  is formulated as follows:

$$\ln\left(\frac{Q_{it}}{L_{it}}\right) = c + \alpha \ln\left(\frac{K_{it}}{L_{it}}\right) + (1 - \alpha)\gamma \left(\frac{L_{it1}}{L_{it}}\right) + \theta_i + \phi_t + \varepsilon_{it}, \quad (4)$$

where  $\theta_i$  is the time-invariant firm fixed effect and  $\phi_t$  is the time effect.

Ideally, we should estimate equation (4); however, because data on fixed assets, such as capital  $K$  are available only for a subset of firms, we omit  $\ln(K/L)$  in the main analysis.

However, as shown in Appendix 1, we confirm that the estimation results using this variable for the sample for which  $\ln(K/L)$  is available do not differ from the main results.<sup>5</sup> Regarding the actual employment rate of persons with disabilities ( $L_{it1}/L_{it}$ ), when we utilize the instrumental variable method with this variable as an endogenous variable, we use the number of employees legally assigned to persons with disabilities as instruments, which vary across firms, instead of the legal employment rate, which does not vary across firms. Therefore, we use the actual number of employees with disabilities ( $L_{i1t}$ ) instead of the actual employment rate of persons with disabilities ( $L_{it1}/L_{it}$ ). We then separately control for  $\ln(L_{it})$  as firm size (i.e., the denominator of the actual employment rate of persons with disabilities). The actual estimation model for the baseline analysis is as follows:

$$\ln\left(\frac{Q_{it}}{L_{it}}\right) = c + \delta L_{it1} + \eta \ln(L_{it}) + \theta_i + \phi_t + \varepsilon_{it}. \quad (5)$$

As for financial performance indicator  $Q_{it}$ , we use sales and net income as the basis, as well as operating income, recurring profit, and total factor productivity (TFP), although the number of observations is smaller due to the differences in data sources. Variables other than TFP are converted to regular employees.

To estimate Eq. (5), we use a variety of estimation methods. First, we present pooled ordinary least squares (OLS) estimates that ignore firm fixed effects ( $\theta_i$ ). When firm fixed effects are not considered, the relationship between the employment of persons with disabilities and productivity is identified based on cross-sectional variation. Next, we introduce firm fixed effects ( $\theta_i$ ). In this case, the relationship is identified as average within-firm variation. The introduction of firm fixed effects addresses the potential spurious correlation between the employment of persons with disabilities and productivity but does not solve all problems. This is because there remains a concern that changes in disability employment are not exogenous to changes in productivity. For example, unobservable negative productivity shock may cause a firm to stop hiring people with disabilities. To address potential endogeneity bias, we conduct an analysis in which the number of employees with disabilities assigned to each firm was used as an instrumental variable (i.e., the fixed effects instrumental variable method).<sup>6</sup>

We consider heterogeneity based on firm characteristics. First, the analysis targets firms with subsidiaries that give special consideration to the employment of people with disabilities. As discussed in Section 2, the advantages of special subsidiaries include: (1) the ability to fully determine the abilities of persons with disabilities by securing jobs and creating a work environment that considers the characteristics of their disabilities, (2) the ability to increase the workplace retention rate and productivity and centralize capital investment when accepting persons with disabilities, and (3) the ability to enable flexible employment management by setting different working conditions from those of the parent company. This

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<sup>5</sup> For details, see Appendix 1.

<sup>6</sup> We also use the generalized method of moments (GMM) with the lagged level variable of the employment of persons with disabilities as the instrumental variable (van Ours and Stoeldraijer, 2011; Cardoso and Varejão, 2011). However, the validity of the instrumental variable is questionable due to Hansen's J test, among others. Therefore, we analyze the number of quotas for the employment of persons with disabilities as the instrumental variable.

means that the employment of persons with disabilities has advantages in terms of productivity and employment costs, especially for companies with a relatively large number of persons with disabilities in special subsidiaries, whose employment may have a positive impact on the overall performance of the company.

Second, we examine whether firms employed persons with disabilities at the beginning of the analysis period. If hiring persons with disabilities involves fixed costs, such as the development of internal rules and capital investment, then the cost of hiring persons with disabilities may be higher for firms that have not previously employed persons with disabilities than for those that have.<sup>7</sup> Morozumi (2017) points out that reasonable accommodation for hiring persons with disabilities, as stipulated in Japan in 2011, includes fixed costs for installing ramps and handrails that are accessible to people with and without disabilities, as well as quasi-fixed costs for customizing the workplace for each individual with a disability. Therefore, in addition to the baseline analysis, we separate the firms that employed no persons with disabilities from those that employed one or more such persons at the beginning of the analysis period.

Third, we consider heterogeneity by industry sector. This may occur between manufacturing and other industries that actively accept people with disabilities. Therefore, we estimate separately for the manufacturing and non-manufacturing industries.

In addition, the employment status of persons with disabilities differs depending on firm size. One caveat of this analysis is that the ratio of the number of workers with disabilities to the total number of employees is marginal, and the impact may be difficult to determine, especially for large firms (Mori and Sakamoto, 2018). Therefore, in addition to the analysis for the whole sample, we also analyze firm sizes with more than 200 employees but less than or equal to 1,000 and those with more than 1,000 employees. Hereafter, we refer to the former as medium-sized and the latter as large firms.

### 3.2 Data

We merge the two datasets for the analysis. First, we use the Report on Employment Status of Persons with Disabilities of the MHLW, which is managed by 47 prefectural labor bureaus under the jurisdiction of the MHLW and was obtained by making a disclosure request to each of them. Employers above a certain size (e.g., 50 or more regular workers in 2013) are required to report the employment status of the workers with disabilities to the Public Employment Security Office in their respective jurisdictions as of June 1 each year.

The analysis covers firms with more than 200 regular workers as of 2013. This is because, as shown in Table 1, firms with fewer than 200 regular workers were affected by the 2015 changes in the levy–grant system.

These data include the name of the firm, address, industrial classification, number of regular workers, legal employment obligations of persons with disabilities, number of workers

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<sup>7</sup> Peck (2017) evaluates the Nitaqat Program, which implemented employment quotas for native workers in Saudi Arabia, finding that it has a negative impact on firm survival. In particular, that the negative impact of employment quotas is larger for firms that did not originally employ Saudi nationals, suggesting that there are large fixed costs associated with hiring quota-eligible workers.

with disabilities, actual employment rate of persons with disabilities, and number of workers with disabilities in shortage. However, the number of employees by degree and type of disability is not available because individuals can be identified.

The analysis period is from 2013 to 2019. However, the 2013 data for the Oita Prefecture were unavailable because of the expiration of the retention period for administrative documents.

Second, we use Tokyo Shoko Research's (TSR) Corporate Information File and Financial Information File. The Financial Information File contains variables related to corporate profits, such as sales, operating income, recurring profit, and net income, as well as other variables that are sufficient to calculate TFP.<sup>8</sup> However, the Corporate Information File only provides information on sales and net income, which are variables related to firm profit. However, the Financial Information File is more prone to missing data for smaller firms and the sample is nearly 30% smaller compared to the Corporate Information File. Sales and net income are analyzed using the Corporate Information File, which has a large sample size, whereas operating income, recurring profit, and TFP are analyzed using data from the Financial Information File. Although most firms have a 12-month fiscal period, some firms have a 6-month or 3-month fiscal year. For this reason, flow variables, such as sales and net income, are divided by the number of months in the fiscal year, and the value per month is used.<sup>9</sup> The financial indicators could be zero. In addition, the operating income, recurring profits, and net income may be negative. If any of these variables is non-negative, we add 1 and take the logarithm. If a variable is negative, we negate it, add 1, take the logarithm, and then negate the logarithm again.

As the Report on Employment Status of Persons with Disabilities and the TSR do not have a common ID for each observation, we merge firms by matching firm names and addresses. In the analysis, both the Report on Employment Status of Persons with Disabilities and the TSR are limited to firms without errors or missing values due to input errors. We also limit our analysis to commercial enterprises, such as joint stock companies (Kabushiki Gaisha), limited liability companies (Yugen Gaisha, Godo Gaisha), limited partnership companies (Goshi Gaisha), and general partnership companies (Gomei Gaisha).

Table 2 shows the descriptive statistics. By firm size, all financial performance indicators are greater for large firms (more than 1,000 employees) than for medium-sized firms (more than 200 but less than or equal to 1,000 employees).

Figure 2 illustrates the average number of workers with disabilities. In general, the number of workers with disabilities increased over the study period. According to company size, in Figure 2(i), more persons with disabilities are employed in large firms than in medium-sized ones. Figure 2(ii) shows that firms with special subsidiaries employ more persons with disabilities than all firms. Figure 2(iii) presents a large gap in the number of workers with disabilities between companies that employed no workers with disabilities at all as of 2013,

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<sup>8</sup> TFP is calculated as the residual of the production function (TFP 1) and measured as the difference between the aggregate production and labor and capital inputs (TFP 2). The specific derivation is explained in Appendix 2.

<sup>9</sup> Since the Financial Information File occasionally has parts where the values are 1/1,000 of those in the Corporate Information File, the data are corrected by multiplying the relevant parts by 1,000.

the beginning of the analysis period, and companies that employed at least one worker with a disability. Comparing manufacturing firms that have actively employed people with disabilities in the past with non-manufacturing firms, Figure 2(iv) shows that the manufacturing industry has been more receptive to people with disabilities.

Table 2 Descriptive statistics

(i) All

Variable	Obs	Mean	Std. Dev.	Min	Max
<b>Corporate Information File</b>					
Log sales per regular employee	78,419	7.67	1.10	-9.19	12.85
Log net income per regular employee	78,419	3.12	2.73	-9.99	9.97
<b>Financial Information File</b>					
Log operating income per regular employee	52,155	3.66	2.63	-8.78	10.18
Log recurring profit per regular employee	52,155	4.00	2.36	-8.64	10.18
Log TFP 1	52,155	3.34	6.23	-36.70	12.56
Log TFP 2	52,155	0.59	6.27	-40.96	17.02

(ii) Medium-sized firms: more than 200 to 1,000 employees

Variable	Obs	Mean	Std. Dev.	Min	Max
<b>Corporate Information File</b>					
Log sales per regular employee	65,936	7.65	1.08	-6.59	12.85
Log net income per regular employee	65,936	3.03	2.72	-9.99	9.97
<b>Financial Information File</b>					
Log operating income per regular employee	42,974	3.59	2.62	-8.78	10.18
Log recurring profit per regular employee	42,974	3.91	2.38	-8.64	10.18
Log TFP 1	42,974	3.21	6.27	-33.19	12.56
Log TFP 2	42,974	0.58	6.31	-38.13	17.02

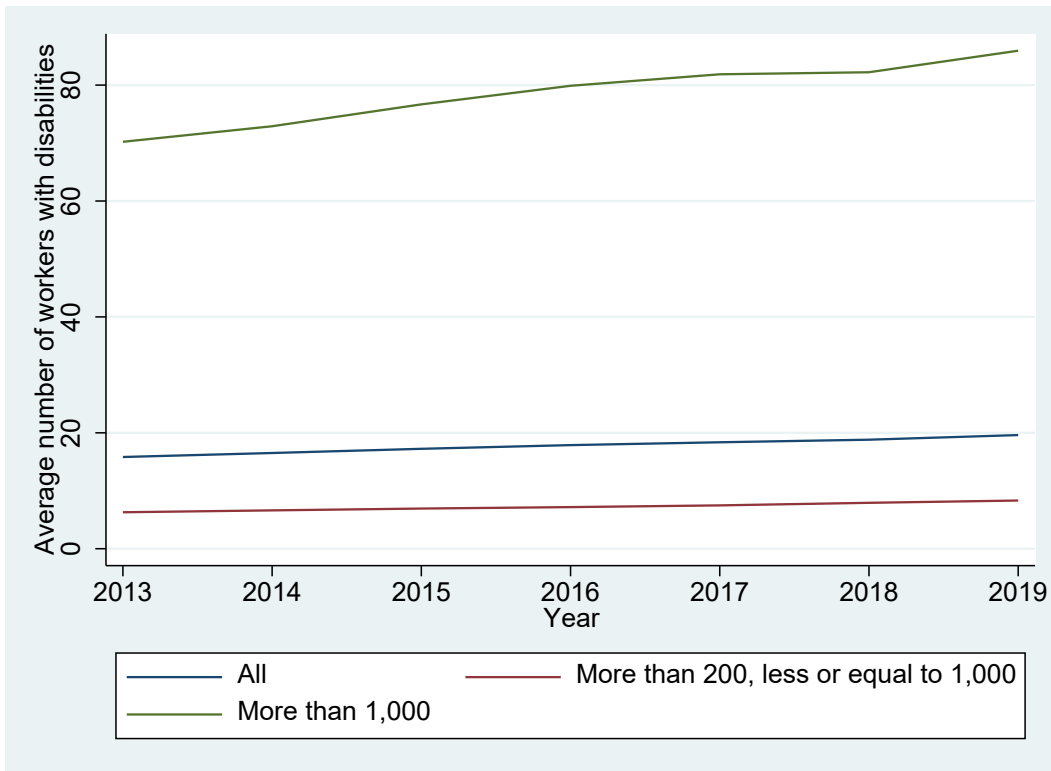
(iii) Large firms: more than 1,000 employees

Variable	Obs	Mean	Std. Dev.	Min	Max
<b>Corporate Information File</b>					
Log sales per regular employee	12,483	7.79	1.20	-9.19	12.10
Log net income per regular employee	12,483	3.60	2.77	-9.47	9.29
<b>Financial Information File</b>					
Log operating income per regular employee	9,181	3.96	2.64	-8.04	9.17
Log recurring profit per regular employee	9,181	4.43	2.22	-8.03	9.41
Log TFP 1	9,181	3.95	6.01	-36.70	8.52
Log TFP 2	9,181	0.63	6.08	-40.96	7.85

