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Disability Employment and Firm Productivity: Evidence from a novel panel data in Japan [*]

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Abstract

This study examines the causal impact of employing persons with disabilities on corporate financial performance and productivity in Japan. Using a novel panel dataset that combines administrative records on disability employment with financial data from Japanese firms between 2013 and 2019, we examine whether hiring persons with disabilities influences firm productivity outcomes. Applying firm fixed effects and controlling for time-varying factors, we find modest but statistically significant increases in operating and net profits for small and medium-sized enterprises (SMEs) with 200–1,000 employees in the manufacturing sector. By contrast, first-time hires or the addition of a single employee with a disability do not yield statistically significant financial effects. These findings suggest that SMEs with more experience in employing persons with disabilities may be better positioned to realize financial benefits, likely by fostering supportive work environments and assigning tasks suited to individual capabilities. The study contributes to the limited empirical literature on disability employment and firm performance, offering evidence to inform labor market policies aimed at promoting inclusive employment practices.

Keywords: Disability Employment, Financial Performance, Firm Productivity, Small and Medium-sized Enterprises (SMEs), Panel Data Analysis

JEL classification: J15, J20, J78, L25

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1. Introduction

In many countries, disability is not a marginal phenomenon. 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, 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, a 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") as 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 for the non-disadvantaged groups and firm profit. 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 existing theoretical studies, 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, finding neutral or positive effects (for Chile, Duryea et al. 2023; for Austria, Lalive et al. 2013; Wuellrich 2010; for Japan, Mori and Sakamoto 2018; for India, Prakash 2020, for Brazil, Szerman 2024). Even fewer studies examine 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. 2022). 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 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 voluntarily disclose information (Jing et al. 2022).

In this study, we use novel 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 comprises official records of companies' employment of persons with disabilities, along with detailed financial information; 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. While disability employment does not necessarily harm financial performance, its impact varies by firm size and industry. In mid-sized firms, employing individuals with disabilities significantly increases net and operating income, while in large firms, it is associated with higher sales. Additionally, in the manufacturing sector, disability employment positively influences net income. However, there is no observed impact on firm performance from the extensive margin of disability employment—whether a firm hires employees with disabilities for the first time—or from the expansion of the statutory employment quota. Overall, the results indicate that companies with prior experience in employing people with disabilities have the potential to strengthen their workforce, whereas firms hiring people with disabilities for the first time do not experience significant changes in performance.

The rest of 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 discusses them. 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 those 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[6] 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 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

[6] In Japan, "regular workers" are defined as individuals employed for either an indefinite period or a fixed period of one month or longer, regardless of their daily working hours. This classification includes part-time workers and similar employment types. In this paper, the term "regular workers" is used consistently to refer to all workers who meet this definition.

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, while 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 5 years by considering the changes in the ratio of the workforce with disabilities to the total workforce to guarantee employment opportunities for persons with disabilities. Table 1 and Figure 1 show 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.[7] Figure 2 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. As 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%.

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

[7] 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.

(see Figure 2(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 (*Nofukin*) in proportion to the number of persons with disabilities they are short of, 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.[8] 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 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.[9]

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 considered 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

[8] 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.

[9] 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.

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 while considering their own production technology.[10]

Based on this employment system, some studies have used 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 both the levy and grant are considered. They thus conclude that the 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 located in Tokyo

[10] Furthermore, the Japanese employment quota system also accommodates company characteristics. Large companies must employ more disabled individuals and, under the special subsidiary system, a subsidiary employing disabled persons can count their employees toward the parent company's quota. To qualify, the subsidiary must meet criteria such as employing at least five disabled individuals (20% or more of employees), 30% or more with severe disabilities, and providing adequate management and facilities. Due to these stringent requirements, there are few such subsidiaries; in 2022, there were 579 special subsidiaries employing 43,857 disabled individuals.

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 novel panel data, that is, 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 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 firm type, 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):

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

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 λ_{i0} and

λ_{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 λ_{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 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:

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

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:

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

where θ_i is the time-invariant firm fixed effect (FE), ϕ_t is the time effect, and ε_{it} is the error term.

Ideally, we should estimate Eq. (4); however, due to the limited availability of data on fixed assets such as capital stock for some firms, we omit $\ln(K_{it}/L_{it})$ from our baseline analysis.[11]

Furthermore, we estimate Eq. (5), in which the disability employment rate (L_{it1}/L_{it}) is transformed into log-linear form. As we explain later, when addressing the endogeneity issue in disability employment using the instrumental variables (IV) method, the validity of the IVs is not confirmed if the disability employment rate is treated as an endogenous variable.

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

The estimation method consists of the following three approaches.[12] First, we conduct a pooled ordinary least squares (OLS) estimation without considering firm FE. In this case, the relationship between the number of employees with disabilities and productivity is identified through cross-sectional variation. Specifically, if a firm with a relatively high proportion of non-disabled employees exhibits greater productivity than otherwise comparable firms due to unobserved characteristics, then the measured productivity gap between non-disabled and disabled employees may, at least in part, reflect these underlying firm-specific factors rather than any inherent differences in individual productivity. To account for this possibility, we next incorporate firm FE into the estimation. By accounting for firm-specific characteristics, we identify the relationship between the employment of people with disabilities and productivity using within-firm variation. The estimation results allow us to interpret how the changes in the proportion of employees with disabilities within a firm affect productivity.

[11] In some analyses, specifically those using the FIF described in Section 3, we are able to include K_{it} and conduct additional analyses controlling for it. However, the results remain largely unchanged.
[12] This description is based on van Ours and Stoeldraijer (2011) and Cardoso et al. (2011).

Although introducing firm FE eliminates potential spurious correlations between the number of employees with disabilities and productivity, it does not fully resolve endogeneity concerns. In particular, the changes in disability employment may not be exogenous to productivity fluctuations. For instance, if a firm experiences a negative productivity shock, it may lay off employees with disabilities, leading to an increase in the proportion of employees without disabilities. In this case, the observed positive correlation between the proportion of employees with disabilities and productivity would be misleading, as it results from an external shock rather than a causal relationship. To address this potential endogeneity bias, we employ an IV approach.

However, finding an appropriate IV is challenging. In our study, we use lagged values of the number of employees with disabilities $\Delta\ln(L_{it1})$ as instruments for changes in disability employment, where the instrument is defined as the lagged level variables $L_{i(t-s)1}$ for $s \geq 2$. Under the assumption that shocks occurring between $t-1$ and t are uncorrelated with input levels prior to $t-2$, we estimate the following baseline model:

$$\Delta\ln\left(\frac{Q_{it}}{L_{it}}\right) = \beta\Delta\ln(L_{it1}) + \gamma\Delta\ln\left(L_{it}\right) + \phi_t + \Delta\varepsilon_{it}, \qquad (6)$$

Note that the Pagan–Hall test indicates that heteroskedasticity is present in most cases (We discuss cases where heteroskedasticity is absent in Section 4). As the generalized method of moments (GMM) estimator is more efficient than the IV estimator under heteroskedasticity, we estimate the model parameters using GMM. We conduct two types of estimations: first, using the two-period lagged number of employees with disabilities as an IV (GMM-1), and second, adding the three-period lagged number of employees with disabilities as an additional instrument (GMM-2).

To assess the validity of our approach, we perform several diagnostic tests. First, we examine the weak instrument problem, which can introduce bias into the estimation if

the correlation between the instrumental and endogenous variables is weak. We use the Kleibergen–Paap statistic to test for this issue, employing two specific tests. The underidentification test (Kleibergen–Paap rk LM statistic) verifies whether the equation is properly identified, meaning that all excluded instruments are relevant. The weak instrument test (generalized Kleibergen–Paap Wald F statistic) tests the null hypothesis that the instruments are weak. If this null hypothesis is rejected, we conclude that the instruments are appropriate. However, a precise criterion for rejecting weak identification has not yet been established. Baum et al. (2007) recommends using the traditional "rule of thumb," which suggests that the F-statistic should be at least 10 to mitigate concerns about weak identification.

Next, we conduct Hansen's J test to evaluate the validity of our instruments. This test examines whether the instruments are uncorrelated with the error term and whether they are correctly excluded from the estimated equation. The null hypothesis states that the overidentifying restrictions are valid. If the null hypothesis is not rejected, we conclude that the instruments are exogenous.

Finally, we test whether employment of people with disabilities is truly endogenous by comparing the OLS and IV estimates using an endogeneity test. The null hypothesis states that the specified endogenous regressors can be treated as exogenous. The test statistic follows a chi-squared distribution (χ^2) with degrees of freedom equal to the number of tested regressors. If the null hypothesis is rejected, we can conclude that the employment of people with disabilities is endogenous.

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.

We consider heterogeneity based on firm characteristics. First, 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 of the entire 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.

Second, we examine the effects of whether or not to employ persons with disabilities on firm productivity. 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.[13] 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 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 replace the number of disabled employees in the model with a dummy variable for the employment of disabled people, which takes the value 0 if no disabled people are employed and 1 if at least one disabled person is employed. We then focus on small and medium sized companies (with more than 200 but less than 500 regular workers), where the proportion of companies that do not employ any disabled people is high.

[13] 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.

Third, we account for industry heterogeneity, particularly the potential differences between the manufacturing sector—which has a long-standing tradition of actively employing individuals with disabilities—and other industries. Using cross-sectional data from manufacturing firms in Japan, Mori and Sakamoto (2018) find that the employment rate of people with disabilities had no significant impact on corporate profits. However, the relationship between disability employment and firm performance in non-manufacturing industries remains unclear. To address this gap, we conduct separate estimations for manufacturing and non-manufacturing industries. This approach allows us to assess whether the effects of disability employment on firm performance differ systematically across industrial sectors.

3.2 Data

In this study, we analyze data from 2013 to 2019 for firms with 200 or more regular employees as of 2013. This selection was made because, as shown in Table 1, there were no major changes in the employment policy for people with disabilities during this period. However, firms with fewer than 200 full-time employees became subject to the levy–grant system in 2015, that is, during the study period. To eliminate the potential impact of these policy changes, we exclude these firms from the analysis.

