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Labor Market Concentration and Heterogeneous Effects on Markdowns: Evidence from Japan*

Atsuko Izumi,† Naomi Kodama,‡ and Hyeog Ug Kwon§

Abstract

This study provides empirical evidence on the impact of labor market concentration on wages, introducing novel instruments that potentially affect plants' entry/exit decision but not wages directly. We find that (1) wages are suppressed in more concentrated labor markets; (2) higher mobility across plants is associated with greater wage responsiveness to labor market concentration, (3) greater job opportunities outside the manufacturing sector weaken the relationship between concentration and wages, and (4) the impact of labor market concentration on wages is smaller for firms with more competitive downstream product markets. In sum, our findings indicate workers' bargaining power as well as the degree of competition in downstream product markets affect the relationship between market concentration and markdowns.

JEL Classification Codes: D33, J23, J31, J42, K21, L49.

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1. Introduction

The effect of labor market concentration on wages has attracted substantial attention from both economic researchers and policy makers. In fact, many countries have witnessed a persistent decline the income share of labor, and labor market concentration has been highlighted as one potential reason (Karabarbounis and Neiman, 2014; IMF, 2017; Autor et al., 2020; Barkai, 2020). Economic theory predicts that if employment is increasingly concentrated among a limited number of firms, employers wield more power during wage negotiations, as workers have fewer employment options (Bhaskar et al., 2002; Manning, 2003; Staiger et al. 2010). Imagine a company town where one large firm hires most of the residents in the area. People cannot easily relocate to take a better-paying job elsewhere, so they have to accept the wage that the firm offers. As a consequence, the firm pays less than the wage in competitive equilibrium.[1] However, while there are a rapidly growing number of empirical studies showing a negative relationship between labor market concentration and wages, studies so far have not established a clear causal relationship between labor market concentration and wages.

This study empirically examines the impact of labor market concentration on wages through potential changes in labor market power using novel instruments namely, the

[1] See Ashenfelter and Krueger (2018) and Ashenfelter et al. (2010) for more evidence on firms' incentive to avoid labor market competition and to mark down wages.

total length of highways and ordinary roads in a prefecture and the average Herfindahl-Hirschman Index (HHI) for the same industry in other geographic markets. Labor market concentration is captured by the HHI of employment following the Merger Guidelines and existing studies (Azar et al., 2020; Benmelech et al., 2020; Marinescu and Hovenkamp, 2019).

Using data from Japan's Census of Manufacture for the period from 2001 through 2014, we estimate the causal effects of labor market concentration on wages. We start by estimating standard wage regressions using the employment HHI in labor markets, which are defined in terms of commuting zones and industry classifications. The estimation is conducted employing panel regression with fixed effects. In the next step, we investigate the causal effects of labor market concentration using three instrumental variables (IVs): the total length of highways and ordinary roads in a prefecture, and the average labor market HHI of the same industry in other geographic areas. Longer highways and ordinary roads mean that a prefecture serves better road infrastructure, making it more favorable for plants to locate there. Therefore, the total length of highways and ordinary roads should be correlated with the number of firms and hence the demand for labor without directly affecting the wage level. In addition, the average HHI of labor markets in the same industry but excluding own labor market is used as an instrument.

The average HHI is used based on the assumption that nation-wide demand shock in downstream product markets affects labor market structure all over local markets in Japan, but not affect local wages. For example, when demand for Nintendo game consoles soared during the pandemic, this is likely to have led Nintendo plants to hire more workers, which is likely to have led to labor markets in the game manufacturing industry to be more concentrated due to an increase in employment share of Nintendo. However, local wage levels in the game manufacturing industry are not directly affected by demand shock in downstream market since product demand shock does not affect productivity of the plants. The average HHI of labor markets in the same industry IV is widely used in the literature (Marinescu, et al., 2021; Azar et al., 2020; Schubert et al., 2020).

The contribution of our study to the literature is fivefold. First, using various models and sub-sample analyses, we show that labor market concentration suppresses wages. Specifically, in the IV regressions, we find that a one standard deviation increases in the HHI (an increase of 1,270 in the HHI defined on a scale to 10,000) lowers wages by 2.1%. Second, we find that the impact of labor market concentration on wages is smaller for large plants than for small and medium-sized plants. We argue that this result is driven by the labor rigidity created by the traditional long-term employment system in large plants. Wages are less responsive to labor market competition in less flexible labor

markets. Third, we divide the sample into an earlier period (2001–2007) and a later period (2008–2014) to investigate the role of labor mobility across plants in the relationship between labor market concentration and wages. We take advantage of the fact that labor mobility in Japan has been gradually increasing since the 2000s. The results indicate that an increase in labor mobility across plants increases the effect of labor market concentration. Fourth, we find that the effects of labor market concentration are heterogeneous and depend on the degree of competition in downstream product markets. Specifically, defining plants engaged in exports as having more competitive downstream markets, we find that the sensitivity of wages to labor market concentration is lower for plants with more competitive downstream markets. These empirical results suggest that firms engaged in exports face stronger pressure to restrain labor costs in order to survive in competitive downstream markets. Lastly, labor market concentration has a stronger effect on wages in prefectures with a high manufacturing intensity than in those with a low intensity. In industrial cities with a high share of manufacturing in total economic activity, workers are likely to have fewer opportunities for non-manufacturing jobs. Therefore, in the manufacturing sector, which this study focuses on, the negative relationship between labor market concentration and wages is stronger in prefectures with higher manufacturing intensity.

Our findings have important implications for the merger and acquisition (M&A) review framework in that they suggest that antitrust authorities should take the potential effect of M&As on wages into account. In fact, in recent years antitrust have already shown an increased interest in competition issues in the labor market. However, current merger guidelines of antitrust authorities such as the U.S. Department of Justice (DOJ)[2] and the Japan Fair Trade Commission (JFTC)[3] focus more on the effects on prices in goods and services markets. Reducing labor input cost increases their revenues similarly as raising product price, so the firms' incentive to cut wages in the labor market should also be evaluated.

The remainder of the study is organized as follows. Section 2 outlines the theoretical background and reviews the related literature. Section 3 provides the definition of the HHI and describes the data used for the analysis. Next, Sections 4 describes our empirical model, while Section 5 presents the results. Finally, Section 6 concludes the paper.

[2] See, e.g., U.S. Department of Justice, "Horizontal Merger Guidelines" (last revision: August 19, 2010), available at https://www.justice.gov/atr/file/810276/download.
[3] JFTC, "Guideline to Application of the Antimonopoly Act Concerning Review of Business Combination" (last revision: December 17, 2019), available at https://www.jftc.go.jp/en/legislation_gls/imonopoly_guidelines_files/191217GL.pdf.

2. Background and hypotheses development

2.1. Theoretical background and literature review

Our study is related to three strands of literature. First, it is linked to the growing literature investigating employers' labor market power over workers. Baskar et al. (2002) provide a summary of stylized observations that illustrate the existence of employer market power in practice. Labor markets are far from the competitive markets and employers often have some degree of market power. –Meanwhile, Ashenfelter et al. (2010) develop labor market monopsony models in both static and dynamic settings. They theoretically show how employers facing an upward-sloping labor supply curve can exert market power over workers. Recent studies (Azar et al., 2020, Benmelech et al., 2020, Naidu et al., 2018) explore the causal relationship between labor market structure and wages and show that wages are uncompetitively low in concentrated labor markets. Prager and Schmitt (2021) examine wage growth for various occupations in hospitals after hospital mergers in the United States. They find that workers with industry-specific skills such as nurses experience a reduction in wages when mergers increase local market concentration, but other occupations do not. In contrast, Lu et al. (2019) find that the deregulation of foreign direct investment (FDI) in China, which potentially increases labor market competition for incumbent Chinese firms, widened

wage markdowns. Their findings conflict with monopsony theory, leading them to conclude that their results are driven by search frictions. Meanwhile, using matched employer-employee data for France, Marinescu et al. (2021) examine the effects of labor market concentration on wages and employment of new hires. Defining labor markets in terms of commuting zones and occupations, they find that an increase in labor market concentration decreases the number of new hires and their wages. Furthermore, they show that product market concentration, calculated as the share of sales in the relevant product market nationwide, increases the wages of new hires and decreases the number of new hires.

The increase in online job postings in recent years has made it possible for researchers to utilize rich data at relatively low cost to gauge labor market power between employers and job seekers. One study taking advantage of this is that by Azar et al. (2020), who use data on online job postings to study the effects of labor market concentration on wages. Running both ordinary least squares (OLS) and IV regressions, they show that posted wages are lower when job vacancies for a particular occupation within a commuting zone are more concentrated among a small number of firms. The elasticity of the HHI to real wages in their baseline IV regression is -0.127.

