RIETI Discussion Paper Series 21-E-022

Establishment Size, Workforce Composition and the College Wage Gap in Japan

IKEUCHI, Kenta
RIETI

FUKAO, Kyoji
RIETI

PERUGINI, Cristiano
University of Perugia / IZA

The Research Institute of Economy, Trade and Industry
https://www.rieti.go.jp/en/

RIETI Discussion Paper Series 21-E-022

March 2021

Establishment size, workforce composition and the college wage gap in Japan*

Kenta Ikeuchi
Research Institute of Economy, Trade and Industry

Kyoji Fukao
Institute of Economic Research, Hitotsubashi University
Research Institute of Economy, Trade and Industry

Cristiano Perugini
Department of Economics, University of Perugia
IZA - Institute of Labour Economics

Abstract

In this paper we investigate whether and to what extent the evolution and variability of the college wage gap in Japan can be tracked down to the firm level. To this aim, we use the microdata on workers from the Basic Survey on Wage Structure (BSWS) over the period 2005 to 2018 and link information on individuals, job characteristics and wages to the characteristics of the employer. We focus in particular on establishment size and workforce composition in terms of regular and non-regular employees. We find that increasing establishment size and share of regular workers tend to increase the within-firm wage gap between high- and medium-educated workers, once all observable individual, job and establishment characteristics are controlled for. Our findings corroborate the idea that firm heterogeneity plays a relevant role in shaping wage inequality between education groups and that employer size and share of regular workers are associated with the capacity to attract and keep high-educated employees with unobservable characteristics that justify a wage premium above average market levels.

Keywords: within-firm college wage gap, firm size, regular employment, Japan
JEL classification: J31; I24; D22; J41

*This study is conducted as a part of the Project "East Asian Industrial Productivity" undertaken at the Research Institute of Economy, Trade and Industry (RIETI). The research is also part of the project "Firms' heterogeneity and education wage premia," supported by the Joint Usage and Research Center Programs at the Institute of Economic Research, Hitotsubashi University. This study utilizes the micro data of the questionnaire information based on "the Basic Survey on Wage Structure" which is conducted by the Ministry of Health, Labour and Welfare (MHLW). The authors are grateful for helpful comments and suggestions by Discussion Paper seminar participants at RIETI.

1. Introduction

Recent research has shown that a remarkable share of observed wage inequality can be explained by factors specific to the employer. The existence of labour market imperfections of different types has provided the conceptual environment for various explanations of the reasons why some firms are willing to pay higher than 'market' wages to their employees, resulting in an already rich set of empirical approaches and evidence. The majority of these contributions link firms' characteristics to their propensity to pay higher remunerations in general; however, an interesting minority of them investigates how the heterogeneity of firms explains gaps in the remuneration of different groups of workers within the firm, classified by skills (Aghion et al., 2019), high/low paid jobs and occupations (Cirillo et al., 2017; Card et al., 2013). Card et al. (2013) also shed light on wage differences by levels of education within firms and provide evidence that the most part of the observed pay gap between high- and low-educated workers is attributable to a widening in the average workplace pay premium received by the education groups. In this paper we contribute to this strand of the empirical literature focusing on employer-specific drivers of the so-called *college (or university) wage gap*, which has been identified as one of the determinates of the remarkable changes in wage inequality observed in most of the world economies in the past decades.

Interestingly, within a generalized picture of growing wage dispersion in similar countries (like the US), a substantial body of research has underlined how wage inequality in Japan has remained relatively stable in the past decades (e.g., Katz and Revenga, 1989; Kambayashi et al., 2008; Lise et al., 2014), one of its main drivers being a substantially flat college education wage premium (Kawaguchi and Mori, 2016). This paper is an attempt to understand whether and to what extent the evolution and variability of the college wage gap in Japan can be tracked down to the firm level and which employer-specific characteristics drive this heterogeneity. To this aim we make use of the rich data from the Basic Survey on Wage Structure (BSWS) over a relative long-time interval, spanning from 2005 to 2018. We focus in particular on two employer characteristics that, as explained in the following section, seem particularly relevant in the case of Japan: size and workforce composition in terms of regular/non-regular employees. The first one can be associated to many factors able to shape within-firm wage dispersion, such has the stringency of labour market institutional settings, the complexity of hiring and compensation policies, the strategic and organisational structure which drives demand of different types of workers. The second dimension (share of regular workers) is instead directly related to technological factors, to the importance of human capital and of knowledge accumulation, which define the competitive environment in which the firms operate and, consequently, its human resources management approach. Our main findings are that increasing size and share of regular workers tend to increase the wage gap between high- and medium-educated workers, once all observable individual and job characteristics are controlled for. This evidence corroborates our hypotheses that larger size and share of regular workers are associated to better capacity of firms to attract and keep high-educated employees with unobservable characteristics that justify a wage premium above average market levels.

The paper is structured as follows. In the next section (2) we provide the conceptual framework for our research, from which we sketch out our research hypotheses (section 3). We then present the dataset and some descriptive evidence (section 4) and describe the empirical model and the econometric methods (5). Section 6 presents our results and some complementary analysis on their robustness. Section 7 summarizes and concludes.