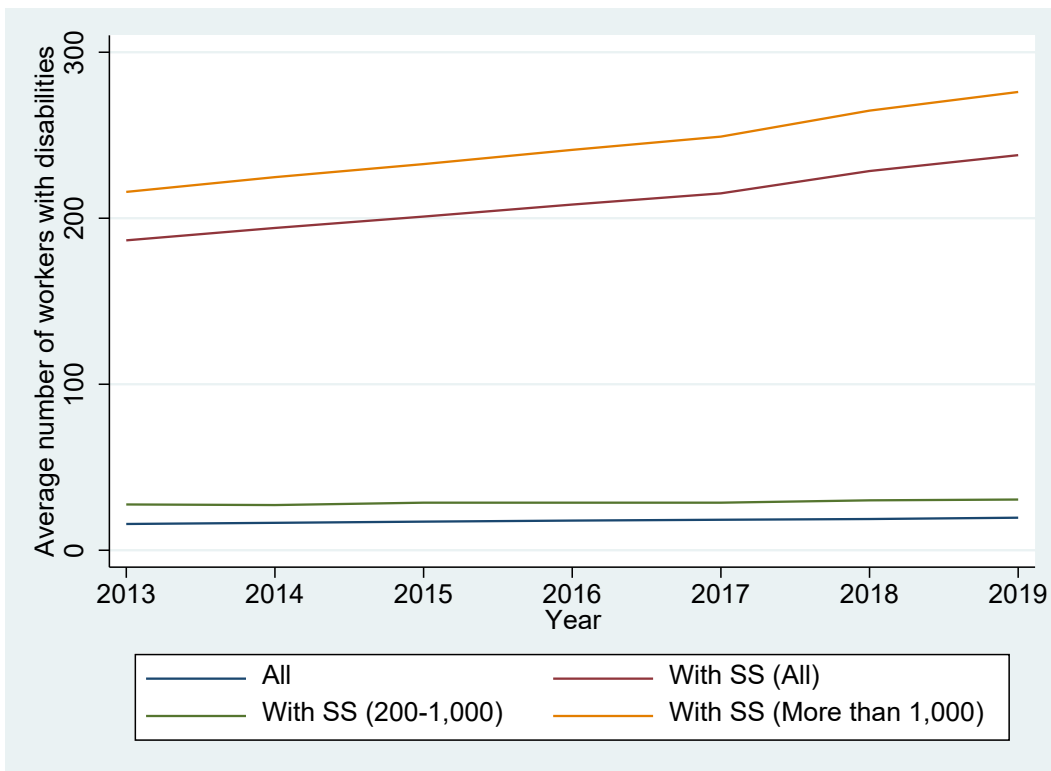
Note: "Log TFP 1" is calculated as the residual of the production function; "Log TFP 2" is measured as the difference between total output and labor and capital inputs. See the Appendix 2 for further details.

Figure 2 Number of employees with disabilities

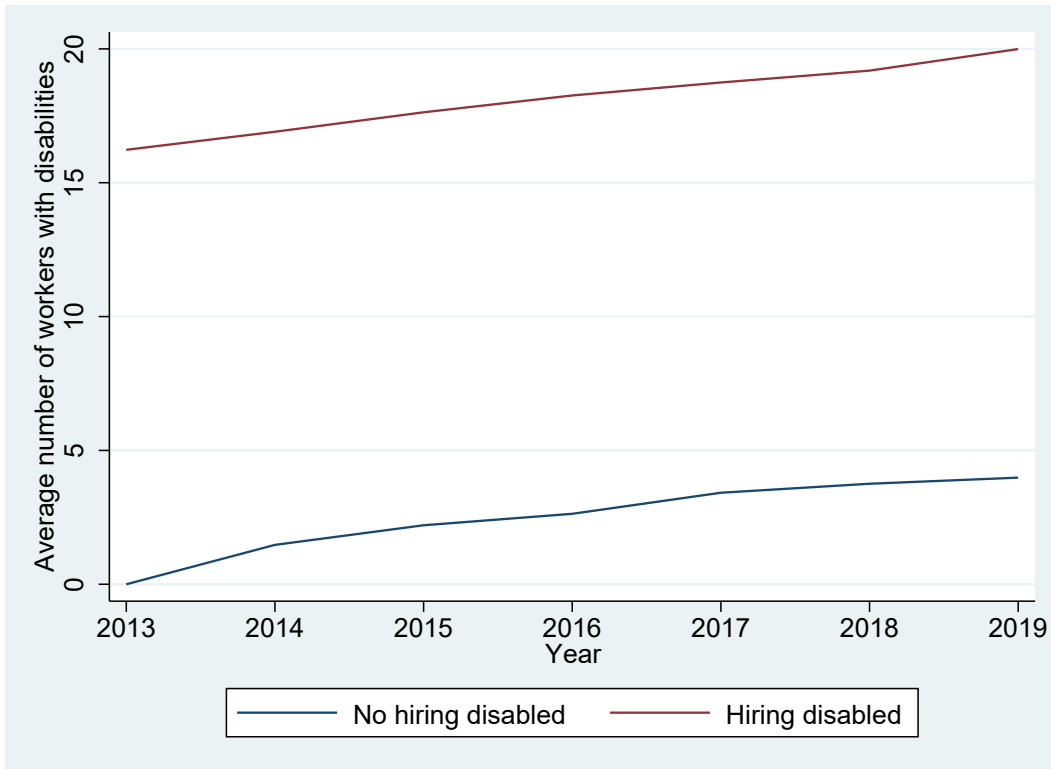
(i) Firm size



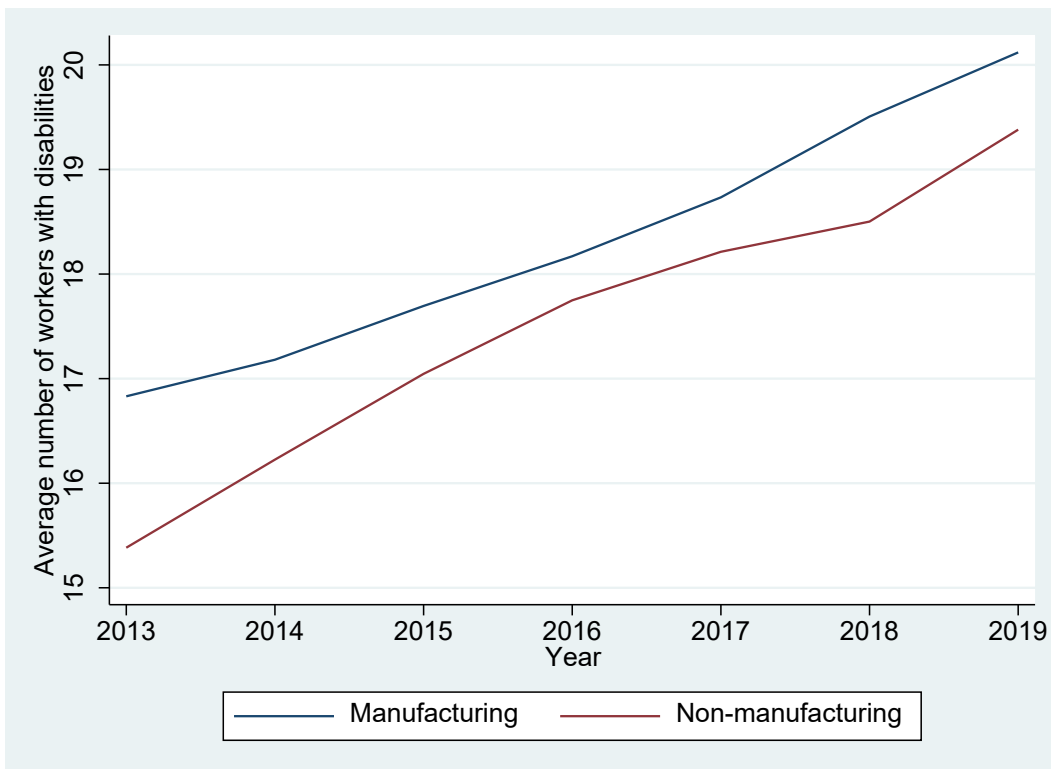
(ii) Companies with special subsidiaries



(iii) Whether the company employs people with disabilities



(iv) Manufacturing and non-manufacturing



Note: SS in (ii) indicates a special subsidiary.



## 4 Results

### 4.1 Baseline Results

Table 3 presents the results of the study. Regarding the number of persons with disabilities, the OLS results show that the coefficient is negative and statistically significant in all cases, except for TFP, regardless of firm size. However, the magnitude of the negative relationship with each outcome when the estimated coefficients indicate an increase of 1,000 persons with disabilities is -8.1% for sales per regular employee, -7.5% for net income per regular employee, -7.8% for operating income per regular employee, -7.5% for recurring profits per regular employee, and -9.5 or -14.1% for TFP. Given that the average number of employees with disabilities per firm is approximately 20, these results are economically insignificant. However, there are differences depending on firm size, with a larger negative coefficient for medium-sized firms.

Second, when firm fixed effects are considered, the coefficients are positive or negative, and, in all cases, they are not statistically significant. For medium-sized firms, the coefficients for operating income (gross profit minus selling and administrative expenses, including grants) and recurring income (operating income minus non-operating income, including grants and rewards) become negative but are still not statistically significant. Therefore, the negative correlation between the number of persons with disabilities and firm performance is spurious because of the unobservable heterogeneity across firms.

To account for unobservable shocks across firms, the sign and magnitude of the estimated coefficients are, in many cases, similar to those of the fixed effects estimation results when using the quota number of employees with disabilities based on the number of adjusted regular workers at each time point as the instrumental variable. Thus, when we consider the unobservable heterogeneity across firms, the changes in the number of workers with disabilities do not have statistically significant effects on firm performance.

Table 3 Results of disability employment and firm productivity

(i) All

Corporate Information File	OLS	FE	FEIV	OLS	FE	FEIV						
	Log sales per regular employee			Log net income per regular employee								
Number of workers with disabilities (/1000)	-0.0807*** (0.0205)	0.0140 (0.0279)	0.0119 (0.0364)	-0.0750** (0.0320)	-0.0957 (0.120)	-0.0857 (0.156)						
Log number of regular employees	0.0888*** (0.0141)	-0.518*** (0.0226)	-0.518*** (0.0232)	0.368*** (0.0256)	-0.814*** (0.0955)	-0.816*** (0.0975)						
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes						
Constant	7.117*** (0.0859)	10.85*** (0.139)	10.85*** (0.142)	0.738*** (0.157)	8.090*** (0.584)	8.100*** (0.594)						
N	78419	78419	78419	78419	78419	78419						
adj. R-sq	0.005	0.102		0.014	0.009							
First stage F values			815.16				815.16					

Financial Information File	OLS	FE	FEIV	OLS	FE	FEIV	OLS	FE	FEIV	OLS	FE	FEIV
	Log operating income per regular employee			Log recurring profit per regular employee			Log TFP 1			Log TFP 2		
Number of workers with disabilities (/1000)	-0.0783** (0.0362)	0.0225 (0.158)	0.0307 (0.208)	-0.0752** (0.0292)	0.0485 (0.128)	0.0467 (0.157)	-0.0945 (0.0596)	-0.0208 (0.307)	-0.152 (0.392)	-0.141* (0.0725)	-0.0172 (0.311)	-0.133 (0.396)
Log number of regular employees	0.285*** (0.0319)	-0.902*** (0.114)	-0.904*** (0.118)	0.333*** (0.0264)	-0.936*** (0.103)	-0.935*** (0.106)	0.515*** (0.0636)	-0.747*** (0.276)	-0.719** (0.282)	0.197*** (0.0675)	-0.761*** (0.276)	-0.737*** (0.283)
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	1.817*** (0.198)	9.208*** (0.697)	9.217*** (0.714)	1.836*** (0.165)	9.736*** (0.634)	9.734*** (0.646)	0.0406 (0.401)	7.895*** (1.695)	7.746*** (1.726)	-0.662 (0.423)	5.287*** (1.697)	5.156*** (1.729)
N	52155	52155	52155	52155	52155	52155	52155	52155	52155	52155	52155	52155
adj. R-sq	0.010	0.010		0.015	0.009		0.006	0.003		0.002	0.003	
First stage F values			575.65			575.65			575.65			575.65

(ii) Medium-sized firms: more than 200 to 1,000 employees

Corporate Information File	OLS	FE	FEIV	OLS	FE	FEIV						
	Log sales per regular employee			Log net income per regular employee								
Number of workers with disabilities (/1000)	-1.179*** (0.206)	-0.00881 (0.101)	-0.226 (0.233)	-2.135*** (0.590)	-0.0291 (0.441)	0.00860 (0.810)						
Log number of regular employees	0.156*** (0.0284)	-0.479*** (0.0241)	-0.460*** (0.0336)	0.620*** (0.0671)	-0.805*** (0.116)	-0.808*** (0.141)						
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes						
Constant	6.787*** (0.159)	10.45*** (0.140)	10.35*** (0.187)	-0.615* (0.367)	7.685*** (0.669)	7.702*** (0.796)						
N	65936	65936	65936	65936	65936	65936						
adj. R-sq	0.005	0.096		0.011	0.009							
First stage F values			499.09			499.09						

Financial Information File	OLS	FE	FEIV	OLS	FE	FEIV	OLS	FE	FEIV	OLS	FE	FEIV
	Log operating income per regular employee			Log recurring profit per regular employee			Log TFP 1			Log TFP 2		
Number of workers with disabilities (/1000)	-2.195*** (0.650)	-0.567 (0.402)	-0.385 (0.742)	-1.858*** (0.536)	-0.173 (0.344)	0.113 (0.610)	-0.617 (0.516)	1.409 (1.022)	1.222 (1.548)	-0.383 (0.538)	1.393 (1.021)	0.961 (1.585)
Log number of regular employees	0.637*** (0.0789)	-0.890*** (0.138)	-0.907*** (0.165)	0.569*** (0.0676)	-0.899*** (0.129)	-0.926*** (0.155)	0.872*** (0.118)	-1.175*** (0.342)	-1.158*** (0.401)	0.642*** (0.120)	-1.194*** (0.344)	-1.154*** (0.403)
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-0.115 (0.438)	8.798*** (0.798)	8.886*** (0.937)	0.567 (0.377)	9.140*** (0.746)	9.278*** (0.879)	-2.020*** (0.691)	9.924*** (1.983)	9.834*** (2.283)	-3.248*** (0.706)	7.462*** (1.992)	7.254*** (2.299)
N	42974	42974	42974	42974	42974	42974	42974	42974	42974	42974	42974	42974
adj. R-sq	0.011	0.010		0.010	0.009		0.005	0.003		0.004	0.004	
First stage F values			350.95			350.95			350.95			350.95