2.2. Labor market characteristics in Japan

Japan's employment system has traditionally been characterized by long-term employment with a low rate of job switching. In contrast, in the United States, switching jobs is common practice and labor market competition across employers is likely more severe. This is illustrated by a study by Kambayashi and Kato (2017), who show that job retention rates over the last few decades differed substantially between the United States and Japan. Moreover, although labor market flexibility in Japan has increased since the collapse of the asset bubble in the early 1990s, labor mobility is still far lower than in the United States. The literature highlights that the difference in labor mobility between the United States and Japan is due to institutional differences, including firm practices and labor laws providing strong protection (see, e.g., Farber, 2007).[4]

Using employment data for Japan to assess the impact of labor market competition on wages adds new evidence to the literature on labor market concentration. Under a long-term employment system such as Japan's, employers are likely to have stronger bargaining power and exert market power over their workers. As a result, the degree of labor market competition matters less in the setting of wages.[5] We examine the

[4] For details on differences in employment protection between regular and temporary employees across countries, see Tables S9.8 and S9.9 in Tomaskovic-Devey et al. (2020).

[5] In Japanese firms, labor unions and management traditionally bargain over wages and bonuses in negotiations held in spring (*shunto*). Labor unions present their wage demands to employers in January,

effect of labor mobility on the relationship between labor market concentration and wages using differences in labor mobility in the Japanese labor market along two dimensions, namely, differences over time and differences by firm size.

Although the Japanese labor market overall tends to be characterized by long-term employment, practices differ between large firms on the one hand and small and medium-sized firms on the other. Data by the Ministry of Health, Labour, and Welfare, for example, show that average job tenure is longer at large firms than small and medium-sized firms.[6] A potential explanation for the difference in labor mobility across firms of different sizes is the high value placed on firm-specific skills at large firms. Given these differences between large firms and small and medium-sized firms we use firm size as one aspect to examine the impact of labor mobility on the link between market concentration and wages. Another aspect we exploit for our analysis is the fact that labor mobility in Japan has increased in recent years, which chiefly is due to changes in the long-term employment system at large firms (Hamaaki et al., 2012).

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and employers decide how to respond to the wage demand in March. Wages and bonuses are finalized taking labor productivity and the fairness of wages relative to other firms in the same industry into account (Kato, 2016). The results of *shunto* affect the wage level in the industry overall. This negotiation practice potentially increases the bargaining power of workers.

[6] The 2010 "White Paper on the Labour Economy" (in Japanese) by the Ministry of Health, Labour, and Welfare shows that in 1995 the average job tenure of 35–39 year-old males was 17 years for large firms (with 1,000 or more employees) but only 12 years for small and medium-sized firms (with 100–999 employees). The difference in job tenure between large firms and small and medium-sized firms has slowly diminished over time. Available at https://www.mhlw.go.jp/wp/hakusyo/roudou/10/dl/03-2.pdf.

2.3. Hypotheses

In this subsection, we develop hypotheses based on economic theory, Japanese labor market characteristics, and other factors that potentially affect the relationship between labor market structure and wages.

Hypothesis 1: Plants mark down wages if the labor market gets more concentrated, ceteris paribus.

Wages are lower in more concentrated markets, ceteris paribus. Conventional economic theory implies that in monopsonic markets, employers enjoy market power over workers. While labor mobility in Japan is relatively low, the degree of labor market concentration does matter for wages.[7]

Hypothesis 2: Wage setting at large employers is less responsive to labor market concentration than wage setting at small and medium-sized employers.

[7] According to the Ministry of Health, Labour and Welfare's "Survey on Wage Increases" (*sic*), among companies that revised wages in 2014, the most important factor (multiple answers allowed) in determining wage revisions was "corporate performance" (62.5%), followed by "securing and retaining labor" (26.9%), and the "market rate" (25.0%). See: https://www.mhlw.go.jp/toukei/itiran/roudou/chingin/jittai/14/dl/05.pdf (in Japanese).

Labor mobility tends to be lower at large employers than small and medium-sized employers. It implies that large employers are less threated by losing their workers, and therefore, less responsive to labor market competition environment. The effect of labor market concentration on wages is smaller at large employers than at small and medium-sized employers.

Hypothesis 3: The increase in labor market mobility in recent years has led to greater competition in labor markets among employers. As a result, wages are more responsive to the degree of labor market concentration. Labor mobility has increased more substantially for large employers, so the impact is likely to be more pronounced among large employers than small and mediums-sized ones.

Our observation period can be divided into an earlier period (2001–2007), when labor mobility was still relatively low, and a later period (2008–2014) characterized by increasing labor mobility. We expect the impact of labor market concentration on wages to have been smaller during the earlier period with less labor mobility than the later period. Moreover, we expect the increase in the impact of labor market concentration on wages to have been larger among large employers, since it is among them that the increase in labor mobility was concentrated. Trends in labor mobility by firm sizes are plotted in

Figure 1, which shows that both inflow and outflow of workers had increased over time for large firms, but they had declined over time for small and medium-sized firms. Figure 2 depicts that the movement of workers by firm size. It shows that workers switching from large plants to other large plants contributes to an increase of worker mobility for large plants.

Hypothesis 4: Greater competition in downstream markets weakens the link between labor market concentration and wages.

To survive in competitive downstream markets, employers are likely to be cost sensitive. If wages rise due to labor market competition, employers may lose their cost competitiveness. As a result, they may replace labor with capital or simply exit the market. Therefore, labor market concentration has less explanatory power for wages when the downstream market is competitive. We capture the intensity of competition in downstream markets by the export ratio, which is calculated as export sales over total sales.

Hypothesis 5: Labor market concentration has a stronger effect on wages in more manufacturing-intensive prefectures than less manufacturing-intensive prefectures.

We define labor markets as the intersect of commuting zones and 2-digit industry groups in the manufacturing sector by assuming that workers search for jobs in the same commuting zone and in the same industry. This labor market definition may be imprecise because it ignores structural changes in industry composition over time. During our observation period, the manufacturing sector in Japan has been shrinking while the service sector has been expanding.[8] Because of such structural change in labor demand, workers in the manufacturing sector likely have responded by acquiring skills that allow them to extend their job search options beyond the manufacturing sector. However, in industrial cities, workers are likely to have fewer outside job opportunities, so that manufacturing employers exert greater market power in concentrated markets. We hypothesize that the link between labor market concentration and wages is higher in prefectures with a higher manufacturing intensity, which we measure in terms of the employment share of the manufacturing sector in total employment in a prefecture.

3. Definition of labor market concentration and data

3.1. Definition of labor market concentration

[8] The declining trend in the number of workers in the manufacturing sector can be seen in Figure 3.

We measure labor market concentration using the Herfindahl-Hirschman Index (HHI), which is defined as the sum of the squares of the ratio of workers at a particular plant to all workers at all plants in the same labor market. The higher the labor market concentration, the higher the HHI. Specifically, the HHI in labor market *m* for year *t* is calculated as

$$HHI_{m,t} = \Sigma_i^n \left(\frac{Number\ of\ Employees_{i,m,t}}{\Sigma_i^n Number\ of\ Employees_{i,m,t}} \right)^2 \quad (1)$$

where *i* represents the plant, *m* stands for the labor market, and *t* is the year. Labor markets are defined in terms of combinations of 54 manufacturing sector industry classifications in the Japan Industrial Productivity (JIP) database and 203 commuting zones defined by the Ministry of Internal Affairs and Communications (MIAC).[9] The commuting zones defined by MIAC are based on where economic and industrial activities are centered, and about 90% or more of workers commute within an economic area. Therefore, using commuting zones allows us to delineate labor markets more accurately

[9] We employed the commuting zones used in the 2014 Family Income and Expenditure Survey, available at https://www.stat.go.jp/data/zensho/2014/furoku.html#c (in Japanese).

than studies using administrative units such as prefectures, counties, or states. Further, we use industry classifications to define labor markets. The reason is that workers often move through different positions within their firm in Japan. Given such frequent job changes within a firm, potential employers consider previous work experience based on the industry and not necessarily the occupation when hiring employees.

Figure 4 provides a map showing the average labor market HHI for each commuting zone over the observation period. As can be seen, the HHI is low in industrial areas such as Tokyo and Osaka, which are located in the center of Japan, and high in more rural areas such as large parts of Hokkaido, Tohoku, Shikoku, and Kyushu located in the north and west of Japan.

Many extant studies use the employment HHI as a labor market concentration measure (Marinescu et al., 2021; Azar et al., 2020; Benmelech et al., 2020). Also, competition authorities such as the U.S. Federal Trade Commission, the U.S. Department of Justice, the European Commission, and the JFTC use the HHI in the review of mergers to assess the impact on market competition.