2. Literature Based Conceptual Framework

The core question we pose in this paper is whether heterogeneity exists in the level of wage inequality by education levels within firms and to what extent this variability is related to firm-level observable attributes. The explanation of the level and evolution of the education wage gap over time and across sectors has been based on two main perspectives. The first one is based on assumptions of market equilibrium and explains wage disparities based on the different nature and contents of jobs and on the corresponding marginal productivity of workers. It relies on labour (relative) demand and supply interactions and emphasises mainly demographic changes and shifts in demand and supply of products, globalisation trends and skill-biased/routine-biased technological change (e.g., OECD, 1996; Acemoglu, 2000; Acemoglu and Autor, 2011). The second perspective focuses on market imperfections related to the role of institutional arrangements, such as the strength of unions, bargaining models and labour and product market regulations (e.g., Blau and Kahn, 1996; Fortin and Lemieux, 1997). There is, however, a significant share of wage inequality left unexplained by such aggregated factors and an important strand of the literature has directed its attention to the potential microeconomic drivers of wage dispersion emphasising, within imperfect labour market settings, the role of firms' heterogeneity. In this class of models, firms, no longer price-takers, can adopt a variety of wage-setting practices shaping a firm-level wage premium that could represent rent-sharing, an efficiency wage premium, or strategic wage posting behavior (e.g., Burdett and Mortensen, 1998; Moscarini and Postel- Vinay, 2013). Cirillo et al. (2017) provide a classification of these models based on the need of firms to deal with: (i) the consequences of asymmetric information, particularly moral hazard issues (Murphy, 1999; Lazear, 1986); (ii) "fair wage" motivations (Arkerlorf and Yellen, 1990); or (iii) rent-sharing mechanisms (Van Reenen, 1996; Song et al., 2019). When such firm-level (specific) responses are generalised across all employees, we can expect to observe a *high(low)-wage firm* (Abowd et al., 1999), i.e., an employer paying compensation higher(lower) than expected given these same observable characteristics of workers. However, such firm-specific responses might also be asymmetric across workers (or groups of them) i.e., only certain types of employees are paid a premium. Should this be the case, firms would exhibit not only heterogeneity in average wages paid, but also in their dispersion.

Various reasons can explain why such asymmetries might take place across groups of workers with different levels of education, in particular college and non-college educated workers. In the first place, some firms could implement human resources management practices aimed at attracting the best worker types belonging to a particular education group, as they are crucial to gain or keep their market power or competitive position. Within the same level of formal observable education, workers can indeed differ significantly in terms of cognitive skills (Becker, 1964), due for example to different quality of education received; or in terms of non-cognitive skills, like the ability to communicate, to work in teams, motivation, tenacity, and trustworthiness (e.g., Heckman and Rubinstein, 2001). As working in the best-performing companies is in the interest of the most productive workers too, this might materialize into a (positive) assortative matching, identified as one of the forces contributing to heterogeneity in firm-specific wage premia (see Bartolucci and Devicienti, 2013; Card et al., 2013; Song et al., 2019). However, if such mechanisms take place for some types of workers only (that firms regard as crucial for their success) and not for others, they could materialize into an increase of within-firm wage inequality too.

High-innovation/productivity firms or those active on international markets, for example, might have interest in attracting high performance R&D staff or exceptional managerial skills, thus being willing to pay

remunerations above market levels to specific types of highly-educated workers. Not unlikely, such firms are also better able to spot unobserved characteristic of the target workers, due to more efficient and organised hiring practices. The same pattern could not necessarily be in place for lower-layer workers, less crucial for the firms' success, provided that the performances of two groups are not strictly interdependent[1]. Such behaviours could materialize into heterogeneous human resources (HR) management practices across workers segments, by offering above market compensations, different compensation schemes (bonuses, benefits, incentives) and career prospects to certain groups only. Asymmetric HR management practices can also materialize in the design of different employees training and development schemes for the different groups, which impact on their relative productivity and remunerations. Similarly, moral hazard issues could be more serious and monitoring costs higher for certain tasks and occupation than others (see Allgulin and Ellingsen, 2002), in which education levels are not randomly allocated. Asymmetric recourse to efficiency wage schemes might therefore also contribute shaping wage gaps within the firm.

Heterogeneity in the college wage gap between firms might also be related to the fact that, in some types of firms, workers of the two groups have different bargaining power. In certain types of firms, for the reasons discussed above, high-skilled/educated workers might have gained specific knowledge or strategic information that, in case of resignation, would be costly for the firm to reconstruct and leak out to competitors. At the same time, highly educated workers might be disproportionally distributed in labour positions more protected and regulated institutionally, while a higher share of lower educated workers tend to be more concentrated in non-standard employment options. The case of the Japanese labour market is especially interesting in these regards. The dichotomy between regular (full-time, permanent) and non-regular (hired on all remaining contractual options) workers is indeed mirrored by significantly higher levels of employment protection and union coverage for the first, compared to the second (see Kalantzis et al., 2012; Miyamoto, 2016). The share of the secondary segment is also not symmetric across industries and occupations and significantly more important for female, young (under 29-years old) and old-age (over 65) workers (see Asao, 2011). As far as education levels are concerned, a clear gender divide seems to exist between highly educated men, almost completely regularly employed, and highly educated women who are often on part-time contracts (Gordon, 2017; Inoue et al., 2016). Lastly, an asymmetry in bargaining power and rent sharing might simply be connected to the degree of substitutability between the two types of workers (Ciccone and Perri, 2004; Mollik, 2011) and between each of them and various forms of capital (IT, non-IT; tangible non-tangible) (see Karabarbounis and Neiman, 2014; Fukao and Perugini, 2020; O'Mahony et al., 2020).

[1] Aghion et al. (2019) show, on the contrary, that the premium to working in more R&D intensity firms is higher for workers in low-skilled occupations than for workers in high-skilled occupations, due to the strong complementarity of the two groups in highly innovative environments.

3. Research Hypotheses

Which observable characteristics of firms are good candidates to explain the variability of within firm college wage gap? Innovation and R&D intensity have been already explored as drivers of within-firm overall wage dispersion (Cirillo et al., 2017) and of wage disparities between workers with different skills (Aghion et al., 2019) and in high/low occupations (Cirillo et al., 2017). We focus our attentions here on two additional main domains: firm size and the workforce composition in terms of regular/non-regular employees.