(iii) Large firms: more than 1,000 employees

	OLS	FE	FEIV	OLS	FE	FEIV
Corporate Information	Log sales per regular employee			Log net income per regular employee		
File						
Number of workers with disabilities (1000)	-0.0685*** (0.0187)	0.0485 (0.0342)	0.0624 (0.0448)	-0.0558** (0.0272)	-0.0860 (0.132)	-0.0704 (0.173)
Log number of regular employees	0.0456 (0.0436)	-0.682*** (0.0485)	-0.690*** (0.0505)	0.369*** (0.0735)	-0.877*** (0.184)	-0.886*** (0.190)
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes
Constant	7.476*** (0.329)	13.02*** (0.367)	13.07*** (0.377)	0.725 (0.561)	10.39*** (1.404)	10.45*** (1.431)
N	12483	12483	12483	12483	12483	12483
adj. R-sq	0.009	0.125		0.010	0.010	
First stage F values	500.26			500.26		

	OLS	FE	FEIV	OLS	FE	FEIV	OLS	FE	FEIV	OLS	FE	FEIV
Financial Information	Log operating income per regular employee			Log recurring profit per regular employee			Log TFP 1			Log TFP 2		
File												
Number of workers with disabilities (1000)	-0.0472* (0.0270)	0.0682 (0.180)	0.0305 (0.244)	-0.0547** (0.0240)	0.0641 (0.148)	0.0376 (0.185)	-0.0278 (0.0431)	-0.285 (0.357)	-0.521 (0.464)	-0.0480 (0.0460)	-0.280 (0.361)	-0.495 (0.469)
Log number of regular employees	0.240*** (0.0882)	-0.776*** (0.224)	-0.753*** (0.241)	0.299*** (0.0719)	-0.998*** (0.179)	-0.982*** (0.190)	0.313* (0.186)	0.463 (0.487)	0.607 (0.516)	-0.0988 (0.191)	0.472 (0.476)	0.603 (0.505)
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	2.105*** (0.674)	9.944*** (1.678)	9.793*** (1.771)	2.047*** (0.553)	12.07*** (1.338)	11.96*** (1.404)	1.509 (1.424)	0.572 (3.693)	-0.367 (3.855)	1.480 (1.457)	-2.762 (3.607)	-3.615 (3.765)
N	9181	9181	9181	9181	9181	9181	9181	9181	9181	9181	9181	9181
adj. R-sq	0.005	0.009		0.008	0.010		0.001	0.002		0.001	0.002	
First stage F values	356.83			356.83			356.83			356.83		

Note 1: Cluster standard errors for each firm level are shown between parentheses.

Note 2: OLS: ordinary least squares; FE: fixed effects; FEIV: fixed effects instrumental variables.

Note 3: “Log TFP 1” is calculated as the residual of the production function; “Log TFP 2” is measured as the difference between total output and labor and capital inputs. See the Appendix 2 for further details.

## 4.2 Heterogeneity of effects by firm type

So far, we have found no statistically significant relationship between the employment of persons with disabilities and firm performance for firms with more than 200 employees. Next, we examine the heterogeneity of the effect of employment of persons with disabilities by firm type, taking advantage of the fact that the data in this study cover a wide range of firms.

First, we focus on firms that employ a relatively large number of persons with disabilities in their special subsidiaries and manage their employment considering persons with disabilities. The estimation results are presented in Table 4. First, an interesting fact when compared to the results for all firms in Table 3, no negative correlation is observed between the number of workers with disabilities and firm performance in the OLS estimation results. Furthermore, according to the estimation results that allow for heterogeneity, such as fixed effects and unobservable shocks, for large firms, the coefficient is statistically significant at the 10% significance level for net income per regular employee, but not for all other outcomes. Meanwhile, the results of the analysis for medium-sized firms show that, although there are only 30 firms with special subsidiaries, financial indicators such as sales, net income, and operating income, which indicate profit from the main business per regular employee, increase as the number of employees with disabilities increases, while the recurring profit per regular employee and TFP are not statistically significantly affected.

Table 4 Results for companies with special subsidiaries

(i) All

	OLS	FE	FEIV	OLS	FE	FEIV						
<b>Corporate Information</b>	<b>Log sales per regular employee</b>			<b>Log net income per regular employee</b>								
File												
Number of workers	-0.0521	0.0251	0.0386	-0.0345	-0.486**	-0.551*						
with disabilities (/1000)	(0.0761)	(0.0674)	(0.0762)	(0.0727)	(0.246)	(0.294)						
Log number of regular employees	-0.0447	-0.280*	-0.298**	0.223	-1.043*	-0.956						
	(0.122)	(0.149)	(0.144)	(0.157)	(0.624)	(0.626)						
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes						
Constant	7.968***	9.765***	9.891***	1.927	13.35**	12.74**						
	(0.892)	(1.294)	(1.252)	(1.227)	(5.198)	(5.160)						
N	1337	1337	1337	1337	1337	1337						
adj. R-sq	0.010	0.011		0.004	0.020							
First stage F values			220.02									220.02
<b>Financial Information</b>	OLS	FE	FEIV	OLS	FE	FEIV	OLS	FE	FEIV	OLS	FE	FEIV
File	<b>Log operating income per regular employee</b>			<b>Log recurring profit per regular employee</b>			<b>Log TFP 1</b>			<b>Log TFP 2</b>		
Number of workers	-0.000779	0.0583	0.00150	-0.0693	0.00558	-0.0563	-0.0532	-0.485	-0.724	-0.0633	-0.451	-0.670
with disabilities (/1000)	(0.0715)	(0.301)	(0.362)	(0.0659)	(0.274)	(0.314)	(0.126)	(0.639)	(0.706)	(0.122)	(0.645)	(0.710)
Log number of regular employees	0.00686	-0.438	-0.356	0.207	-1.000	-0.911	0.0744	1.126	1.468	-0.371	1.160	1.474
	(0.164)	(0.706)	(0.729)	(0.154)	(0.655)	(0.692)	(0.270)	(1.383)	(1.557)	(0.267)	(1.385)	(1.555)
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	3.687***	7.323	6.749	2.663**	12.72**	12.10**	3.525	-4.503	-6.918	3.460	-8.706	-10.92
	(1.295)	(5.839)	(5.943)	(1.224)	(5.357)	(5.583)	(2.175)	(11.99)	(13.13)	(2.137)	(12.02)	(13.14)
N	1199	1199	1199	1199	1199	1199	1199	1199	1199	1199	1199	1199
adj. R-sq	-0.004	0.001		0.007	0.017		-0.002	0.003		0.007	0.004	
First stage F values			200.43						200.43			200.43

(ii) Medium-sized firms: more than 200 to 1,000 employees

	OLS	FE	FEIV	OLS	FE	FEIV						
<b>Corporate Information</b>	<b>Log sales per regular employee</b>			<b>Log net income per regular employee</b>								
File												
Number of workers	-0.340	0.0857	3.320**	0.788**	-0.126	29.20**						
with disabilities (/1000)	(0.246)	(0.521)	(1.652)	(0.383)	(3.246)	(13.58)						
Log number of regular employees	-0.353	-0.470*	-1.172***	-0.406	-3.032*	-9.404***						
	(0.289)	(0.244)	(0.362)	(0.599)	(1.483)	(3.455)						
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes						
Constant	9.691***	10.40***	13.91***	5.183	22.08**	53.92***						
	(1.791)	(1.565)	(1.941)	(3.681)	(8.842)	(18.01)						
N	195	195	195	195	195	195						
adj. R-sq	0.008	0.094		0.012	0.046							
First stage F values			34.19									34.19
<b>Financial Information</b>	OLS	FE	FEIV	OLS	FE	FEIV	OLS	FE	FEIV	OLS	FE	FEIV
File	<b>Log operating income per regular employee</b>			<b>Log recurring profit per regular employee</b>			<b>Log TFP 1</b>			<b>Log TFP 2</b>		
Number of workers	0.721	-3.422	23.95*	0.632	-4.566	18.90	-0.247	-8.021	23.55	-0.543	-7.351	23.98
with disabilities (/1000)	(0.568)	(5.084)	(14.05)	(0.516)	(4.583)	(12.93)	(0.755)	(11.82)	(16.39)	(0.524)	(11.91)	(16.47)
Log number of regular employees	-0.213	-1.310	-7.305*	-0.259	-0.782	-5.923	0.494	-0.397	-7.313	0.437	-0.547	-7.410
	(0.705)	(2.011)	(4.117)	(0.669)	(1.826)	(3.982)	(0.604)	(3.398)	(6.408)	(0.554)	(3.388)	(6.365)
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	4.261	12.39	41.74*	4.853	9.688	34.85	-0.868	7.132	40.99	-3.149	5.155	38.75
	(4.467)	(12.11)	(21.87)	(4.192)	(11.08)	(21.24)	(4.559)	(20.32)	(35.31)	(4.312)	(20.24)	(35.06)
N	154	154	154	154	154	154	154	154	154	154	154	154
adj. R-sq	-0.002	0.051		-0.005	0.055		0.003	0.024		0.005	0.023	
First stage F values			49.51						49.51			49.51

(iii) Large firms: more than 1,000 employees

	OLS	FE	FEIV	OLS	FE	FEIV
Corporate Information File	Log sales per regular employee			Log net income per regular employee		
Number of workers with disabilities (/1000)	-0.0153 (0.0943)	0.0221 (0.0698)	0.0355 (0.0783)	-0.0290 (0.0957)	-0.500* (0.260)	-0.581* (0.313)
Log number of regular employees	-0.213 (0.226)	-0.250 (0.164)	-0.271* (0.159)	0.176 (0.320)	-0.754 (0.684)	-0.633 (0.689)
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes
Constant	9.413*** (1.800)	9.604*** (1.487)	9.751*** (1.442)	2.402 (2.644)	11.49* (5.935)	10.61* (5.901)
N	1142	1142	1142	1142	1142	1142
adj. R-sq	0.015	0.006		-0.002	0.016	
First stage F values	220.35			220.35		

	OLS	FE	FEIV	OLS	FE	FEIV	OLS	FE	FEIV	OLS	FE	FEIV
Financial Information File	Log operating income per regular employee			Log recurring profit per regular employee			Log TFP 1			Log TFP 2		
Number of workers with disabilities (/1000)	-0.00921 (0.0897)	0.0719 (0.307)	-0.0200 (0.377)	-0.0535 (0.0886)	-0.00685 (0.284)	-0.0928 (0.331)	-0.0819 (0.159)	-0.441 (0.657)	-0.756 (0.733)	-0.109 (0.157)	-0.409 (0.663)	-0.703 (0.737)
Log number of regular employees	0.0346 (0.314)	-0.294 (0.752)	-0.151 (0.785)	0.116 (0.315)	-0.887 (0.694)	-0.754 (0.742)	0.224 (0.574)	1.387 (1.469)	1.875 (1.676)	-0.135 (0.570)	1.428 (1.466)	1.884 (1.670)
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	3.551 (2.619)	6.244 (6.457)	5.202 (6.626)	3.507 (2.579)	12.21** (5.883)	11.24* (6.185)	2.546 (4.837)	-6.863 (13.26)	-10.43 (14.68)	1.731 (4.785)	-11.30 (13.26)	-14.64 (14.66)
N	1045	1045	1045	1045	1045	1045	1045	1045	1045	1045	1045	1045
adj. R-sq	-0.006	-0.004		0.001	0.013		-0.003	0.003		0.002	0.003	
First stage F values	201.33			201.33			201.33			201.33		

Note 1: Cluster standard errors for each firm level are shown between parentheses.

Note 2: OLS: ordinary least squares; FE: fixed effects; FEIV: fixed-effects instrumental variables.

Note 3: “Log TFP 1” is calculated as the residual of the production function; “Log TFP 2” is measured as the difference between total output and labor and capital inputs. See the Appendix 2 for further details.

Second, to consider the quantitative size of the employment of persons with disabilities, we distinguish between firms that did not employ persons with disabilities and those that employed at least one person with disabilities at the beginning of the analysis period in 2013. Table 5 shows the estimated results for firms that did not employ persons with disabilities, and Table 6 the estimated results for firms that employed at least one person with disabilities. Because almost all large firms have employed at least one person with a disability since 2013, Table 5 shows only the results for medium-sized firms with more than 200 but less than or equal to 1,000 employees.

Among the medium-sized firms that did not employ any persons with disabilities as of 2013, according to the OLS estimation results in Table 5, none of the coefficients are statistically significant. However, there is a statistically significant negative correlation between the subsequent variation in the number of workers with disabilities and the recurring profit per regular employee based on the results of fixed effects considering unobservable heterogeneity across firms. However, when firms’ unobservable shocks are considered using instrumental variable methods, the coefficients become statistically insignificant. This suggests that firms that start employing persons with disabilities are likely to be small in terms of profit after considering the levies and grants of the employment promotion system for persons with disabilities; further, the extensive margin of employment of persons with disabilities, that is, the profit and cost effects of employing persons with disabilities for the first time, are not found, on average. By contrast, Table 6 shows that the results for firms that employed at least one person with a disability as of 2013 are consistent with the results for all

firms in Table 3. In other words, although the OLS shows a negative correlation between the number of employees with disabilities and firm performance, the effect of the number of workers with disabilities is not statistically significant when firm heterogeneity is considered.

