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Economic Consequences of Employment Quota System for Disabled People: Evidence from a Regression Discontinuity Design in Japan[*]

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Abstract

This study examines the effect of Japanese employment quota system for disabled people on their employment. By using official data pertaining to Japan, we show that a levy-grant scheme increases the employment of disabled workers in Japan's manufacturing industry. In addition, we find that small-sized firms hire disabled workers when increasing firm size, although they are not obligated to pay a levy. Finally, we use the increase in the number of disabled workers by the quota system as an instrumental variable (IV) to evaluate the impact of disability employment on a firm's profit rate. The results of the fuzzy regression discontinuity design (RDD) suggest that an increase in the number of disabled workers does not necessarily decrease firms' profit rates, which is in contrast to the results of the ordinary least squares (OLS) regression that suggest negative relationships between a firm's profit rate and the number of disabled workers.

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1. Introduction

Since the mid-twentieth century, many developed countries such as UK, France, and Germany have constructed and maintained support systems of education and employment for disabled people. Despite decades of efforts for achieving normalization and mainstreaming, many surveys have indicated that disabled people are faced with difficult situations in their employment and education. For example, OECD (2003; 2010) reported that disabled people are at twice the risk of unemployment and falling into poverty compared to non-handicapped people. In order to lessen the severity of these problems, some western European and eastern Asian countries have adopted employment quota systems that require public and private firms to employ disabled people above a certain targeted level.

In general, employment quota systems can be classified in terms of levy-grant schemes. The simplest quota system requires only moral responsibility for employers to employ disabled people above a certain level. However, this system has been criticized as few employers are usually able to achieve their quotas. The other quota system requires employers to pay a levy if they are not able to achieve their quotas. This system has also been criticized because employers often prefer to pay a levy rather than achieve their quotas (Waddington 1995; National Institute of Vocational Rehabilitation 2002). Therefore, there has been considerable interest and concern regarding the problem of how much levy is reasonable and how to achieve a certain employment level of disabled people. In this study, we examine whether a levy-grant scheme could actually promote employment of disabled people by using official data pertaining to Japan. Moreover, we use the number of employed disabled people assigned by the quota system as an instrumental variable (IV) to investigate the causal effect of disability employment on

the firm's profit and efficiency.

The Japanese disability employment system was established in 1960.[1] In the initial system, there was no levy-grant scheme and only a moral responsibility drove private firms to employ disabled people. In 1976, a levy-grant scheme was introduced and private firms were strictly requested to achieve a quota of employing a certain number of disabled people. If they were not able to meet their quotas, the employers were required to pay a levy. This disability employment system was slightly modified several times but adhered fundamentally to the levy-grant scheme. The present system stipulates 2% as the legal targeted level for private firms and requires employers to pay a monthly sum of 50,000 yen per person if they are not able to achieve the quota. However, since its inception, the legal targeted level has never been satisfied, and the proportion of disabled people in the entire workforce has always been approximately 0.2% points below the targeted level. Therefore, some administrators and specialists criticize that the levy is too low to motivate employers to employ the required number of disabled persons.[2]

The purpose of this study is to investigate the effect of the Japanese levy-grant scheme on the employment of disabled workers by using Japanese official data from 2008. According to the 2008 disability employment policy of Japan, private firms with more than 301 regular workers were required to pay a levy if they could not achieve their quotas. On the contrary, private firms with less than 300 regular workers had no obligation to pay a levy. We consider baselines of the levy-grant scheme, where each

[1] See Matsui (1998) and Hasegawa (2010) for the historical background of Japan's disability employment system.

[2] Makoto Hata, one of the most influential specialists in the field of Japanese disability employment, said that the levy should be tripled in order to achieve the targeted level of disability employment (http://www.nhk.or.jp/baribara/lineup/130419.html).

baseline equals each quota if a firm has more than 301 regular workers, and equals zero otherwise. If a firm was unable to employ disabled workers beyond the baseline defined above, then it must pay a levy. By focusing on the effect of these baselines on the employment of disabled people, we investigate the employment effect of the levy-grant scheme. In addition, we use an increment of disabled workers by the levy-grant scheme as an instrumental variable (IV) to examine whether disability employment decreases firms' profit rates. Employers often consider disabled workers as an economic burden in maximizing their profit. Therefore, firms with a high proportion of disabled workers have lower motivation to maximize their profit than firms with a lower proportion of disabled workers. Hence, simple regression overestimates the negative effect of disability employment on a firm's profit.[3] In this study, we identify the causal effect of disability employment on a firm's profit by using the increase in the number of disabled workers due to the quota system as an IV.

Our main results show that a levy can promote disability employment in Japan's manufacturing industry. Moreover, we also find that small-sized firms have an incentive to hire disabled workers with increasing firm size. Finally, we show that there is no clear relationship between the number of disabled workers and the firm's profit rate, although results of the ordinary least squares (OLS) regression indicate a negative relationship between the two aspects. This fact suggests that the negative effects of disability employment on profit or efficiency are much smaller than expected.

Although there are many studies on the economics of disability,[4] very few

[3] Nagae (2014) regressed a firm's operating income margin on a dummy variable that indicates whether firms meet their quotas. Then, he showed that firms achieving their quotas have lower operating income margins than the other firms. However, as our paper shows, his result lacked robustness since he did not consider problems of endogeneity.

[4] See Bound and Burkhauser (1999) and Haveman and Wolfe (2000).

have focused on employment quota systems for disabled people. This is because US and UK disability employment policies do not adopt employment quota systems.[5] Consequently, the majority of studies focused on the problems faced by US and UK institutions and examined the economic effects of the disability discrimination law on the employment rate of disabled people (DeLeire 2000; Schumacher and Baldwin 2000; Acemoglu and Angrist 2001; Beegle and Stock 2003; Kruse and Schur 2003; Jolls and Prescott 2004), disincentive effects of disability benefits on their labor supply (Chen and van der Klaauw 2008), and the reasons for the wage gap between non-disabled and disabled people (Johnson and Lambrinos 1985; Gunderson and Hyatt 1996; DeLeire 2001). Notably, Lalive et al. (2013) examined the effect of the quota system on disability employment in Austria, where firms must hire one disabled worker per 25 non-disabled workers or pay a tax otherwise. Then, Lalive et al. (2013) showed that firms with 25 non-disabled workers employed more disabled workers than without the tax.[6] Our study makes several contributions to the existing literature. First, our study uses official data from the Japanese government. Notably, we use the complete survey of firms and disabled workers in 2008, which was originally constructed by the Ministry of Health, Labor, and Welfare. Hence, our analysis does not face problems concerning the missing variables of disabled workers. Second, we analyze "threshold design" of disability employment *à la* Lalive et al. (2013). Hence, this paper can be interpreted as a further review of quota systems for disability employment in the context of threshold

[5] By 1996, the UK adopted the quota system for disabled people. Since there were few registered disabled people and the targeted employment level was too high, the quota system was abolished.

[6] Economists have been paying considerable attention to the economic effects of the quota system as an affirmative action for protecting the interests of disadvantaged groups such as women and ethnic minorities (Holzer and Neumark 2000). In the context of elections, Pande (2003) evaluated the effects of the Indian quota system for disadvantaged groups on the redistribution policy. Mori and Kurosaki (2011) evaluated the effect of the Indian quota system for disadvantaged groups on voting behavior.

design. Third, our study investigates the effects of disability employment on firms' profits and efficiency using the fuzzy regression discontinuity design (RDD). As usual, firms' managers believe that disabled workers have lower productivity and usefulness in terms of improving firms' profits. Our results suggest that under current systems for disabled workers, such a belief is wrong. We believe that the economic analysis of employment quota systems for disabled people is as important as other economic analyses concerning disabled people, because many countries have maintained the quota system as an affirmative action for protecting the interests of disabled people.[7]

The remainder of this paper is organized in the following manner. The next section explains Japan's employment system for disabled people in 2008. Section 3 provides details of our data and methods. Section 4 examines the effect of Japan's levy-grant scheme on disability employment. Section 5 discusses the impact of hiring disabled people on firms' profits by comparing the results of the OLS with those of the fuzzy RDD. Finally, Section 6 concludes our analysis.