For the analysis, we merge two datasets. First, we utilize the *Report on Employment Status of Persons with Disabilities*, compiled by the MHLW and managed by 47 prefectural labor bureaus under its jurisdiction. These data were obtained through disclosure requests submitted to each bureau.[14] Employers above a certain size threshold (e.g., firms with 50 or more regular employees in 2013) are required to report the

[14] Note that the 2013 data for Oita Prefecture are unavailable due to the expiration of the retention period for administrative documents. Therefore, the 2013 firm-level data for Oita Prefecture are missing from the analysis.

employment status of workers with disabilities to the Public Employment Security Office in their respective jurisdictions as of June 1 each year. As a result, this dataset provides highly accurate panel data on disability employment, covering nearly all firms in Japan. The dataset includes firm-level information such as the company name, address, industrial classification, total number of regular employees, legal employment obligations for persons with disabilities, actual number of employees with disabilities, realized employment rate of persons with disabilities, and the shortfall in the number of employees needed to meet legal requirements. However, data on the degree and type of disability are not available due to privacy concerns, as this information could potentially lead to individual identification.

Second, we utilize firm-level data compiled by Tokyo Shoko Research, LTD (TSR). TSR is the oldest credit research organization in Japan and the company information it provides—both domestic and international—is widely used not only for business purposes such as credit management, marketing, and supplier management but also for empirical research on corporate financial performance (e.g., Hoshi et al. 2023). The corporate information data provided by TSR consist of two types: Corporate Information Files (CIF) and Financial Information Files (FIF), each with its own advantages and limitations. The CIF provide broad coverage of firms but contain limited information on corporate profits, including only sales and net income. By contrast, the FIF include more detailed financial indicators, such as sales, operating income, recurring profit, and net income, along with the necessary variables for calculating TFP.[15] However, the FIF cover a narrower range of firms, with the sample size being approximately 30% smaller than that of the CIF. To balance sample size and data availability, this study

[15] 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 B.

employs the CIF to analyze sales and net income, leveraging their broader firm coverage, while the FIF are used to analyze operating income, ordinary income, and TFP, given their richer financial data. Additionally, while most firms operate on a 12-month fiscal year, some adopt shorter accounting periods, such as 6 or 3 months. To ensure comparability, flow variables such as sales and net income are adjusted by dividing them by the number of months in the firm's fiscal year. As financial indicators can be zero and operating, recurring, and net income may be negative, a transformation is applied before taking the natural logarithm. Specifically, all financial variables are adjusted by adding 1 before the log transformation to accommodate zero values. For negative values, the sign is inverted, 1 is added, the logarithm is taken, and then the sign is inverted again. This transformation ensures that financial variables remain interpretable while addressing potential issues with zero and negative values in the logarithmic calculations.

As the Report on Employment Status of Persons with Disabilities and the TSR datasets do not share a common firm identifier, firms are merged based on matching firm names and addresses. To ensure data reliability, the analysis is restricted to firms without errors or missing values caused by input inconsistencies in either dataset. Additionally, the analysis is limited to commercial enterprises, including joint-stock companies (Kabushiki Gaisha), limited liability companies (Yugen Gaisha and Godo Gaisha), limited partnership companies (Goshi Gaisha), and general partnership companies (Gomei Gaisha). This restriction ensures that the study focuses on business entities that are subject to corporate financial reporting and employment regulations. An important consideration is that in the Report on Employment Status of Persons with Disabilities, firms that own special subsidiary companies report the total number of employees with disabilities by aggregating

figures from both the headquarters and the special subsidiary.[16] By contrast, the TSR dataset records productivity-related variables separately for headquarters and special subsidiaries. This discrepancy in reporting could introduce inconsistencies in the analysis. To ensure data accuracy and consistency, we exclude firms that own special subsidiary companies from our analysis. This exclusion prevents potential biases arising from differences in how employment and productivity data are reported across the two datasets.[17]

In Appendix A, we conduct a detailed examination of the number of firms excluded when matching the "Report on Employment Status of Persons with Disabilities"—a source of administrative data—with the TSR company information and financial records. Additionally, we assess how the characteristics of firms in the matched dataset change as a result of this integration. The population under consideration comprises commercial firms employing more than 200 full-time workers, excluding those that own special-purpose subsidiaries, as reported in the Report on Employment Status of Persons with Disabilities. Within this population, approximately 74% of the firms are successfully matched to the TSR company information file. While the average number of employees with disabilities and the total workforce size are slightly smaller in the matched sample, the sectoral distribution, including the share of manufacturing firms, remains unchanged. When matched with the TSR financial information file, the sample size is further reduced to 49%. In this case, the average number of employees with disabilities and the overall workforce size are marginally larger, yet the industrial composition exhibits no substantive differences. These findings indicate that, although the sample size decreases when

[16] For further details, refer to MHLW's website (https://www.mhlw.go.jp/bunya/koyou/koureisha-koyou/dl/kinyuyouryou.pdf).

[17] Assuming that all disabled employees at the head office belong to a special subsidiary, we attempted to analyze the impact of employing disabled people at the special subsidiary alone on corporate productivity. However, the diagnostic test for GMM estimation showed that the instrumental variable was not valid. Therefore, this study does not consider the impact of special subsidiaries.

integrating employment records for persons with disabilities with TSR company data, the fundamental characteristics of the sample remain largely unchanged. Consequently, any potential biases introduced by the data integration process are likely minimal.

Table 2 presents the descriptive statistics for the dataset used in this study, which comprises data from the Report on Employment Status of Persons with Disabilities, matched with either the CIF or FIF. 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 3 illustrates the trends in the employment status of people with disabilities. In general, the number of workers with disabilities increased over the study period. According to company size, in Figure 3(i), more persons with disabilities are employed in large firms than in medium-sized ones. Figure 3(ii) shows the number of employees with disabilities in the manufacturing and non-manufacturing sectors. From 2013 to 2017, which corresponds to the early part of the analysis period, the number is higher in the manufacturing sector. However, from 2018 onward, the number becomes higher in the non-manufacturing sector. Figure 3(iii) illustrates the trend in the probability of firms with more than 200 but no more than 500 employees that employ at least one person with a disability. Comparing the manufacturing and non-manufacturing sectors, the gap between the two sectors narrows between 2013 and 2015.

4. Results

4.1 Baseline Results

This section presents the estimation results of the baseline model, which examines the impact of changes in the number of employees with disabilities on firm productivity. The dependent variables include the logarithm of sales and net income per employee, obtained

from the CIF, as well as the logarithm of operating income, recurring profit per regular employee, and TFP, derived from the FIF.

Table 3(i) presents the estimation results of the OLS and FE models. The OLS estimates for the full sample consistently yield negative coefficients across all specifications. Specifically, a 1% increase in the number of employees with disabilities is associated with a 0.1% decline in sales per regular employee, a 0.3% reduction in net income per regular employee, a 0.4% decrease in operating income per regular employee, a 0.3% decline in recurring profit per regular employee, and a 0.1% decrease in TFP. With the exception of the specification in which TFP is the dependent variable, all estimated coefficients are statistically significant.

The OLS estimates for medium-sized firms are nearly identical to those obtained for the full sample. By contrast, notable differences emerge in the estimates for large firms. Notably, some coefficients exhibit sign reversals, suggesting heterogeneity in the relationship between disability employment and firm performance across firm sizes. For instance, in the case of large firms, a 1% increase in the number of employees with disabilities is associated with a 0.4% increase in sales per regular employee, a result that is statistically significant.

When incorporating firm FE, the estimated coefficients exhibit varying signs (positive or negative); however, most are not statistically significant. This suggests that much of the observed negative correlation between the number of employees with disabilities and firm performance is likely spurious, driven by the unobserved heterogeneity across firms. Nonetheless, when analyzing the full sample and the subsample of medium-sized firms, the coefficient on sales per regular employee remains slightly positive (0.01%) and statistically significant. Next, we examine the results of the GMM estimation to account for the effects of unobservable shocks. In the GMM

estimation, the sample size decreases as additional lags of the number of employees with disabilities are incorporated. Specifically, when including the two-period lagged number of employees with disabilities (GMM-1), the number of observations declines, and further decreases with the inclusion of the three-period lagged number of employees with disabilities (GMM-2). In estimations using the CIF, the sample comprises 76,538 observations for the pooled OLS and FE models. However, this figure drops to 49,964 observations in GMM-1 and further declines to 38,536 in GMM-2. Similarly, when using the FIF, the sample size is initially 50,543 for the pooled OLS and FE models, decreasing to 32,033 in GMM-1 and 24,419 in GMM-2.

Table 3(ii) reports the results of the first-stage regression in the GMM framework, where the number of employees with disabilities is instrumented using its two- and three-period lags. The coefficients on these lagged variables are statistically significant at the 1% level, confirming their relevance as instruments.

Table 3(iii) presents the second-stage estimates obtained from the GMM framework. In the GMM estimation, which accounts for unobserved shocks across firms, several diagnostic tests are conducted to assess the robustness of the IV approach. Table 3(iii) primarily reports results for specifications without issues in the diagnostic tests. First, regarding instrument strength, the Kleibergen–Paap Wald F statistic slightly decreases when the three-period lag of the number of employees with disabilities is introduced for large firms; however, no major issues are detected. Second, the Hansen J test raises concerns about the exogeneity of the instrument when the three-period lag is included, as the test results are statistically significant at the 10% level for the full sample and for sales in medium-sized firms. Third, certain endogeneity tests fail to reject the null hypothesis that the IV is endogenous. The results suggest that the IV approach is valid when the endogenous nature of the variables is acknowledged. Specifically, for the full sample and

medium-sized firms, the approach is fully supported in the cases of net income and operating income. For large firms, the approach is supported for sales. Finally, the Pagan–Hall general test for heteroskedasticity indicates its presence in most specifications. However, in the GMM-1 estimations using the FIF—particularly for large firms—heteroskedasticity is not detected, necessitating caution when interpreting these results.

Regarding the sign and magnitude of the estimated coefficients, in the full sample and medium-sized firms, the coefficients generally range from 0.5% to 1.0% in specifications without diagnostic issues and are statistically significant. Notably, the coefficients for net income and operating income per regular employee are statistically significant across all specifications. By contrast, for large firms, the validity of the IV is questionable in most cases. Focusing on the coefficient of sales per regular employee in specifications without diagnostic issues, it is positive and statistically significant.