The size of the employer has been associated to many of the factors that could shape overall within-firm wage dispersion (see Cirillo et a., 2017; Abowd et al, 2019; Song et al., 2019). A first relevant dimension is related to labour market institutional settings. In the first place, and generally speaking, unions tend to be more active and powerful in large firms and Japan is not an exception (Morikawa, 2010; Benson, 2008). We would therefore expect, generally speaking, asymmetries in the stringency of mechanisms that tend to compress wages (collective bargaining, unionisation) in favour of larger firms. In the case of Japan, however, not only this inequality-reducing force has been declining over time (as in almost all economies) but has been always relatively weak due to the its highly decentralised labour relations model (Fujimura, 2012). At the same time, starting already from the 1970s, Japanese unions of large firms have become increasingly concentrated on the objectives of job security and more flexible on wages. In particular, the potential of the *Shunto* systems (spring negotiations) to revise base wages upwards has declined remarkably (see OECD, 2017a) and the small room left for wage level negotiations has increasingly taken the form of bonus bargaining. This last component is almost exclusively used to remunerate regular workers (see Kato, 2016) and as a major incentive to attracting high quality workers. As a consequence, this mechanism, mainly in place in larger firms, might be one of the sources of employer-specific wage premia associated to larger firms. If the mechanism does not apply symmetrically to workers of all levels of education, as their relative importance to firm's performance differs, this might materialize into increasing education wage gaps too.

Larger firms also tend to implement more complex and diversified compensation policies, as well as hiring practices better able to spot unobserved desirable workers' characteristics. One reason might be again related to asymmetries, across firm size, in labour market institutional dimensions, namely in employment protection and firing regulations. Firing of regular workers employed in small and medium enterprises (SMEs) is relatively easy in Japan in case of adverse economic circumstances; however, this is not the case in large firms that, due to their size and diversification, are less likely to be at risk of bankruptcy (see Kambayashi and Kato, 2016). As a consequence, for large firms, the recruitment of fulltime workers is a long-term investment, which entails a stronger incentive to select high quality full-time workers and design consistent training and pay schemes. Agency issues and monitoring also tend to be more difficult in larger firms, with a consequent more intensive resort to efficiency wage schemes. Larger firms also tend to be more internationalised, operate in more competitive market environment and have complex and formalised organisational and governance structures; such features all demand high-capacity human resources in job positions and occupations requiring high levels of education. *Our first research hypothesis is therefore that larger firms exhibit a wider college education wage gap (H1)*, as their success significantly depends on their ability to attract and keep high-productivity college workers in key strategic positions. Such workers consequently gain a strong bargaining power they can use to appropriate a larger share

of rents. A similar pattern does not necessarily apply to workers with lower levels of education, less crucial for the firm performance and more easily replaced by outside candidates, capital or intermediate input purchase.

The second firm-level dimension we focus on is related to the workforce composition in terms of employment contracts. The increase in non-standard employment has been one of the most pervasive and inequality-enhancing labour market developments of the last decades in all developed economies (see, for example, Boeri and Garibaldi, 2007; Blanchard and Landier, 2002; Perugini and Pompei, 2017). Japan represents a particularly interesting case, as the increase of the so-called non-regular workers (Asano et al., 2013; OECD, 2017b) was part of a more general labour market evolution leading to the decline of its main peculiar feature, lifetime employment (Ono 2010; Kawaguchi and Ueno, 2013). Initially regarded as an 'employment buffer' which protects the long-term employment of regular employees in the internal labour market (e.g., Odagiri, 1994; Usui and Colignon, 1996), the rising role of non-regular employment has shaped an important dimension of duality on the Japanese labour market (Keizer, 2008; Gordon, 2017). Non-standard employment is largely used in Japan for tasks requiring limited skills and is associated to low productivity/wage positions, poor unionisation, short contract duration and low mutual commitment between worker and employer (Asao, 2011).

An extensive literature exists on the association between the importance of non-regular work and firms' behaviours, strategies and performances (see Cirillo and Ricci, 2020). On the one hand, non-regular contracts may favour the matching between supply of and demand for labour, especially in turbulent economic periods (Houseman, 2001); at the same time, they may enable more efficient screening and selection of productive workers, which would improve productivity and wages (Wang and Weiss, 1998; Autor, 2001). On the other hand, hirings on a non-regular basis can negatively affect firm performance by decreasing incentives to invest in specific inputs, including human capital (Arulampalam et al., 2004; Booth et al. 2002; Acemoglu and Pischke, 1999) and weakening the firm's organizational capabilities, which are embedded in the firm's procedural knowledge (Dosi et al., 2019). Knowledge accumulation relies indeed on long-lasting employment relationships, allowing the development of training opportunities and increased job specific experience.

A low share of non-regular workers can therefore identify firm contexts in which the substitutability of full-time workers with non-regular ones is low, due to technological, strategic or organisational reasons. In such environments, on the contrary, the accumulation of sector- and/or firm-specific knowledge is probably crucial to ensure cost and organisation efficiency and the competitive position on the market. The presence of high-quality educated employees for the top occupations (supervisory or management tasks) is therefore likely to be key to firms' success and paying them a wage premium might be a rational choice to attract and keep workers with the desired characteristics. On the contrary, a high share of non-standard employment is associated to firms that mainly compete on the side of costs and to low knowledge-intensity production processes, such as low value-added intermediate input suppliers or certain low knowledge-intensive services (see Houseman and Osawa, 2003; Rebick, 2005; Fukao and Perugini, 2020). Being these employers less attractive for high quality educated workers, and being the latter less crucial for firms' success, it is likely that their remuneration is aligned to average market levels. Such allocation of the heterogeneous high-educated workers suggests that *the college wage gap might be larger for firms with a high share of regular workers and smaller for those more intensively recurring to non-standard employment (H2)*.

In sketching out our research hypotheses we have focused our attention on the allocation of heterogeneous high-educated workers into firms of different types. However, as already mentioned, Aghion et al. (2019) suggest that a similar pattern might be in place for the low-educated workers too, when they are strongly complementary to high-layer workers. In such contexts, firms might be interested in paying higher than market average wages to attract low educated/skilled employees, because their efficiency enables the performance and the efficiency of the highly skilled and, ultimately, the success of the firm. Should this be the case, the heterogeneity in education wage inequality would not be (only) due to differences across firms in average remunerations of the highly educated, but also to differences in employer-specific premiums paid to low-educated employees. Such mechanism might decisively affect the pro-inequality effect of larger firm size and regular employment (H1 and H2), as the wage premium for the highly educated hypothesised as the main driver of the education gap might be accompanied (and even compensated) by higher wage premia for the low educated. In our empirical analysis we attempt shedding light on these aspects too.