2. Japan's Disability Employment System

This section provides an overview of Japan's disability employment system. In the 2008 system, the quota for private firms was set to be 1.8% of the entire regular workforce.[8]

[7] More than a third of OECD countries, such as Austria, Belgium, France, Germany, Italy, Japan, Korea, Poland, and Spain, etc., adopt the quota system.

[8] Japan's level at 1.8% was the lowest of all OECD countries. The quota of OECD countries was calculated to be in the range of 2% to 7% of the entire workforce. Of course, Japan's definition of disabled people is very different from that in other countries. In fact, the proportion of disabled people among the entire population in Japan was approximately 4% or 5%, but the range of those in other European countries was from 7% to 20% (OECD 2010). In general, Japan's definition is narrower than that in other countries. Hence, it must be noted that Japan's quota may not be

The quota was rounded down to the closest integer. For example, the quota of a firm with 200 regular workers would be 3 because 200 multiplied by 0.018 equals 3.6. The quota system required employers with more than 301 workers to pay a monthly sum of 50,000 yen per person if they were unable to achieve their quotas. On the contrary, there was no legal obligation for firms with less than 300 regular workers to pay a levy even if they were unable to achieve their quotas. In addition, certain industries that seemed to have more difficulties with disability employment than other industries were exempt from this quota. For example, the deducted rate for medical services was set at 40%. Then, the quota of a medical service company was calculated to be 1.8% of the deducted regular workforce that equaled the number of total workers multiplied by (1 - 0.4). In general, we can calculate the quota of a firm *i* in the following manner:

$$Quota_i = \lfloor 0.018 \times (1 - d_i) L_i \rfloor, \qquad (1)$$

where $\lfloor x \rfloor$ is the largest integer not greater than x for all real numbers x, d_i is the deducted rate of firm *i*, and L_i is the number of regular workers in firm *i*. Hereafter, we refer to $(1 - d_i) L_i$ as the "*deducted firm size*."

Next, a firm could receive a grant for disability employment if the firm employed disabled people beyond the targeted level. Firms with more than 301 regular workers could receive a monthly sum of 27,000 yen per person if they employ disabled people over the quota. On the other hand, firms with less than 300 regular workers could receive a monthly sum of 21,000 yen per person if they employed disabled people

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necessarily small as compared to the quota of other countries.

over the quota, which would be calculated in a slightly complicated manner. Basically, the quota was calculated to be 4% of the entire regular workforce. However, the quota was limited to a ceiling 6, that is, the quota was 6 whenever the value of firm size multiplied by 0.04 was greater than 6. Then, the grant baseline for firm *i* can be expressed in the following manner:

$$Grant_i = \begin{cases} \min\{\lfloor 0.04 \times L_i \rfloor, 6\} & if \quad L_i \leq 300 \\ Quota_i & otherwise. \end{cases} \qquad (2)$$

By the definition of a grant baseline, if firm *i* hired disabled workers beyond the grant baseline, then the firm would have the right to receive the grant.

Apart from the levy-grant scheme discussed above, there were the other support systems for disability employment that played a central role in decreasing the costs accruing to firms for hiring disabled people. First, firms employing disabled workers were eligible to receive two-thirds of the total cost for improving their workplaces. This subsidy system permitted firms to receive this amount up to a maximum of 4.5 million yen per hired disabled person. Second, firms had the option of establishing a special subsidiary company (*tokurei-kogaisya*). Under the special subsidiary company system, a parent company could add the number of disabled workers employed in the subsidiary company to the number of disabled workers in the parent company. Then, a large-sized company with large quotas could save the costs of disability employment by just concentrating disabled workers in their subsidiary company. Third, there was a double count system that permitted firms to count employing one person with *severe disabilities* as employing two disabled persons. In the

double count system, employers could save the cost of disability employment by hiring one person with *severe disabilities* who is more productive than one person with *disabilities.*[9] Fourth, if the labor productivity of disabled workers was much lower than that of regular workers, then firms could employ them at less than the minimum wage. However, since firms had to undergo complicated processing with administrative institutions, not too many firms were approved for the minimum wage exemption. Finally, some programs for decreasing job search costs were provided, such as job coaching services and trial employment support. These programs were considered to reduce the number of mismatch problems between firms and disabled workers.

Thus, although there were numerous support systems for disability employment in Japan, the targeted disability employment level of 1.8% for private firms was never been satisfied. The proportion of disabled employed people among the entire workforce has always hovered at approximately 0.2% less than the targeted level.[10] In 2008, the aggregate rate of disability employment was 1.59%. Half the total number of employers did not achieve their quotas and seemed to prefer to pay a levy than employ disabled workers at or beyond the quota. Hence, some administrators and specialists believe that a levy is insufficient to ensure employment of disabled workers beyond the targeted level. The following sections investigate the effect of the levy-grant scheme on disability employment in Japan's manufacturing industry.

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[9] Disabled people are classified according to the Japanese official criteria. The grades of disabilities are specified by an ordinance of the Ministry of Health, Labor, and Welfare. Thus, the criteria are not relevant to labor productivity of disabled workers but to functions of their physical conditions. For example, a person with paraplegia is classified as a person with severe disabilities, but while working in an office, she/he could be more productive than a person with mental illness or intellectual disabilities. Hence, people with severe disabilities are not necessary less productive than people with disabilities.

[10] Some people believe that disability benefits decrease the work incentives of disabled people. See Section 4.2 in Haveman and Wolfe (2000).

3. Data and Method

3.1. Data

In this study, we use two data originally obtained from official surveys in Japan. The first source, “The 2008 Firm’s Employment of People with Disabilities,” is available from the Web site of *Japan National Assembly of Disabled Peoples’ International* (DPI, Japan). The data are obtained from the 2008 annual investigation conducted by the Ministry of Health, Labor, and Welfare. In general, the data set is unavailable, but the DPI makes this data available for the promotion of empirical studies on disability employment. The data contain information such as firms’ names, addresses, phone numbers, and the actual rates of disability employment. The second source, “Basic Survey of Business and Activity 2004–2009” compiled by the Ministry of Economy, Trade and Industry, contains varied information on firms’ financial statuses used to calculate firms’ efficiency indices, such as profit rate, and the Japan Standardized Industrial Classification code used to calculate each firm’s deducted firm size and quota.[11] The basic survey of Japanese business structure and activities examines financial data of firms having more than 50 regular workers and capitalized at 30

[11] All the deducted rates are calculated by using the small classification codes of the Japan Standard Industrial Classification from the basic survey of Japanese business structure and activities. However, the survey assigns a small classification code to a firm according to the section that earns the highest sales in the firm’s business. Therefore, for a firm with a diversified business, the deducted firm size can be either overestimated or underestimated. For example, if the deducted rate of the section earning the highest sales in a firm is 0%, then we assign 0% to this firm as its deducted rate. In this case, the deducted firm size is overestimated compared to the true value whenever the firm has the other sections that are assigned positive values as their deducted rates. On the contrary, the deducted firm size is underestimated whenever the deducted rate of the section with the highest sales has a positive value, and the deducted rates of the other sections are 0%. However, these problems are not serious, since aggregated data from the 2008 annual report of the Ministry of Health, Labor, and Welfare provides approximately the same value as our estimations.

million yen or more. It covers all the firms in the following industries: mining and quarrying of stone, manufacturing, and wholesale and retail trade. In addition, it covers a part of the firms in the following industries: electricity, gas, heat supply and water; information and communications; finance and insurance; real estate lessors and managers; scientific research, professional and technical services; accommodations, eating and drinking services; living-related and personal services and amusement services; and services n.e.c. We merge these micro data by using the firm's name and its phone number and construct the data set for our analysis.[12] Due to the availability of the Japan Standardized Industrial Classification code and sample-size of industries from the basic survey of Japanese business structure and activities, this paper focuses on the manufacturing industry's analysis.