In summary, an increase in the number of employees with disabilities significantly enhances net income and operating income for medium-sized firms, while for large firms, it leads to a statistically significant increase in sales.[18]

4.2 The "Extensive Margin" of Disability Employment

We have so far examined the average effect of marginal changes in the number of employees with disabilities, holding firm size constant. However, given that approximately half of the small and medium-sized firms do not employ any individuals with disabilities, it is essential to analyze the extensive margin, that is, whether employing at least one worker with a disability has a significant impact on firm performance. As previously discussed, hiring employees with disabilities entails fixed costs, including adjustments to

[18] We also estimate a model with the logarithm of K_{it}, but the results show no significant differences. See Appendix C for details.

internal regulations and capital investments. Firms that have never employed individuals with disabilities may face higher initial costs compared to firms that have already integrated them into their workforce. This suggests that the decision to employ individuals with disabilities could have implications beyond marginal employment adjustments. To investigate this issue, we replace the logarithm of the number of employees with disabilities used in prior models with a binary indicator variable denoting whether a firm employs any individuals with disabilities. Given that nearly all large firms employ at least one person with a disability, the analysis is restricted to firms with 200 to 500 employees as of 2013.

Table 4(i) reports the first-stage results from the GMM estimation. In the specification incorporating both the two- and three-period lags of the disability employment dummy, the coefficient on the three-period lag is not statistically significant, suggesting weak instrument concerns.

Table 4(ii) and (iii) present the estimation results for the OLS and FE models, along with the second-stage estimates obtained from the GMM framework. In both OLS and FE models, the coefficient on the disability employment dummy is not statistically significant across all specifications. In the GMM estimation, a key diagnostic test for the validity of the IV approach is the endogeneity test. Across all specifications, the null hypothesis of exogeneity cannot be rejected, indicating that the IV approach lacks empirical support. Additionally, no major concerns arise from other diagnostic tests.

Consistent with the OLS and FE results, the coefficient on the disability employment dummy remains statistically insignificant in the GMM estimation. While the endogeneity test does not support the use of IVs—necessitating caution in interpreting the GMM results—this analysis finds no significant effect of disability employment on the extensive margin (i.e., whether a firm employs at least one worker with a disability).

4.3 Comparison of Effects Between Manufacturing and Non-Manufacturing Industries

This section examines whether the impact of disability employment on firm performance differs between manufacturing and non-manufacturing industries, given that manufacturing firms tend to employ a higher proportion of workers with disabilities.

First, regarding the effect of the number of employees with disabilities on firm performance in the manufacturing sector, as shown in Table 5(i) and (ii), the coefficients on the FE estimates for manufacturing firms are not statistically significant. Furthermore, in the GMM estimation, the Pagan–Hall general test for heteroskedasticity confirms its presence across all specifications. Regarding the validity of the IVs, the endogeneity test provides mixed results. In some cases—such as the analysis of net income and operating income using the full sample of manufacturing firms—the IV approach is supported, as the null hypothesis of exogeneity is rejected. However, in most cases, the approach is not supported. Among the cases where the IVs are valid, the results indicate a positive and statistically significant effect on net income when using the full sample of manufacturing firms. Therefore, the findings for manufacturing firms are broadly consistent with the baseline estimation results.

By contrast, the results for non-manufacturing firms, shown in Table 5(i) and (ii), exhibit some differences from those for manufacturing firms. Specifically, in the GMM estimation, the previously positive and statistically significant effects on net income and operating income for the manufacturing sector become insignificant. However, it is important to note that the endogeneity test fails to reject the null hypothesis, raising concerns about the validity of the IV approach in this context.

Next, regarding the effect of disability employment at the extensive margin—whether a firm employs at least one worker with a disability—as shown in Table 5(iii) and (iv), the Kleibergen–Paap rk LM statistic and the Kleibergen–Paap Wald F statistic indicate potential concerns regarding weak instruments in the manufacturing sector, as the values remain low across all specifications. By contrast, for non-manufacturing firms, the GMM estimation results suggest that when the IVs are deemed valid—specifically, in the model using the two-period lag of the disability employment dummy as an instrument—the coefficient on net income is negative and statistically significant at the 5% level. These findings suggest that employing workers with disabilities is associated with a 2% decrease in net income.

In summary, for manufacturing firms, an increase in the number of employees with disabilities significantly enhances net income, a result consistent with the baseline analysis. However, for non-manufacturing firms, despite the concerns about the validity of the IV approach, an increase in disability employment does not have a statistically significant effect. Furthermore, when considering the extensive margin of disability employment (i.e., whether a firm employs at least one worker with a disability), the results indicate that, in non-manufacturing industries, disability employment significantly reduces net income. These findings highlight industry-specific heterogeneity in the relationship between disability employment and firm performance.

4.4. Extended Analysis: The Effect of Increasing the Employment Quota for People with Disabilities

We analyzed panel data from 2013 to 2019; however, we did not explicitly account for the change in the statutory employment rate introduced in 2018. Therefore, as an additional validation, we examine the impact of the increased quota-based employment requirement

for people with disabilities on firm productivity, leveraging the change in the statutory disability employment rate from 2.0% to 2.2% in 2018.

As discussed in Section 2, the number of employees with disabilities that each firm is required to hire is determined by multiplying the adjusted number of regular employees by the statutory employment rate and rounding down to the nearest whole number. Figure 4 illustrates the required number of employees with disabilities under the quota system for firms with adjusted regular employees ranging from 200 to 500. Prior to the policy change, when the disability employment rate was 2.0%, firms with adjusted regular employees between 200 and 249 were required to employ four workers with disabilities. After the statutory rate increased to 2.2%, firms with adjusted regular employees of 200 to 227 remained subject to the same four-employee requirement. However, firms with adjusted regular employees of 228 to 249 saw their requirement increase by one, to five employees with disabilities. Consequently, the 2018 increase in the statutory employment rate created a natural division between two groups: firms that were required to hire one additional employee with a disability (treatment group) and those whose employment obligations remained unchanged (control group). For large firms, the requirement to hire one additional employee with a disability may have had a negligible impact, whereas for small and medium-sized enterprises, this policy change likely imposed a relatively greater burden.

Table 6 presents the number of firms in the treatment and control groups based on 2017 pre-policy data. Among relatively small firms, the control group is slightly larger. However, as the adjusted number of regular employees approaches 500, the number of firms in the control group decreases, and ultimately, the treatment group becomes larger. Figure 5 depicts the trend in the number of employees with disabilities for both the treatment and control groups. A comparison of these trends suggests that the treatment

group experienced a slightly greater increase in disability employment. This exogenous increase in quota-based employment serves as an IV for analysis. Specifically, we estimate the following two-stage model:

$$L_{it1} = \alpha + \beta \ln(L_{it}) + \gamma Treat_i + \lambda After_t + \rho Treat_i \cdot After_t + \mu_{it}, \quad (7)$$

$$\ln\left(\frac{Q_{it}}{L_{it}}\right) = c + \delta L_{it1} + \eta \ln(L_{it1}) + \gamma Treat_i + \zeta After_t + \varepsilon_{it}. \quad (8)$$

In the first stage, a difference-in-differences (DID) estimation is performed. Based on the adjusted number of regular employees in 2017, we define a treatment dummy variable, $Treat_i$, which takes a value of 1 if a firm's required quota for employees with disabilities increased due to the policy change, and 0 if it remained unchanged. The analysis period spans from 2016 to 2019, with dummy variable $After_t$ set to 1 for 2018 and 2019, and 0 otherwise. This allows us to estimate the effect of the change in the statutory employment rate on the number of employees with disabilities.

Additionally, to assess the validity of the IV, we conduct tests using the Kleibergen–Paap rk LM statistic and the Kleibergen–Paap Wald F statistic, consistent with our previous GMM analysis. Furthermore, we perform an endogeneity test to evaluate the appropriateness of the instrument.

The results are presented in Table 7(i). First, in the first-stage estimation using the CIF, where the dependent variable is the number of employees with disabilities (per 100 employees), the coefficient on the interaction term between the treatment dummy and the post-policy dummy is positive and statistically significant at the 1% level. Interpreting the magnitude of this coefficient, an increase of one additional quota for hiring an employee with a disability leads to an increase of 0.15 employees with disabilities per firm. The IV test indicates that the Kleibergen–Paap Wald F statistic is 8, suggesting that the instrument may be somewhat weak. Next, examining the impact of the number of employees with

disabilities on sales and net income, the estimated coefficients are positive but not statistically significant.

Similarly, in the first-stage estimation using the FlF, the coefficient on the interaction term between the treatment dummy and the post-policy dummy is positive and statistically significant at the 10% level. In this case, an increase of one additional quota for hiring an employee with a disability results in an increase of 0.4 employees with disabilities per firm. The IV test shows that, as in the CIF results, the Kleibergen–Paap Wald F statistic is 3.6, indicating that the instrument remains somewhat weak. In the second-stage estimation, examining the effect of the number of employees with disabilities on firm performance, all estimated coefficients remain statistically insignificant, consistent with the results from the CIF.

Additionally, in all analyses reported in Table 7(i), the endogeneity test fails to reject the null hypothesis. Therefore, caution is required when interpreting the results based on the IV approach.

The results of the industry-specific analysis, which separately examines manufacturing and non-manufacturing firms, are presented in Table 7(ii). For manufacturing firms, the results are largely consistent with those obtained using the full sample. While the Kleibergen–Paap Wald F statistic remains somewhat low, the overall conclusion is that the number of employees with disabilities does not have a statistically significant impact on firm productivity. For the non-manufacturing sector, the IV test similarly suggests a weak instrument, and an increase in the disability employment quota by one does not significantly increase the number of employees with disabilities.

In summary, we find that an increase in the statutory employment quota for hiring employees with disabilities does not have a statistically significant impact on the productivity of small and medium-sized enterprises.

4.5 Discussion

The findings of this study can be summarized as follows. An increase in disability employment significantly enhances net income and operating income in mid-sized firms and sales in large firms. By contrast, in mid-sized firms, the presence or absence of disability employment does not have a statistically significant effect on productivity. Additionally, while disability employment increases net income in the manufacturing sector, it does not exhibit a statistically significant effect in the non-manufacturing sector. Notably, in the non-manufacturing sector, the mere presence of employees with disabilities is associated with a decline in net income, highlighting industry-specific heterogeneity. Furthermore, expanding the disability employment quota by one additional position in small firms does not significantly affect productivity.

These results diverge in some respects from previous studies, such as Mori and Sakamoto (2018), which analyzed 2008 manufacturing sector data, and Nagae (2014), which used panel data on publicly listed firms headquartered primarily in Tokyo during the 2000s. Our study suggests that disability employment does not necessarily impose a financial burden on small firms. Conversely, given the observed positive impact on operating income, firms appear to benefit not merely from government grants but also from economic incentives to actively employ workers with disabilities.