3.2. Data

Data on manufacturing plants are obtained from the Census of Manufacture (Kogyo Tokei), which was conducted annually by the Ministry of Economy, Trade, and Industry. We focus on the years 2001 to 2014. The Census covers all manufacturing plants in Japan with more than three employees. The Census includes plant identifiers and information on the production, shipments, etc., of more than 380,000 plants. The Census of Manufacture covers all manufacturing plants with 4 or more employees. [10]

Data we use in our analysis are plant shipment values; production costs, including annual cash payments to employees; the number of employees; the location of a plant; payments for consignments, i.e., payments to other plants for production that has been outsourced; and the export ratio, which is the amount of exports in the total amounts of shipments. Since 2001, detailed questions on employees, such as the number of male and female employees and non-fulltime employees, have been included in the questionnaires. Including such information on employees in our regression analyses helps to control for factors other than labor market concentration that affect the average wages at plants, which is why we focus on the period from 2001 onward. In 2011, the Census of Manufacture was conducted as a part of the Economic Census, and the targeted plants are

[10] Establishments not engaged in manufacturing (e.g., head offices, warehouses, etc.) are not included in the survey.

slightly different in that year. Since to calculate the HHI consistently across years the rules for the selection of plants must be identical, we omit data for 2011 to avoid anomalies resulting from the change in the coverage.

Using the Census rather than other possible data sources has two major benefits. First, the Census covers a large percentage of manufacturing employment in Japan. Second, the Census makes it possible to control for the impact of plant-level differences in productivity, which can significantly affect wages. We calculate plant-level labor productivity as the real value of plant output divided by hours worked. While the Census does not provide data on hours worked, it does contain the number of workers in each plant. We obtain hours worked in each plant by multiplying the number of workers in the Census and the industry-average hours worked from the JIP 2018 database.[11]

Table 1 provides summary statistics of the key variables in our analysis. The average HHI in the sample is 0.086 (or 860 on a scale to 10,000).[12,13] The average shares of non-standard and female workers are 24.5% and 35.7%, respectively.[14] The annual average real wage normalized to the 2015 price level is approximately 3.2 million yen.

[11] JIP 2018 database is available at https://www.rieti.go.jp/en/database/JIP2018/.
[12] The maximum value of the HHI in the Merger Guidelines is 10,000. We normalize the maximum value to 1.
[13] It is worth noting that the average HHI when plants are weighted equally is lower than the average HHI when labor markets are weighted equally because there are more plants in less concentrated labor markets. The average HHI when labor markets are weighted equally is 0.35 or 3,500.
[14] We refer to part-time workers and temporary workers as non-standard workers.

4. Methodology

4.1 Regression models

We start by estimating the effects of labor market concentration on the outcome variables using the following equation:

$$Y_{i,m,t} = \alpha + \beta X_{i,m,t} + \gamma Labor\ Marktet\ Concentration_{m,t} + Plant\ Dummies + Year\ Dummies + \epsilon_{i,m,t}. \quad (2)$$

$Labor\ Marktet\ Concentration_{m,t}$ is the degree of labor market concentration in labor market *m* in year *t.* As described in the previous section, labor markets are defined using 203 geographic markets (commuting zones) and 54 industry classifications for the manufacturing sector, assuming that workers cannot move freely beyond commuting zones and across industries. As a robustness check, we use an alternative definition of labor markets, in which we use only the 203 commuting zones and not the industry classification. The underlying assumption regarding this definition of labor markets is that workers can move freely across industries within the same commuting zone. As shown later, the effect of labor market concentration on wages vanishes when labor markets are defined using only geographic information. This result indicates that our

labor market definition using 2-digit industry classifications and commuting zones captures well the "area" that workers take into consideration when switching jobs, and employers can potentially exert market power.

Plant fixed effects are included in the estimation of equation (2). This means that the estimated coefficients on the labor market concentration measure represent the effect of annual variations in labor market concentration on the outcome variable after controlling for average plant outcomes. $Y_{i,m,t}$ represents the outcome for plant i in labor market m in year t. We mainly use the natural logarithm of the plant average wage as the outcome of interest. Based on labor market monopsony/oligopsony theory, we expect the average wage to be lower in more concentrated labor markets.

$X_{i,m,t}$ is a vector of factors that potentially affect the outcome variable. Following conventional wage regressions in the literature, we include the share of female employees and the share of non-fulltime employees in each plant, as well as the unemployment rate to control for labor demand in the labor market, as controls. We then incorporate plant-specific elements – namely, the average plant labor productivity, the consignment ratio, and the export ratio – which potentially affect the link between labor market concentration and wages in the wage regressions.

A key concern in establishing causality is the potential issue of endogeneity. To deal with this, we take advantage of the panel structure of the dataset and control for plant fixed effects on wages and employment. However, labor demand or labor supply shocks simultaneously affect labor market concentration and plant-level wages, generating bias in the estimated coefficients on the labor market concentration measure. For example, a negative supply shock could increase both the HHI and wages, and offset the negative effect of the HHI on wages. To rule out this possibility, we use the average HHI of the same industry in other geographic areas and the total length of highways and ordinary roads in a prefecture/ as instrumental variables.

The use of information on other markets as instruments is a widely used strategy in the literature. For example, Azar, Marinescu, and Steinbaum (2020) use the average number of employers within the same industry in other geographic markets as an instrument for the labor market HHI. Similarly, in a study of ready-to-eat cereal prices, Nevo (2001) uses prices in other regions as an instrument for prices in the region in question.

Meanwhile, the rationale for using the length of highways and ordinary roads as an alternative instrument is that this is likely to be closely related to the employment HHI, since plants tend to be located in places with good transport connections. The employment

HHI therefore likely is closely linked to transportation infrastructure such as the extent of highways and roads as places with a better transportation infrastructure will have more and/or larger plants. To the best of our knowledge, using the length of highways and ordinary roads extension as an instrument for labor market concentration is novel in the literature. We discuss the validity of our instruments in Section 5.

4.2. Subsample analyses

To examine the heterogenous effects of labor market concentration on wages, we estimate equation (2) for various subsamples and compare the results. Specifically, we split the sample based on plant size, the time period, the export ratio of the plant, and the manufacturing intensity of the prefecture, measured in terms of the share of manufacturing in total prefectural employment.

We start by examining the impact of labor market concentration on wages exploiting the differences in labor mobility between large firms on the one hand and small and medium-sized ones on the other. We divide the sample into large and small and medium-sized plants, considering plants that belong to firms with multiple plants as large plants. We also consider single plants with 300 or more employees as large plants.

Therefore, “large plants” in our analysis are plants with 300 or more employees or belonging to multi-plant firms, while all other plants are small or medium-sized plants.

To further explore the effects of labor mobility, we divide the observation period into two sub-periods, 2001 through 2007 and 2008 through 2014. This allows us to examine the impact of the increase in labor mobility observed in Japan over time. Furthermore, we divide the sample into large plants on the one hand and small and medium-sized plants for these two periods to examine separately how the increase in labor mobility has affected wages at large plants and small and medium-sized plants. These subsample analyses help us test Hypotheses 2 and 3.

Further, we estimate the effect of competition in downstream markets on wages. Plants with more competitive downstream markets face greater pressure to keep wages low, so that the link between labor market concentration and wages should be weaker than at plants facing less severe competition. To test this hypothesis, the plant-level export amount is used to capture the intensity of downstream market competition.[15] As not that many plants export, we use a dummy variable that takes a value of 1 if the firm has positive sales from exporting and zero otherwise. If a plant has positive sales from

[15] Another study using the export ratio as a proxy for the degree of competition in downstream markets is that by Harasztosi and Lindner (2019).

exporting, the plant is regarded to be facing a competitive downstream market. This analysis tests Hypothesis 4.

Third, we split the sample into plants located in prefectures with a higher percentage of workers employed in the manufacturing sector and those located in prefectures with a lower percentage of workers employed in the manufacturing sector. Plants in manufacturing-intensive prefectures are more likely to wield market power in a concentrated labor market because presumably workers are locked into the manufacturing sector. We split the sample using the median across all prefectures of the percentage of workers employed in the manufacturing sector in 2014. This analysis tests Hypothesis 5.

5. Results

5.1. Wages and labor market concentration

Table 2 presents estimates of the effects of labor market concentration on wages obtained using plant fixed effects models. Column (1), in which the continuous HHI is used to measure labor market concentration, indicates that a one standard deviation increase in the HHI reduces wages by 0.3% (=-0.02×0.127). This is smaller than the value obtained in a recent study focusing on the United States, in which a one standard deviation increase in the employment HHI decreases wages by 0.8% (Benmelech et al., 2020). Next,

instead of the continuous HHI, we use a dummy for labor markets with an HHI of 1,500 or more, which in the merger guidelines of various authorities is used as the threshold to define markets with a high degree of concentration, as the dependent variable. The results are shown in column (2) and suggest that wages in concentrated labor markets are 1.1% lower. Thus, the results in both columns (1) and (2) indicate that labor market concentration has a negative effect on wages, but the magnitude of the effect is small.