3.2. Method

Next, we explain the methodology used in this paper. As explained in Section 2, the quota changes discontinuously. For example, the quota is 5 when the deducted firm size ranges from 278 to 333. However, if the deducted firm size is 334, the quota changes from 5 to 6. We investigate whether firms decide the number of disabled workers they employ in response to discontinuous changes in quota.

To examine the effect of a quota on the employment of disabled people, we estimate the following model:

[12] We merge the different datasets in the following manner. First, when both the firm's name and its phone number from one data set correspond to those from the other data set, we merge these datasets into one. Second, when both the firm's name and its area code of phone number from one data set correspond to those from the other data set, we merge these datasets. Third, we remove abbreviated expressions such as "Co., Ltd." or "Inc." from the firm's original names and merge the datasets whenever both the revised firm's name and its phone number from one data set correspond to those from the other data set. Fourth, we merge the datasets whenever both the revised firm's name and its area code from one data set correspond to those from the other data set.

$$Disabled_i = \beta_0 + \beta_1 Quota_i + f(\widetilde{L_i}) + \epsilon_i, \qquad (3)$$

where $Disabled_i$ is the number of disabled workers in firm *i*, $Quota_i$ corresponds to equation (1), and $\widetilde{L_i}$ is the deducted firm size. We use the linear and fourth-order polynomial function for $\widetilde{L_i}$. As mentioned in Section 2, under Japan's 2008 legislation, firms with less than 300 regular workers were not subject to the levies, while firms with more than 301 regular workers were. To examine the effect of a quota system with and without the levy component, this model is separately estimated for firms with less than 300 regular workers and for firms with more than 301 regular workers. Since the DPI's data cover firms with more than 56 regular workers, we exclude firms with less than 85 deducted firm size (that is, the value of the second threshold 112 minus 27).

It is most common in the RDD literature (Lee and Lemiux 2010) to allow the function of deducted firm size to differ between the right- and the left-hand sides of the threshold. Therefore, to conduct a robustness check, we use an alternative model.[13] First, we define $threshold_i$ as the closest quota threshold for firm *i*. Second, we classify firms into groups *g*, according to the closest threshold for each firm. Third, we calculate the normalized deducted firm size for firm *i*, which is defined as the deducted firm size minus the closest threshold for firm *i*. Finally, we pool the data from all groups and estimate the following model:

$$Disabled_i = \alpha_0 + \alpha_1 T_i + \delta_0 NL_i + \delta_1 T_i NL_i + G_g + u_i, \qquad (4)$$

[13] Lalive et al. (2013) used a similar model.

where $T_i = 1(\tilde{L}_i \geq threshold_i)$ is a dummy variable for a treatment that indicates whether the deducted firm size is more than $threshold_i$, $NL_i = \tilde{L}_i - threshold_i \in [-27,27]$ denotes the normalized deducted firm size, and G_i is the fixed effect of group *g*. To consider the different functions of deducted firm size for firms under the threshold and above the threshold, we add the interaction terms *T* and *NL*. Since we pool all thresholds, α_1 is interpreted as the weighted average of the treatment effect at each threshold.

The descriptive statistics are reported in Table 1. While the fraction of disabled workers among all workforces of firms with less than 300 regular workers is 1.57, that of firms with more than 301 regular workers is 1.69. Therefore, the fraction of disabled workers is not largely different between firms with and without the levy component.

3.3. Manipulation Checks

To identify the treatment effect by the discontinuous change of quota, we have to check whether firms manipulate the deducted firm size at the quota threshold. Following the RDD literature (Lee and Lemiux 2010), we test whether the density of deducted firm size and potential covariates are continuous at thresholds.

Lalive et al. (2013) noted that if firms manipulate the firm size to avoid the payment of a levy, the estimate of the quota effects will be biased. For example, consider a firm that pays a levy rather than hiring disabled workers. This firm might restrain the number of employees to avoid crossing the threshold and pay a levy. In this

case, the estimate of the "jump" at the threshold has a downward bias.[14] To consider this matter, we check the density of the deducted firm size. Panel (a) in Figure 1 illustrates the density of deducted firm size for firms with less than 300 regular workers. Around the thresholds 112 and 167, the density seems to fall downwards. Discontinuity estimates based on McCrary's test are reported in Table 2. The difference in the densities between deducted firm sizes barely below and above the threshold are statistically significant around the thresholds 112 and 167, while those at the thresholds of 223 and 278 are not statistically significant. Since the possibility of manipulation at the thresholds 112 and 167 cannot be rejected, we estimate the effects of the quota both with and without the firms around these two thresholds. On the other hand, Panel (b) in Figure 1 shows the density of deducted firm size for firms with more than 301 and less than 700 employees. Although it is not clear whether there are discontinuous changes at the thresholds, the results of the estimates, as shown in columns (5)-(10) of Table 2, confirm that there are no statistically significant estimates of the difference in the density at the thresholds.[15]

Next, we test the continuity of potential covariates such as physical fixed assets, firm age, employment stability, and employment growth.[16] Employment stability indicates the coefficient of variation of the entire workforce from 2004 to 2008. Employment growth is the growth rate of the workforce from 2007 to 2008. Panels (a) - (d) in Figure 2 plot the average of each variable for a band width of 2. These figures confirm there are significant discontinuities at all thresholds. To confirm the continuities

[14] Lalive (2013) theoretically showed that since quotas are decided based on the number of non-disabled workers in Austria, there were two possibilities for bias: upward bias and downward bias. However, the quotas in Japan are based on the entire work force, including both disabled and non-disabled workers. Thus, in Japan's case, only the downward bias is considered.

[15] Regarding the other thresholds, we also estimate the continuity of the density using McCrary's test and confirm the discontinuity of the density at all thresholds.

[16] All variables are sourced from the basic survey of Japanese business structure and activities.

based on the regression, we use equation (3) by replacing the dependent variable for each potential covariate. As shown in Table 3, there are no significant “jumps” at the thresholds.

4. The Effect of a Levy-Grant Scheme

4.1. The Effect of the Quota on Disability Employment

The relationship between deducted firm size and number of disabled workers is reported in Figure 3. The red line represents 1.8% of deducted firm size. Notably, regardless of the levy component, the number of disabled workers increases approximately linearly along with deducted firm size, and the slope is close to 1.8%. This implies that although firms with less than 300 regular workers have no obligation to pay a levy, they respond to the quota. Panel (a) in Figure 4 plots the average number of disabled workers by each deducted firm size with less than 300 regular workers. The solid line represents the quota, although there is no obligation to pay a levy. This figure shows that while the number of disabled workers increases approximately linearly with deducted firm size, it does not increase discontinuously at the quota threshold. Panel (b) in Figure 4 focuses on firms with more than 300 regular workers and a deducted firm size of less than 445. Although the number of disabled workers increases along with deducted firm size, it seems to be constant within the same quota. This implies that a levy is effective for firms with more than 301 regular workers.

Table 4 presents the results for firms with less than 300 regular workers using equation (3). Column (1) includes the quota and the linear function of deducted firm

size. While the coefficient of quota is small and statistically insignificant, that of deducted firm size is 13.325 and statistically significant. This result indicates that an increase in deducted firm size by 100 is associated with an increase in the number of disabled workers by 0.013, which is not too different from the quota of 1.8%. In column (2), we use the fourth-order polynomial function of deducted firm size. Here too, the coefficient of quota is small and statistically insignificant. Since there is a possibility of manipulation at thresholds 112 and 167, we exclude firms around these thresholds for the robustness check. As shown in columns (3) and (4), the coefficients of quota are small and statistically insignificant. In addition, the coefficient of linear deducted firm size is 17.527, which is also close to 1.8%. In column (5), we conduct another check for robustness ±5 points around the quota cut-off. The coefficient of quota is small and statistically insignificant. We add the interaction term between deducted firm size and a dummy for thresholds to consider if the function of the deducted firm size is different below and above the thresholds in column (6). The coefficient of quota is also statistically insignificant.