For large firms, disability employment significantly increases sales, which may be related to corporate social responsibility strategies. In this context, Nagae (2005) empirically demonstrates that meeting the statutory employment rate for people with disabilities does not necessarily lead to positive evaluations from stakeholders, such as shareholders. However, Sakamoto and Mori (2017) highlight concerns regarding the identification strategy used in Nagae's study, leaving the impact of disability employment

on corporate image an open question. While our findings suggest that disability employment may positively influence sales for large firms, further research is necessary to explore this relationship in greater detail.

Regarding industry heterogeneity, disability employment significantly increases net income in the manufacturing sector but does not have a statistically significant effect in the non-manufacturing sector. Additionally, when analyzing the extensive margin of disability employment (i.e., whether a firm hires employees with disabilities), we find no statistically significant effect overall. However, in the non-manufacturing sector, disability employment is associated with a significant reduction in net income, reinforcing the presence of industry-specific disparities. Unlike the manufacturing sector, which has a long history of employing workers with disabilities, the non-manufacturing sector may lack the accumulated experience and organizational infrastructure necessary for effective integration. This suggests that the initial costs related to workplace adaptation and accessibility improvements may be higher in non-manufacturing firms, potentially creating additional barriers to disability employment. However, the observed disparities between manufacturing and non-manufacturing firms may also stem from differences in the distribution of disability types (physical, intellectual, and mental) among employees, as well as variations in the costs associated with providing reasonable accommodations. Unfortunately, our dataset does not contain information on the specific types of disabilities among employed individuals, making it impossible to directly assess this factor. Addressing this limitation remains an important avenue for future research.[19]

[19] A key challenge in studying the employment of persons with disabilities is the limited availability of granular data on the types and severity of disabilities. Given that most firms employ only a small number of individuals with disabilities—often just a few—disclosing such detailed information could inadvertently reveal individual identities, raising substantial privacy concerns. These concerns largely explain the scarcity of such data, despite the potential analytical value. The tension between safeguarding privacy and generating comprehensive data to inform policy decisions remains a critical constraint in this area of research.

When examining the impact of increasing the statutory employment quota for people with disabilities by one additional position in small and medium-sized firms, we find no statistically significant effect on productivity, nor do we observe differences across industries. This result aligns with Mori and Sakamoto (2018), who analyze the effect of quota increases in the manufacturing industry, further supporting the robustness of our findings. Additionally, when extending the analysis to non-manufacturing industries, we find that an increase in the statutory quota does not significantly affect the number of employees with disabilities hired by non-manufacturing firms.

Therefore, increasing the number of employees with disabilities in firms that already employ them does not negatively impact firm performance and may even strengthen the workforce. However, for firms that have never previously employed individuals with disabilities or those required to increase their legally mandated disability employment quota by one, the policy change does not produce a significant effect on firm performance.

5. Conclusions

This study examined the impact of employing people with disabilities on corporate productivity. Prior theoretical and empirical research has presented mixed perspectives on how disability employment affects firm performance. Moreover, data linking disability employment to corporate outcomes have been limited, both domestically and internationally, resulting in a relatively small body of empirical research on this topic. To address this gap, we utilized newly constructed panel data that combine administrative records on disability employment policies with financial data collected through credit research on private firms. This dataset allowed a rigorous analysis of the causal effects of disability employment on corporate financial indicators and productivity. Furthermore,

rather than focusing on average effects across all firms, we examined heterogeneity in these effects across different firm sizes and industries.

Our findings indicate that, while disability employment does not necessarily harm financial performance, its impact varies by firm size and industry. In mid-sized firms, employing individuals with disabilities significantly increases net income and operating income, while in large firms, it is associated with higher sales. Additionally, in the manufacturing sector, disability employment positively influences net income. However, there is no observed impact on corporate performance from the extensive margin of disability employment—whether a firm hires employees with disabilities for the first time—or from the expansion of the statutory employment quota.

These findings contrast with prior studies and challenge concerns that disability employment may impose a financial burden on small firms. Instead, our results suggest that firms can derive economic benefits from disability employment beyond simply receiving government subsidies, highlighting potential productivity gains or efficiency improvements associated with inclusive hiring practices.

Our analysis also suggests that companies with prior experience employing people with disabilities have the potential to strengthen their workforce. However, firms hiring people with disabilities for the first time do not experience significant changes in performance. Given that small and medium-sized enterprises in Japan have historically employed fewer people with disabilities—and that firms without prior experience in disability employment are more likely to encounter challenges—the government has recently enhanced employment consultation and subsidy programs to support small and medium-sized enterprises in hiring individuals with disabilities. Our findings suggest that increasing the number of firms with experience in disability employment would be a desirable policy objective. Moving forward, it will be important to assess the effectiveness

of these newly introduced support systems and evaluate their impact on corporate performance and disability employment outcomes.

Appendix A: Matching the Report on Employment Status of People with Disabilities with TSR Corporate Data

In this study, we focus on firms for which we can merge data from the Ministry of Health, Labour and Welfare's Report on Employment Status of Persons with Disabilities with corporate information from TSR. Therefore, it is necessary to examine which types of firms are excluded from the sample.

Table A1(i) presents the data compiled from the Report on Employment Status of Persons with Disabilities, serving as a basis for comparison with the merged dataset. This dataset includes only commercial enterprises, excludes firms that own special subsidiary companies, and is limited to firms with more than 200 regular employees. Table 2(i) shows the sample size, number of employees with disabilities, and total number of regular employees before merging. The total sample size is 103,766, with an average of 14.39 employees with disabilities and an average of 755.65 regular employees.

Table A1(ii) and (iii) present the datasets after merging the Report on Employment Status of Persons with Disabilities with TSR's Corporate Information File and Financial Information File, respectively.

For the Corporate Information File, the merged dataset contains 76,538 observations, meaning that approximately 74% of the original dataset matches TSR's corporate information. The average number of employees with disabilities slightly decreases to 14.17, and the average number of regular employees decreases to 745.29, but these changes are minimal. Examining firm size, before merging, medium-sized firms account for 85% (88,984/103,766), while large firms make up 15% (14,782/103,766). After merging, the proportions remain nearly the same, with medium-sized firms accounting for 85% (65,613/76,538) and large firms for 15% (10,925/76,538), indicating that firm size distribution remains largely unchanged. Similarly, the proportion of manufacturing firms before merging is 31% (32,337/103,766) and after merging is 32% (24,706/76,538), showing no significant difference.

For the Financial Information File, the merged dataset consists of 50,543 observations, meaning that approximately 49% of the original dataset matches with TSR's financial data. The average number of employees with disabilities increases slightly to 15.02, and the average number of regular employees rises to 791.78, but again, these differences are minimal. In terms of firm size, medium-sized firms account for 84% (42,724/50,543) and large firms for 16% (7,819/50,543), with no major change in distribution. The proportion of manufacturing firms remains at 33% (16,873/50,543), showing little variation.

Appendix Table A1. Comparison of Firm Characteristics Before and After Merging the Ministry of Health, Labour and Welfare's Report on Employment Status of Persons with Disabilities with Tokyo Shoko Research (TSR) Corporate Data

(i) Characteristics of the Ministry of Health, Labour and Welfare's Report on Employment Status of Persons with Disabilities Before Merging

Variable	Obs.	Mean	Std. dev.	Min	Max
(i) Total					
The number of employees with disabilities	103,766	14.39	35.74	0	1,495.5
The number of regular employees	103,766	755.65	1,612.96	45.5	58,998.5
(ii) Medium-sized firms: more than 200 to 1,000 employees					
The number of employees with disabilities	88,984	7.16	6.76	0	363
The number of regular employees	88,984	410.46	227.41	45.5	8,671
(iii) Large firms: more than 1,000 employees					
The number of employees with disabilities	14,782	57.92	80.52	0	1,495.5
The number of regular employees	14,782	2,833.62	3,594.03	54	58,998.5
(iv) Manufacturing					
The number of employees with disabilities	32,337	14.54	33.30	0	835.5
The number of regular employees	32,337	740.45	1,564.62	49	43,424
(v) Non-manufacturing					
The number of employees with disabilities	71,429	14.32	36.79	0	1,495.5
The number of regular employees	71,429	762.53	1,634.34	45.5	58,998.5

Note: The dataset is limited to commercial enterprises, excludes firms that own special subsidiary companies, and includes only firms with more than 200 employees.

(ii) Characteristics After Merging the Ministry of Health, Labour and Welfare's Report on Employment Status of Persons with Disabilities with TSR's Corporate Information File

Variable	Obs.	Mean	Std. dev.	Min	Max
(i) Total					
The number of employees with disabilities	76,538	14.17	32.85	0	1,315
The number of regular employees	76,538	745.29	1,497.80	45.5	58,998.5
(ii) Medium-sized firms: more than 200 to 1,000 employees					
The number of employees with disabilities	65,613	7.25	7.07	0	363
The number of regular employees	65,613	415.01	229.02	45.5	8,671
(iii) Large firms: more than 1,000 employees					
The number of employees with disabilities	10,925	55.74	72.42	0	1,315
The number of regular employees	10,925	2,728.81	3,288.32	63	58,998.5
(iv) Manufacturing					
The number of employees with disabilities	24,706	14.24	31.91	0	835.5
The number of regular employees	24,706	724.54	1,491.47	48.5	39,862
(v) Non-manufacturing					

The number of employees with disabilities	51,832	14.13	33.29	0	1,315
The number of regular employees	51,832	755.18	1,500.72	45.5	58,998.5

(ii) Characteristics After Merging the Ministry of Health, Labour and Welfare's Report on Employment Status of Persons with Disabilities with TSR's Financial Information File

Variable	Obs.	Mean	Std. dev.	Min	Max
(i) Total					
The number of employees with disabilities	50,543	15.02	35.79	0	1,315
The number of regular employees	50,543	791.78	1,640.32	46.5	58,998.5
(ii) Medium-sized firms: more than 200 to 1,000 employees					
The number of employees with disabilities	42,724	7.27	7.26	0	363
The number of regular employees	42,724	420.76	231.25	46.5	8,671
(iii) Large firms: more than 1,000 employees					
The number of employees with disabilities	7,819	57.36	76.63	0	1,315
The number of regular employees	7,819	2,819.04	3,498.54	77	58,998.5
(iv) Manufacturing					
The number of employees with disabilities	16,873	15.36	35.96	0	835.5
The number of regular employees	16,873	784.40	1,684.92	49	39,862
(v) Non-manufacturing					
The number of employees with disabilities	33,670	14.85	35.70	0	1,315
The number of regular employees	33,670	795.47	1,617.52	46.5	58,998.5

Appendix B: Method for Calculating Total Factor Productivity (TFP)

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

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

where Y represents value-added, K capital stock, L labor input, and A is the 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[20] 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 Labor Survey by the MHLW.[21] 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.2.1) and rearranging it, TFP (natural logarithm) can be expressed as in Eq. (A.2.2). 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:

$\ln A = \ln Y - \alpha \ln K - (1-\alpha)\ln L$. (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.[22]

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[20] https://www.esri.cao.go.jp/jp/sna/data/data_list/kakuhou/files/2020/2020_kaku_top.html, last accessed March 7, 2024

[21] 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&stat_infid=000032185240&metadata=1&data=1, last accessed March 7, 2024

[22] We refer to Nishihata and Yamamoto (2021).