4. Data and Descriptive Evidence

Our data is extracted from the Basic Survey on Wage Structure (BSWS), conducted by the Ministry of Health, Labour and Welfare. The survey supplies information, on an annual basis, on the wage structure of Japanese employees in major industries by a number of relevant features that include the type of employment, type of work, occupation, sex, age, school career, length of service and occupational career. Employees are selected by a uniform sampling method from among the establishments selected for the survey (establishments with 10 regular employees or more – private establishments and specific establishments of public corporations; private establishments with 5-9 regular employees). It is therefore possible to connect workers' characteristics and wages to establishment attributes such as industry, prefecture of location, size (number of regular employees) and a number of indicators based on the establishment workforce characteristics (such as average wages, relative importance of job positions, shares of employees by education, age, occupation, gender, etc.). The Survey is implemented since 1948 but, since 1982, it has been carried out on the same scale and on an annual basis. We limit our analysis to the period 2005-2018, when detailed information on the type of employment (regular / non-regular work) is available. Part-time workers and temporary employees are not included in the analysis as they miss crucial information on education and some job characteristics[2].

[2] Part-time workers are those whose scheduled working hours a day or a week are less than those of general workers in establishments and account for about 17% of total employees. Temporary workers are those employed on very short-term contracts (less than one month) and represent about 2.5% of the total. The exclusion of these employment types from our analysis raises some concerns on possible biases to the measures of college wage gap. According the information provided by the Japanese Employment Status Survey (see: https://www.stat.go.jp/english/data/shugyou/index.html), the segment of part-time work can be described as follows (figures referred to 2017): (i) the majority of part-timers are low educated (the part-time rate is 22% for the junior/senior high school employees and only 7% and 2% for university and graduate school graduates, respectively); (ii) the majority of low-income employees (defined as those earning less than 1/3 of the average annual salary) are part-timers (60% of low-income employees with high-school education; 45% with university and 26% with graduate schools); (3) the majority of part-timers are low-income (80% of part-timers with high-school; 73% and 64% with university and graduate school education, respectively). The picture for temporary workers is largely overlapping. The fact that we do not observe part-time (and temporary) workers in our sample is therefore likely to generate an underestimation of the wage gap between high and medium educated, because low-wage employees missing in the sample (part-timers and temporary workers) are disproportionally more in the lower levels of education.

Our wage variable is overall hourly cash earnings (*hwage*). This wage rate is obtained by dividing the monthly cash earnings by the actual number of scheduled and overtime hours worked. The monthly cash wage is obtained by adding two components: (i) contractual cash earnings, defined as before-tax amount of cash wages paid to employees including overtime allowances, based on paying conditions specified in advance in the labour contract or agreement and in the working rules of the establishments; and (ii) special cash earnings that include bonuses and term-end allowances. The second component is available on a yearly basis and linearly allocated to the monthly salary. The set of drivers of the wage rate includes the usual variables such as gender, age, highest level of education achieved, tenure (length of service in the establishment), experience in the present occupation[3], type of employment (regular staff for an indefinite period, regular staff for a definite period, non-regular staff for an indefinite period, non-regular staff for a definite period)[4], number of days and hours worked, occupation and industry of the establishment. Education levels, the focus of our analysis, are classified into four groups: (i) graduates of junior high schools; (ii) graduates of senior high schools; (iii) graduates of higher professional schools and junior colleges; (iv) graduates of universities or graduate schools. To the aims of our paper, we define the college wage gap as the distance of remuneration between (iv) - university/graduate schools graduates - and (ii) - senior high-school graduates. We also run robustness checks including among the highly educated all employees with post-secondary education, i.e. (iv) plus (iii) - graduates of higher professional school and junior colleges. As regards establishment level variables to be used as drivers of heterogeneous wage gaps in accordance with our working hypotheses, we consider firm size (number of regular employees) and the share of regular workers on the total establishment workforce. We identify regular workers as those holding a full time, permanent job position (classified as 'regular staff for an indefinite period' in the BSWS).

Table 1 presents some descriptive statistics on the sample used for our empirical analysis. The total sample (polling all years) is composed of 13,142,691 dependent workers, of which about 32% are women and university graduates; over 80% of them are employed on a full-time, permanent contract, are on average 41.5 years old and have an average length of service of about 12 years. The number of establishments for which we are able to construct the variables of interest is 609,330; their average size is 108 regular employees and the average share of regular employment is around 70%.

In order to provide a first snapshot on the evolution of wage inequality across education levels in Japan and on the relative importance of its drivers, we follow Card et al. (2013) and compare a measure of dispersion in actual (raw data) wages to the dispersion of various residual hourly wages in our sample. Residual wages are extracted from (log) wage regression models, fit separately in each year, in which we include step-by-step additional sets of explanatory variables. The change in the level of dispersion of wages due to the inclusion of each set of right-hand variables indicates its relative importance in explaining overall wage variability.

[3] The variable is defined as *Occupational career* (number of years during which the a worker has engaged in the present occupation) and coded into 5 categories (see Table 1). The variable has many missing values, but its inclusion in the wage equations tends to increase the explanatory power of the model to a not negligible extent. Therefore, we decided to keep the variable as a control and the many missing values have been recoded into a separate, residual group.

[4] The first category identifies permanent employees on a regular (standard) contract and can be identified as belonging to the primary segment of the Japanese labour market; the remaining three groups of workers (on fixed-term and/or non standard contracts) belong to the secondary segment.