Next, Table 5 demonstrates the results of firms with more than 300 regular workers. As shown in column (1), the coefficient of quota is 0.932 and statistically significant while that of deducted firm size is small and statistically insignificant, which is contrary to the results of firms with less than 300 regular workers. When we use the fourth-order polynomial function of deducted firm size in column (2), the estimate of the quota is close to 1 and statistically significant. As discussed in Section 3.1, the deducted firm sizes large firms may have measurement errors, and thus, we restrict our observations in columns (3) and (4) to firms with a deducted firm size of less than 1000. Although the coefficients of quota are smaller than those in columns (1) and (2), they

are still statistically significant. In columns (5) and (6), only the observations of ±5 around the quota thresholds are used to identify the effect of the quota. The coefficients of quota are positive and statistically significant.

For check the robustness further, we estimate equation (4) to consider the different functions of deducted firm sizes for firms under the threshold and above the threshold. Table 6 shows that firms with more than 300 regular workers are positively affected by the quota on the number of disabled workers. In column (1), the coefficients of the normalized deducted firm size are the same among all threshold groups. The coefficient of the dummy for the threshold is larger than the results in Table 4 and statistically significant. Column (2) adds the interaction term between the normalized deducted firm size and dummy variables for threshold groups to consider the different slopes of normalized deducted firm sizes. The coefficient is 1.441, which is close to the results in Table 4. Therefore, we confirm the positive effect of quota for firms with a levy component.

Thus, the analysis conducted in this section reveals that if there is an obligation to pay a levy, firms respond to discontinuity of the quota, and the effect of the levy ranges from 1 to 1.5. Compared to the estimates of Lalive et al. (2013), who found that the effect of the levy was 0.04, our estimates are large. However, Lalive et al.'s (2013) study is different from this study in that they focused on only the first threshold, included all industries, and the amount of levy in Austria is 200 euro (about half the levy in Japan). Moreover, the differences in the results may be attributed to the existence of sufficient support offered by the Japanese government; the various support systems described in Section 2 may contribute toward improving the productivity of disabled workers. We discuss the relationship between employment with disabilities and

firms' profits to consider this point in more detail.

On the other hand, even if there is no obligation to pay a levy, with increasing firm size, firms have an incentive to hire disabled workers. This fact may imply the effectiveness of social norms for employing disabled people. This is possibly related to the considerable importance given to activities promoting corporate social responsibility in Japan. In addition, the result can be partially attributed to the Japanese government's success in pressurizing Japanese firms to meet the quota through policy requirements. In fact, administrative institutions monitor all firms to check whether they achieve their quotas and require those firms that cannot satisfy their quotas for several years to submit annual documents on their disability employment schedules so that they may hire disabled people beyond the targeted level.[17]

4.2. The Effect of a Grant on Disability Employment

As explained in Section 2, the government offers a grant to firms that hire disabled workers beyond the quota. This section discusses the effect of the grant on the employment of disabled workers.

First, firms with less than 300 regular workers can receive 21,000 yen per month when they hire disabled workers at the rate of 4% of the entire workforce or when they hire more than 6 disabled workers. This means that the threshold for the grant is different from that of the quota. By replacing *Quota* with *Grant* in equation (3), we estimate the effect of a grant on disability employment. The result is reported in Table 7. Column (1) includes only the linear estimation of deducted firm size, while

[17] For large firms that had achieved substantially below their quotas for several years, the Ministry of Health, Labor, and Welfare can publish their names as a punishment. However, this penalty is quite rare. The number of published firms' names have hovered between 0 and 7 for the last 10 years.

column (2) includes the fourth-order polynomial estimation. The coefficients of grant are small and statistically insignificant. When we control both grant and quota in column (3), both coefficients are small and statistically insignificant. This implies that the amount of the grant for firms with less than 300 regular workers is not a sufficiently large incentive for them to hire disabled workers.

Second, for firms with more than 300 regular workers, the threshold of the grant is almost similar to that of the levy (or quota). The difference is that while the provision of the grant is based on firm size, which is not deducted using the deduction rate, the imposition of the levy is based on deducted firm size. Although the number of firms with different thresholds for the grant and levy is limited, we compare the result between firms with the same thresholds and firms with different thresholds. The results are reported in Table 8. The result of column (1) is the same as the result of column (2) in Table 5. In column (2) of Table 8, we restrict the sample to firms with the same threshold for the grant and levy. The coefficient of quota is larger than that in column (1). When we restrict the sample to firms with different thresholds for the grant and levy, as shown in column (3), the coefficient of quota is small. This confirms that firms with the same threshold are more likely to have an incentive to hire disabled workers on account of the grant and levy. In column (4), we control only the grant. The coefficient of grant is small and statistically insignificant. When both the quota and the grant are controlled in column (5), the coefficient of quota is close to 1 while that of grant is small. Although these estimates are insignificant because of limited observations, this result may imply that the effect of the quota is larger than that of the grant.

5. The Effect of Disability Employment on Firms' Profits

Although Japan's quota system for disabled workers is often criticized for enforcing a low levy and providing a low grant, the results in the previous section demonstrate the positive effect of a quota and social norms on disability employment. This may be partially because the employment of disabled people does not always adversely affect firms' profits, although disability employment is often considered to decrease firms' profits. However, if employers employ disabled workers in suitable posts, the productivity of disabled workers may not be necessarily low. In addition, to improve the working condition of disabled workers, the government offers a subsidy to firms for providing facilities for the disabled. This support may contribute to improving the productivity of disabled workers. In this section, we examine the effect of disability employment on firms' profits.

When we investigate the effect of hiring disabled workers on firms' profits, a potential concern is the existence of an omitted variable that is correlated with the number of disabled workers and affects firms' profits. For example, firms that hire many disabled workers may be welfare-oriented companies with less incentive to maximize profits. In this case, the coefficient of hiring disabled workers will be biased downward. Another possibility is that firms that hire many disabled workers may have higher profits and can afford to hire disabled workers. In this case, the coefficient of hiring disabled workers will be biased upward. To deal with this endogeneity problem, we use the quota as an IV. This identification strategy is based on the fuzzy RDD. We exploit discontinuities in an expected number of disabled workers conditional on deducted firm size. There is no clear difference in firms' characteristics between firms with barely

more deducted firm size than the threshold of the quota and firms with barely less deducted firm size than the threshold of the quota. Using the external variation of disability employment implied by the quota, we estimate the causal effect of disability employment on firms' profits.

For the first-stage regression, we use the same specification as that of equation (3). Since we only use the information on firms that respond to a levy for the IV regression, this section focuses on firms with more than 301 regular workers. The second-stage regression is expressed in the following manner:

$$y_i = \delta_0 + \delta_1 Disabled_i + g(\tilde{L}_i) + ui\,, \qquad (5)$$

where y_i is the profit rate of firm *i*. For firms' profit rates, we use the firms' gross incomes on sales, which do not include both the levy and the grant.[18] Based on IV regression, δ_1 captures the causal effect of employment of disabled people on the firm's profit rate. For the robustness check, we also use the pooled quota thresholds model.