Table 5 Results for medium-sized firms that did not employ people with disabilities at all in 2013

Corporate Information File	OLS	FE	FEIV	OLS	FE	FEIV						
	Log sales per regular employee			Log net income per regular employee			Log TFP 1			Log TFP 2		
Number of workers with disabilities (/1000)	-1.835 (2.249)	-0.626 (0.862)	-0.817 (2.087)	-5.145 (5.043)	-2.401 (4.866)	-32.20 (20.53)	24.61 (19.02)	-15.00 (10.59)	-29.59 (40.50)	25.95 (19.69)	-14.58 (10.60)	-30.52 (40.91)
Log number of regular employees	-0.287 (0.250)	-0.307*** (0.0958)	-0.300** (0.135)	-0.0694 (0.513)	-0.198 (0.700)	0.885 (0.979)	1.588 (1.550)	0.446 (2.066)	0.957 (2.908)	1.920 (1.580)	0.605 (2.100)	1.164 (2.970)
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	9.072*** (1.385)	9.192*** (0.527)	9.154*** (0.742)	2.884 (2.839)	3.872 (3.871)	-2.108 (5.378)	(8.643)	(11.27)	(15.85)	(8.833)	(11.45)	(16.18)
N	1230	1230	1230	1230	1230	1230	746	746	746	746	746	746
adj. R-sq	0.007	0.110		-0.002	0.000		0.008	0.002		0.010	0.003	
First stage F values	70.14			70.14			42.97			42.97		

Note 1: Cluster standard errors for each firm level are shown between parentheses.

Note 2: OLS: ordinary least squares; FE: fixed effects; FEIV: fixed-effects instrumental variables.

Note 3: “Log TFP 1” is calculated as the residual of the production function; “Log TFP 2” is measured as the difference between total output and labor and capital inputs. See the Appendix 2 for further details.

Table 6 Results for firms that employed at least one person with a disability (2013 baseline)

(i) All

Corporate Information File	OLS	FE	FEIV	OLS	FE	FEIV						
	Log sales per regular employee			Log net income per regular employee			Log TFP 1			Log TFP 2		
Number of workers with disabilities (/1000)	-0.0805*** (0.0205)	0.0154 (0.0279)	0.0134 (0.0365)	-0.0737** (0.0316)	-0.0935 (0.120)	-0.0810 (0.156)	0.503*** (0.0635)	-0.732*** (0.279)	-0.702** (0.286)	0.189*** (0.0673)	-0.750*** (0.279)	-0.723** (0.286)
Log number of regular employees	0.0868*** (0.0143)	-0.523*** (0.0231)	-0.523*** (0.0238)	0.363*** (0.0257)	-0.823*** (0.0967)	-0.825*** (0.0988)	0.107 (0.401)	7.819*** (1.720)	7.656*** (1.752)	-0.621 (0.423)	5.222*** (1.722)	5.077*** (1.754)
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	7.133*** (0.0869)	10.90*** (0.142)	10.89*** (0.145)	0.777*** (0.158)	8.167*** (0.593)	8.179*** (0.603)	0.107 (0.401)	7.819*** (1.720)	7.656*** (1.752)	-0.621 (0.423)	5.222*** (1.722)	5.077*** (1.754)
N	76689	76689	76689	76689	76689	76689	51098	51098	51098	51098	51098	51098
adj. R-sq	0.004	0.102		0.014	0.009		0.006	0.003		0.002	0.003	
First stage F values	796.13			796.13			564.43			564.43		

(ii) Medium-sized firms: more than 200 to 1,000 employees

Corporate Information File	OLS	FE	FEIV	OLS	FE	FEIV
	Log sales per regular employee			Log net income per regular employee		
Number of workers with disabilities (/1000)	-1.218*** (0.217)	-0.00777 (0.102)	-0.235 (0.232)	-2.173*** (0.604)	-0.0180 (0.445)	0.0813 (0.814)
Log number of regular employees	0.156*** (0.0292)	-0.483*** (0.0248)	-0.463*** (0.0347)	0.616*** (0.0682)	-0.816*** (0.118)	-0.825*** (0.144)
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes
Constant	6.791*** (0.163)	10.49*** (0.144)	10.38*** (0.193)	-0.572 (0.373)	7.767*** (0.682)	7.813*** (0.813)
N	64206	64206	64206	64206	64206	64206
adj. R-sq	0.005	0.096		0.011	0.009	
First stage F values			469.01			469.01

Financial Information File	OLS	FE	FEIV	OLS	FE	FEIV	Log TFP 1			Log TFP 2		
	Log operating income per regular employee			Log recurring profit per regular employee								
Number of workers with disabilities (/1000)	-2.216*** (0.659)	-0.569 (0.404)	-0.520 (0.775)	-1.895*** (0.548)	-0.172 (0.347)	0.0227 (0.625)	-0.633 (0.516)	1.606 (1.030)	1.240 (1.569)	-0.357 (0.534)	1.598 (1.029)	1.013 (1.602)
Log number of regular employees	0.631*** (0.0798)	-0.870*** (0.141)	-0.875*** (0.170)	0.566*** (0.0686)	-0.887*** (0.132)	-0.905*** (0.159)	0.849*** (0.118)	-1.188*** (0.349)	-1.153*** (0.410)	0.621*** (0.120)	-1.212*** (0.350)	-1.157*** (0.413)
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-0.0752 (0.443)	8.694*** (0.818)	8.718*** (0.967)	0.591 (0.382)	9.082*** (0.766)	9.178*** (0.906)	-1.893*** (0.694)	9.999*** (2.024)	9.818*** (2.339)	-3.145*** (0.708)	7.556*** (2.032)	7.268*** (2.354)
N	41917	41917	41917	41917	41917	41917	41917	41917	41917	41917	41917	41917
adj. R-sq	0.011	0.010		0.011	0.009		0.005	0.004		0.004	0.004	
First stage F values			332.82			332.82			332.82			332.82

(iii) Large firms: more than 1,000 employees

Corporate Information File	OLS	FE	FEIV	OLS	FE	FEIV
	Log sales per regular employee			Log net income per regular employee		
Number of workers with disabilities (/1000)	-0.0685*** (0.0187)	0.0485 (0.0342)	0.0624 (0.0448)	-0.0558** (0.0272)	-0.0860 (0.132)	-0.0704 (0.173)
Log number of regular employees	0.0456 (0.0436)	-0.682*** (0.0485)	-0.690*** (0.0505)	0.369*** (0.0735)	-0.877*** (0.184)	-0.886*** (0.190)
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes
Constant	7.476*** (0.329)	13.02*** (0.367)	13.07*** (0.377)	0.725 (0.561)	10.39*** (1.404)	10.45*** (1.431)
N	12483	12483	12483	12483	12483	12483
adj. R-sq	0.009	0.125		0.010	0.010	
First stage F values			500.26			500.26

Financial Information File	OLS	FE	FEIV	OLS	FE	FEIV	Log TFP 1			Log TFP 2		
	Log operating income per regular employee			Log recurring profit per regular employee								
Number of workers with disabilities (/1000)	-0.0472* (0.0270)	0.0682 (0.180)	0.0305 (0.244)	-0.0547** (0.0240)	0.0641 (0.148)	0.0376 (0.185)	-0.0278 (0.0431)	-0.285 (0.357)	-0.521 (0.464)	-0.0480 (0.0460)	-0.280 (0.361)	-0.495 (0.469)
Log number of regular employees	0.240*** (0.0882)	-0.776*** (0.224)	-0.753*** (0.241)	0.299*** (0.0719)	-0.998*** (0.179)	-0.982*** (0.190)	0.313* (0.186)	0.463 (0.487)	0.607 (0.516)	-0.0988 (0.191)	0.472 (0.476)	0.603 (0.505)
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	2.105*** (0.674)	9.944*** (1.678)	9.793*** (1.771)	2.047*** (0.553)	12.07*** (1.338)	11.96*** (1.404)	1.509 (1.424)	0.572 (3.693)	-0.367 (3.855)	1.480 (1.457)	-2.762 (3.607)	-3.615 (3.765)
N	9181	9181	9181	9181	9181	9181	9181	9181	9181	9181	9181	9181
adj. R-sq	0.005	0.009		0.008	0.010		0.001	0.002		0.001	0.002	
First stage F values			356.83			356.83			356.83			356.83

Note 1: Cluster standard errors for each firm level are shown between parentheses.

Note 2: OLS: ordinary least squares; FE: fixed effects; FEIV: fixed-effects instrumental variables.

Note 3: “Log TFP 1” is calculated as the residual of the production function; “Log TFP 2” is measured as the difference between total output and labor and capital inputs. See the Appendix 2 for further details.

Third, we focus on the differences in effects across industries. Tables 7 and 8 show the estimated results for manufacturing and non-manufacturing industries, respectively. Most of the results are similar to those in Table 3, with the coefficient on the number of workers with disabilities being statistically insignificant. For the non-manufacturing industry, although the coefficients are positive and statistically significant at the 10% level under the fixed effects

and instrumental variable methods, they are not statistically significant when analyzed by firm size.

Table 7 Results for manufacturing

(i) All

	OLS	FE	FEIV	OLS	FE	FEIV						
<b>Corporate Information</b>	Log sales per regular employee			Log net income per regular employee								
File												
Number of workers with disabilities (/1000)	-0.0759** (0.0326)	0.0637 (0.0782)	0.0777 (0.0948)	-0.192** (0.0860)	-0.355 (0.321)	-0.372 (0.379)						
Log number of regular employees	0.228*** (0.0188)	-0.432*** (0.0515)	-0.435*** (0.0530)	0.583*** (0.0523)	-1.404*** (0.274)	-1.401*** (0.277)						
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes						
Constant	6.440*** (0.113)	10.49*** (0.317)	10.51*** (0.323)	-0.382 (0.317)	11.97*** (1.679)	11.95*** (1.695)						
N	25363	25363	25363	25363	25363	25363						
adj. R-sq	0.049	0.071		0.026	0.014							
First stage F values			378.33									378.33
<b>Financial Information</b>	Log operating income per regular employee			Log recurring profit per regular employee			Log TFP 1			Log TFP 2		
File												
Number of workers with disabilities (/1000)	-0.239** (0.0970)	-0.0704 (0.412)	0.00745 (0.438)	-0.221*** (0.0792)	0.0909 (0.304)	0.142 (0.314)	-0.528*** (0.204)	-0.521 (0.831)	-0.724 (0.892)	-0.510** (0.202)	-0.489 (0.837)	-0.680 (0.897)
Log number of regular employees	0.459*** (0.0669)	-1.745*** (0.294)	-1.764*** (0.295)	0.614*** (0.0516)	-1.677*** (0.265)	-1.690*** (0.266)	0.867*** (0.129)	-2.882*** (0.755)	-2.833*** (0.761)	0.495*** (0.129)	-2.926*** (0.757)	-2.879*** (0.763)
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.770* (0.410)	14.50*** (1.808)	14.60*** (1.812)	0.307 (0.320)	14.56*** (1.633)	14.62*** (1.639)	-2.650*** (0.806)	20.71*** (4.663)	20.44*** (4.691)	-3.274*** (0.810)	18.02*** (4.678)	17.77*** (4.705)
N	17493	17493	17493	17493	17493	17493	17493	17493	17493	17493	17493	17493
adj. R-sq	0.018	0.018		0.039	0.014		0.011	0.008		0.006	0.008	
First stage F values			300.83			300.83			300.83			300.83

(ii) Medium-sized firms: more than 200 to 1,000 employees

	OLS	FE	FEIV	OLS	FE	FEIV						
<b>Corporate Information</b>	Log sales per regular employee			Log net income per regular employee								
File												
Number of workers with disabilities (/1000)	-2.162*** (0.327)	0.123 (0.153)	-0.552 (0.663)	-4.711*** (1.224)	0.334 (0.899)	-5.837 (4.567)						
Log number of regular employees	0.421*** (0.0392)	-0.421*** (0.0507)	-0.372*** (0.0877)	1.085*** (0.110)	-1.445*** (0.310)	-0.994** (0.505)						
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes						
Constant	5.450*** (0.215)	10.24*** (0.304)	10.000*** (0.481)	-3.013*** (0.604)	11.55*** (1.804)	9.329*** (2.717)						
N	21359	21359	21359	21359	21359	21359						
adj. R-sq	0.034	0.067		0.019	0.012							
First stage F values			109.19			109.19						
<b>Financial Information</b>	Log operating income per regular employee			Log recurring profit per regular employee			Log TFP 1			Log TFP 2		
File												
Number of workers with disabilities (/1000)	-5.079*** (1.386)	-0.652 (0.980)	-0.962 (5.001)	-4.812*** (1.224)	-0.343 (0.899)	3.586 (4.567)	-2.852 (2.318)	1.992 (2.616)	14.02 (11.90)	-1.443 (2.235)	1.966 (2.626)	13.98 (12.06)
Log number of regular employees	1.074*** (0.159)	-1.870*** (0.324)	-1.845*** (0.509)	1.101*** (0.135)	-1.689*** (0.309)	-2.012*** (0.479)	1.251*** (0.312)	-3.618*** (0.880)	-4.606*** (1.426)	0.796** (0.309)	-3.664*** (0.883)	-4.651*** (1.441)
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-2.538*** (0.868)	14.50*** (1.882)	14.37*** (2.729)	-2.241*** (0.738)	13.89*** (1.797)	15.52*** (2.575)	-4.766*** (1.741)	23.50*** (5.116)	28.49*** (7.733)	-5.002*** (1.731)	20.96*** (5.133)	25.94*** (7.810)
N	14255	14255	14255	14255	14255	14255	14255	14255	14255	14255	14255	14255
adj. R-sq	0.019	0.018		0.023	0.014		0.006	0.008		0.004	0.008	
First stage F values			64.66			64.66			64.66			64.66