To deal with the possibility that controlling for plant fixed effects does not fully address potential endogeneity issues, we employ IV estimation. The results are presented in columns (3) and (4). In the estimations, we use the average HHI in the same industry in other geographic areas excluding the HHI in the area concerned as well as the length of highways and ordinary roads as instruments. We find that the estimated impact of labor market concentration on wages is larger in the IV regressions than in the firm fixed effects regressions. The results in column (3) indicate that a one standard deviation increase in the HHI, which correspond to a rise in the HHI by 1,270, is associated with 2.1% (=0.127 ×-0.169) lower wages. Thus, the downward effect of labor market concentration on wages is more pronounced in the IV regression results, but the magnitude of the coefficient is economically plausible. The size of the coefficient is larger than that in the fixed effects model, suggesting that the fixed effects model suffers from endogeneity. A

possible reason for such endogeneity is that, as highlighted out by Schubert et al. (2020), both the number of firms and productivity will simultaneously be low in a labor market where economic dynamism is low. Another possibility is that the coefficients in the IV estimates are local average treatment effects (LATE), meaning that the effects of compliers are often larger than average treatment effects[16]. Overall, the results of both the fixed effects and the IV estimation confirm Hypothesis 1.

Meanwhile, column (5) shows the first-stage result of the IV estimation when the HHI is used as the dependent variable, and the HHI for same industry in other areas, the length of highways and ordinary roads, and other exogenous variables are used as independent variables. The coefficient on the average HHI of the same industry in other geographic areas is positive and statistically significant at the 1% level, which suggests that the higher the labor market concentration in other geographic areas in the same industry, the higher is the labor market concentration in the geographic area concerned. While the coefficient on the length of highways is statistically insignificant, that on the length of ordinary roads is negative and statistically significant at the 1% level. This suggests that, as expected, the density of road infrastructure affects the location of plants. The first-stage results pass both the overidentification test and the weak instrument test,

[16] See Angrist and Pischke (2009), sections 4.4-4.6 for more detail on LATE.

which indicate that our IV sets are valid. In the remainder of the analysis, we therefore focus on the IV regression results.

5.2. Heterogeneity in the responsiveness of wages to labor market concentration due to differences in labor mobility

Next, we examine Hypotheses 2 and 3, which focus on differences in labor mobility across subsamples. Specifically, Hypothesis 2 suggests that labor market concentration is expected to influence wages more at small and medium-sized plants than at large plants because of the lower labor mobility at large plants. The IV regression results to examine this hypothesis are presented in Table 3. Columns (1) and (3) show the results for small and medium-sized plants and large plants using the continuous HHI as the variable for market concentration. The results show that a one standard deviation increase in the HHI lowers wages by 2.6% (=0.127 × -0.204) at small and medium-sized plants and by 1.4% (=0.127 × -0.111) at large plants. The impact of the HHI on wages is larger at small and medium-sized plants than at large plants, which confirms Hypothesis 2 stating that wage setting at large employers is less responsive to labor market concentration than wage setting at small and medium-sized employers. Meanwhile, columns (2) and (4) shows the results using *HHI≥0.15* instead of the continuous HHI to

represent market concentration. The results are consistent with those using the continuous HHI.

Next, Table 4 shows the results when dividing the sample into two subperiods, 2001–2007 and 2008–2014, to examine whether the increase in labor mobility has affected the impact of labor market concentration on wages. Column (1) shows that the coefficient on the HHI for 2001–2007 is -0.129, while column (3) shows that that for 2008–2014 is -0.165. Therefore, as expected, the absolute value of the coefficient for 2008–2014 is larger than that for 2001–2007. The same is true when using the HHI dummy (columns (2) and (4)).

Finally, we split the sample into subgroups based on plant size and period to investigate which plants have been more affected by the increase in labor mobility. The results are presented in Table 5, with columns (1) and (2) showing those for small and medium-sized plants for 2001–2007 and 2008–2014, respectively. The coefficient on the HHI is -0.155 for the earlier period and -0.192 for the later period, meaning that the absolute value of the coefficient is larger in the later period. Columns (3) and (4) show the results for large plants for the two periods. The coefficient on the HHI for the earlier period is -0.093, while that for the later period is -0.141. Thus, the sensitivity of wages to labor market concentration is larger at small and medium-sized plants than at large plants,

which is consistent with the results obtained in Table 3. However, focusing on the size of the jump in the coefficient on the HHI from the earlier to the later period, we find that the change is more substantial for large plants. In other words, the increase in labor mobility has affected wages at large plants more than at small and medium-sized plants. This is consistent with our hypothesis that large plants now also have to compete with other employers to attract workers and their wage setting is affected by the structure of the labor market, i.e., the degree of concentration. Overall, our results confirm Hypotheses 2 and 3.

5.3. Heterogeneity in downstream competition

Next, we examine the effects of downstream product market competition on the link between labor market concentration and wages. We use the export ratio as a proxy for the intensity of competition in downstream markets. Our hypothesis is that the explanatory power of the HHI with regard to wages should be weaker for plants facing more intense competition in downstream markets, since such plants, if they want to survive, presumably have less room to pass on the costs of higher wages. The results for this analysis are presented in Table 6. We find that the coefficient on the HHI in column (1) for plants with no exports is -0.168, while that for plants that do export is -0.124,

suggesting that for plants exposed to international competition in downstream markets, labor market concentration has a smaller impact on wages. Similar results are obtained using *HHI≥0.15* (columns (2) and (4)). Overall, our estimates are consistent with Hypothesis 4.

5.4. Heterogeneity in extent of outside job opportunities

Our last exercise is to explore the effects of adjacent markets on the relationship between labor market concentration and wages, i.e., Hypothesis 5. While our dataset only captures employment concentration within 2-digit industry groups in the manufacturing sector, the ability of employers in the manufacturing sector to exploit their market power might potentially also be affected by the extent to which employment opportunities outside the manufacturing sector are available. To examine this hypothesis, we divide our sample in terms of the share of workers in the manufacturing sector in a particular prefecture. Specifically, we use the median of the share of workers employed in the manufacturing sector as of 2014 to divide prefectures into two groups. This does not perfectly capture the extent of outside job opportunities; however, given that manufacturing plants tend to cluster in specific prefectures, dividing our sample in this manner does provide an approximation of the degree of competition from adjacent labor markets, which is what

we are interested in. The results of this analysis are displayed in Table 7. The coefficient on the HHI is -0.180 in column (1) for labor markets in prefectures with a higher manufacturing share, while it is -0.158 (Column 3 in Table 7) for labor markets in prefectures with a lower manufacturing share. These estimates indicate that the sensitivity of wages to labor market concentration is lower when opportunities in outside markets are larger.

5.5. Robustness checks

This subsection shows that our results are robust to other model specifications.

The first robustness check we conduct is to change the definition of labor markets, using only commuting zones but not industry groups. As shown in Table 8, the coefficient on the HHI is no longer statistically significant. This result suggests that our definition of labor markets provides a good approximation of the relevant labor markets, i.e., areas in which employers have market power.

Second, to ensure that our findings are not driven by the particular measure of market concentration that we selected, we use the number of plants in a labor market as an alternative measure of market concentration. The key finding that less competition has a negative effect on wages remains unchanged (Table 9).

Third, time trend might affect both the HHI and wages. To address this concern, we include a time trend in the equation (2) in order to control for any time trend. We find that our findings are unaffected by adding a time trend (Table 10).

6. Conclusion

This study examined the impact of labor market concentration on wages using the Census of Manufacture for Japan for the period from 2001 through 2014. Using the HHI – a measure of market concentration employed in merger guidelines in countries around the world – we show that wages are lower in more concentrated labor markets. In contrast with previous studies, which suggest that there is a homogenous negative effect of labor market concentration on wages, we find heterogeneity in the response of wages to the HHI.

We presented evidence consistent with our hypotheses focusing on potential factors that might affect the link between labor market concentration and wages. First, exploiting differences in labor mobility between small and medium-sized plants on the one hand and large plants on the other, and between the early and late parts of our observation period (2001–2007 and 2008–2014), we examine the role of labor market flexibility in labor market competition. The estimates show that labor mobility amplifies

the effects of labor market concentration on wages. In addition, we find that at large plants, where the traditional long-term employment system was most prevalent, the response of wages to the labor market environment has changed more in recent years than at small and medium-sized plants. Further, our results show that competitive pressure from adjacent markets has an impact on the link between labor market concentration and wages: the larger the outside market, the lower the sensitivity of wages to labor market concentration. Finally, we find that the sensitivity of wages to the employment HHI is lower at plants that export. This result implies that for plants that face greater competition in downstream markets the degree of labor market concentration has a smaller effect on wages.

Our study has important implications for competition agencies. Specifically, they mean that in certain circumstances labor market concentration has a negative impact on wages, such as when the labor force is relatively mobile, downstream markets are less competitive, and one sector accounts for a substantial share of employment in the area. These findings provide competition authorities with criteria for a warning system to examine whether a merger might potentially have a negative impact on wages.