Table 9 reports the estimates of the second-stage regression based on equation (3). As shown in column (1), the coefficient of the number of disabled workers based on the OLS regression is negative and statistically significant. Column (2) presents the

[18] We also investigate the relationship between the employment of disabled workers and the other profit indices such as operating income margin and recurring profit margin, and we arrive at results similar to those shown in Tables 9 and 10. Note that both the operating income margin and the recurring profit margin include the cost of levies as taxes and dues in the firm's balance sheet, whereas only the latter includes the benefits from rewards and subsidies as miscellaneous income. In addition to our analysis of the indices of firms' profits, we try to examine the impact of the employment of disabled workers on typical efficiency indices such as labor productivity and the Solow residual. However, we cannot construct these efficiency indices, since almost all the relevant variables are missing in the basic survey of Japanese business structure and activities.

result based on the IV regression. The effect of disabled workers is positive and statistically insignificant. This suggests that the OLS estimate of hiring disabled workers has a negative bias. When we use a more flexible fourth-order polynomial function, the estimates based on both the OLS and the IV regressions in columns (3) and (4) are similar to the results in columns (1) and (2), respectively. Although the number of observations decreases, we estimate the same specification using the ±5 discontinuity sample. The coefficient of the number of disabled workers is insignificant. Although the magnitude of the negative coefficient is larger than that based on OLS, this specification suffers from a weak IV problem since the F statistic of the first stage is 2.6.

The results based on the pooled quota thresholds analysis are reported in Table 10. While columns (1) and (2) include only the linear regression of deducted firm size, columns (3) - (6) include the second-order regressions of deducted firm size. The coefficients of number of disabled workers based on OLS are all negative. On the other hand, those based on the IV are positive, and the F statistic of the first stage is sufficiently large. Therefore, these results also imply that the estimate based on OLS has a negative bias, and the employment of disabled workers does not have a negative effect on firms' profits.

In sum, this section demonstrates that the employment of disabled workers does not necessarily decrease firms' profit rates. In addition, in the OLS regression, the coefficient of employment of disabled people has a downward bias. This implies that firms that employ a higher proportion of disabled people place greater importance on welfare or corporate social responsibility rather than pursuing profit.

6. Conclusion

In this study, we examined the economic effects of the quota system for the employment of disabled people in the Japanese manufacturing industry. Using the baselines of the levy-grant scheme, we showed that the levy-grant scheme helps to increase the employment of disabled people. Moreover, our results suggest that social norms may be one of the most important factors in promoting disability employment, because half the total number of firms in the industry achieved their quotas without the legal obligation of paying the levy. Undoubtedly, the employment effect of the levy-grant scheme or social norms are influenced by the existence of other support systems for disabled people in Japan. Without these support systems, such as subsidies for ensuring a barrier-free workplace and job training services, the levy would have to be increased in order to make firms achieve their quotas. Hence, these support systems can be interpreted as the hidden aspects of the levy-grant scheme.

In response to the employment effects of the levy-grant scheme, we used an increase in the number of disabled workers through the policy channel as an IV to investigate the causal effect of disability employment on firms' profit rates. Our results revealed that there is no clear relationship between firms' profit rates and disability employment in fuzzy RDD, whereas the OLS regression results suggest a negative relationship between firms' profit rates and disability employment. Hence, thus far, the negative effects of disability employment on firms' profits are smaller than expected. This finding suggests that there is room for both firms and administrative institutions to create productive jobs for disabled people. We strongly hope that our study will enable Japanese policymakers to understand the problems of achieving the quota efficiently

and determining the levy that is appropriate in the event the quota is unmet.

This study has several limitations. First, our study could not estimate appropriate levels or ranges for levies and grants, since both levies and grants were fixed in the Japanese disability employment system. Therefore, note that our estimations simply observe responses to disability employment mandates among firms under the fixed levy-grant scheme of 2008. Second, we need to investigate the overall effects of the levy-grant scheme on disability employment in other industries. This paper focused on the Japanese manufacturing industry, since the available industrial codes and financial data are restricted. However, the cost of hiring disabled workers would vary considerably by industry and area. We hope further studies refine estimations of prefecture- and industry-wide effects of Japanese disability policies on their economic situations.[19] Finally, our study is based on cross-section analysis. In the 2008 system, the quota of disability employment for private firms was set to 1.8% of the firm's entire regular workforce. However, the quota was increased by 2.0% in April 2013. Our results suggest that the 2008 levy-grant scheme improved disability employment in the Japanese manufacturing industry, but the same results may not necessarily hold under the modified quota. In order to review the economic effects of the quota system, further examination based on panel data will be needed.

[19] In order to review the industry- and prefecture-wide effects and construct the firm's panel data covering all industrial codes, we have submitted applications to the relevant ministries and agencies for permission to use complete survey.

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Table 1. Descriptive Statistics

	Observation	Mean	Std. Dev.	Min	Max
Firm size<301					
Deducted firm size	5965	155.97	57.27	85	300
Number of disabilities	5965	2.43	2.57	0	48
Fraction of disabled workers (%)	5965	1.57	1.82	0	35.56
Firm size≥301					
Deducted firm size	2481	1276	3335	210	73149
Number of disabilities	2481	23.08	65.15	0	1368
Fraction of disabled workers (%)	2481	1.69	0.82	0	18.33

Table 2: McCrary's Discontinuity Test

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Threshold	112	167	223	278	334	389	445	500
Log difference in height	-0.13	-0.15	0.05	0.12	0.11	0.05	0.08	-0.0004
	(0.05)	(0.07)	(0.08)	(0.10)	(0.10)	(0.11)	(0.13)	(0.14)

Note: Observation is 8446. Standard error is reported in parenthesis.

Table 3: Continuity of Potential Covariates

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variables	Physical fixed asset		Firm age		Employment stability		Employment growth	
Firm size	85-300	301-	85-300	301-	85-300	301-	85-300	301-
Quota	0.142	-6.102	1.170	-1.323	-3.662	-3.865	1.263	1.373
	(0.122)	(4.112)	(0.822)	(1.452)	(4.379)	(7.466)	(0.763)	(0.990)
Observations	5,932	2,466	5,965	2,481	4,430	1,995	5,475	2,327
R-squared	0.053	0.458	0.002	0.043	0.001	0.008	0.003	0.004

Note: Standard errors are in parentheses. All regression include fourth-order polynomial function for deducted firm size.

Table 4: Quota and Employment with Disabilities, Firm Size ≦ 300

	(1)	(2)	(3)	(4)	(5)	(6)
Sample	All		196-300		196-300 and +/- 5	
Quota	0.051	0.060	-0.071	-0.149	-0.326	1.123
	(0.111)	(0.113)	(0.237)	(0.256)	(0.347)	(2.663)
Deducted firm size (/1000)	13.325	104.717	17.527	-1,580	11.622	-11.634
	(2.151)	(71.773)	(5.367)	(7,039)	(8.885)	(43.312)
Deducted firm size* dummy for threshold						-0.005
						(0.010)
Polynomial order in $\tilde{L}_i$	1	4	1	4	1	1
Observations	5,965	5,965	1,497	1,497	323	323
R-squared	0.101	0.101	0.034	0.035	0.005	0.006

Note: Standard errors are in parentheses.

Table 5: Quota and Employment with Disabilities, Firm Size ≧ 301

	(1)	(2)	(3)	(4)	(5)	(6)
Sample	All		300 ≦ L_i ≦1000		+/- 5	
Quota	0.932	0.997	0.816	0.794	1.471	1.498
	(0.470)	(0.460)	(0.358)	(0.359)	(0.644)	(0.705)
Deducted firm size (/1000)	2.651	0.812	4.359	107.972	-6.467	-6.959
	(8.456)	(8.288)	(6.464)	(62.006)	(11.586)	(12.668)
Deducted firm size* dummy for threshold						-0.00002
						(0.0002)
Polynomial order in $\tilde{L}_i$	1	4	1	4	1	1
Observations	2,481	2,481	1,876	1,876	489	489
R-squared	0.989	0.990	0.376	0.380	0.992	0.992

Note: Standard errors are in parentheses.

Table 6: Quota and Employment with Disabilities Based on the Pooled Quota Thresholds Analysis, Firm Size ≧ 301

	(1)	(2)
Threshold dummy	1.876	1.441
	(0.442)	(0.415)
NL	Yes	Yes
NL*Threshold	Yes	Yes
Group Dummy (G)	Yes	Yes
NL*G	No	Yes
NL*Threshold*G	No	Yes
Polynomial order in NL	1	1
Observations	2,453	2,453
R-squared	0.993	0.995

Note: Standard errors are in parentheses.