(iii) Large firms: more than 1,000 employees

Corporate Information File	OLS	FE	FEIV	OLS	FE	FEIV
	Log sales per regular employee			Log net income per regular employee		
Number of workers with disabilities (/1000)	-0.0271 (0.0359)	0.0767 (0.0899)	0.102 (0.108)	-0.0874 (0.103)	-0.357 (0.352)	-0.334 (0.402)
Log number of regular employees	0.127** (0.0627)	-0.522*** (0.0949)	-0.541*** (0.0957)	0.412** (0.177)	-1.443*** (0.550)	-1.461*** (0.566)
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes
Constant	7.161*** (0.465)	12.14*** (0.726)	12.27*** (0.720)	0.832 (1.324)	15.50*** (4.206)	15.62*** (4.299)
N	4004	4004	4004	4004	4004	4004
adj. R-sq	0.008	0.094		0.014	0.021	
First stage F values			298.3			298.3

Financial Information File	OLS	FE	FEIV	OLS	FE	FEIV	Log TFP 1			Log TFP 2		
	Log operating income per regular employee			Log recurring profit per regular employee								
Number of workers with disabilities (/1000)	-0.151 (0.128)	-0.0203 (0.442)	0.0197 (0.469)	-0.147 (0.0995)	0.0766 (0.340)	0.0815 (0.357)	-0.272 (0.237)	-0.861 (0.931)	-1.129 (1.003)	-0.262 (0.235)	-0.829 (0.935)	-1.087 (1.004)
Log number of regular employees	0.331 (0.230)	-0.987 (0.703)	-1.022 (0.709)	0.475*** (0.165)	-1.464*** (0.505)	-1.468*** (0.519)	0.240 (0.393)	-0.341 (1.281)	-0.108 (1.327)	-0.104 (0.396)	-0.353 (1.278)	-0.128 (1.323)
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	1.794 (1.724)	12.00** (5.331)	12.24** (5.368)	1.289 (1.241)	16.27*** (3.824)	16.30*** (3.913)	2.095 (2.950)	7.179 (9.754)	5.578 (10.04)	1.252 (2.970)	3.713 (9.738)	2.170 (10.02)
N	3238	3238	3238	3238	3238	3238	3238	3238	3238	3238	3238	3238
adj. R-sq	0.010	0.026		0.016	0.017		0.006	0.012		0.010	0.012	
First stage F values			257.64			257.64			257.64			257.64

Note 1: Cluster standard errors for each firm level are shown between parentheses.

Note 2: OLS: ordinary least squares; FE: fixed effects; FEIV: fixed-effects instrumental variables.

Note 3: “Log TFP 1” is calculated as the residual of the production function; “Log TFP 2” is measured as the difference between total output and labor and capital inputs. See the Appendix 2 for further details.

Table 8 Results for non-manufacturing

(i) All

Corporate Information File	OLS	FE	FEIV	OLS	FE	FEIV
	Log sales per regular employee			Log net income per regular employee		
Number of workers with disabilities (/1000)	-0.0836*** (0.0268)	-0.00872 (0.0231)	-0.0255 (0.0278)	-0.0535* (0.0278)	0.0100 (0.105)	0.0788 (0.130)
Log number of regular employees	0.0263 (0.0191)	-0.537*** (0.0247)	-0.534*** (0.0252)	0.285*** (0.0286)	-0.683*** (0.0989)	-0.695*** (0.101)
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes
Constant	7.416*** (0.116)	10.89*** (0.151)	10.88*** (0.154)	1.160*** (0.178)	7.171*** (0.605)	7.236*** (0.614)
N	53056	53056	53056	53056	53056	53056
adj. R-sq	0.003	0.114		0.010	0.008	
First stage F values			571.2			571.2

Financial Information File	OLS	FE	FEIV	OLS	FE	FEIV	Log TFP 1			Log TFP 2		
	Log operating income per regular employee			Log recurring profit per regular employee								
Number of workers with disabilities (/1000)	-0.0460** (0.0233)	0.0878 (0.113)	0.0825 (0.155)	-0.0470** (0.0221)	0.0327 (0.0903)	-0.00641 (0.0929)	-0.00303 (0.0194)	0.316** (0.150)	0.396* (0.217)	-0.0598** (0.0287)	0.305** (0.150)	0.394* (0.215)
Log number of regular employees	0.221*** (0.0340)	-0.704*** (0.121)	-0.702*** (0.125)	0.211*** (0.0296)	-0.758*** (0.110)	-0.750*** (0.113)	0.400*** (0.0721)	-0.250 (0.281)	-0.266 (0.287)	0.0984 (0.0743)	-0.255 (0.280)	-0.273 (0.286)
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	2.206*** (0.213)	7.951*** (0.745)	7.946*** (0.763)	2.490*** (0.187)	8.533*** (0.678)	8.491*** (0.689)	1.032** (0.453)	5.058*** (1.731)	5.144*** (1.761)	0.358 (0.466)	2.519 (1.725)	2.616 (1.755)
N	34662	34662	34662	34662	34662	34662	34662	34662	34662	34662	34662	34662
adj. R-sq	0.006	0.007		0.007	0.008		0.004	0.001		0.001	0.002	
First stage F values			390.43			390.43			390.43			390.43

(ii) Medium-sized firms: more than 200 to 1,000 employees

Corporate Information File	OLS			FE			FEIV			OLS			FE			FEIV		
	Log sales per regular employee						Log net income per regular employee						Log TFP 1			Log TFP 2		
Number of workers with disabilities (/1000)	-1.111***	-0.0384	-0.182	-1.785***	-0.274	0.174	0.0762	0.916	-0.578	0.269	0.909	-0.857						
Log number of regular employees	0.0785**	-0.493***	-0.480***	0.492***	-0.628***	-0.668***	0.682***	-0.507	-0.365	0.493***	-0.518	-0.351						
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes						
Constant	7.162***	10.47***	10.40***	0.0463	6.597***	6.808***	-0.611	6.398***	5.655**	-1.955***	4.008*	3.130						
N	44577	44577	44577	44577	44577	44577	28719	28719	28719	28719	28719	28719						
adj. R-sq	0.004	0.109		0.009	0.008		0.004	0.002		0.003	0.002							
First stage F values			412.69						333.29			333.29						

(iii) Large firms: more than 1,000 employees

Corporate Information File	OLS			FE			FEIV			OLS			FE			FEIV		
	Log sales per regular employee						Log net income per regular employee						Log TFP 1			Log TFP 2		
Number of workers with disabilities (/1000)	-0.0739***	0.0287	0.0304	-0.0532*	0.0557	0.131	-0.00170	0.130	0.160	-0.0227	0.117	0.170						
Log number of regular employees	-0.0128	-0.706***	-0.706***	0.367***	-0.809***	-0.847***	0.511**	0.554	0.538	0.0344	0.572	0.543						
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes						
Constant	7.762***	13.03***	13.04***	0.539	9.522***	9.762***	0.0567	-0.394	-0.289	0.670	-3.639	-3.452						
N	8479	8479	8479	8479	8479	8479	5943	5943	5943	5943	5943	5943						
adj. R-sq	0.015	0.132		0.010	0.009		0.005	0.000		-0.001	0.001							
First stage F values			335.15						220.55			220.55						

Note 1: Cluster standard errors for each firm level are shown between parentheses.

Note 2: OLS: ordinary least squares; FE: fixed effects; FEIV: fixed-effects instrumental variables.

Note 3: “Log TFP 1” is calculated as the residual of the production function; “Log TFP 2” is measured as the difference between total output and labor and capital inputs. See the Appendix 2 for further details.

4.3 Discussion

Figure 3 summarizes the estimated effect of the number of workers with disabilities on financial performance using the instrumental variable method.

First, for all firms with more than 200 employees, the OLS results show an apparent negative correlation between the number of workers with disabilities and firm performance;

however, when unobservable heterogeneity is considered, the negative effect of the employment of workers with disabilities on firm performance is not statistically significant. These trends do not differ significantly by industry sector, such as manufacturing or non-manufacturing. This result is consistent with Mori and Sakamoto (2018), who use data from the manufacturing industry in 2008, but is somewhat different from Nagae (2014), who uses data from a panel of listed firms whose headquarters are located mainly in Tokyo in the 2000s.

Our results suggest that firms that employ a large number of people with disabilities and those that do not may exhibit heterogeneous corporate behavior, such as the pursuit of profit. In addition, the lack of a causal relationship between the number of workers with disabilities and firm profits at the individual firm level suggests that each firm may have achieved an optimal employment level after factoring in the levies and grants for the employment of disabled workers.

However, this result may be due to the fact that the legal employment rate of persons with disabilities is only around 2%, which is a marginal effect of employment quotas in terms of the overall production activities of firms.<sup>10</sup> In fact, as a new finding of this study, in medium-sized firms with more than 200 but up to 1,000 employees who have special subsidiaries that specialize in the employment of persons with disabilities, financial indicators such as sales, net income, and operating income, which indicate profit from the main business per regular employee, increase with the number of workers with disabilities, whereas the recurring profit per regular employee and TFP have no statistically significant effect. Specifically, examining the 30 medium-sized firms with special subsidiaries analyzed in this study, relatively fewer burdensome tasks related to the parent company's production activities were assigned as special subsidiary tasks, and the majority of these tasks included partial manufacturing operations, product packaging, and food material preparation. These tasks are considered to be those in which people with disabilities are relatively good at, in that the work content is not complex or sophisticated, and the required outcomes and rough processes of the outcomes are easy to set in advance (Nakajima, 2018). This finding suggests that economies of scale exist in firms that produce goods and services that match persons with disabilities by employing them on a large scale.

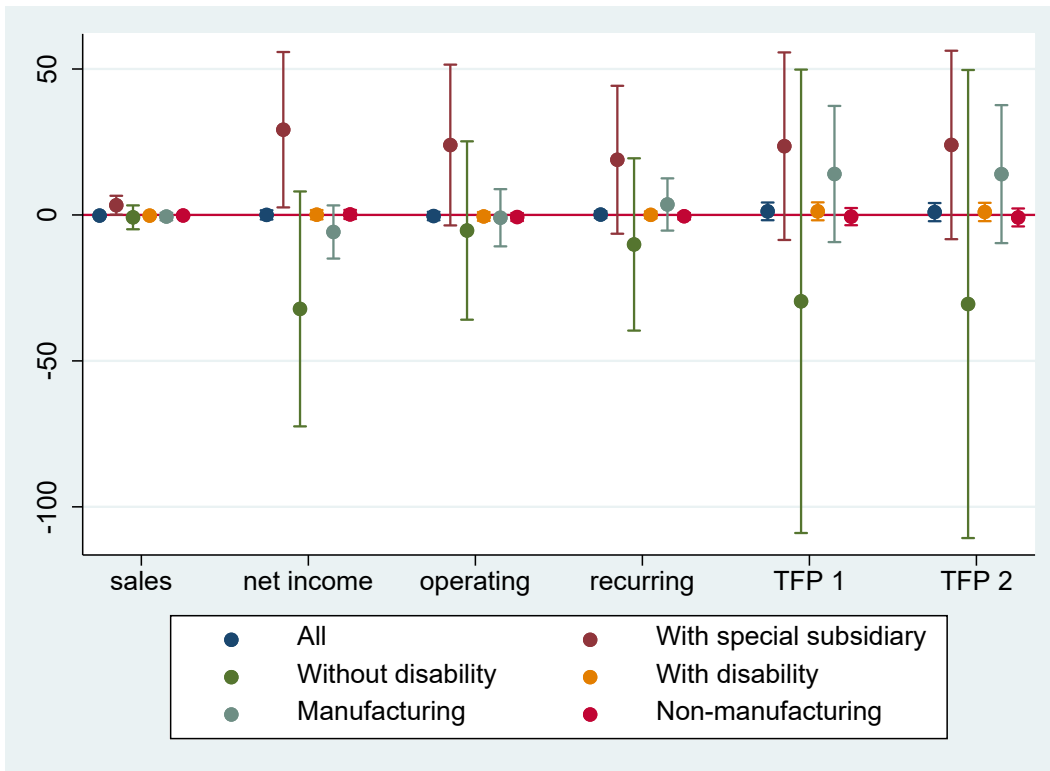
Finally, comparing firms that did not employ any persons with disabilities with those that employed at least one such person in 2013, the beginning of the analysis period, the effect of employment of persons with disabilities is not statistically significant for either group, although the error in the estimated coefficient of employment of persons with disabilities tended to be larger for the former group. Therefore, we find no evidence of an extensive margin of impact of the employment of persons with disabilities on firms' profits or costs, on average.

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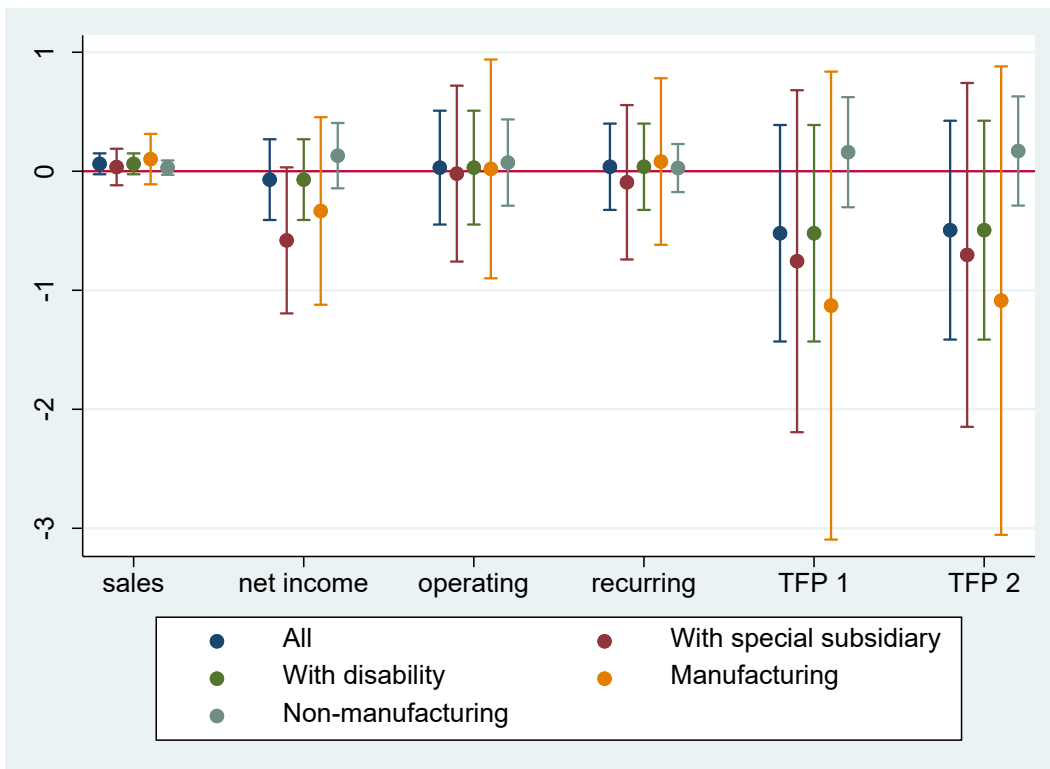
<sup>10</sup> By contrast, Peck (2017) reports that, in Saudi Arabia, the effect of quota employment on the majority—quota employment of its own citizens with high employment costs—has a significant impact on firm profits and survival.