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:

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

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.2.3) 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 the 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.

Appendix C:

We estimate the equations that add the logarithm of K to the models in Eqs. (5) and (6):

$$\ln\left(\frac{Q_{it}}{L_{it}}\right) = \delta \ln(L_{it1}) + \eta \ln(L_{it}) + \zeta \ln(K_{it}) + \theta_i + \phi_t + \varepsilon_{it},$$

(A.3.1)

$$\Delta \ln\left(\frac{Q_{it}}{L_{it}}\right) = \beta \Delta \ln(L_{it1}) + \gamma \Delta \ln(L_{it}) + \xi \Delta \ln(K_{it}) + \phi_t + \Delta\varepsilon_{it},$$

(A.3.2)

To estimate this model, we use only data for firms included in TSR's Financial Information file, for which information on the total fixed assets (K_{it}) in logarithmic form is available. The results for the effect of employing people with disabilities on productivity remain essentially unchanged from the estimates of Eqs. (5) and (6) without the capital variable.

Table C1: OLS and Fixed-Effect Estimates for the Log of the Number of Employees with Disabilities on Firm Productivity

		Full Sample			Medium-Sized Firms (2013 Employee Count: 200–1,000 Employees)			Large Firms (2013 Employee Count: More than 1,000 Employees)		
		OLS	FE	N	OLS	FE	N	OLS	FE	N
FIF	Operating income	-0.328***	-0.0118	50,543	-0.323***	-0.0145	42,724	-0.235	0.0422	7,819
		(0.046)	(0.040)		(0.047)	(0.042)		(0.195)	(0.149)	
	Recurring profit	-0.253***	0.00546		-0.262***	0.00147		0.0544	0.0657	
		(0.041)	(0.037)		(0.042)	(0.038)		(0.151)	(0.127)	
	TFP 1	-0.0712	0.156		-0.103	0.155		0.941*	0.213	
		(0.104)	(0.108)		(0.106)	(0.111)		(0.486)	(0.431)	
	TFP 2	-0.121	0.16		-0.146	0.159		0.714	0.227	
		(0.104)	(0.108)		(0.106)	(0.111)		(0.485)	(0.431)	

Table C2: GMM Estimation Results for the Log of the Number of Employees with Disabilities on Firm Productivity

(i) Full Sample

	Δ Operating income	Δ Recurring profit	Δ TFP 1	Δ TFP 2

Panel C. GMM (lagged 2)				
Δ ln Number of employees with disabilities	0.752*	0.547	1.321	1.348
	(0.409)	(0.351)	(1.083)	(1.083)
N	32,033			
Kleibergen–Paap rk LM statistic	259.815***			
Kleibergen–Paap rk Wald F statistic	258.67			
Endogeneity test	3.417*	2.598	1.219	1.273
Pagan–Hall general test statistic	174.804***	178.083***	133.926***	134.419***
Panel D. GMM (lagged 2 and 3)				
Δ ln Number of employees with disabilities	0.889*	0.471	1.253	1.283
	(0.520)	(0.459)	(1.350)	(1.351)
N	24,419			
Kleibergen–Paap rk LM statistic	169.677***			
Kleibergen–Paap rk Wald F statistic	86.601			
Hansen J statistic	0.733	0.277	0.232	0.263
Endogeneity test	3.003*	0.991	0.704	0.74
Pagan–Hall general test statistic	164.546***	150.838***	116.836***	117.264***

(ii) Medium-Sized Firms (2013 Employee Count: 200–1,000 Employees)

	Δ Operating income	Δ Recurring profit	Δ TFP 1	Δ TFP 2
Panel C. GMM (lagged 2)				
Δ ln Number of employees with disabilities	0.664**	0.554**	1.246	1.244
	(0.287)	(0.257)	(0.769)	(0.769)
N	26,886			
Kleibergen–Paap rk LM statistic	357.076***			
Kleibergen–Paap rk Wald F statistic	412.8			
Endogeneity test	5.519**	5.059**	2.212	2.202
Pagan–Hall general test statistic	172.935***	169.152***	136.655***	137.222***
Panel D. GMM (lagged 2 and 3)				

Δ ln Number of employees with disabilities	0.631*	0.408	1.436	1.431
	(0.369)	(0.331)	(0.990)	(0.991)
N	20,441			
Kleibergen–Paap rk LM statistic	236.141***			
Kleibergen–Paap rk Wald F statistic	134.927			
Hansen J statistic	0.606	0.199	0.156	0.171
Endogeneity test	3.124*	1.464	1.825	1.809
Pagan–Hall general test statistic	161.02***	139.196***	111.955***	112.541***

(iii) Large Firms (2013 Employee Count: More than 1,000 Employees)

	Δ Operating income	Δ Recurring profit	Δ TFP 1	Δ TFP 2
Panel C. GMM (lagged 2)				
Δ ln Number of employees with disabilities	-0.497	-1.289	-2.713	-2.588
	(3.208)	(2.664)	(9.344)	(9.347)
N	5,147			
Kleibergen–Paap rk LM statistic	21.04***			
Kleibergen–Paap rk Wald F statistic	21.58			
Endogeneity test	0.043	0.277	0.124	0.115
Pagan–Hall general test statistic	15.445**	12.433*	8.85	8.787
Panel D. GMM (lagged 2 and 3)				
Δ ln Number of employees with disabilities	-3.263	-3.882	3.740	3.809
	(4.440)	(3.801)	(11.86)	(11.87)
N	3,978			
Kleibergen–Paap rk LM statistic	10.291***			
Kleibergen–Paap rk Wald F statistic	5.472			
Hansen J statistic	0.218	0.025	0.283	0.272
Endogeneity test	0.762	1.31	0.081	0.084
Pagan–Hall general test statistic	25.121***	20.037***	15.632**	15.504**

Note 1: Operating income, and Recurring profit are divided by the number of regular employees to obtain per-employee values.

Note 2: Clustered standard errors at the individual firm level are shown between parentheses.

Note 3: *** p<0.01, ** p<0.05, * p<0.1

Note 4: FIF refers to the Financial Information File.

Note 5: “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 Appendix B for further details.

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Table 1. Changes in the Employment Quota System since 2010

Year	Details of the main policy changes
2010	● The revised law took effect in July, changing the scope of companies subject to the levy–grant system from those with more than 300 regular employees to those with more than 200. ● A short-term worker (20–30 hours) is counted as 0.5 of a regular employee.
2015	● The revised law took effect in April, changing the scope of companies subject to the levy–grant system from those with more than 200 regular employees to those with more than 100.
2016	● The implementation of the Act for Eliminating Discrimination against Persons with Disabilities and the revised Act to Facilitate the Employment of Persons with Disabilities
2018	● Add people with mental disabilities to the calculation base of the legal employment rate

Source: Compiled based on the websites of the Ministry of Health, Labour, and Welfare (https://www.mhlw.go.jp/stf/seisakunitsuite/bunya/koyou_roudou/koyou/shougaishakoyou/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).

Table 2. Descriptive Statistics

	Full sample			Medium-Sized Firms (2013 Employee Count: 200–1,000 Employees)			Large Firms (2013 Employee Count: More than 1,000 Employees)		
Variable	Obs	Mean	Std. Dev.	Obs	Mean	Std. Dev.	Obs	Mean	Std. Dev.
Corporate Information File									
Log sales per regular employee	76,538	7.68	1.09	65,613	7.65	1.08	10,925	7.82	1.13
Log net income per regular employee		3.10	2.73		3.03	2.72		3.52	2.75
Financial Information File									
Log operating income per regular employee	50,543	3.65	2.62	42,724	3.59	2.62	7,819	3.95	2.57
Log recurring profit per regular employee		3.97	2.36		3.90	2.38		4.36	2.21
Log TFP 1		3.31	6.24		3.20	6.28		3.88	5.99
Log TFP 2		0.59	6.29		0.58	6.33		0.68	6.06

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

Table 3. Results by Firm Size (based on 2013 Employee Count)

(i) OLS and Fixed-Effect Estimates for the Log of the Number of Employees with Disabilities on Firm Productivity

		Full Sample			Medium-Sized Firms (2013 Employee Count: 200–1,000 Employees)			Large Firms (2013 Employee Count: More than 1,000 Employees)		
		OLS	FE	N	OLS	FE	N	OLS	FE	N
CIF	Sales	-0.106***	0.0100**	76,538	-0.126***	0.00972**	65,613	0.356***	0.0170	10,925
		(0.0188)	(0.00428)		(0.0191)	(0.00428)		(0.0881)	(0.0263)	
	Net income	-0.332***	-0.0285		-0.333***	-0.0314		-0.203	0.0435	
		(0.0357)	(0.0360)		(0.0365)	(0.0369)		(0.171)	(0.163)	
FIF	Operating income	-0.356***	-0.0118	50,543	-0.357***	-0.0149	42,724	-0.210	0.0636	7,819
		(0.0478)	(0.0402)		(0.0490)	(0.0415)		(0.204)	(0.148)	
	Recurring profit	-0.287***	0.00550		-0.300***	0.000812		0.0883	0.102	
		(0.0433)	(0.0369)		(0.0445)	(0.0381)		(0.171)	(0.126)	
	TFP 1	-0.0716	0.156		-0.105	0.155		0.937*	0.200	
		(0.104)	(0.108)		(0.106)	(0.111)		(0.486)	(0.429)	
	TFP 2	-0.0882	0.160		-0.109	0.162		0.681	0.163	
		(0.106)	(0.108)		(0.109)	(0.111)		(0.500)	(0.428)	