Table 7: Grant and Employment with Disabilities, Firm Size ≦ 300

	(1)	(2)	(3)
Grant	-0.070	0.039	0.060
	(0.050)	(0.131)	(0.136)
Quota			0.073
			(0.117)
Polynomial order in $\tilde{L}_i$	1	4	4
Polynomial order in L_i	-	-	4
Observations	5,965	5,965	5,965
R-squared	0.098	0.099	0.101

Note: Standard errors are in parentheses.

Table 8: Grant and Employment with Disabilities, Firm size ≧ 301

	(1)	(2)	(3)	(4)	(5)
Sample	All	$\tilde{L}_i = L_i$	$\tilde{L}_i \neq L_i$	$\tilde{L}_i \neq L_i$	$\tilde{L}_i \neq L_i$
Quota	0.997	1.259	0.317		
	(0.460)	(0.510)	(0.886)		
Grant				0.006	0.456
				(1.001)	(0.814)
Polynomial order in $\tilde{L}_i$	4	4	4	-	4
Polynomial order in L_i	-	-	-	4	4
Observations	2,481	1,951	530	530	530
R-squared	0.990	0.988	0.995	0.992	0.996

Note: Standard errors are in parentheses.

Table 9. Employment with Disabilities and Firms' Profit, Firm size ≧ 301

	(1)	(2)	(3)	(4)	(5)	(6)
Sample	All				+/- 5	
	OLS	IV	OLS	IV	OLS	IV
Number of disabled workers (/100)	-0.117	0.092	-0.106	0.049	-0.179	-0.861
	(0.044)	(1.116)	(0.045)	(1.022)	(0.103)	(1.040)
Polynomial order in $\tilde{L}_i$	2	2	4	4	1	1
First stage F value	-	3.81	-	4.71	-	2.608
J test (P value)	-	-	-	-	-	0.51
Observations	2,479	2,479	2,479	2,479	489	489
R-squared	0.005	-0.005	0.007	0.003	0.007	-0.083

Note: Standard errors are in parentheses.

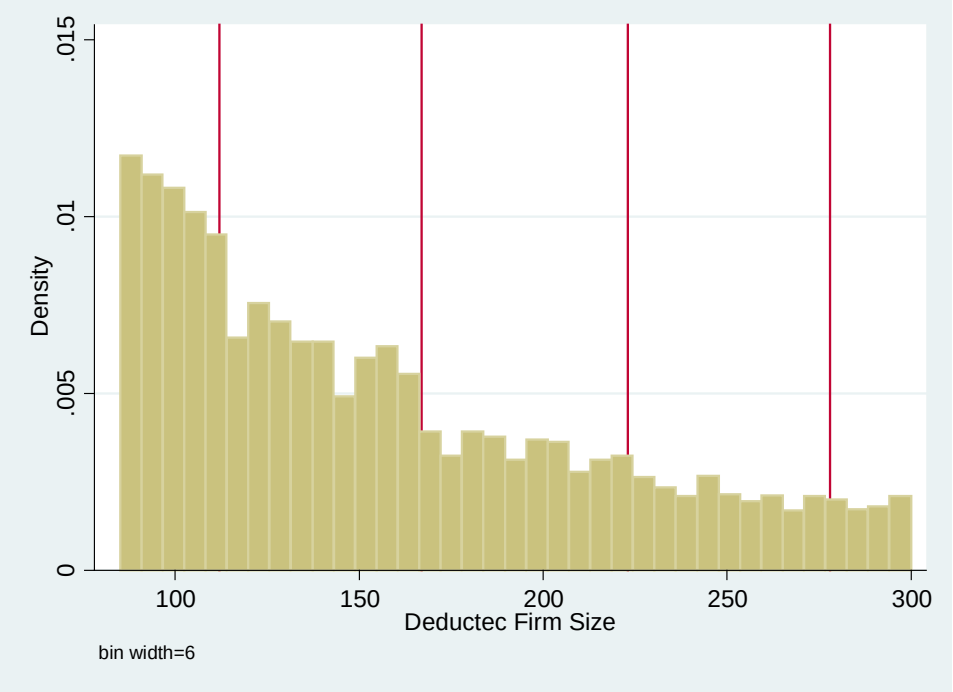
Table 10. Employment with Disabilities and Firms' Profit at Pooled Thresholds, Firm size ≧ 301

	(1) OLS	(2) IV	(3) OLS	(4) IV	(5) IV
Number of disabled workers	-0.169	0.142	-0.169	0.156	0.122
	(0.062)	(0.669)	(0.063)	(0.671)	(0.667)
NL	Yes	Yes	Yes	Yes	Yes
NL*Threshold	Yes	Yes	Yes	Yes	Yes
Group Dummy (G)	Yes	Yes	Yes	Yes	Yes
NL*G	No	No	No	No	Yes
NL*Threshold*G	No	No	No	No	Yes
Polynomial order in NL	1	1	2	2	1
First stage F value	-	14.69	-	14.60	7.367
J-test (P value)	-	-	-	-	0.7
Observations	2,143	2,143	2,143	2,143	2,143
R-squared	0.097	0.084	0.097	0.084	0.086

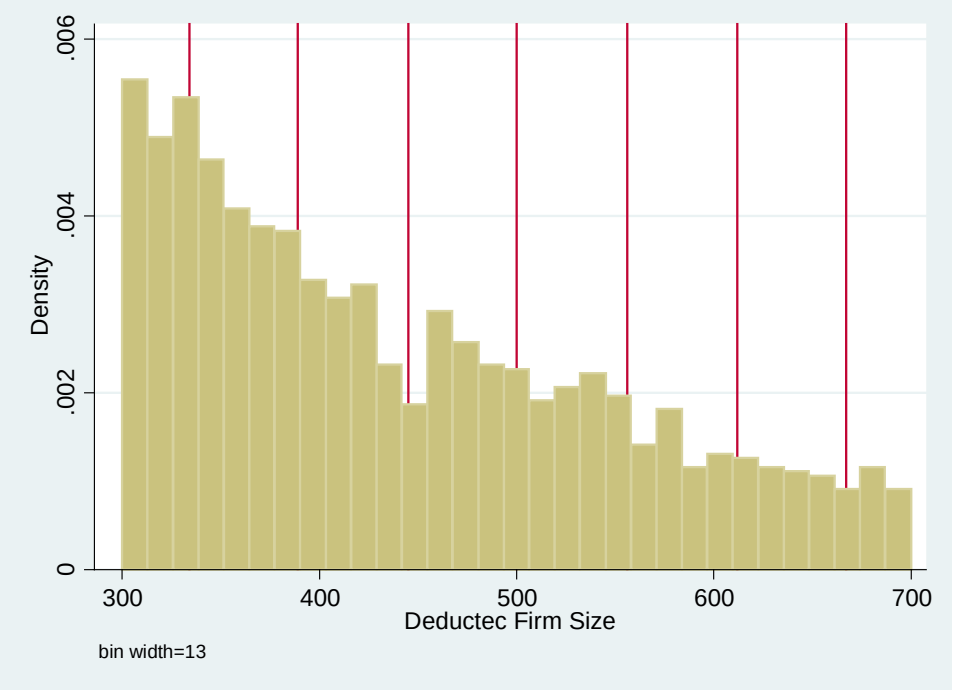
Note: Standard errors are in parentheses.