Figure 3 Effects on productivity of employing people with disabilities

(i) Medium-sized firms: more than 200 to 1,000 employees



(ii) Large firms: more than 1,000 employees



Note 1: This figure shows the results of the analysis using the fixed effects instrumental variable method.

Note 2: The error bars indicate 95% confidence intervals calculated using cluster standard errors at each firm level.

Note 3: “operating” indicates operating income and “recurring” indicates recurring profit. In addition, sales, net income, operating income, and recurring profits per regular employee are included.

Note 4: “Log TFP 1” is calculated as the residual of the production function; “Log TFP 2” is measured as the difference between total output and labor and capital inputs. See the Appendix 2 for further details.

## 5. Conclusions

This study examined the impact of employment of persons with disabilities on firm productivity. According to previous theoretical studies and empirical analyses, the impact of the employment of persons with disabilities on firm productivity is controversial. In addition, data availability is limited in Japan, as the analysis of high-quality data is desired. This study used high-quality panel data: administrative data collected based on Japan's employment policy for persons with disabilities and financial information collected through credit surveys of private firms. We examined the causal effects of the employment of persons with disabilities on firms' financial indicators and productivity, not only the average effect across firms, but also the heterogeneity across various firm types. The results are as follows.

First, the employment of people with disabilities does not significantly affect firm performance in many cases. This is consistent with the findings of Mori and Sakamoto (2018), who use manufacturing industry data for a single time point. The analysis in this study showed that these trends were observed not only in the manufacturing industry but also in non-manufacturing industries. Second, a new finding is that, among medium-sized firms with special subsidiaries specializing in the employment of persons with disabilities, the higher is the employment rate of persons with disabilities, the higher are the sales, operating income, and net income per regular employee, indicating that gains from the employment of persons with disabilities are accrued. Finally, we could not find an extensive or intensive margin of employment for persons with disabilities at the beginning of the analysis period, since there was no impact of the increased employment of persons with disabilities on the financial indicators and productivity of firms, regardless of whether they employed persons with disabilities.

The fact that the number of persons with disabilities does not affect the profit margin, although there is a disparity in the number of workers with disabilities among firms, suggests that firms may have achieved optimal employment levels after factoring in the current levies and grants. However, there is a possibility that this result is due to the fact that the ratio of persons with disabilities in the labor market and the legal employment rate are marginal (around 2 %) and that persons with disabilities have not been able to develop jobs in which they have a comparative advantage.

One policy and business implication is consolidating people with disabilities in special subsidiaries, where the cost of hiring people with disabilities is low, to minimize costs to the company. However, this argument, which emphasizes the efficiency of employment for people with disabilities, is fraught with problems. This is because of the idea of normalization, in which people with disabilities are present in the general workplace as a norm. Further discussion is desirable among researchers, policymakers, and stakeholders regarding the type

of policies that should be implemented for the future employment of people with disabilities.

There are, of course, remaining issues in this study. We were unable to consider the impact of the type and degree of disability on firms' production activities due to data limitations. Future studies should analyze these aspects as well.

## Appendix 1

For Eq. (4), derived from the Cobb–Douglas production function, we also estimate the following model using the actual number of people with disabilities and the total number of employees, which constitute the actual employment rate of people with disabilities:

$$\ln\left(\frac{Q_{it}}{L_{it}}\right) = c + \alpha \ln\left(\frac{K_{it}}{L_{it}}\right) + \delta L_{it1} + \eta \ln(L_{it}) + \theta_i + \phi_t + \varepsilon_{it}. \quad (\text{A.1.1})$$

To estimate this model, we use only data for firms included in TSR's financial information file for which information on total fixed assets is available. The results for the effect of the employment of persons with disabilities on productivity are essentially unchanged from the results of the estimation in Eq. (5), which does not include the capital variable.

Table A.1 Results including all companies

(i) All

	OLS	FE	FEIV	OLS	FE	FEIV	OLS	FE	FEIV	OLS	FE	FEIV
	Log operating income per regular employee			Log recurring profit per regular employee			Log TFP 1			Log TFP 2		
Number of workers with disabilities (/1000)	-0.0823** (0.0396)	0.0218 (0.158)	0.0317 (0.208)	-0.0801** (0.0327)	0.0473 (0.128)	0.0483 (0.158)	-0.0945 (0.0597)	-0.0201 (0.308)	-0.153 (0.392)	-0.136** (0.0672)	-0.0131 (0.312)	-0.139 (0.398)
Log number of regular employees	0.181*** (0.0318)	-0.834*** (0.118)	-0.836*** (0.121)	0.206*** (0.0253)	-0.828*** (0.107)	-0.828*** (0.109)	0.515*** (0.0632)	-0.808*** (0.293)	-0.779*** (0.299)	0.321*** (0.0648)	-1.134*** (0.292)	-1.107*** (0.298)
Log fixed assets per regular employee	0.455*** (0.0151)	0.126*** (0.0483)	0.126*** (0.0483)	0.555*** (0.0127)	0.199*** (0.0481)	0.199*** (0.0481)	0.00313 (0.0333)	-0.113 (0.159)	-0.113 (0.159)	0.538*** (0.0339)	-0.691*** (0.157)	-0.691*** (0.157)
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-1.620*** (0.242)	7.656*** (0.932)	7.667*** (0.943)	-2.350*** (0.188)	7.280*** (0.873)	7.281*** (0.881)	0.0170 (0.497)	9.291*** (2.663)	9.139*** (2.677)	3.398*** (0.505)	13.82*** (2.642)	13.68*** (2.655)
N	52155	52155	52155	52155	52155	52155	52155	52155	52155	52155	52155	52155
adj. R-sq	0.076	0.010		0.138	0.010		0.006	0.003		0.018	0.005	
First stage F values			512.47			512.47			512.47			512.47

(ii) Medium-sized firms: more than 200 to 1,000 employees

	OLS	FE	FEIV	OLS	FE	FEIV	OLS	FE	FEIV	OLS	FE	FEIV
	Log operating income per regular employee			Log recurring profit per regular employee			Log TFP 1			Log TFP 2		
Number of workers with disabilities (/1000)	-1.755*** (0.580)	-0.564 (0.405)	-0.410 (0.760)	-1.350*** (0.457)	-0.168 (0.347)	0.0739 (0.618)	-0.590 (0.514)	1.404 (1.020)	1.255 (1.533)	-0.869 (0.567)	1.372 (1.015)	1.124 (1.507)
Log number of regular employees	0.568*** (0.0724)	-0.834*** (0.141)	-0.848*** (0.168)	0.489*** (0.0596)	-0.812*** (0.131)	-0.835*** (0.157)	0.868*** (0.117)	-1.248*** (0.357)	-1.234*** (0.411)	0.719*** (0.120)	-1.561*** (0.356)	-1.538*** (0.409)
Log fixed assets per regular employee	0.470*** (0.0158)	0.110** (0.0500)	0.110** (0.0500)	0.544*** (0.0143)	0.171*** (0.0514)	0.171*** (0.0514)	0.0290 (0.0352)	-0.144 (0.173)	-0.144 (0.173)	0.519*** (0.0358)	-0.722*** (0.170)	-0.722*** (0.170)
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-3.907*** (0.423)	7.492*** (1.007)	7.565*** (1.114)	-3.822*** (0.355)	7.109*** (0.957)	7.225*** (1.059)	-2.254*** (0.754)	11.64*** (2.908)	11.57*** (3.104)	0.945 (0.763)	16.05*** (2.885)	15.93*** (3.079)
N	42974	42974	42974	42974	42974	42974	42974	42974	42974	42974	42974	42974
adj. R-sq	0.082	0.010		0.125	0.009		0.005	0.004		0.018	0.005	
First stage F values			312.92			312.92			312.92			312.92

(iii) Large firms: more than 1,000 employees

	OLS	FE	FEIV	OLS	FE	FEIV	OLS	FE	FEIV	OLS	FE	FEIV
	Log operating income per regular employee			Log recurring profit per regular employee			Log TFP 1			Log TFP 2		
Number of workers with disabilities (/1000)	0.0403 (0.0255)	0.0591 (0.182)	0.0253 (0.246)	0.0442** (0.0210)	0.0491 (0.151)	0.0292 (0.189)	0.0292 (0.0427)	0.292 (0.357)	-0.525 (0.464)	-0.0582 (0.0456)	-0.268 (0.361)	-0.488 (0.469)
Log number of regular employees	0.113 (0.0844)	-0.605** (0.259)	-0.583** (0.273)	0.105 (0.0650)	-0.717*** (0.212)	-0.705*** (0.222)	0.340* (0.181)	0.605 (0.610)	0.754 (0.630)	0.0891 (0.183)	0.235 (0.609)	0.375 (0.630)
Log fixed assets per regular employee	0.402*** (0.0430)	0.262 (0.180)	0.263 (0.180)	0.611*** (0.0256)	0.429*** (0.137)	0.429*** (0.137)	-0.0841 (0.0918)	0.218 (0.413)	0.227 (0.413)	-0.592*** (0.0939)	-0.360 (0.416)	-0.352 (0.416)
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-0.693 (0.761)	6.145* (3.204)	5.993* (3.245)	-2.207*** (0.535)	5.847** (2.576)	5.757** (2.613)	2.094 (1.679)	-2.590 (7.781)	-3.641 (7.830)	5.600*** (1.691)	2.463 (7.794)	1.470 (7.838)
N	9181	9181	9181	9181	9181	9181	9181	9181	9181	9181	9181	9181
adj. R-sq	0.058	0.010		0.182	0.013		0.002	0.002		0.023	0.002	
First stage F values			316.92			316.92			316.92			316.92

Table A.2 Results for companies with special subsidiaries

(i) All

	OLS	FE	FEIV	OLS	FE	FEIV	OLS	FE	FEIV	OLS	FE	FEIV
	Log operating income per regular employee			Log recurring profit per regular employee			Log TFP 1			Log TFP 2		
Number of workers	0.0102	0.0607	0.0111	-0.0401	0.00818	-0.0460	-0.0596	-0.467	-0.652	0.0903	-0.437	-0.611
with disabilities (/1000)	(0.0633)	(0.303)	(0.364)	(0.0466)	(0.278)	(0.316)	(0.120)	(0.642)	(0.711)	(0.115)	(0.647)	(0.714)
Log number of regular employees	-0.0864	-0.207	-0.137	-0.0407	-0.750	-0.673	0.129	2.853	3.115	-0.142	2.575	2.823
	(0.155)	(0.914)	(0.918)	(0.130)	(0.792)	(0.813)	(0.239)	(1.852)	(1.987)	(0.236)	(1.891)	(2.020)
Log fixed assets per regular employee	0.259	0.406	0.404	0.690***	0.439	0.438	-0.151	3.034*	3.028*	-0.637*	2.486	2.481
	(0.185)	(0.635)	(0.637)	(0.0645)	(0.570)	(0.572)	(0.377)	(1.600)	(1.607)	(0.378)	(1.626)	(1.633)
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	1.900	1.369	0.891	-2.093*	6.279	5.756	4.567	-49.01*	-50.80*	7.853***	-45.18	-46.87
	(1.820)	(12.95)	(12.89)	(1.080)	(10.89)	(10.91)	(4.001)	(29.19)	(29.84)	(3.960)	(29.82)	(30.43)
N	1199	1199	1199	1199	1199	1199	1199	1199	1199	1199	1199	1199
adj. R-sq	0.012	0.001		0.198	0.018		-0.002	0.012		0.028	0.010	
First stage F values			183.92			183.92			183.92			183.92

(ii) Medium-sized firms: more than 200 to 1,000 employees

	OLS	FE	FEIV	OLS	FE	FEIV	OLS	FE	FEIV	OLS	FE	FEIV
	Log operating income per regular employee			Log recurring profit per regular employee			Log TFP 1			Log TFP 2		
Number of workers	0.525	-4.912	23.92*	0.416	5.543	18.89	-0.539	-10.10	23.51	0.537	-9.960	23.92
with disabilities (/1000)	(0.462)	(5.049)	(13.65)	(0.407)	(4.670)	(12.83)	(0.536)	(10.44)	(16.33)	(0.543)	(10.47)	(16.32)
Log number of regular employees	-0.153	-1.668	-7.563*	-0.193	-1.017	-6.013	0.583	-0.896	-7.769	0.436	-1.174	-8.100
	(0.670)	(2.157)	(4.020)	(0.628)	(1.961)	(3.973)	(0.564)	(3.440)	(6.174)	(0.575)	(3.443)	(6.172)
Log fixed assets per regular employee	0.415	-1.621*	-0.622	0.456*	-1.064	-0.218	0.619	-2.263	-1.099	-0.0122	-2.839	-1.666
	(0.268)	(0.880)	(1.149)	(0.229)	(0.764)	(0.823)	(0.415)	(3.022)	(3.347)	(0.418)	(3.040)	(3.365)
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.231	29.57	48.93**	0.419	20.96	37.36	-6.883	31.12	53.68	-3.031	35.25	57.99
	(5.480)	(18.63)	(23.95)	(5.029)	(17.26)	(22.91)	(6.789)	(33.82)	(41.60)	(6.849)	(33.98)	(41.78)
N	154	154	154	154	154	154	154	154	154	154	154	154
adj. R-sq	0.029	0.068		0.039	0.061		0.020	0.026		-0.002	0.029	
First stage F values			31.28			31.28			31.28			31.28