(ii) Results of the First Stage Regression of GMM Estimation: Full Sample

	CIF		FIF	
	Δ ln Disability employment			
2-period lag ln Disability employment	-0.0222***	-0.0584***	-0.0202***	-0.0570***
	(0.00106)	(0.00643)	(0.00126)	(0.00833)
3-period lag ln Disability employment		0.0396***		0.0402***
		(0.00637)		(0.00826)
Δ ln Regular employees	0.693***	0.714***	0.740***	0.764***
	(0.0301)	(0.0357)	(0.0416)	(0.0487)
Year dummy	Yes	Yes	Yes	Yes
Constant	0.0845***	0.0600***	0.0810***	0.0519***
	(0.00383)	(0.00396)	(0.00466)	(0.00491)
N	49,964	38,536	32,033	24,419
Adj. R^2	0.079	0.087	0.081	0.090

(iii) GMM Estimation Results for the Log of the Number of Employees with Disabilities on Firm Productivity

	Full Sample		Medium-Sized Firms (2013 Employee Count: 200–1,000 Employees)			Large Firms (2013 Employee Count: More than 1,000 Employees)
	CIF	FIF	CIF	FIF		CIF
	Δ Net income	Δ Operating income	Δ Net income	Δ Operating income	Δ Recurring profit	Δ Sales
GMM-1						
Δ ln Number of employees with disabilities	0.981***	0.749*	0.665***	0.656**	0.539**	0.352*
	(0.349)	(0.409)	(0.254)	(0.287)	(0.257)	(0.201)
N	49,964	32,033	42,642	26,886		7,322
Kleibergen-Paap rk LM statistic	439.395***	260.015***	573.958***	357.576***		27.927***
Kleibergen-Paap rk Wald F statistic	436.26	258.81	658.673	413.394		28.294
Endogeneity test	8.638***	3.393*	7.792***	5.411**	4.843**	3.258*
Pagan-Hall general test statistic	141.084***	110.018***	113.595***	120.118***	93.041***	13.047**
GMM-2						
Δ ln Number of employees with disabilities	0.909**	0.884*	0.752**	0.622*	0.393	0.485*
	(0.450)	(0.520)	(0.322)	(0.370)	(0.331)	(0.273)
N	38,536	24,419	32,827	20,441		5,709
Kleibergen-Paap rk LM statistic	300.538***	169.776***	401.455***	236.456***		16.57***
Kleibergen-Paap rk Wald F statistic	154.17	86.669	229.354	135.145		8.522
Hansen J statistic	1.336	0.753	1.08	0.63	0.175	0.798
Endogeneity test	4.484**	2.973*	6.122**	3.042*	1.363	3.401*
Pagan-Hall general test statistic	124.428***	102.47***	94.137***	117.663***	92.765***	14.564**

Notes:
1. Sales, net income, operating income, and recurring profit are divided by the number of regular employees to obtain per-employee values.
2. Clustered standard errors at the individual firm level are shown in parentheses.
3. *** p<0.01, ** p<0.05, * p<0.1
4. “Log TFP 1” is calculated as the residual from the production function; “Log TFP 2” is measured as the difference between total output and labor and capital inputs. See Appendix B for further details.

5. CIF refers to the Corporate Information File, and FIF refers to the Financial Information File.
6. GMM-1 uses the two-period lagged logarithm of the number of employees with disabilities as an instrumental variable, whereas GMM-2 extends GMM-1 by adding the three-period lagged logarithm of the number of employees with disabilities.

Table 4. Results on the extensive margin of disability employment

(i) Results of the First Stage Regression of GMM Estimation (2013 Employee Count: 200–500 Employees)

	CIF		FIF	
	Δ Disability employment dummy			
2-period lag Disability employment dummy	-0.121***	-0.142***	-0.107***	-0.137***
	(0.0200)	(0.0248)	(0.0268)	(0.0318)
3-period lag Disability employment dummy		0.00446		-0.000655
		(0.0208)		(0.0272)
Δ ln Regular employees	0.133***	0.140***	0.154***	0.167***
	(0.0326)	(0.0328)	(0.0494)	(0.0504)
Year dummy	Yes	Yes	Yes	Yes
Constant	0.120***	0.130***	0.104***	0.130***
	(0.0201)	(0.0227)	(0.0272)	(0.0323)
N	10,656	8,149	6,605	4,987
Adj. R^2	0.019	0.024	0.018	0.025

(ii) OLS and Fixed-Effect Estimates for Hiring One or More People with Disabilities on Firm Productivity (2013 Employee Count: 200–500 Employees)

		OLS	FE	N
CIF	Sales	0.0571	-0.0106	50,230
		(0.0539)	(0.0101)	
	Net income	0.0397	-0.0490	
		(0.113)	(0.0986)	
FIF	Operating income	0.172	0.0702	32,395
		(0.187)	(0.107)	
	Recurring profit	0.146	0.0437	
		(0.168)	(0.0983)	
	TFP 1	0.533	0.0587	
		(0.530)	(0.284)	
	TFP 2	0.383	0.0577	
		(0.547)	(0.285)	

(iii) GMM Estimates for Hiring One or More People with Disabilities on Firm Productivity (2013 Employee Count: 200–500 Employees)

	CIF	FIF	CIF	FIF		CIF
	Δ Sales	Δ Net income	Δ Operating income	Δ Recurring profit	Δ TFP 1	Δ TFP 2

GMM-1						
Δ Disability employment dummy	0.0256	-1.474	-1.117	-0.369	-0.570	-0.575
	(0.0590)	(0.926)	(1.068)	(0.883)	(3.204)	(3.207)
N	32,500		20,243			
Kleibergen-Paap rk LM statistic	43.992***		20.518***			
Kleibergen-Paap rk Wald F statistic	54.95		25.073			
Endogeneity test	0.17	2.506	1.268	0.193	0.027	0.028
Pagan-Hall general test statistic	22.566***	69.726***	68.484***	57.408***	53.609***	54.491***
GMM-2						
Δ Disability employment dummy	-0.0165	-0.701	-0.644	-0.0952	0.0387	-0.0513
	(0.0623)	(1.006)	(1.298)	(0.925)	(3.384)	(3.389)
N	24,971		15,362			
Kleibergen-Paap rk LM statistic	40.895***		19.828***			
Kleibergen-Paap rk Wald F statistic	27.127		12.968			
Hansen J statistic	0.114	0.901	3.194*	0.717	0.098	0.082
Endogeneity test	0.029	0.467	0.37	0.047	0	0.001
Pagan-Hall general test statistic	23.676***	59.428***	70.405***	60.327***	49.276***	50.018***

Notes:
1. Sales, net income, operating income, and recurring profit are divided by the number of regular employees to obtain per-employee values.
2. Clustered standard errors at the individual firm level are shown in parentheses.
3. *** p<0.01, ** p<0.05, * p<0.1
4. “Log TFP 1” is calculated as the residual from the production function; “Log TFP 2” is measured as the difference between total output and labor and capital inputs. See Appendix B for further details.
5. CIF refers to the Corporate Information File, and FIF refers to the Financial Information File.
6. GMM-1 uses the two-period lagged logarithm of the number of employees with disabilities as an instrumental variable, whereas GMM-2 extends GMM-1 by adding the three-period lagged logarithm of the number of employees with disabilities.

Table 5. The Effect of the Number of Employees with Disabilities on Productivity in the Manufacturing and Non-Manufacturing Industries

(i) Fixed-Effect Estimates for the Log of the Number of Employees with Disabilities on Firm Productivity

		Manufacturing Industry		Non-manufacturing Industry	
		FE	N	FE	N
CIF	Sales	0.00121	24,706	0.0134***	51,832
		(0.0104)		(0.00455)	
	Net income	0.0305		-0.0557	
		(0.0904)		(0.0376)	
	Operating income	-0.0513		-0.00634	
		(0.100)		(0.0415)	
	Recurring profit	-0.0569		0.0204	
		(0.0912)		(0.0382)	
FIF	TFP 1	0.238	16,873	0.110	33,670
		(0.266)		(0.113)	
	TFP 2	0.242		0.115	
		(0.267)		(0.113)	

(ii) GMM Estimation Results for the Log of the Number of Employees with Disabilities on Firm Productivity

	Manufacturing Industry		Non-manufacturing Industry	
	CIF	FIF	CIF	FIF
	Δ Net income	Δ Operating income	Δ Net income	Δ Operating income
GMM-1				
Δ ln Number of employees with disabilities	1.788**	1.415	0.560	0.384
	(0.803)	(0.964)	(0.370)	(0.414)
N	16465	11041	33499	20992
Kleibergen-Paap rk LM statistic	172.896***	101.232***	281.028***	164.054***
Kleibergen-Paap rk Wald F statistic	170.883	100.094	278.951	163.222
Endogeneity test	4.644**	2.335	2.964*	0.807
Pagan-Hall general test statistic	74.791***	35.768***	70.957***	73.37***
GMM-2				
Δ ln Number of employees with disabilities	2.410**	2.140*	0.350	0.279

	(1.018)	(1.217)	(0.484)	(0.532)
N	12810	8529	25726	15890
Kleibergen-Paap rk LM statistic	120.555***	68.7***	190.187***	104.583***
Kleibergen-Paap rk Wald F statistic	61.925	34.979	97.659	53.558
Hansen J statistic	1.531	2.865*	0.417	0.345
Endogeneity test	5.223**	3.52*	0.812	0.28
Pagan-Hall general test statistic	56.769***	39.592***	71.153***	59.032***

(iii) Fixed-Effect Estimates for Hiring One or More Employees with Disabilities on Firm Productivity (2013 Employee Count: 200–500 Employees)

		Manufacturing Industry		Non-manufacturing Industry	
		FE	N	FE	N
CIF	Sales	-0.0819***	16,285	0.00576	33,945
		(0.0279)		(0.0105)	
	Net income	-0.0947		-0.0441	
		(0.289)		(0.101)	
	Operating income	-0.255		0.154	
		(0.279)		(0.112)	
	Recurring profit	-0.254		0.120	
		(0.266)		(0.101)	
FIF	TFP 1	-0.150	10,788	0.107	21,607
		(0.814)		(0.286)	
	TFP 2	-0.112		0.0956	
		(0.815)		(0.287)	

(iv) GMM Estimates for Hiring One or More People with Disabilities on Firm Productivity (2013 Employee Count: 200–500 Employees)

	Manufacturing Industry		Non-manufacturing Industry	
	CIF	FIF	CIF	FIF
	Δ Net income	Δ Operating income	Δ Net income	Δ Operating income
GMM-1				
Δ Disability employment dummy	1.592	-7.512	-2.031**	-0.326
	(3.802)	(7.706)	(0.946)	(1.003)
N	10,803	7,005	21,697	13,238
Kleibergen-Paap rk LM statistic	3.74*	1.523	40.906***	19.804***

Kleibergen-Paap rk Wald F statistic	4.358	1.709	51.74	24.723
Endogeneity test	0.193	2.675	4.853**	0.164
Pagan-Hall general test statistic	48.287***	13.752**	34.087***	49.233***
GMM-2				
Δ Disability employment dummy	4.042	-4.087	-1.058	0.894
	(5.793)	(5.365)	(0.952)	(1.115)
N	8,393	5,395	16,578	9,967
Kleibergen-Paap rk LM statistic	2.619	3.266	41.89***	22.633***
Kleibergen-Paap rk Wald F statistic	1.729	2.647	28.301	14.754
Hansen J statistic	0.947	1.639	3.61*	4.023
Endogeneity test	0.455	0.564	1.13	0.543
Pagan-Hall general test statistic	48.467***	29.434***	26.446***	43.376***

Notes:
1. Sales, Net income, operating income, and recurring profit are divided by the number of regular employees to obtain per-employee values.
2. Clustered standard errors at the individual firm level are shown in parentheses.
3. *** p<0.01, ** p<0.05, * p<0.1
4. “Log TFP 1” is calculated as the residual from the production function; “Log TFP 2” is measured as the difference between total output and labor and capital inputs. See Appendix B for further details.
5. CIF refers to the Corporate Information File, and FIF refers to the Financial Information File.
6. GMM-1 uses the two-period lagged logarithm of the number of employees with disabilities as an instrumental variable, whereas GMM-2 extends GMM-1 by adding the three-period lagged logarithm of the number of employees with disabilities.