Figure 1: Density of Deducted Firm Size

Panel (a): Deducted Firm Size ≦ 300



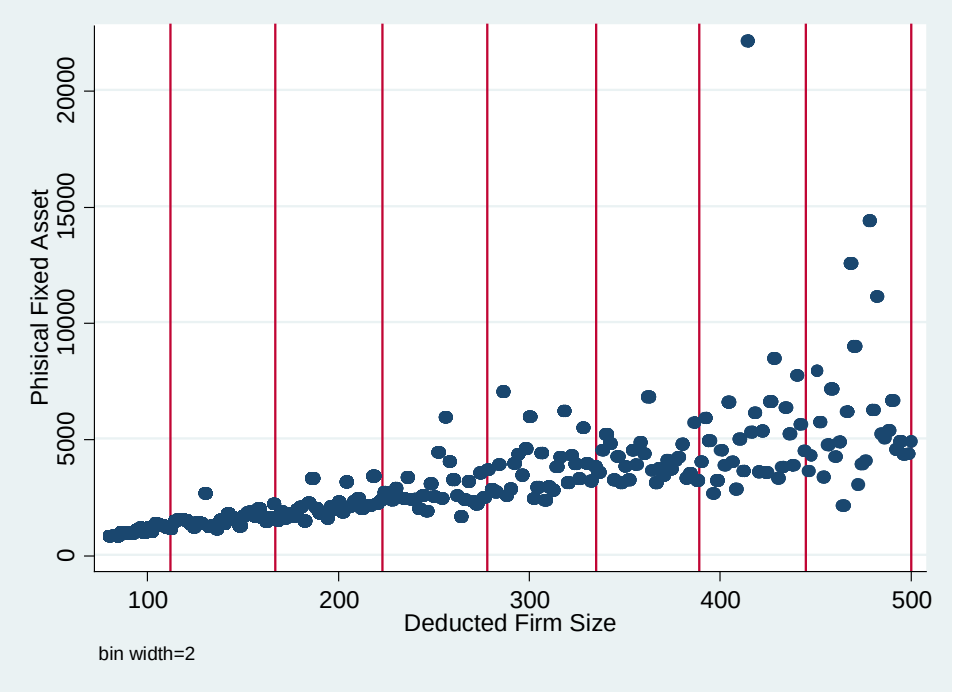
Panel (b): 301 ≦ Deducted Firm Size ≦ 700



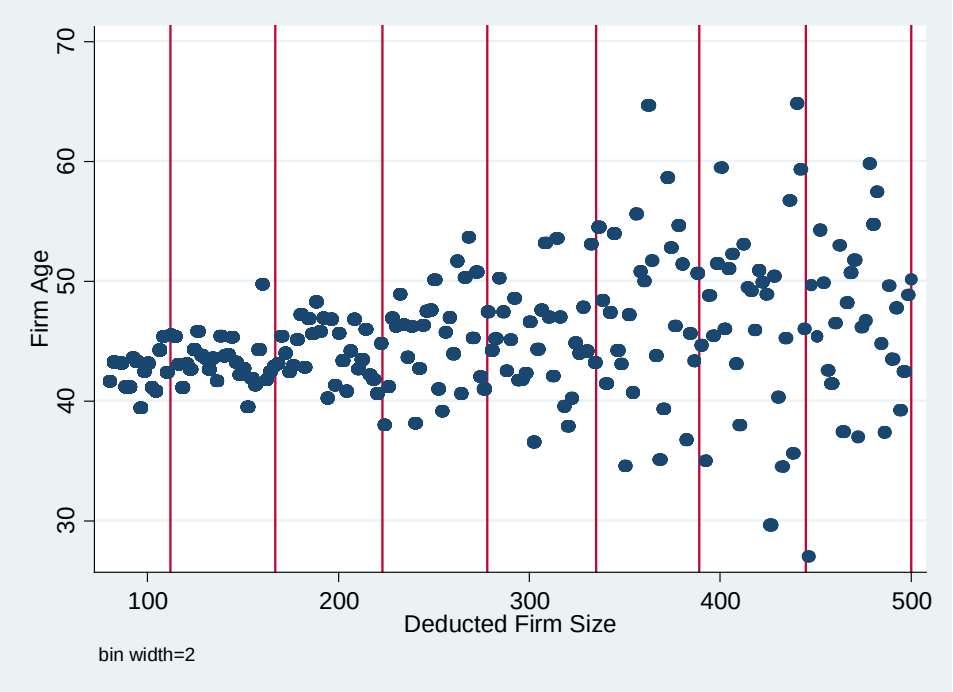
Note: The density of each deducted firm size is reported in Figure 2. Bin width is 6 in Panel (a) and 13 in Panel (b). Red line represents threshold of quota.