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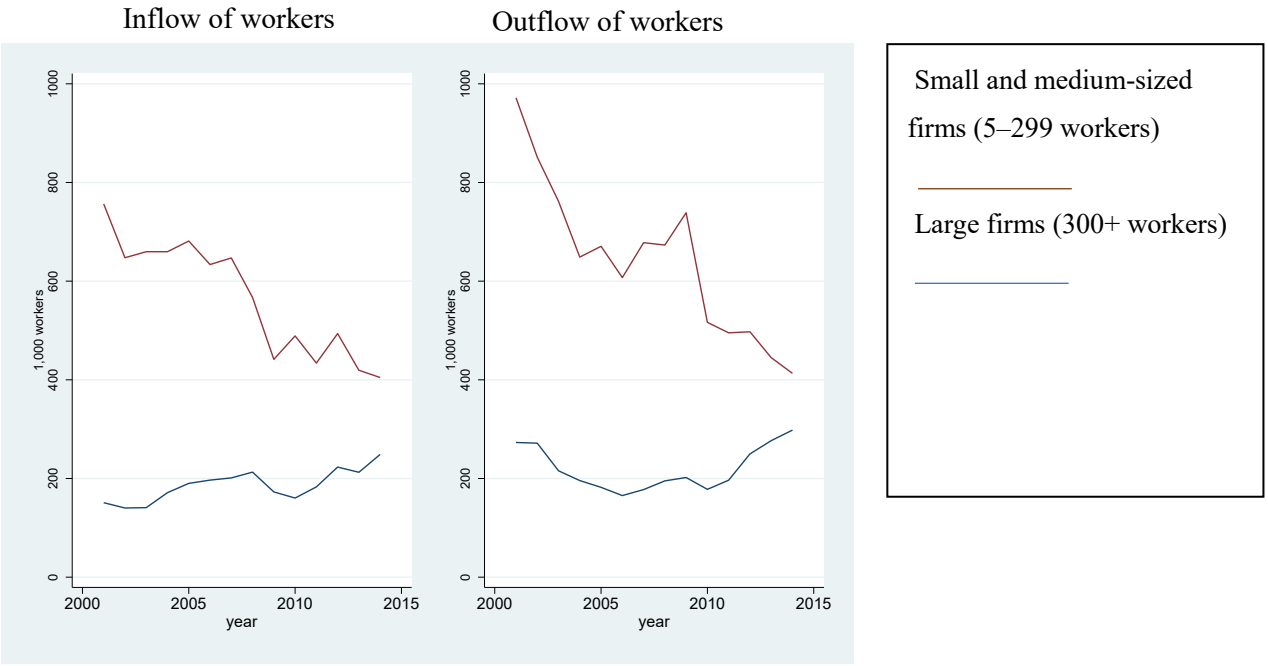
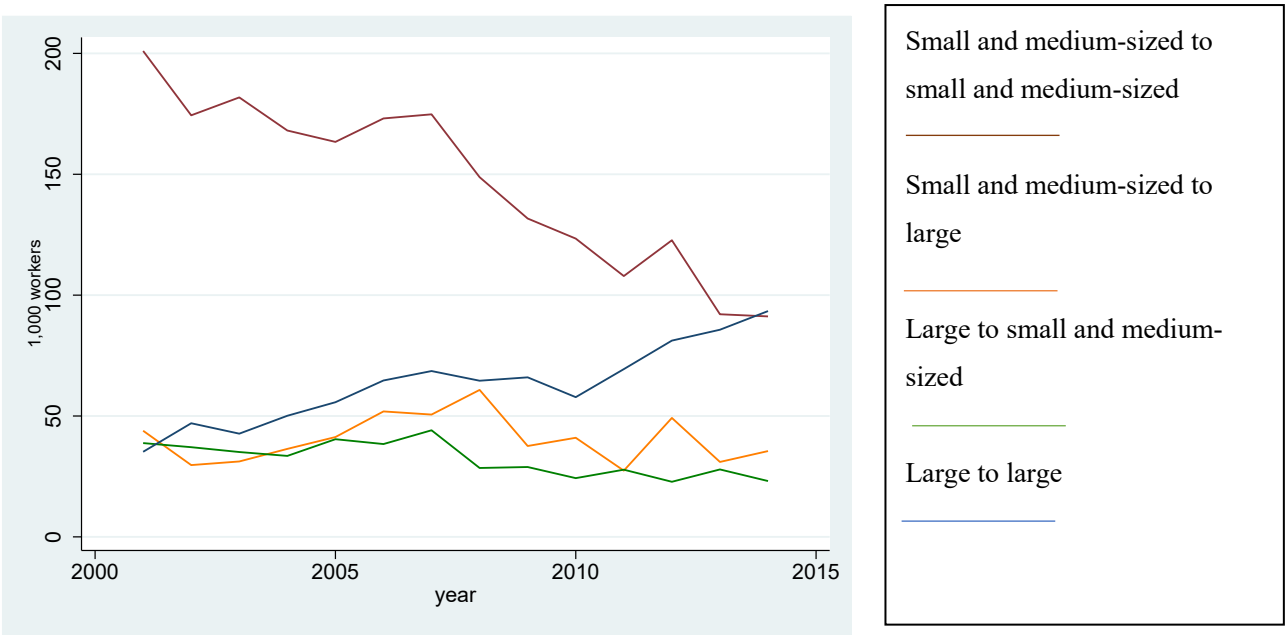
Figure 1. Labor inflows and outflows by firm size in manufacturing sector: 2001–2014



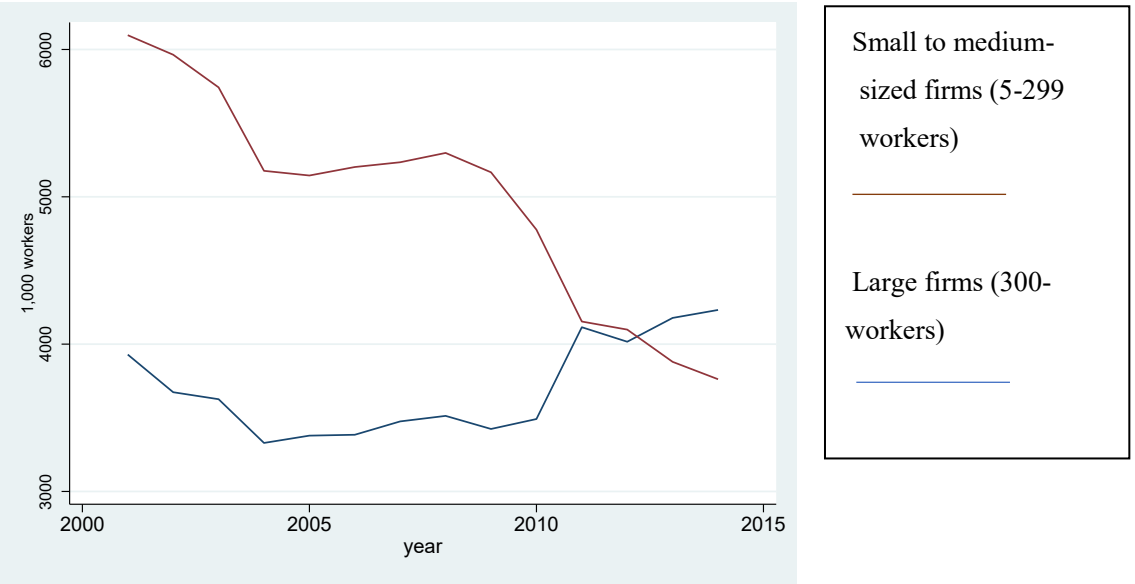
Note: The data are taken from the Survey of Employment Trends. The figure shows the inflow and outflow of manufacturing workers in the year.

Figure 2. Number of job switchers in manufacturing sector by firm size: 2001–2014