(iii) Large firms: more than 1,000 employees

	OLS	FE	FEIV	OLS	FE	FEIV	OLS	FE	FEIV	OLS	FE	FEIV
	Log operating income per regular employee			Log recurring profit per regular employee			Log TFP 1			Log TFP 2		
Number of workers	-0.00379	0.0709	-0.00776	-0.0381	-0.00782	-0.0813	-0.0862	-0.447	-0.690	-0.123	-0.414	-0.647
with disabilities (/1000)	(0.0826)	(0.311)	(0.380)	(0.0695)	(0.291)	(0.336)	(0.155)	(0.661)	(0.742)	(0.152)	(0.666)	(0.744)
Log number of regular employees	-0.0272	0.125	-0.247	-0.0592	-0.494	-0.380	0.272	3.636*	4.015*	0.0323	3.353	3.716*
	(0.312)	(0.968)	(0.981)	(0.284)	(0.836)	(0.866)	(0.563)	(2.011)	(2.187)	(0.556)	(2.057)	(2.226)
Log fixed assets per regular employee	0.247	0.705	0.706	0.702***	0.662	0.662	-0.194	3.789**	3.791**	-0.668	3.244*	3.246*
	(0.196)	(0.678)	(0.680)	(0.0675)	(0.619)	(0.620)	(0.403)	(1.651)	(1.661)	(0.403)	(1.682)	(1.692)
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	1.616	-4.462	-5.363	-1.994	2.167	1.325	4.066	-64.40**	-67.19**	6.965	-60.56*	-63.23*
	(2.692)	(14.11)	(14.09)	(2.343)	(11.90)	(11.95)	(6.226)	(31.86)	(32.92)	(6.131)	(32.62)	(33.63)
N	1045	1045	1045	1045	1045	1045	1045	1045	1045	1045	1045	1045
adj. R-sq	0.008	-0.001		0.208	0.016		-0.002	0.016		0.025	0.013	
First stage F values			185.93			185.93			185.93			185.93

Table A.3 Results for medium-sized firms that did not employ people with disabilities at all in 2013

	OLS	FE	FEIV	OLS	FE	FEIV	OLS	FE	FEIV	OLS	FE	FEIV
	Log operating income per regular employee			Log recurring profit per regular employee			Log TFP 1			Log TFP 2		
Number of workers	-5.627	-7.977	-5.827	6.369	-6.968*	-10.53	23.42	-15.02	-29.29	22.19	-14.65	-29.51
with disabilities (/1000)	(7.678)	(4.921)	(15.27)	(7.627)	(3.960)	(14.71)	(18.78)	(10.59)	(40.74)	(18.82)	(10.59)	(41.56)
Log number of regular employees	0.567	-0.552	-0.627	0.0163	-0.576	-0.452	1.342	0.316	0.814	1.148	0.170	0.688
	(0.670)	(0.851)	(1.004)	(0.646)	(0.750)	(0.903)	(1.558)	(1.973)	(2.839)	(1.582)	(2.006)	(2.904)
Log fixed assets per regular employee	0.326***	0.384	0.384	0.379***	0.327	0.326	-0.281	-0.232	-0.237	-0.882***	-0.781	-0.786
	(0.111)	(0.307)	(0.307)	(0.109)	(0.287)	(0.285)	(0.172)	(0.587)	(0.591)	(0.177)	(0.591)	(0.595)
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-2.353	3.318	3.726	0.422	4.164	3.487	-1.423	3.658	0.948	2.541	6.927	4.104
	(4.001)	(5.528)	(6.373)	(3.896)	(4.766)	(5.578)	(8.736)	(10.72)	(15.47)	(8.864)	(10.96)	(15.88)
N	746	746	746	746	746	746	746	746	746	746	746	746
adj. R-sq	0.041	0.010		0.069	0.012		0.012	0.001		0.058	0.003	
First stage F values			38.12			38.12			38.12			38.12



Table A.4 Results for firms that employ at least one person with a disability (2013 baseline)

(i) All

	OLS	FE	FEIV	OLS	FE	FEIV	OLS	FE	FEIV	OLS	FE	FEIV
	Log operating income per regular employee			Log recurring profit per regular employee			Log TFP 1			Log TFP 2		
Number of workers with disabilities (/1000)	-0.0812** (0.0392)	0.0164 (0.159)	0.0230 (0.210)	-0.0795** (0.0325)	0.0438 (0.129)	0.0428 (0.158)	-0.0908 (0.0583)	-0.0146 (0.308)	-0.156 (0.393)	0.132** (0.0659)	-0.00692 (0.312)	-0.141 (0.398)
Log number of regular employees	0.177*** (0.0319)	-0.819*** (0.120)	-0.821*** (0.123)	0.203*** (0.0253)	-0.820*** (0.109)	-0.819*** (0.111)	0.502*** (0.0630)	-0.791*** (0.297)	-0.760** (0.303)	0.308*** (0.0646)	-1.121*** (0.296)	-1.092*** (0.302)
Log fixed assets per regular employee	0.458*** (0.0152)	0.123** (0.0491)	0.123** (0.0491)	0.558*** (0.0124)	0.198*** (0.0490)	0.198*** (0.0490)	0.00860 (0.0340)	-0.110 (0.162)	-0.110 (0.162)	-0.531*** (0.0345)	-0.688*** (0.159)	-0.688*** (0.159)
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-1.623*** (0.243)	7.596*** (0.950)	7.604*** (0.962)	-2.367*** (0.187)	7.255*** (0.890)	7.254*** (0.899)	0.0420 (0.501)	9.176*** (2.713)	9.009*** (2.727)	3.403*** (0.509)	13.73*** (2.691)	13.57*** (2.705)
N	51098	51098	51098	51098	51098	51098	51098	51098	51098	51098	51098	51098
adj. R-sq	0.077	0.010		0.139	0.010		0.006	0.003		0.018	0.005	
First stage F values			502.43			502.43			502.43			502.43

(ii) Medium-sized firms: more than 200 to 1,000 employees

	OLS	FE	FEIV	OLS	FE	FEIV	OLS	FE	FEIV	OLS	FE	FEIV
	Log operating income per regular employee			Log recurring profit per regular employee			Log TFP 1			Log TFP 2		
Number of workers with disabilities (/1000)	-1.743*** (0.580)	-0.564 (0.406)	-0.538 (0.794)	-1.347*** (0.459)	-0.164 (0.349)	-0.00541 (0.636)	0.596 (0.513)	1.600 (1.028)	1.263 (1.555)	-0.867 (0.566)	1.567 (1.025)	1.133 (1.529)
Log number of regular employees	0.562*** (0.0726)	-0.816*** (0.144)	-0.818*** (0.173)	0.486*** (0.0598)	-0.802*** (0.135)	-0.817*** (0.161)	0.844*** (0.118)	-1.259*** (0.364)	-1.227*** (0.421)	0.696*** (0.120)	-1.576*** (0.362)	-1.535*** (0.418)
Log fixed assets per regular employee	0.473*** (0.0158)	0.107** (0.0510)	0.107** (0.0510)	0.548*** (0.0140)	0.169*** (0.0524)	0.169*** (0.0524)	0.0363 (0.0360)	-0.141 (0.176)	-0.141 (0.176)	-0.510*** (0.0364)	-0.719*** (0.173)	-0.720*** (0.173)
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-3.909*** (0.424)	7.422*** (1.030)	7.435*** (1.146)	-3.844*** (0.355)	7.077*** (0.980)	7.154*** (1.089)	-2.187*** (0.760)	11.67*** (2.971)	11.51*** (3.175)	0.986 (0.768)	16.11*** (2.947)	15.90*** (3.149)
N	41917	41917	41917	41917	41917	41917	41917	41917	41917	41917	41917	41917
adj. R-sq	0.082	0.010		0.126	0.009		0.005	0.004		0.018	0.006	
First stage F values			296.82			296.82			296.82			296.82

(iii) Large firms: more than 1,000 employees

	OLS	FE	FEIV	OLS	FE	FEIV	OLS	FE	FEIV	OLS	FE	FEIV
	Log operating income per regular employee			Log recurring profit per regular employee			Log TFP 1			Log TFP 2		
Number of workers with disabilities (/1000)	-0.0403 (0.0255)	0.0591 (0.182)	0.0253 (0.246)	-0.0442** (0.0210)	0.0491 (0.151)	0.0292 (0.189)	-0.0292 (0.0427)	-0.292 (0.357)	-0.525 (0.464)	-0.0582 (0.0456)	-0.268 (0.361)	-0.488 (0.469)
Log number of regular employees	0.113 (0.0844)	-0.605*** (0.259)	-0.583** (0.273)	0.105 (0.0650)	-0.717*** (0.212)	-0.705*** (0.222)	0.340* (0.181)	0.605 (0.610)	0.754 (0.630)	0.0891 (0.183)	0.235 (0.609)	0.375 (0.630)
Log fixed assets per regular employee	0.402*** (0.0430)	0.262 (0.180)	0.263 (0.180)	0.611*** (0.0256)	0.429*** (0.137)	0.429*** (0.137)	0.0841 (0.0918)	0.218 (0.413)	0.227 (0.413)	-0.592*** (0.0939)	-0.360 (0.416)	-0.352 (0.416)
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-0.693 (0.761)	6.145* (3.204)	5.993* (3.245)	-2.207*** (0.535)	5.847** (2.576)	5.757** (2.613)	2.094 (1.679)	-2.590 (7.781)	-3.641 (7.830)	5.600*** (1.691)	2.463 (7.794)	1.470 (7.838)
N	9181	9181	9181	9181	9181	9181	9181	9181	9181	9181	9181	9181
adj. R-sq	0.058	0.010		0.182	0.013		0.002	0.002		0.023	0.002	
First stage F values			316.92			316.92			316.92			316.92

Table A.5 Results for manufacturing

(i) All

	OLS	FE	FEIV	OLS	FE	FEIV	OLS	FE	FEIV	OLS	FE	FEIV
	Log operating income per regular employee			Log recurring profit per regular employee			Log TFP 1			Log TFP 2		
Number of workers with disabilities (/1000)	-0.214** (0.0889)	-0.0765 (0.412)	-0.0000810 (0.439)	-0.187*** (0.0681)	0.0942 (0.305)	0.146 (0.314)	-0.520** (0.203)	-0.547 (0.833)	0.756 (0.896)	0.531** (0.207)	0.534 (0.841)	-0.737 (0.904)
Log number of regular employees	0.282*** (0.0660)	-1.822*** (0.302)	-1.841*** (0.303)	0.379*** (0.0488)	-1.634*** (0.271)	-1.647*** (0.272)	0.810*** (0.132)	-3.214*** (0.764)	-3.163*** (0.769)	0.641*** (0.133)	-3.505*** (0.761)	-3.456*** (0.766)
Log fixed assets per regular employee	0.478*** (0.0380)	-0.182 (0.142)	-0.181 (0.142)	0.631*** (0.0352)	0.102 (0.137)	0.102 (0.137)	0.154 (0.0938)	-0.779*** (0.362)	-0.781** (0.362)	-0.395*** (0.0953)	-1.363*** (0.363)	-1.364*** (0.363)
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-2.674*** (0.474)	16.72*** (2.551)	16.81*** (2.550)	-4.239*** (0.388)	13.32*** (2.333)	13.38*** (2.336)	-3.756*** (1.056)	30.20*** (6.425)	29.94*** (6.439)	-0.426 (1.067)	34.62*** (6.440)	34.37*** (6.453)
N	17493	17493	17493	17493	17493	17493	17493	17493	17493	17493	17493	17493
adj. R-sq	0.044	0.018		0.099	0.014		0.011	0.009		0.009	0.011	
First stage F values			270.75			270.75			270.75			270.75

(ii) Medium-sized firms: more than 200 to 1,000 employees

	OLS	FE	FHIV	OLS	FE	FHIV	OLS	FE	FHIV	OLS	FE	FHIV
	Log operating income per regular employee			Log recurring profit per regular employee			Log TFP 1			Log TFP 2		
Number of workers with disabilities (/1000)	-3.567*** (1.248)	-0.630 (0.980)	-0.975 (4.945)	-2.839*** (1.021)	-0.346 (0.899)	3.588 (4.576)	-2.117 (2.300)	2.074 (2.604)	13.98 (11.61)	-2.513 (2.315)	2.099 (2.607)	13.91 (11.57)
Log number of regular employees	0.793*** (0.153)	-1.970*** (0.335)	-1.942*** (0.517)	0.734*** (0.124)	-1.676*** (0.314)	-2.000*** (0.482)	1.114*** (0.318)	-3.995*** (0.890)	-4.976*** (1.398)	0.995*** (0.319)	-4.272*** (0.890)	-5.245*** (1.394)
Log fixed assets per regular employee	0.468*** (0.0417)	-0.253* (0.152)	-0.253* (0.152)	0.611*** (0.0401)	0.0342 (0.156)	0.0310 (0.155)	0.228** (0.110)	-0.954** (0.417)	-0.963** (0.412)	-0.331*** (0.112)	-1.538*** (0.418)	-1.548*** (0.413)
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-5.381*** (0.844)	17.46*** (2.679)	17.32*** (3.355)	-5.952*** (0.699)	13.49*** (2.545)	15.16*** (3.123)	-6.148*** (1.844)	34.67*** (7.067)	39.72*** (8.778)	-2.990 (1.851)	38.97*** (7.093)	43.98*** (8.779)
N	14255	14255	14255	14255	14255	14255	14255	14255	14255	14255	14255	14255
adj. R-sq	0.044	0.018		0.078	0.014		0.007	0.009		0.006	0.011	
First stage F values			59.26			59.26			59.26			59.26