Table 6. Total Number of Firms Affected and Unaffected by the 2018 Increase in the Statutory Employment Rate

Firm size (x)	Employment quota	Control	Treatment
$200 < x \leq 250$	4	3,205	2,994
$250 < x \leq 300$	5	2,755	2,858
$300 < x \leq 350$	6	1,706	2,462
$350 < x \leq 400$	7	888	2,168
$400 < x \leq 450$	8	565	2,107
$450 < x \leq 500$	9	184	1,840
Total number of companies		9,303	14,429

Table 7. Impact of the Number of Employees with Disabilities on Firm Performance: Results from a Difference-in-Differences Approach (2017 Employee Count: 200–500 Employees)

(i) Full sample

	CIF			FIF				
	Disability employment (1/100)	ln Sales	ln Net income	Disability employment (1/100)	ln Operating income	ln Recurring profit	ln TFP 1	ln TFP 2
Treatment	0.0011	0.00770	-0.0115	0.0003	0.0837	0.0516	0.00119	-0.00162
	(0.0013)	(0.0315)	(0.0887)	(0.0021)	(0.0791)	(0.0742)	(0.175)	(0.177)
After	0.0030***	0.0218	-0.221	0.0012	-0.235***	-0.121*	-0.575***	-0.641***
	(0.0004)	(0.0342)	(0.155)	(0.0019)	(0.0721)	(0.0699)	(0.191)	(0.192)
Treatment*After	0.0015***			0.0039*				
	(0.0005)			(0.0021)				
ln Regular employees	0.0563***	-0.286	-0.310	0.0577***	0.194	0.837	-0.675	-0.801
	(0.0030)	(0.474)	(2.147)	(0.0035)	(0.983)	(0.951)	(2.608)	(2.618)
Disability employment (per 100 employees)		2.270	11.59		-0.322	-10.77	14.29	15.02
		(8.325)	(38.05)		(16.85)	(16.23)	(44.93)	(45.07)
Constant	-0.2695***	9.191***	4.372	-0.2782***	2.634	-0.200	6.637	4.721
	(0.0180)	(2.279)	(10.29)	(0.0207)	(4.764)	(4.615)	(12.62)	(12.67)
N	23732			15707				
Kleibergen-Paap rk LM statistic	7.951***			3.556*				
Kleibergen-Paap rk Wald F statistic	7.959			3.555				
Endogeneity test		0.201	0.131		0.012	0.335	0.105	0.112

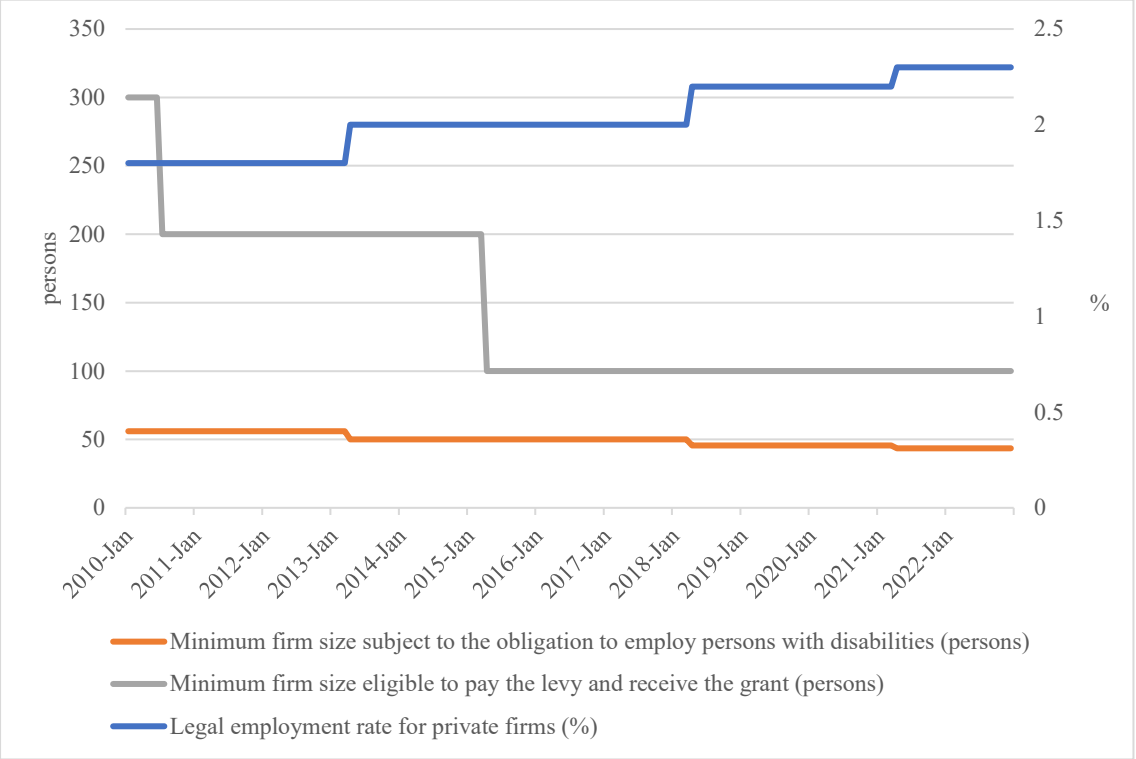
(ii) Manufacturing and Non-manufacturing Firms

	Manufacturing Industry								Non-manufacturing Industry	
	CIF			FIF					CIF	FIF
	Disability employment (1/100)	ln Sales	ln Net income	Disability employment (1/100)	ln Operating income	ln Recurring profit	ln TFP 1	ln TFP 2	Disability employment (1/100)	
Treatment	0.0011	-0.0434	0.172	0.0009	0.0902	0.0194	0.0850	0.155	0.0008	-0.0002
	(0.0014)	(0.0396)	(0.145)	(0.0017)	(0.181)	(0.150)	(0.415)	(0.413)	(0.0019)	(0.0030)
After	0.0021***	-0.0157	-0.244	0.0024***	-0.532**	-0.304	-0.901	-0.922	0.0035	0.0006
	(0.0005)	(0.0250)	(0.186)	(0.0006)	(0.254)	(0.221)	(0.673)	(0.671)	(0.0005)	(0.0029)
Treatment*After	0.0022***			0.0020**					0.0011	0.0049
	(0.0007)			(0.0009)					(0.0007)	(0.0031)
ln Regular employees	0.0560***	-0.207	1.775	0.0575***	-1.864	-0.0961	-2.673	-2.780	0.0576***	0.0588***
	(0.0027)	(0.394)	(2.783)	(0.0030)	(3.688)	(3.244)	(9.707)	(9.685)	(0.0043)	(0.0049)
Disability employment (per 100 employees)		8.965	-20.46		34.14	8.655	45.67	41.07		
		(6.840)	(49.65)		(64.04)	(56.21)	(169.2)	(168.8)		
Constant	-0.2645***	8.470***	-5.740	-0.2747***	12.57	4.244	15.70	13.71	-0.2786***	-0.2853***
	(0.0155)	(1.881)	(13.17)	(0.0171)	(17.64)	(15.52)	(46.40)	(46.30)	(0.0258)	(0.0294)
N	8184			5490					15548	10217
Kleibergen-Paap rk LM statistic	8.795***			4.824**					2.388	2.451
Kleibergen-Paap rk Wald F statistic	8.826			4.833					2.388	2.449
Endogeneity test		3.944	0.063		0.458	0.082	0.075	0.055		

Notes:

1. Sales, Net income, Operating income, and Recurring profit are divided by the number of regular employees to obtain per-employee values.
2. Clustered standard errors at the individual firm level are shown in parentheses.
3. *** p<0.01, ** p<0.05, * p<0.1
4. CIF refers to the Corporate Information File, and FIF refers to the Financial Information File.
5. “Log TFP 1” is calculated as the residual from the production function; “Log TFP 2” is measured as the difference between total output and labor and capital inputs.