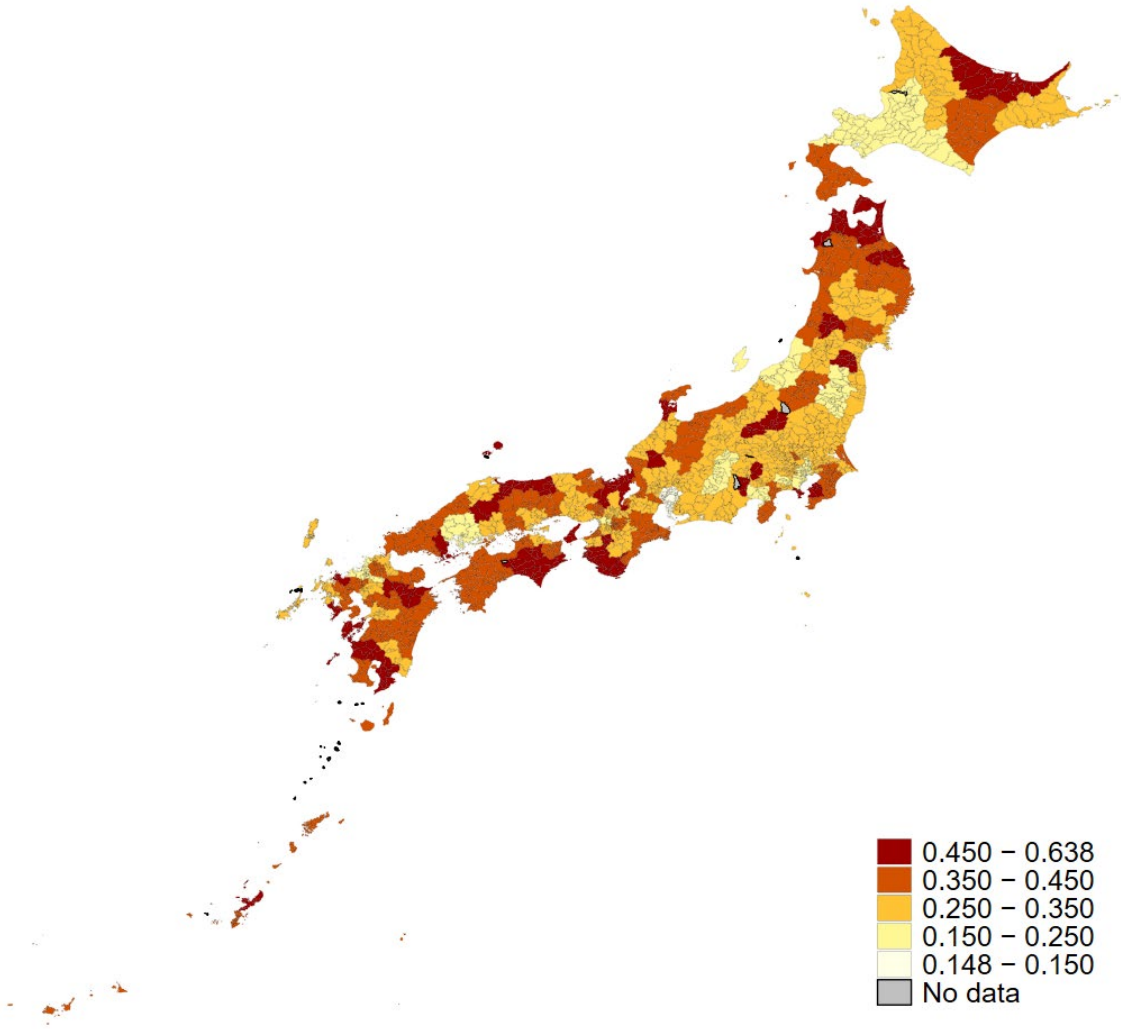
Note: The data are taken from the Survey of Employment Trends. The figure shows the number of job switchers in the manufacturing sector by firm size. "Small and medium-sized to small and medium-sized" refers to the number of job switchers from one small or medium-sized manufacturing firm (5–299 employees) to another small or medium-sized manufacturing firms (5–299 employees). "Small and medium-sized to large" refers to the number of job switchers from a small or medium manufacturing firm to a large firm (300+ employees). "Large to small and medium-sized" and "Large to large" are defined in a similar fashion.

Figure 3. Number of workers in manufacturing sector: 2001–2014



Note: The data are taken from the Survey of Employment Trends. The figure shows the number of manufacturing workers at the beginning of the year.

Figure 4. Employment HHI in Japan



Note: The HHI for each commuting zone is calculated by taking the weighted average of the HHIs using total value of shipment as a weight.

Table 1. Summary statistics (All plants)

Variable	Mean	Std. Dev.	Min.	25th percentile	50th percentile	75th percentile	Max.	Obs.
Total real wages (million yen)	143.42	973.45	0.01	15.42	33.01	81.9	212,531.54	3,255,971
Annual real wages (1,000 yen)	3,310.53	1,728.44	0.441	2,070.69	3,135.90	4,318.65	331,017.93	3,255,971
Log annual real wages	14.86	0.603	6.09	14.54	14.96	15.28	19.62	3,255,971
Hourly real wages	1,717.86	885.74	0.229	1,094.70	1,631.69	2,226.97	169,070.44	3,255,971
Total employees	31.81	132.41	4	6	10	23	22,343	3,255,971
Log employment	2.59	1.05	1.39	1.79	2.3	3.14	10.01	3,255,971
Non-standard employee ratio	0.259	0.266	0	0	0.188	0.43	1	3,255,971
Female employee ratio	0.39	0.251	0	0.19	0.333	0.571	1	3,255,971
Log labor productivity	-0.655	0.933	-12.48	-1.243	-0.657	-0.091	6.726	3,255,971
HHI	0.086	0.127	0.002	0.019	0.042	0.096	1	3,255,971
Plants per labor market	205.32	339.93	1	37	91	220	3,262	3,255,971
HHI in other regions	0.2	0.135	0.052	0.098	0.156	0.25	1	3,255,971
Total value of shipments (million yen)	1,084.60	14,453.26	0	10	72.13	293.33	6,848,671	3,255,971
Consignment ratio	0.078	62.36	0	0	0	0	110,404	3,255,971
Export ratio	0.006	0.051	0	0	0	0	6.91	3,255,971
Highways (10,000 km)	0.021	0.015	0.002	0.013	0.017	0.028	0.089	3,255,971
Ordinary roads (10,000 km)	3.288	1.666	0.860	2.012	2.957	4.036	9.744	3,255,971

Note: The table presents descriptive statistics for the plant-year observations used in the analysis. The sample is restricted to plants for which multiple observations across years are available. Plant data are obtained from the Census of Manufacture from 2001 through 2014. 2011 is excluded due to inconsistencies in the plants surveyed. "Total real wages" are the sum of wages paid by a plant at 2015 prices. "Annual real wages" are the average annual wage of employees, calculated as total real wages divided by the total number of employees. "Hourly real wages" are calculated using total real wages and total hours worked, which are obtained by multiplying the total number of employees and the industry average of hours worked. "Total employees" are the total headcount of all employees at a plant. "Non-standard employee ratio" is the ratio of non-standard employees to the total number of employees. "Female employee ratio" is the ratio of female employees to the total number of employees. "Log labor productivity" is the natural logarithm of labor productivity, which is calculated as real output in 10,000 yen divided by total hours worked. "HHI" is the Herfindahl-Hirschman Index, which is the sum of the squared employment shares of all plants in a labor market defined in terms of 2-digit industry categories and commuting zones. "Plants per labor market" is the number of plants in a particular labor market. "HHI in other regions" is the average HHI in the same industry but in other geographic regions for a particular labor market. "Import ratio" is the ratio of imports to the total value of shipments by domestic plants within an industry. "Consignment ratio" is the ratio of consignment payments to the total value of shipments of a plant. "Export ratio" is the ratio of exports to the total value of shipments of a plant. Small and medium-sized plants are plants belonging to single-plant firms with fewer than 300 employees. Large plants are plants belonging to multi-plant firms or plants belonging to single-plant firms with 300 or more employees. "Highways" and "Ordinary roads" are the length of highways and ordinary roads in the prefecture in which a plant is located.

Table 2. Labor market concentration and wages: Plant fixed effects and IV regressions (baseline model)

	(1)	(2)	(3)	(4)	(5)	(6)
	Fixed effects		IV 2nd stage		IV 1st stage	
Dep. variable	Log(annual real wages)				HHI	HHI≥0.15
HHI	-0.022***		-0.169***			
	(0.004)		(0.009)			
HHI≥0.15		-0.011***		-0.115***		
		(0.001)		(0.006)		
Non-standard employee ratio	-0.292***	-0.292***	-0.291***	-0.292***	0.003	0.000
	(0.004)	(0.004)	(0.004)	(0.004)	(0.002)	(0.002)
Female employee ratio	-0.184***	-0.184***	-0.184***	-0.184***	-0.002	-0.000
	(0.006)	(0.006)	(0.006)	(0.006)	(0.003)	(0.003)
Log(unemployment rate)	-0.021***	-0.021***	-0.021***	-0.020***	-0.000	0.007**
	(0.005)	(0.005)	(0.005)	(0.005)	(0.003)	(0.003)
Log(labor productivity)	0.197***	0.197***	0.198***	0.198***	-0.004***	-0.005***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)
Export ratio	0.027**	0.027**	0.029***	0.025**	0.013**	-0.018***
	(0.011)	(0.011)	(0.011)	(0.011)	(0.006)	(0.005)
Consignment ratio	0.00001**	0.00001**	0.00001**	0.00001**	0.0000002	-0.0000006
	(0.000006)	(0.000006)	(0.000006)	(0.000006)	(0.0000006)	(0.0000004)
HHI in other regions					0.911***	1.336***
					(0.006)	(0.009)
Highways					-0.114	0.045
					(0.157)	(0.155)
Ordinary roads					-0.037***	-0.046***
					(0.014)	(0.014)
Constant	15.236***	15.235***			0.139***	0.276***
	(0.008)	(0.008)			(0.043)	(0.040)
Observations	3,255,971	3,255,971	3,255,971	3,255,971	3,255,971	3,255,971
R-squared	0.877	0.877	0.138	0.134	0.916	0.852
F statistic					7188.0	7804.1
Hansen J statistic					5.5	5.3
Plant FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Note: The table shows the estimates for the impact of labor market concentration on wages using plant fixed effects regressions and instrumental variable regressions for the baseline model. Columns (1) and (2) present the fixed effects estimation results of the baseline model. Columns (3) and (4) present the IV estimation results of the baseline model. Columns (5) and (6) present the first-stage results of the IV estimation in columns (3) and (4). The regressions are weighted by (1/N), where N is the number of plants in the relevant labor market. Labor markets are defined in terms of 54 industry groups and 203 commuting zones. The dependent variable in columns (1) through (4) is the natural logarithm of annual real wages. "HHI≥0.15" is an indicator variable that equals one if the HHI is greater than 0.15. The dependent variable in columns (5) and (6) is the HHI and HHI≥0.15, respectively. The sample is restricted to plants for which multiple observations across years are available. White standard errors are reported in parentheses. The F statistic and Hansen J statistic are presented for the IV regressions.
*** p<0.01, ** p<0.05 * p<0.1.