(iii) Large firms: more than 1,000 employees

	OLS	FE	FHIV	OLS	FE	FHIV	OLS	FE	FHIV	OLS	FE	FHIV
	Log operating income per regular employee			Log recurring profit per regular employee			Log TFP 1			Log TFP 2		
Number of workers with disabilities (/1000)	-0.142 (0.119)	-0.0186 (0.443)	0.0213 (0.470)	-0.135 (0.0860)	0.0810 (0.345)	0.0856 (0.361)	-0.276 (0.239)	-0.861 (0.932)	-1.129 (1.004)	-0.276 (0.242)	-0.834 (0.936)	-1.092 (1.005)
Log number of regular employees	0.203 (0.226)	-0.889 (0.753)	-0.923 (0.757)	0.291* (0.153)	-1.214** (0.554)	-1.217** (0.567)	0.305 (0.394)	-0.299 (1.423)	-0.0679 (1.467)	0.103 (0.395)	-0.663 (1.416)	-0.440 (1.459)
Log fixed assets per regular employee	0.461*** (0.0950)	0.163 (0.375)	0.163 (0.375)	0.666*** (0.0691)	0.414 (0.253)	0.414 (0.253)	-0.238* (0.143)	0.0689 (0.710)	0.0660 (0.710)	-0.749*** (0.148)	-0.512 (0.717)	-0.515 (0.717)
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-1.855 (1.848)	9.586 (7.916)	9.818 (7.907)	-3.981*** (1.283)	10.13* (5.620)	10.16* (5.680)	3.974 (3.206)	6.157 (15.61)	4.599 (15.84)	7.176** (3.228)	11.31 (15.68)	9.805 (15.91)
N	3238	3238	3238	3238	3238	3238	3238	3238	3238	3238	3238	3238
adj. R-sq	0.031	0.026		0.094	0.020		0.007	0.012		0.022	0.012	
First stage F values			232.43			232.43			232.43			232.43

Table A.6 Results for non-manufacturing

(i) All

	OLS	FE	FHIV	OLS	FE	FHIV	OLS	FE	FHIV	OLS	FE	FHIV
	Log operating income per regular employee			Log recurring profit per regular employee			Log TFP 1			Log TFP 2		
Number of workers with disabilities (/1000)	-0.0542** (0.0268)	0.0819 (0.114)	0.0786 (0.157)	-0.0563** (0.0260)	0.0265 (0.0896)	-0.0104 (0.0921)	-0.00409 (0.0194)	0.314** (0.150)	0.394* (0.216)	-0.0516** (0.0246)	0.317** (0.150)	0.403* (0.216)
Log number of regular employees	0.139*** (0.0328)	-0.578*** (0.125)	-0.577*** (0.128)	0.118*** (0.0270)	-0.627*** (0.113)	-0.619*** (0.115)	0.390*** (0.0711)	-0.195 (0.303)	-0.212 (0.308)	0.180** (0.0715)	-0.528* (0.302)	-0.546* (0.307)
Log fixed assets per regular employee	0.487*** (0.0176)	0.220*** (0.0461)	0.220*** (0.0460)	0.554*** (0.0139)	0.230*** (0.0475)	0.230*** (0.0475)	0.0626* (0.0377)	0.0963 (0.163)	0.0961 (0.163)	-0.485*** (0.0383)	-0.480*** (0.160)	-0.480*** (0.160)
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-1.525*** (0.270)	5.248*** (0.948)	5.244*** (0.962)	-1.749*** (0.207)	5.709*** (0.895)	5.668*** (0.902)	0.553 (0.583)	3.877 (2.749)	3.967 (2.762)	4.068*** (0.584)	8.402*** (2.717)	8.498*** (2.731)
N	34662	34662	34662	34662	34662	34662	34662	34662	34662	34662	34662	34662
adj. R-sq	0.109	0.008		0.165	0.010		0.005	0.001		0.019	0.003	
First stage F values			351.48			351.48			351.48			351.48

(ii) Medium-sized firms: more than 200 to 1,000 employees

	OLS	FE	FHIV	OLS	FE	FHIV	OLS	FE	FHIV	OLS	FE	FHIV
	Log operating income per regular employee			Log recurring profit per regular employee			Log TFP 1			Log TFP 2		
Number of workers with disabilities (/1000)	-1.313*** (0.490)	-0.671 (0.418)	-0.774 (0.733)	-1.003*** (0.383)	-0.228 (0.350)	-0.502 (0.614)	0.153 (0.468)	0.921 (1.053)	-0.603 (1.525)	-0.137 (0.470)	0.880 (1.052)	-0.720 (1.459)
Log number of regular employees	0.483*** (0.0706)	-0.508*** (0.153)	-0.498*** (0.180)	0.386*** (0.0602)	-0.580*** (0.142)	-0.555*** (0.168)	0.677*** (0.123)	-0.459 (0.373)	-0.315 (0.419)	0.523*** (0.123)	-0.780** (0.372)	-0.629 (0.417)
Log fixed assets per regular employee	0.505*** (0.0179)	0.213*** (0.0480)	0.213*** (0.0480)	0.552*** (0.0158)	0.211*** (0.0500)	0.211*** (0.0501)	0.0876** (0.0377)	0.0890 (0.173)	0.0883 (0.173)	-0.464*** (0.0382)	-0.487*** (0.169)	-0.488*** (0.169)
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-3.600*** (0.433)	4.749*** (1.052)	4.699*** (1.162)	-3.228*** (0.376)	5.394*** (0.993)	5.259*** (1.106)	-1.338* (0.805)	5.345* (2.989)	4.596 (3.163)	1.901** (0.806)	9.771*** (2.958)	8.985*** (3.130)
N	28719	28719	28719	28719	28719	28719	28719	28719	28719	28719	28719	28719
adj. R-sq	0.117	0.008		0.159	0.009		0.005	0.002		0.019	0.003	
First stage F values			301.31			301.31			301.31			301.31

(iii) Large firms: more than 1,000 employees

	OLS	FE	FEIV	OLS	FE	FEIV	OLS	FE	FEIV	OLS	FE	FEIV
	Log operating income per regular employee			Log recurring profit per regular employee			Log TFP 1			Log TFP 2		
Number of workers with disabilities (/1000)	-0.0263 (0.0160)	0.0916 (0.134)	0.0581 (0.190)	-0.0325** (0.0162)	0.0388 (0.103)	0.00592 (0.101)	-0.00231 (0.0314)	0.114 (0.158)	0.148 (0.235)	-0.0344 (0.0307)	0.138 (0.159)	0.186 (0.237)
Log number of regular employees	0.112 (0.0908)	-0.537** (0.259)	-0.517* (0.271)	0.0668 (0.0742)	-0.608*** (0.229)	-0.589** (0.229)	0.521** (0.220)	0.719 (0.690)	0.699 (0.697)	0.231 (0.220)	0.351 (0.688)	0.322 (0.695)
Log fixed assets per regular employee	0.415*** (0.0554)	0.305* (0.171)	0.307* (0.171)	0.575*** (0.0290)	0.437*** (0.160)	0.439*** (0.160)	-0.0292 (0.121)	0.246 (0.493)	0.243 (0.493)	-0.552*** (0.123)	-0.330 (0.493)	-0.333 (0.493)
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-0.844 (0.865)	5.113* (3.086)	4.962 (3.136)	-1.679*** (0.608)	4.767 (2.903)	4.618 (2.886)	0.241 (2.067)	-3.894 (9.060)	-3.742 (9.069)	4.152** (2.076)	1.063 (9.028)	1.278 (9.037)
N	5943	5943	5943	5943	5943	5943	5943	5943	5943	5943	5943	5943
adj. R-sq	0.085	0.009		0.201	0.014		0.005	0.000		0.023	0.001	
First stage F values			195.37			195.37			195.37			195.37

Note 1: Cluster standard errors for each firm level are shown between parentheses.

Note 2: OLS: ordinary least squares; FE: fixed effects; FEIV: fixed-effects instrumental variables.

Note 3: “Log TFP 1” is calculated as the residual of the production function; “Log TFP 2” is measured as the difference between total output and labor and capital inputs.

## Appendix 2

TFP can be derived in two ways. First, TFP is calculated as the residual of the production function. Assume the following Cobb–Douglas type production function:

$$Y = AK^\alpha L^{1-\alpha} \quad (\text{A.2.1}),$$

where  $Y$  represents value-added,  $K$  capital stock,  $L$  labor input, and  $A$  is TFP.  $Y$  is the sum of operating income, directors’ compensation, salaries and allowances, provision of bonuses, retirement benefits, provision of retirement benefits, legal welfare expenses, welfare expenses, miscellaneous salaries, depreciation and amortization, taxes, and dues multiplied by the output deflator by industry. There are 20 industries (by major classification) and we apply a deflator that fits each industry. The Cabinet Office National Accounts of Japan<sup>11</sup> are used as the output deflator; otherwise, the TSR is used.  $K$  is the real value obtained by multiplying TSR’s total fixed assets by the capital formation deflator from the Cabinet Office’s National Accounts.  $L$  is obtained by multiplying the total number of employees in the TSR by the working hours from the Monthly Labour Survey by the MHLW.<sup>12</sup> As firm-level data do not exist for labor hours, we use industry averages instead. As in the case of the output deflator above, we use the corresponding labor hours for each of the 20 industries.

Taking the logarithm of both sides of Eq. (A.1) and rearranging it, TFP (natural logarithm) can be expressed as in Eq. (A.2). Therefore, TFP (natural logarithm) can be calculated by estimating the production function and obtaining the regression coefficients for capital stock and labor input. If  $Y$  is non-negative, we add 1 and take the logarithm of the variable as it is. If  $Y$  is negative, the variable is negativized, 1 is added, the logarithm of the variable is taken, and the logarithm of the variable is negativized again:

<sup>11</sup> [https://www.esri.cao.go.jp/jp/sna/data/data\\_list/kakuhou/files/2020/2020\\_kaku\\_top.html](https://www.esri.cao.go.jp/jp/sna/data/data_list/kakuhou/files/2020/2020_kaku_top.html), last accessed March 7, 2024

<sup>12</sup> [https://www.e-stat.go.jp/stat-search/files?page=1&query=産業別労働時間指数&layout=dataset&toukei=00450071&tstat=000001011791&tstat\\_infid=000032185240&metadata=1&data=1](https://www.e-stat.go.jp/stat-search/files?page=1&query=産業別労働時間指数&layout=dataset&toukei=00450071&tstat=000001011791&tstat_infid=000032185240&metadata=1&data=1), last accessed March 7, 2024

$$\ln A = \ln Y - \alpha \ln K - (1 - \alpha) \ln L. \quad (\text{A.2.2})$$

However, production factors such as capital, labor, and value-added are simultaneous, but OLS does not provide a consistent estimator. To solve these problems, we need to control for the shocks that affect productivity, which are unobservable to analysts but observable to management. Olley and Pakes (1996) propose an estimation method that addresses this problem using capital investment as a proxy measure for productivity shocks. However, this approach is not feasible when the sample includes a large number of firms that have not made capital investments. Levinsohn and Petrin (2003) use a method with intermediate inputs as a proxy indicator for productivity shocks. In this study, intermediate inputs are defined as the TSR cost of sales plus selling, general, and administrative expenses minus personnel costs (executive compensation, salaries and allowances, provision for bonuses, retirement benefits, provision for retirement benefits, legal welfare expenses, welfare expenses, and miscellaneous salaries) and depreciation.<sup>13</sup>

Second, we use the methods employed by Fukao and Kwon (2006) and Kwon et al. (2008). The initial point in time is 2013, and the log TFP level of firm  $i$  at time  $t$  relative to the log TFP level of the industry-representative firm is defined as follows:

$$\begin{aligned} \ln TFP_{i,t} = & (\ln Y_{i,t} - \overline{\ln Y_t}) - \frac{1}{2}(SL_{j,t} + \overline{SL_t})(\ln L_{i,t} - \overline{\ln L_t}) - \frac{1}{2}(SK_{j,t} + \overline{SK_t})(\ln K_{i,t} - \\ & \overline{\ln K_t}) + (\ln Y_t - \ln Y_T) - \frac{1}{2}(\overline{SL_t} + \overline{SL_T})(\ln L_t - \ln L_T) - \frac{1}{2}(\overline{SK_t} + \overline{SK_T})(\ln K_t - \ln K_T) \quad , \end{aligned} \quad (\text{A.2.3})$$

where  $TFP$  is the total factor productivity,  $Y$  the value added,  $L$  the labor input,  $K$  the capital stock,  $SL$  the labor cost share, and  $SK$  the capital cost share.  $T$  denotes the base year (2013).  $j$  represents the industry and  $i$  the firm. The upper bars indicate the average values for each year. In this case, the factors of production are labor and capital. The first, second, and third terms on the right side of Eq. (A.3) represent the deviation in the logarithm of the TFP level between firm  $i$  at time  $t$  and the representative firm at that time. The fourth, fifth, and sixth terms represent the deviation in the logarithm of the TFP level between the representative firm at time  $t$  and the representative firm at the initial time. The TFP measured in this way not only captures the cross-sectional productivity distribution but also changes in the TFP distribution over time by considering the changes in the TFP of the representative firms over time. Unlike TFP measurements that use production function estimation, it also has the advantage of allowing for different factor inputs across firms and imperfect competition in the product market. The method of creating each variable is the same as that defined above for the method used to calculate TFP as the residual of the production function.

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<sup>13</sup> We refer to Nishihata and Yamamoto (2021).

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