Table 1. Variables definition and descriptive statistics, BSWS data (2005-2018)

Variable	Definition	N	Mean	S.D.
Individual level variables				
wr	Hourly Contractual & Special Cash Earnings (1000 JPY)	13,142,691	2.272	1.560
lnwr	Ln. Hourly Contractual & Special Cash Earnings (1000 JPY)	13,142,691	0.670	0.532
female	Female (dummy)	13,142,691	0.318	0.466
age	Age (number of years)	13,142,691	41.506	12.372
edu_junihigh	Dummy for graduates in junior high school (e=1)	13,142,691	0.043	0.204
edu_senihigh	Dummy for graduates in senior high school (e=2)	13,142,691	0.488	0.500
edu_junicoll	Dummy for graduates in higher professional schools and junior colleges (e=3)	13,142,691	0.152	0.359
edu_univ	Dummy for graduates of universities or graduate schools (e=4)	13,142,691	0.317	0.465
reg_indefper	Regular staff for an indefinite period (dummy)	13,142,691	0.829	0.376
reg_defper	Regular staff for a definite period (dummy)	13,142,691	0.026	0.159
noreg_indefper	Non-Regular staff for an indefinite period (dummy)	13,142,691	0.038	0.192
noreg_defper	Non-Regular staff for a definite period (dummy)	13,142,691	0.106	0.308
tenure	Length of service (years)	13,142,691	12.088	10.873
wd	Actual number of Days worked	13,142,691	21.561	2.385
wh_sch	Actual number of Scheduled Hours Worked	13,142,691	163.669	19.972
wh_ex	Actual number of Overtime Hours Worked	13,142,691	12.264	18.418
Occupational career (expr)				
expr_0to1y	(1) Less than 1 year (dummy)	13,142,691	0.023	0.151
expr_1to5y	(2) 1 year and more and less than 5 years (dummy)	13,142,691	0.074	0.262
expr_5to10y	(3) 5 years and more and less than 10 years (dummy)	13,142,691	0.063	0.242
expr_10to15y	(4) 10 years and more and less than 15 years (dummy)	13,142,691	0.043	0.203
expr_15ymore	(5) 10 years and more (dummy)	13,142,691	0.094	0.291
expr_missing	Missing occupational career (dummy)	13,142,691	0.703	0.457
Establishment level variables				
estsize	Number of regular workers in the establishment	609,330	107.678	340.802
shrregemp	Share of regular workers (full-time, permanent)	609,330	69.461	29.974

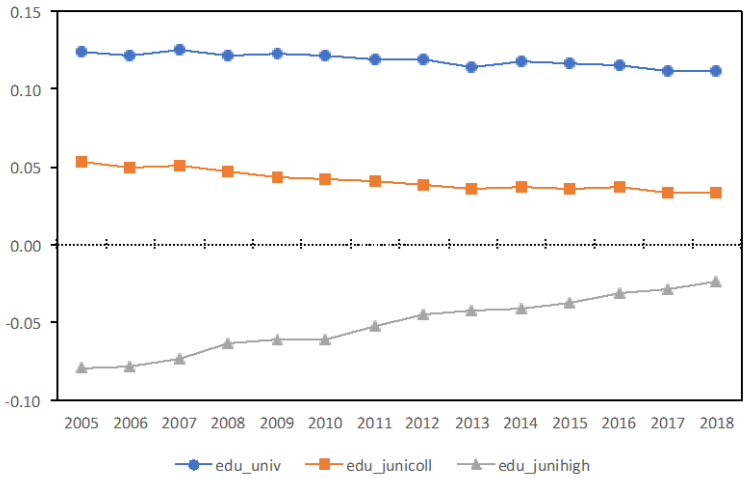
Source: own elaborations from BSWS data

As a preliminary step, in Figure 1 we report the evolution of the adjusted education wage gap. They are obtained by plotting the regression coefficients of education dummies from year-by-year wage equation models that include the whole set of drivers described in Table 1, plus occupation dummies and establishment fixed effects (complete results available upon request). Compared to the benchmark group (the senior high school education), average wages of primary educated workers have been increasing significantly. However, the distance between wages of university graduates and senior high school graduates has remained virtually unchanged, amounting to approximately 12% over the whole period. The same holds for the wage gap between senior high school and junior college graduates (around 4%). This evidence is consistent with the results provided by previous studies (see Kawaguchi and Mori, 2016).

Figure 2 compares the evolution of the variability of hourly wages (standard deviation of log wages) for raw data and residual wages obtained by estimating wage equations and adding controls as indicated in the figure. As obvious, the most important role in explaining wage variability is played by the explanatory variables normally appearing in Mincer-type equations (gender, age, age squared, experience, tenure and education); this is described by the jump from the top line in Figure 2 to the second line. However, once these factors are controlled for, the other drivers play, cumulatively, a similarly important role. Among them, the inclusion of establishment effects

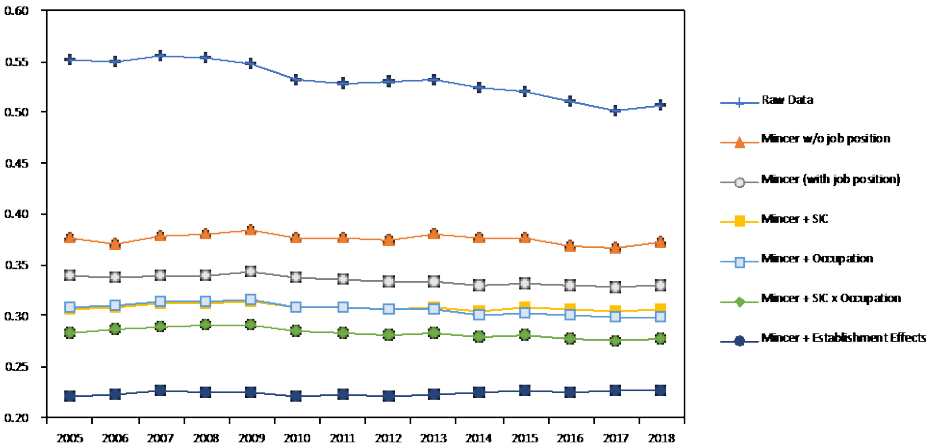
(the jump to the last line) plays a particularly relevant role, confirming that the firm-level dimension of wage inequality in Japan is important and deserves attention.