Table 3. Labor market concentration and wages: IV regressions (SM plants vs. large plants)

	(1)	(2)	(3)	(4)
	SM plants		Large plants	
Dep. variable	Log(annual real wages)			
HHI	-0.204***		-0.111***	
	(0.011)		(0.015)	
HHI≥0.15		-0.131***		-0.083***
		(0.007)		(0.011)
Non-standard employee ratio	-0.270***	-0.270***	-0.312***	-0.312***
	(0.005)	(0.005)	(0.007)	(0.007)
Female employee ratio	-0.145***	-0.145***	-0.244***	-0.244***
	(0.007)	(0.007)	(0.012)	(0.012)
Log(unemployment rate)	-0.037***	-0.036***	0.002	0.002
	(0.007)	(0.007)	(0.008)	(0.008)
Log(labor productivity)	0.252***	0.252***	0.145***	0.145***
	(0.003)	(0.003)	(0.003)	(0.003)
Export ratio	0.034	0.028	0.023*	0.021*
	(0.021)	(0.021)	(0.012)	(0.012)
Consignment ratio	-0.0001	-0.0001	0.0000001**	0.00001**
	(0.0001)	(0.0001)	(0.0000005)	(0.000005)
Observations	2,234,485	2,234,485	998,556	998,556
R-squared	0.162	0.157	0.116	0.114
Plant FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes

Note: The table shows the estimates of the impact of labor market concentration on wages using IV regressions for small and medium-sized (SM) plants and large plants. The regressions are weighted by (1/N), where N is the number of plants in the relevant labor market. Small and medium-sized plants are plants belonging to single-plant firms with fewer than 300 employees. Large plants are plants belonging to multi-plant firms or plants belonging to single-plant firms with 300 or more employees.
The dependent variable is the natural logarithm of annual real wages. "HHI≥0.15" is an indicator variable that equals one if the HHI is equal to or greater than 0.15. The sample is restricted to plants for which multiple observations across years are available. White standard errors are reported in parentheses.
*** p<0.01, ** p<0.05 * p<0.1.

Table 4. Labor market concentration and wages: IV regressions (2001–2007 vs. 2008–2014)

	(1)	(2)	(3)	(4)
	2001–2007		2008–2014	
Dep. variable	Log(annual real wages)			
HHI	-0.129***		-0.165***	
	(0.013)		(0.018)	
HHI≥0.15		-0.086***		-0.113***
		(0.009)		(0.012)
Non-standard employee ratio	-0.272***	-0.272***	-0.257***	-0.257***
	(0.006)	(0.006)	(0.007)	(0.007)
Female employee ratio	-0.158***	-0.158***	-0.180***	-0.179***
	(0.009)	(0.009)	(0.011)	(0.011)
Log(unemployment rate)	0.005	0.006	-0.037***	-0.034***
	(0.007)	(0.007)	(0.009)	(0.009)
Log(labor productivity)	0.226***	0.226***	0.194***	0.194***
	(0.003)	(0.003)	(0.003)	(0.003)
Export ratio	-0.003	-0.005	0.015	0.010
	(0.016)	(0.016)	(0.018)	(0.018)
Consignment ratio	-0.00002	-0.00002	0.00001**	0.00001**
	(0.00002)	(0.00002)	(0.000004)	(0.000004)
Observations	1,899,917	1,899,917	1,310,817	1,310,817
R-squared	0.142	0.139	0.107	0.103
Plant FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes

Note: The table shows the estimates of the impact of labor market concentration on wages using IV regressions for 2001 to 2007 and 2008 to 2014. The regressions are weighted by (1/N), where N is the number of plants in the relevant labor market. The dependent variable is the natural logarithm of annual real wages. "HHI≥0.15" is an indicator variable that equals one if the HHI is equal to or greater than 0.15. The sample is restricted to plants for which multiple observations across years are available. White standard errors are reported in parentheses.
*** p<0.01, ** p<0.05 * p<0.1.

Table 5. Labor market concentration and wages: IV regressions (SM plants and large plants: 2001–2007 vs. 2008–2014)

	(1)	(2)	(3)	(4)
	SM plants		Large plants	
	2001–2007	2008–2014	2001–2007	2008–2014
Dep. variable	Log(annual real wages)			
HHI	-0.155***	-0.192***	-0.093***	-0.141***
	(0.017)	(0.020)	(0.021)	(0.035)
Non-standard employee ratio	-0.252***	-0.243***	-0.300***	-0.268***
	(0.006)	(0.009)	(0.011)	(0.011)
Female employee ratio	-0.114***	-0.139***	-0.234***	-0.247***
	(0.010)	(0.013)	(0.020)	(0.020)
Log(unemployment rate)	-0.009	-0.046***	0.031**	-0.024*
	(0.009)	(0.011)	(0.013)	(0.014)
Log(labor productivity)	0.273***	0.239***	0.176***	0.152***
	(0.005)	(0.004)	(0.004)	(0.005)
Export ratio	0.040	-0.069**	-0.019	0.042**
	(0.034)	(0.029)	(0.019)	(0.021)
Consignment ratio	-0.0001**	-0.00005	0.000002	0.00001**
	(0.00006)	(0.0002)	(0.000004)	(0.000004)
Observations	1,324,635	872,980	555,708	423,372
R-squared	0.155	0.122	0.131	0.096
Plant FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes

Note: This table shows the estimates of the impact of labor market concentration on wages using IV regressions for small and medium-sized plants and large plants. Regressions are weighted by (1/N) where N is the number of plants in the relevant labor market. Small and medium-sized plants are plants belonging to single-plant firms with fewer than 300 employees. Large plants are plants belonging to multi-plant firms or plants belonging to single-plant firms with 300 or more employees. Furthermore, the dataset is dived into two periods: 2001–2007 and 2008–2014. The dependent variable is the natural logarithm of annual real wages. "HHI≥0.15" is an indicator variable that equals one if the HHI is equal to or greater than 0.15. The sample is restricted to plants for which multiple observations across years are available. White standard errors are reported in parentheses.
*** p<0.01, ** p<0.05 * p<0.1.

Table 6: Labor market concentration and wages: IV regressions (exporting plants vs. non-exporting plants)

	(1)	(2)	(3)	(4)
	Less competitive downstream markets (non-exporting plants)		More competitive downstream markets (exporting plants)	
Dep. variable	Log(annual real wages)			
HHI	-0.168***		-0.124***	
	(0.009)		(0.044)	
HHI≥0.15		-0.113***		-0.109***
		(0.006)		(0.038)
Non-standard employee ratio	-0.286***	-0.287***	-0.379***	-0.384***
	(0.004)	(0.004)	(0.024)	(0.024)
Female employee ratio	-0.182***	-0.182***	-0.234***	-0.232***
	(0.006)	(0.006)	(0.045)	(0.045)
Log(unemployment rate)	-0.023***	-0.021***	0.001	0.000
	(0.005)	(0.005)	(0.022)	(0.022)
Log(labor productivity)	0.204***	0.204***	0.114***	0.115***
	(0.002)	(0.002)	(0.007)	(0.007)
Export ratio			0.011	0.008
			(0.017)	(0.017)
Consignment ratio	0.0003***	0.0003***	0.000005***	0.000005***
	(0.00005)	(0.00005)	(0.000001)	(0.000001)
Observations	3,154,747	3,154,747	93,919	93,919
R-squared	0.141	0.138	0.100	0.099
Plant FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes

Note: The table shows the estimates of the impact of labor market concentration on wages using IV regressions for non-exporting plants and exporting plants. Regressions are weighted by (1/N) where N is the number of plants in the relevant labor market. The dependent variable is the natural logarithm of annual real wages. "HHI≥0.15" is an indicator variable that equals one if the HHI is equal to or greater than 0.15. The sample is restricted to plants for which multiple observations across years are available. White standard errors are reported in parentheses.