Figure 2: Continuity of Potential Covariates

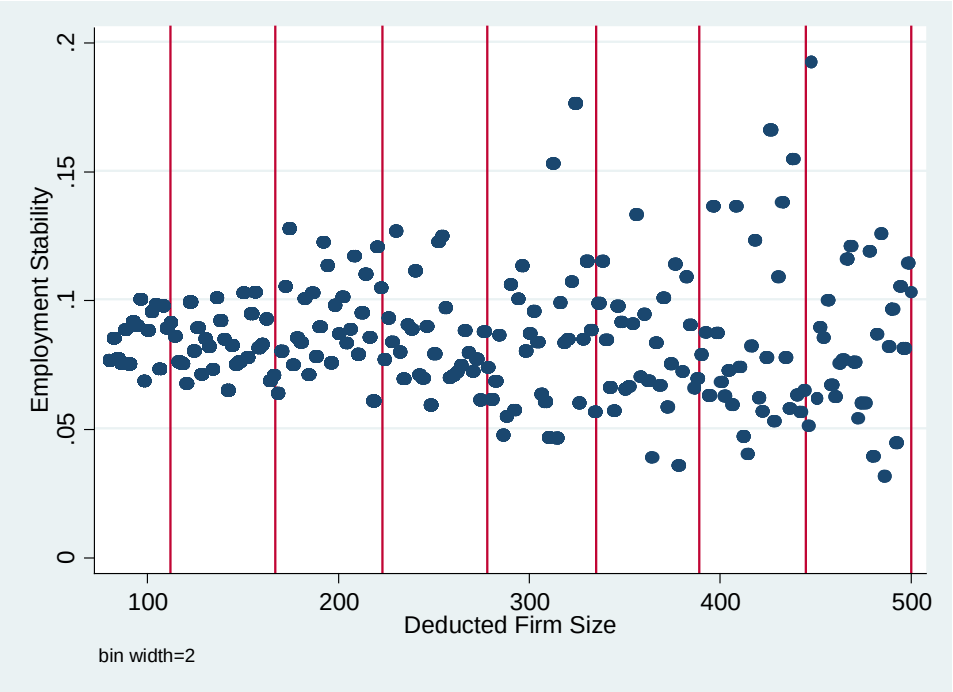
Panel (a): Physical Asset



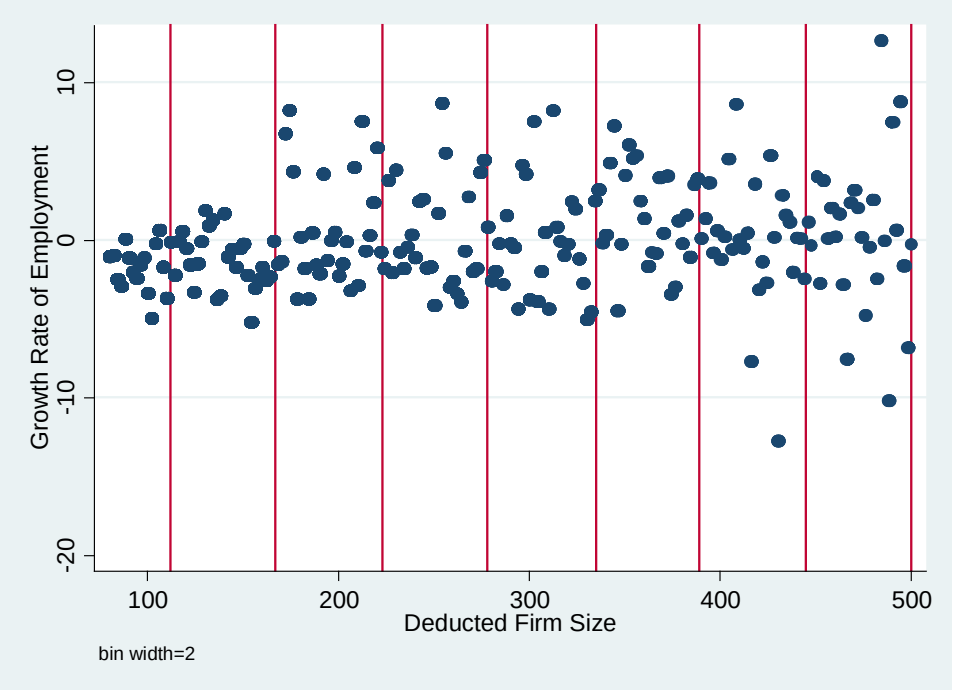
Panel (b): Firm Age



(c) Employment Stability

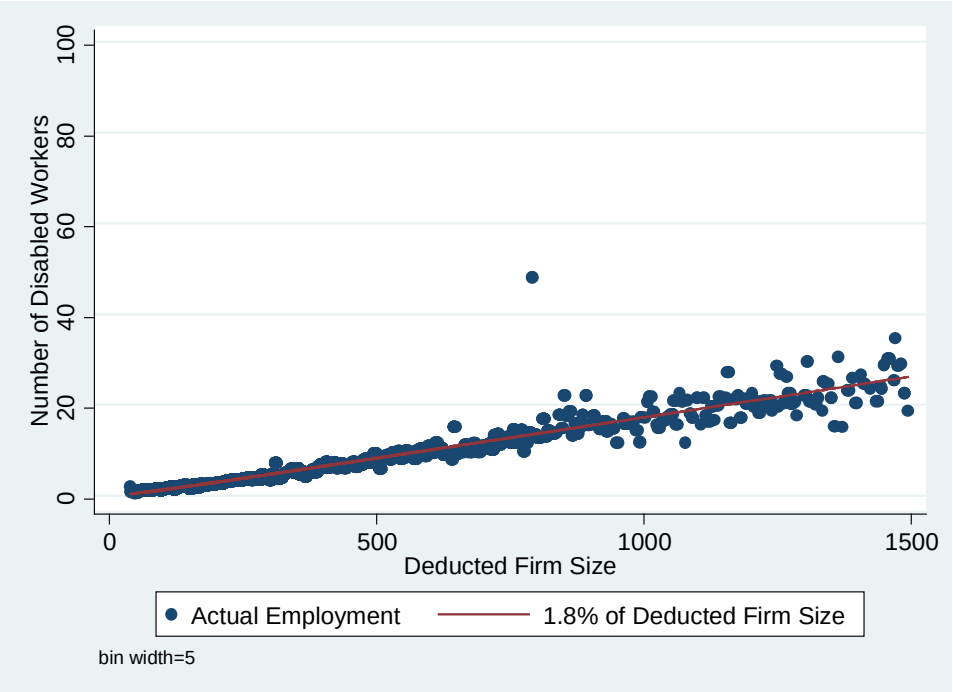


(d) Growth Rate of Employment



Notes: A bandwidth of 2 is used to calculate binned averages. Each circle represents the average value of a baseline covariate for each bin. The red line represents each threshold of quota.

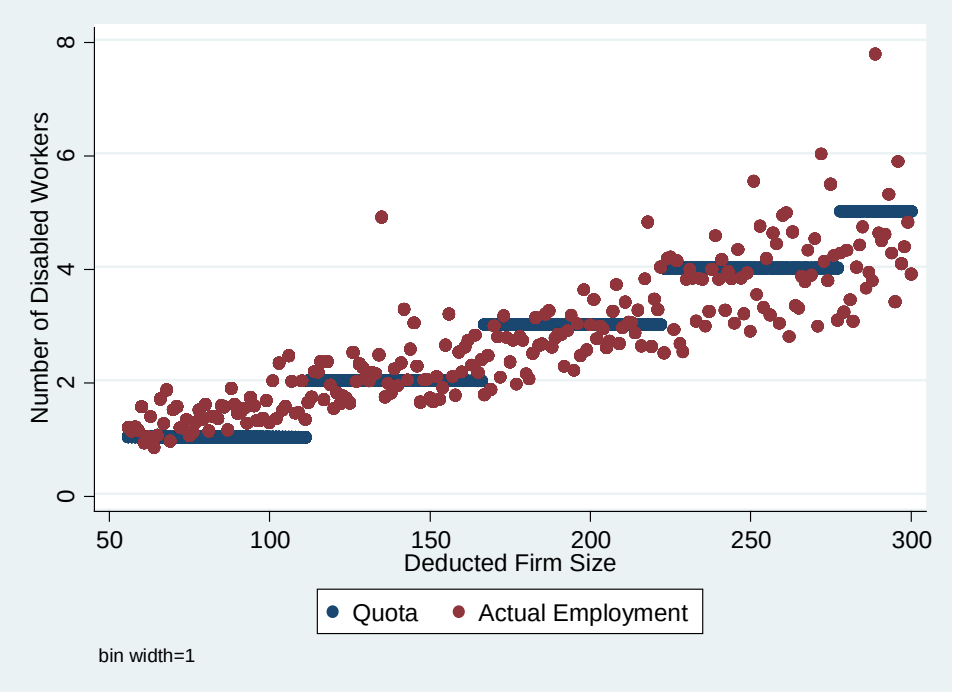
Figure 3: Deducted Firm Size and Number of Disabled Workers



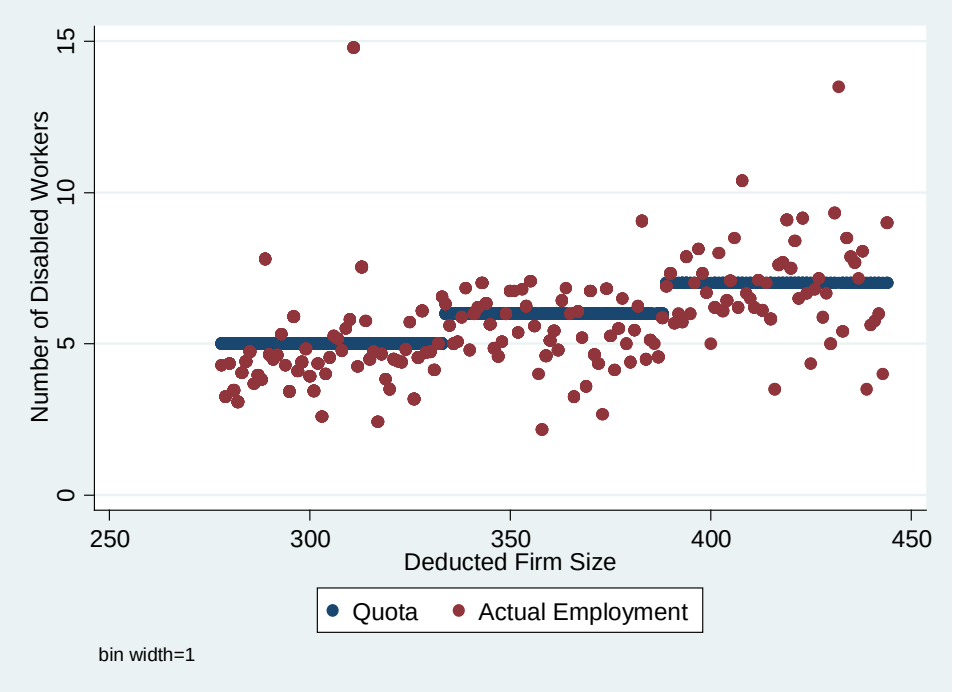
Note: The bin width is 5. Each circle is the average number of employment with disabilities of each bin. The red line represents 1.8% of deducted firm size.

Figure 4: Deducted Firm Size and Number of Disabled Workers by firm size

Panel (a): Firm Size ≦ 300



Panel (b): 300 ≦ Firm Size and Deducted Firm Size ≦ 450



Note: Each circle is the average the number of employment with disabilities of each deducted firm size. Solid line represents quota.