Figure 1. Adjusted education wage gap in Japan, 2005-2018



Source: own elaborations from BSWS data

Figure 2. The components of wage dispersion in Japan, 2005-2018

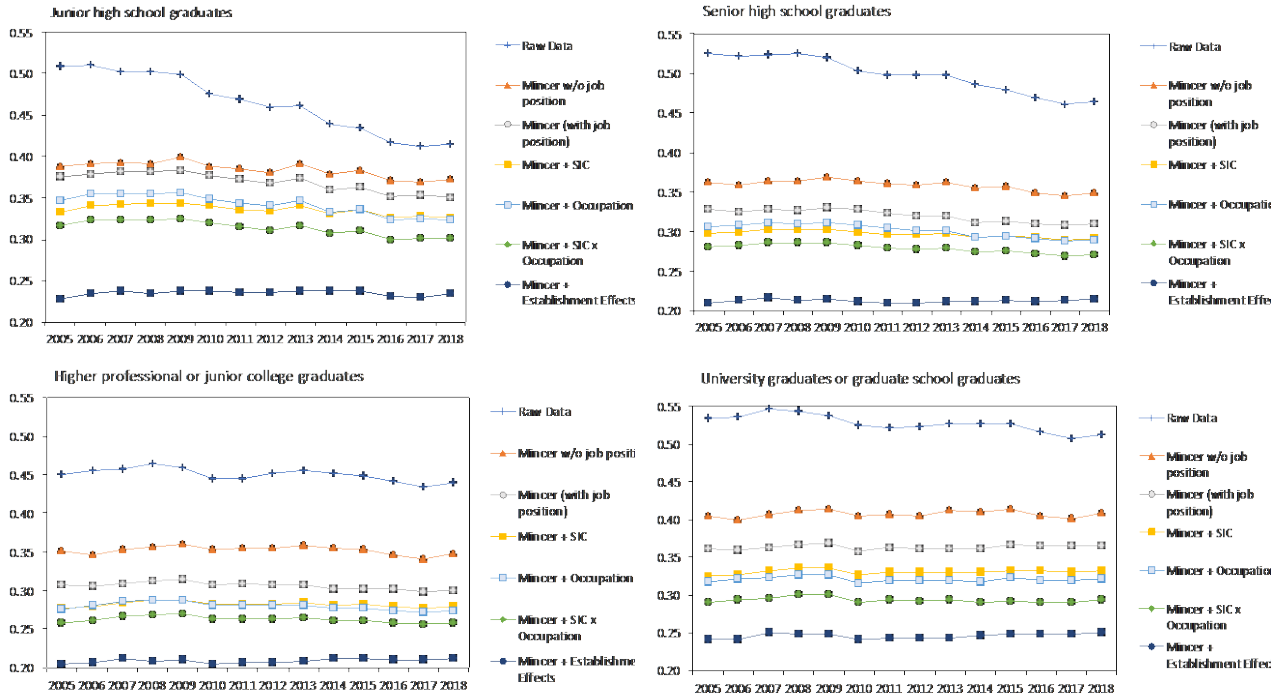


Source: own elaborations from BSWS data

In order to understand whether the importance of establishment-level fixed effects is symmetric or not in explaining the variability of wages for workers within different education groups, we have replicated the same kind of analysis of Figure 2 for each education level (Figure 3). Wage inequalities within education levels tend to be very different and significantly higher for the university graduates. Interestingly, for this group as well as for the junior college graduates, the level of wage dispersion has remained stable over the period considered, whereas it has declined remarkably for lower levels if education (junior and senior high school graduates). Within all education groups, establishment level effects play a significant role in explaining residual wage inequality. However, the relative size if this effect is asymmetric across groups and a clear dichotomy emerges between higher and lower education levels. Establishment-level heterogeneity in paying wages seems to play a relatively more important role for junior and senior high school graduates. This indicates that not only firm-specific factors shape

the tendency of different firms to pay different wages; but also, that they tend to shape a variability of wage education gaps, which is the focus of our research.

Figure 3. The components of wage dispersion in Japan, by levels of education



Source: own elaborations from BSWS data

5. Empirical models and methods

The aim of our research is to investigate the effects of establishment-level characteristics on the college wage gap. As a first step, we follow Aghion et al. (2019) and estimate an individual wage equation that includes in the set of regressors workers and job characteristics and is augmented by establishment-specific effects. This baseline model reads:

$$ln(w)_{ij} = \alpha + \beta Z_{ij} + \sum_{e=2}^{4} \boldsymbol{\delta_e ED(e)_{ij}} + \theta X_{ij} + \gamma_j + \widehat{w}_{ij} \qquad (1)$$

where $(w)_{ij}$ is hourly wage of individual *i* employed in establishment *j.* In the data a longitudinal dimension is not available neither for individuals nor establishments. The model can therefore be estimated either separately for each year t (obtaining t specific coefficients for each explanatory variable) or pooling all years together and obtaining a coefficient averaged over t. Z_{ij} is a set of worker's personal characteristics (gender, age and age squared); $ED(e)_{ij}$is the set of dummy variables for the highest level (e) of education attained, where the omitted dummy variable is e=1 (graduates in junior high school); and X_{ij} is a set of variables describing the worker's job position in establishment j (tenure, occupational career, occupation, type of contract, number of working hours and days). The equation includes establishment dummies γ_j that obviously incorporate other information associated to the establishment and common to all its employees (prefecture of location and industry). The size of the establishment-specific effects, in this specification, is a measure of the tendency of each establishment to pay

high/low wages to its employees. The inclusion of γ_j in equation 1 obviously prevents other establishment level variables of interest (size and share of non-standard employment) to be added as main effects, as γ_j fully encapsulate all cross-establishment differences (Snijders and Bosker, 1999). However, establishment-level variables (EST_j) can replace establishment fixed effects and be interacted with individual level variables (equation 2). This allows identifying the additional impact that an establishment-level characteristic produces on the main effects of interest (in our case the impact of education levels on wages):

$$ln(w)_{ij} = \alpha + \beta Z_{ij} + \sum_{e=2}^{4} \boldsymbol{\delta_e ED(e)_{ij}} + \sum_{e=2}^{4} \boldsymbol{\delta'_e EST_j \cdot ED(e)_{ij}} + \theta X_{ij} + \boldsymbol{EST_j} + \widehat{w}_{ij} \quad (2)$$