Table 7: Labor market concentration and wage: IV regressions (manufacturing-intensive prefectures vs. less manufacturing-intensive prefectures)

	(1)	(2)	(3)	(4)
	More manufacturing-intensive prefectures		Less manufacturing-intensive prefectures	
Dep. variable	Log(annual real wages)			
HHI	-0.180***		-0.158***	
	(0.011)		(0.013)	
HHI≥0.15		-0.107***		-0.126***
		(0.006)		(0.011)
Non-standard employee ratio	-0.302***	-0.301***	-0.282***	-0.283***
	(0.005)	(0.005)	(0.006)	(0.006)
Female employee ratio	-0.165***	-0.163***	-0.204***	-0.204***
	(0.008)	(0.008)	(0.009)	(0.009)
Log(unemployment rate)	-0.025***	-0.025***	-0.023***	-0.020**
	(0.007)	(0.007)	(0.008)	(0.008)
Log(labor productivity)	0.193***	0.193***	0.203***	0.203***
	(0.002)	(0.002)	(0.003)	(0.003)
Export ratio	0.036**	0.032**	0.021	0.016
	(0.015)	(0.014)	(0.015)	(0.015)
Consignment ratio	-0.000001	-0.000004	0.00001**	0.00001**
	(0.00001)	(0.00001)	(0.00001)	(0.00001)
Observations	1,805,556	1,805,556	1,450,415	1,450,415
R-squared	0.135	0.132	0.142	0.137
Plant FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes

Note: The table shows the estimates of the impact of labor market concentration on wages using IV regressions for prefectures with a higher share of workers in the manufacturing sector and prefectures with a lower share of workers in the manufacturing sector. Regressions are weighted by (1/N) where N is the number of plants in the relevant labor market. The dependent variable is the natural logarithm of annual real wages. "HHI≥0.15" is an indicator variable that equals one if the HHI is equal to or greater than 0.15. The sample is restricted to plants for which multiple observations across years are available. White standard errors are reported in parentheses.
*** p<0.01, ** p<0.05 * p<0.1.

Table 8. Robustness check with labor markets defined by commuting zone

	(1)	(2)	(3)
	Fixed effects	IV 2nd stage	IV 1st stage
Dep. variable	Log(annual real wages)		HHI
HHI	-0.040	-0.036	
	(0.076)	(0.103)	
Non-standard employee ratio	-0.266***	-0.266***	-0.00003
	(0.002)	(0.002)	(0.00003)
Female employee ratio	-0.171***	-0.171***	-0.00002
	(0.004)	(0.004)	(0.00003)
Log(unemployment rate)	-0.036***	-0.036***	-0.001***
	(0.003)	(0.003)	(0.0001)
Log(labor productivity)	0.256***	0.256***	-0.00003***
	(0.001)	(0.001)	(0.00001)
Export ratio	-0.013*	-0.013*	0.0002*
	(0.007)	(0.007)	(0.0001)
Consignment ratio	0.000	0.000	0.00000005
	(0.000)	(0.000)	(0.0000001)
HHI in other regions			-164.671***
			(0.712)
Highways			-0.007***
			(0.001)
Ordinary roads			0.0002
			(0.0002)
Constant	15.202***		1.850***
	(0.006)		(0.008)
Observations	3,255,971	3,255,971	3,255,971
R-squared	0.876	0.169	0.970
F statistic			20030.2
Hansen J statistic			67.2
Plant FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes

Note: The table shows the estimates of the impact of labor market concentration on wages using plant fixed effects regressions and instrumental variable regressions. Column (1) presents the fixed effects estimation results. Column (2) presents the IV estimation results. Column (3) presents the first-stage results of the IV estimation in column (2). The regressions are weighted by (1/N), where N is the number of plants in the relevant labor market. Labor markets are defined by commuting zone. The dependent variable in columns (1) and (2) is the natural logarithm of annual real wages. In column (3), the dependent variable is the HHI. The sample is restricted to plants for which multiple observations across years are available. In the IV regression, the two-year [lagged leave-one-out HHI – *See Table 1. Suggest:* "…the two-year lage of the HHI in other regions"] is used as an instrument due to multicollinearity. White standard errors are reported in parentheses. The F statistic and Hansen J statistic are presented for the IV regressions.
*** p<0.01, ** p<0.05 * p<0.1.

Table 9. Robustness check with alternative concentration measure

	(1)	(2)	(3)
	Fixed effects	IV 2nd stage	IV 1st stage
Dep. variable	Log(annual real wages)		Log(no. of competitors)
Log(no. of competitors)	0.013***	0.032***	
	(0.001)	(0.002)	
Non-standard employee ratio	-0.292***	-0.292***	-0.005
	(0.004)	(0.004)	(0.004)
Female employee ratio	-0.184***	-0.184***	0.016**
	(0.006)	(0.006)	(0.007)
Log(unemployment rate)	-0.021***	-0.021***	-0.019***
	(0.005)	(0.005)	(0.007)
Log(labor productivity)	0.198***	0.198***	0.025***
	(0.002)	(0.002)	(0.002)
Export ratio	0.027**	0.027**	-0.005
	(0.011)	(0.011)	(0.015)
Consignment ratio	0.00001**	0.00001**	0.000002***
	(0.00001)	(0.000006)	(0.0000004)
HHI in other regions			-4.847***
			(0.021)
Highways			-0.831**
			(0.392)
Ordinary roads			-0.037
			(0.034)
Constant	15.196***		4.187***
	(0.009)		(0.100)
Observations	3,255,971	3,255,971	3,255,971
R-squared	0.877	0.142	0.970
F statistic			17921.7
Hansen J statistic			5.9
Plant FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes

Note: The table shows the estimates of the impact of labor market concentration on wages using plant fixed effects regressions and instrumental variable regressions. Labor market concentration is measured in terms of the logarithm of (N-1), where N is the number of plants in the relevant labor market. Column (1) presents the. fixed effects estimation results. Column (2) present the IV estimation results. Column (3) presents the first-stage results of the IV estimation in column (2). The regressions are weighted by (1/N). Labor markets are defined in terms of 54 industry groups and 203 commuting zones. The dependent variable in columns (1) and (2) is the natural logarithm of annual real wages. In column (3), the dependent variable is ln(N-1). The sample is restricted to plants for which multiple observations across years are available. White standard errors are reported in parentheses. The F statistic and Hansen J statistic are presented for the IV regressions.
*** $p<0.01$, ** $p<0.05$ * $p<0.1$.

Table 10. Robustness check with time trend

	(1)	(2)	(3)	(4)
	Fixed effects	IV 2nd stage	IV 1st stage	IV 1st stage
Dep. variable	Log(annual real wages)		HHI	HHI*year
HHI	-0.058***	-0.124***		
	(0.005)	(0.044)		
HHI*year	0.005***	-0.006		
	(0.000)	(0.006)		
Non-standard employee ratio	-0.292***	-0.292***	0.003	-0.025
	(0.004)	(0.004)	(0.002)	(0.026)
Female employee ratio	-0.184***	-0.184***	-0.002	-0.037
	(0.006)	(0.006)	(0.003)	(0.043)
Log(unemployment rate)	-0.021***	-0.022***	-0.0004	-0.139***
	(0.005)	(0.005)	(0.003)	(0.049)
Log(labor productivity)	0.197***	0.199***	-0.004***	0.093***
	(0.002)	(0.002)	(0.001)	(0.010)
Export ratio	0.025**	0.032***	0.013**	0.627***
	(0.010)	(0.011)	(0.006)	(0.117)
Consignment ratio	0.00001**	0.000**	0.0000002	-0.000003
	(0.00001)	(0.000)	(0.000001)	(0.00001)
HHI in other regions			0.911***	6.384***
			(0.006)	(0.075)
Highways			-0.114	-7.683***
			(0.157)	(2.786)
Ordinary roads			-0.037***	-3.888***
			(0.014)	(0.248)
Constant	15.245***		0.139***	10.000***
	(0.008)		(0.043)	(0.729)
Observations	3,255,971	3,255,971	3,255,971	3,255,971
R-squared	0.878	0.136	0.916	0.824
F statistic			7188.0	2530.8
Hansen J statistic			4.4	4.4
Plant FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes

Note: The table shows the estimates of the impact of labor market concentration on wages using plant fixed effects regressions and instrumental variable regressions. Column (1) presents fixed effects estimation results. Column (2) present IV estimation results. Column (3) presents the first-stage results of the IV estimation in column (2). The regressions are weighted by (1/N). Labor markets are defined in terms of 54 industry groups and 203 commuting zones. The dependent variable in columns (1) and (2) is the natural logarithm of annual real wages. The dependent variables in columns (3) and (4) are the HHI and the cross-term of the HHI and the linear trend, respectively. The sample is restricted to plants for which multiple observations across years are available. White standard errors are reported in parentheses. The F statistics and Hansen J statistic are presented for the IV regressions.
*** $p<0.01$, ** $p<0.05$ * $p<0.1$.