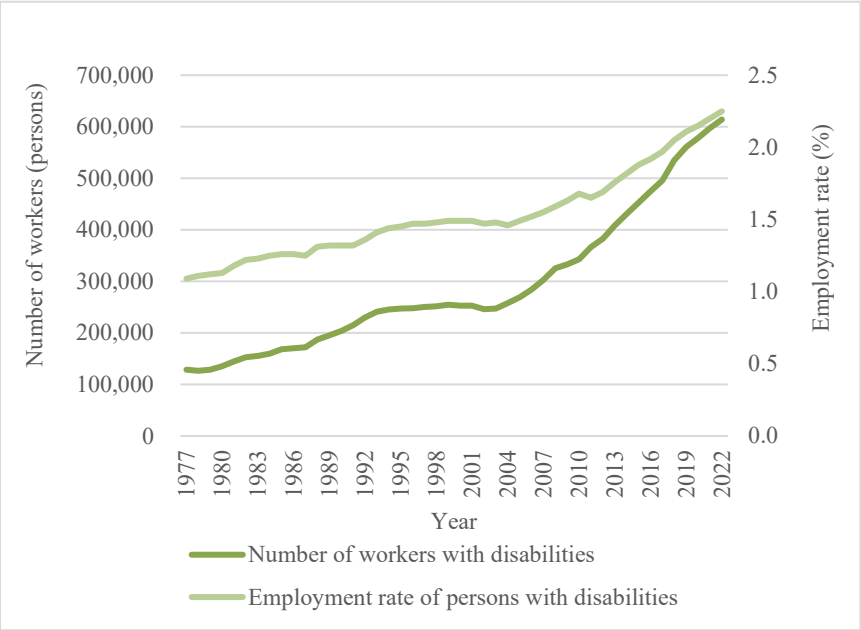
Fig 1. Changes in the Employment Quota System since 2010



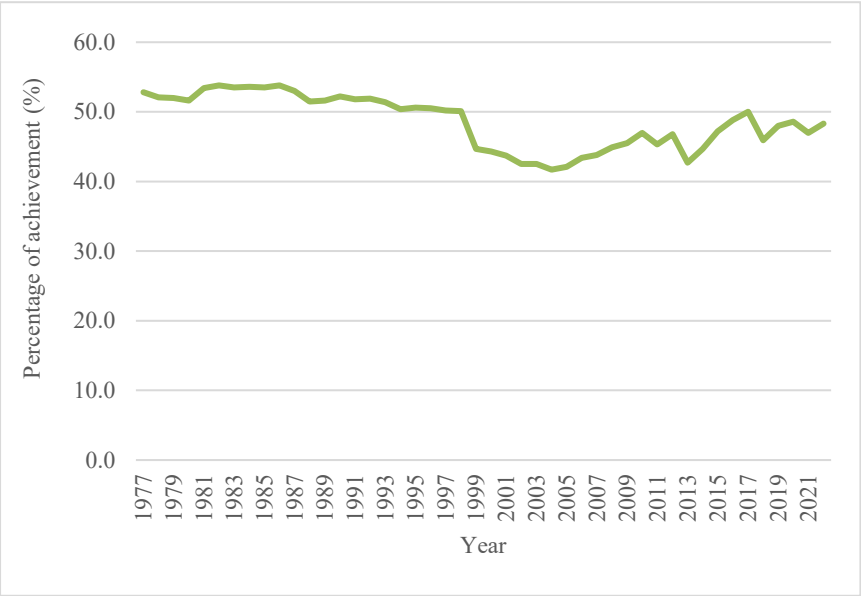
Source: Compiled based on the websites of the Ministry of Health, Labour, and Welfare (https://www.mhlw.go.jp/stf/seisakunitsuite/bunya/koyou_roudou/koyou/shougaishakoyou/index.html, last accessed November 17, 2023) and the Japan Organization for Employment of the Elderly, Persons with Disabilities,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

Fig. 2 Employment Situation of Persons with Disabilities

(i) Number and Employment Rate of Persons with Disabilities



(ii) Proportion of Companies Achieving the Legal Employment Rate¸¸¸ZÅÍ„¸

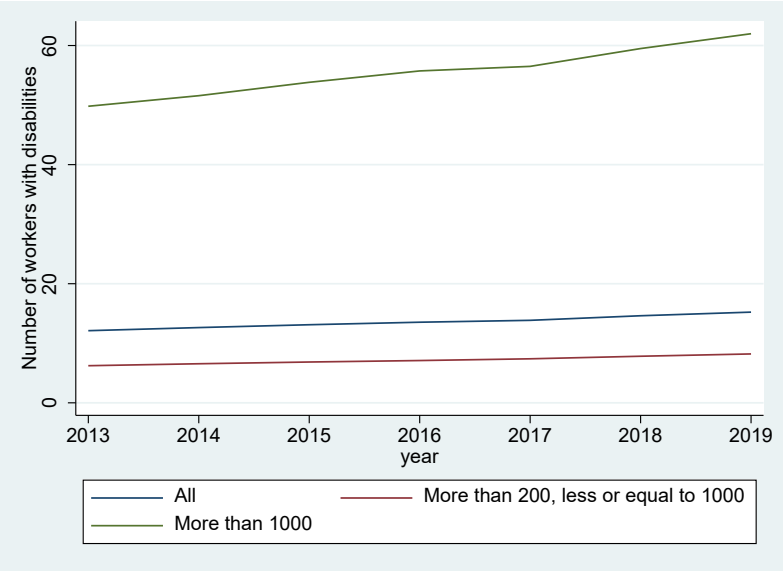


Note: The achievement rate indicates the ratio of companies subject to the employment rate system that have achieved the legal employment rate.

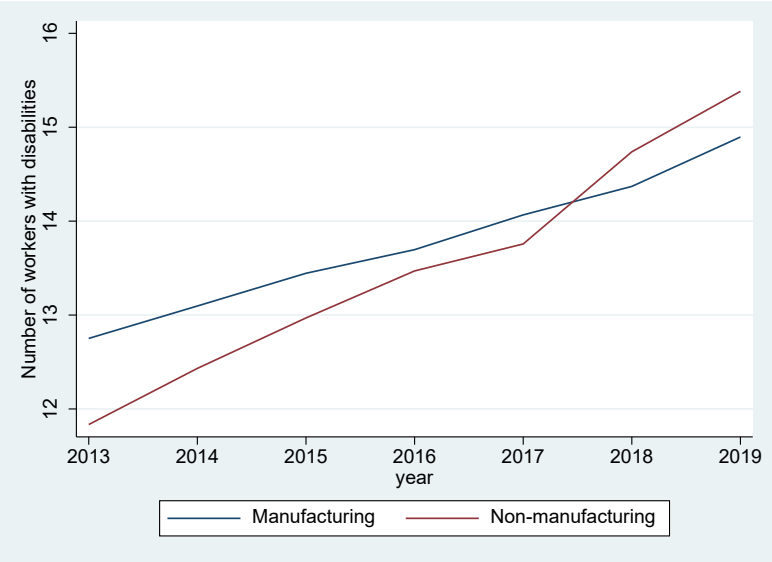
Source: Ministry of Health, Labour and Welfare (2022)

Fig. 3 Trends in the Employment Status of People with Disabilities

(i) Average Number of Employees with Disabilities by Firm Size (based on 2013 Employee Count)



(ii) Average Number of Employees with Disabilities in the Manufacturing and Non-manufacturing Industries



(iii) Disability Employment Rate for Companies with 200–500 Employees (based on 2013 employee count:)

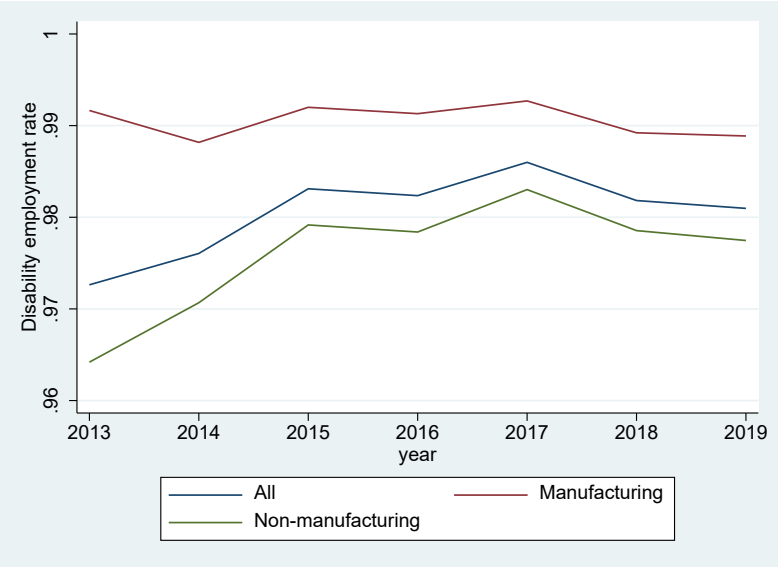

Disability employment rate
.96
.97
.98
.99
1
2013
2014
2015
2016
2017
2018
2019
year
All
Manufacturing
Non-manufacturing

Fig. 4 Exogenous Increase in Employment Quotas Following the 2018 Policy Change

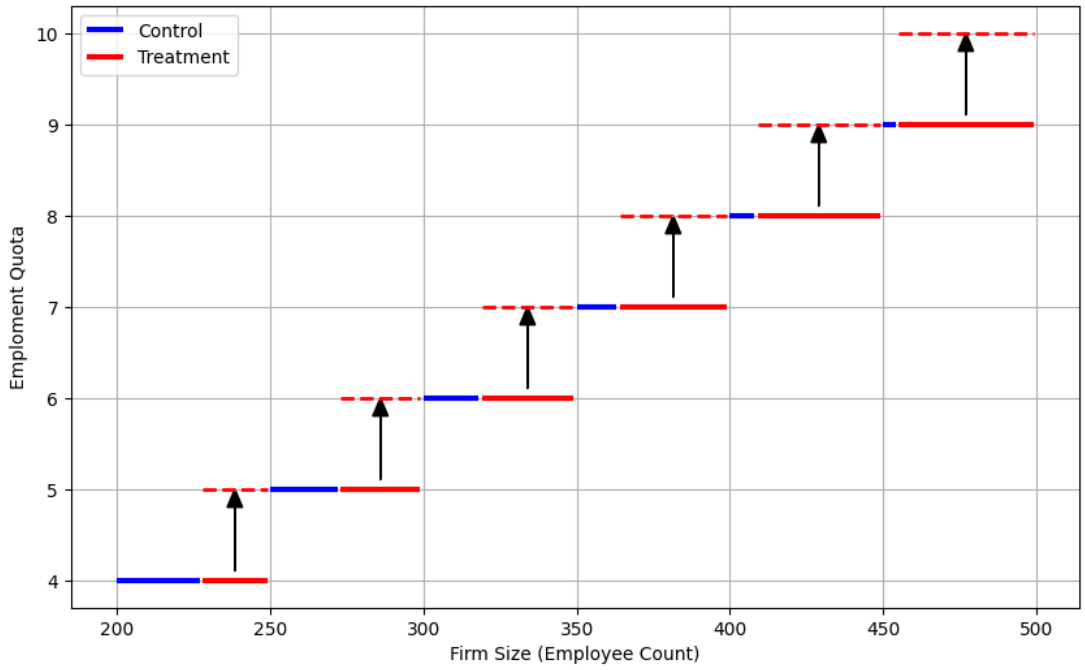


Fig. 5 Trend in the Average Number of Employees with Disabilities: Comparison Between Firms with Increased Employment Quotas and Firms with Unchanged Quotas Following the Statutory Employment Rate Increase