The size of the coefficients of the interaction terms (δ'_e) illustrates the impact of the establishment level variables of interest – size and share of regular employment in our case - on the remunerations of each education group and, indirectly, on its impact on the wage education gap. The estimation of the impact of firm-level attributes on the education wage gap in equation 2 is therefore indirect (through interaction terms); at the same time, the impossibility to include individual workers' effects might introduce a bias in the estimated effects of establishment characteristics, as higher quality workers of the various levels of education might select non randomly into firms of different size or non-standard employment share.

A second approach, organized into two steps, allows addressing this kind of issues and highlighting a more direct link between employer's characteristics and the education wage gap. Based on the seminal work of Winter-Ebmer and Zweimuller (1999) and following Cirillo et al. (2017), the approach relies on the use of *adjusted* individual wages to construct an establishment-level wage inequality variable. *Adjusted* individual wages are obtained as the residuals from a Mincer-type wage regression,of the type of our equation 1, estimated year-by-year. This worker-specific residual $\widehat{w}_{ij}$ is the part of the individual wage that is not explained by personal characteristics of the workers (age, education, etc.) or by the general tendency of firms to pay high/low wages to their employees. In other words, this is the component of individual wages that differs between observationally identical individuals who work in the same establishment. This residual includes the effects of unobservable workers' characteristics that generate a wage premium/penalty (such as innate abilities/disabilities or the quality of education received, which shape higher productivity and/or bargaining power). $\widehat{w}_{ij}$ can then be used to compute and compare, within each firm and for each year (t), the average adjusted wage for different types of workers. As we are interested in wage inequality between levels of education:

$$\Delta w_{jt}^{ED} = E_{jt}\left(\widehat{w}_{ijt}^{HIGH}\right) - E_{jt}\left(\widehat{w}_{ijt}^{MEDIUM}\right) \quad (3)$$

where $\left(\widehat{w}_{ijt}^{HIGH}\right)$ and $\left(\widehat{w}_{ijt}^{MEDIUM}\right)$ can is the wage gap between tertiary and secondary educations groups (university *vs* senior high school graduates; or university/college vs senior high school graduates). This measure of within establishment wage inequality is then used, in a second stage, as the dependent variable in an establishment level equation of the type:

$$\Delta w_{jt}^{ED} = \alpha + \beta \Lambda_{jt} + \delta_s + \rho_r + \tau_t + \varepsilon_{jt} \quad (4)$$

where Δw_{jt}^{ED} is the education adjusted wage gap of establishment j in year t, Λ_{jt} is a set of establishment level characteristics that include our variables of interest (size and the share of non-regular employment), and δ_s, ρ_r and τ_t are industry, prefecture and time specific effects, respectively (included separately or interacted). As we do not benefit from a panel dataset enabling for usual treatment of unobserved establishment heterogeneity, we include a relatively large number of variables in the set Λ, describing workforce and jobs-related characteristics of the establishments (see Section 6 for details). In addition, as all regressions include sector and prefecture fixed effects, the identification of the impact of the variable of interest comes from variation within sectors and prefectures, and across large/small (or high/low regular employment) establishments. Despite the large set of controls and the fixed effects contribute to considerably reduce omitted variable bias, potential endogeneity arising from joint determination of establishment level attributes of interest and wage dispersion cannot be ruled out. We design specific procedures to deal with this issue, as explained in section 6.3.

6. Results

6.1 Establishment characteristics and wages

Table 2 illustrates the baseline estimates of our wage models. Given the nature of our dataset, all models are estimated by means of ordinary least square (OLS), pooling all workers and years and, depending on the specifications, they include different sets of dummy variables (years, industry, prefecture, establishment, occupation). To take possible correlation of errors within groups of workers employed in similar contexts into account, robust standard errors are always clustered at establishment/industry/prefecture/year level.

The first column of Table 2 reports our baseline estimation (equation 1), which includes establishment/year and occupation/year dummy variables. All coefficients turn out highly significant and with the expected signs. All other personal and job characteristics being equal, female workers suffer a gender wage penalty of about 20% compared to their male counterparts employed in the same establishment. Similarly, *ceteris paribus*, older workers earn higher hourly wages (but the magnitude of the effect tends to decline as age increases) and higher levels of education are associated to increasing returns; seniority in the establishment (variable "tenure", i.e., length of service) is also associated to higher wages, as it is the case for experience. As regards job positions, a clear divide exists between permanent full-time workers (reference category in the estimates) and the remaining contractual options, which all suffer a remarkable wage penalty ranging from 18% to 36%. The actual numbers of days, scheduled hours and overtime hours worked are included as further controls.

In column 2 establishment fixed effects are replaced by the two establishment level variables of interest (size and share of regular employment) and industry/year, prefecture/year, occupation/year dummies are included. The fit of the model inevitably declines, but not dramatically (Adjusted R-squared from 0.84 to 0.74), indicating that the two variables are able to allow for a significant amount of employer-level heterogeneity in average wages paid to employees. The information supplied by this specification is that while the sign and significance of the individual level variables are all confirmed, larger establishments and establishments with a higher share of regular workers pay, on average, higher wages once all observable workers and job characteristics are controlled for. In other terms, there is evidence of a wage premium enjoyed by all workers employed in larger establishments and in establishments that make less intensive use of non-standard contracts. This first evidence

is in accordance with the discussion provided in sections 2 and 3 and, with reference to the effect of firm size, with some previous findings related to higher rents enjoyed by workers in large Japanese firms due to higher productivity and employment protection or to the role of training. Fukao (2018) and Fukao et al. (2014) show that large firms in Japan tend to provide much more off-the-job training to workers than SMEs. Similarly, using microdata on labor turnover and resulting wage changes, Genda (1996) finds that firm-size differences in on-the-job training contribute to a large extent to shape firm-size wage differences.

Table 2. Baseline wage estimates and effects of establishment size and regular employment share on wages, BSWS data (2005-2018)

	[1]	[2]	[3]	[4]	[5]	[6]
	Total	Total	Junior high	Senior high	Junior college	University
female	-0.198***	-0.220***	-0.271***	-0.246***	-0.174***	-0.158***
	[0.00192]	[0.00228]	[0.00347]	[0.00231]	[0.00286]	[0.00242]
age	0.0447***	0.0472***	0.0376***	0.0403***	0.0370***	0.0694***
	[0.000745]	[0.000794]	[0.000505]	[0.000579]	[0.000780]	[0.00146]
age_square	-0.000465***	-0.000520***	-0.000421***	-0.000456***	-0.000406***	-0.000725***
	[0.00000783]	[0.00000818]	[0.00000535]	[0.00000634]	[0.00000865]	[0.0000154]
edu_senihigh	0.0386***	0.0617***				
	[0.00118]	[0.00151]				
edu_junicoll	0.0663***	0.112***				
	[0.00161]	[0.00207]				
edu_univ	0.122***	0.197***				
	[0.00198]	[0.00245]				
tenure	0.0112***	0.0133***	0.00927***	0.0138***	0.0155***	0.0112***
	[0.000123]	[0.000143]	[0.000142]	[0.000135]	[0.000187]	[0.000261]
reg_defper	-0.185***	-0.133***	-0.133***	-0.143***	-0.129***	-0.129***
	[0.00386]	[0.00304]	[0.00445]	[0.00282]	[0.00366]	[0.00554]
noreg_indefper	-0.310***	-0.309***	-0.228***	-0.300***	-0.335***	-0.375***
	[0.00262]	[0.00288]	[0.00340]	[0.00264]	[0.00339]	[0.00475]
noreg_defper	-0.365***	-0.295***	-0.233***	-0.284***	-0.295***	-0.351***
	[0.00303]	[0.00314]	[0.00367]	[0.00324]	[0.00398]	[0.00432]
wd	-0.00160***	-0.00588***	0.000797	-0.00745***	-0.0100***	-0.00176**
	[0.000343]	[0.000406]	[0.000605]	[0.000374]	[0.000424]	[0.000748]
wh_sch	-0.00324***	-0.00443***	-0.00301***	-0.00369***	-0.00432***	-0.00642***
	[0.0000605]	[0.0000769]	[0.0000656]	[0.0000667]	[0.0000700]	[0.000104]
wh_ex	-0.00142***	-0.00110***	-0.000853***	-0.000918***	-0.000715***	-0.00156***
	[0.0000369]	[0.0000427]	[0.0000759]	[0.0000423]	[0.0000427]	[0.0000588]
expr_1to5y	0.103***	0.103***	0.0648***	0.0877***	0.122***	0.124***
	[0.00322]	[0.00319]	[0.00436]	[0.00351]	[0.00462]	[0.00314]
expr_5to10y	0.113***	0.112***	0.0914***	0.104***	0.127***	0.114***
	[0.00510]	[0.00501]	[0.00532]	[0.00638]	[0.00533]	[0.00426]
expr_10to15y	0.114***	0.110***	0.0966***	0.104***	0.121***	0.103***
	[0.00662]	[0.00637]	[0.00599]	[0.00828]	[0.00602]	[0.00541]
expr_15ymore	0.118***	0.114***	0.0900***	0.104***	0.134***	0.119***
	[0.00880]	[0.00820]	[0.00725]	[0.0105]	[0.00722]	[0.00670]
ln_estsize		0.0426***	0.0570***	0.0433***	0.0343***	0.0402***
		[0.000845]	[0.00140]	[0.000994]	[0.000808]	[0.00112]
shrregemp		0.0462***	-0.00797*	0.0242***	0.0378***	0.0966***
		[0.00398]	[0.00479]	[0.00354]	[0.00383]	[0.00610]
_cons	0.156***		-0.127***	0.240***	0.525***	0.167***
	[0.0135]		[0.0159]	[0.0137]	[0.0172]	[0.0366]
Establishment-year dummies	Yes					
Occupation-year dummies	Yes	Yes	Yes	Yes	Yes	Yes
Industry-year dummies		Yes	Yes	Yes	Yes	Yes
Prefecture-year dummies		Yes	Yes	Yes	Yes	Yes
N	13,113,630	13,142,685	569,254	6,407,790	1,996,987	4,168,074
R-squared	0.850	0.739	0.653	0.718	0.700	0.730
Adjusted R-squared	0.841	0.738	0.648	0.718	0.698	0.730
N. of absorbed fixed-effects	2	3	3	3	3	3
D-o-F lost due to the FE	1,890	1,890	1,600	1,815	1,802	1,880
Model degrees of freedom	17	19	16	16	16	16
N. of cluster variables	3	3	3	3	3	3
N. of clusters	658	658	658	658	658	658

Clustered robust at establishment/industry/prefecture-year standard errors in brackets
* p < 0.1, ** p < 0.05, *** p < 0.01
Singleton observations are dropped.

Results in column 1 and 2 do not shed light on the effects of employers' characteristics on the wages of different education groups and on their wage gap. To move a step forward in this direction, we estimate the same model for subsamples of education (columns 3 to 6). All estimates confirm the sign and significance of control variables, even though some variability emerges in their size between education subsamples. Despite the statistical significance of the differences cannot be tested across estimations, for two variables (female and age) the magnitude of the coefficients diverges remarkably and is worth being commented. The gender wage gap is significantly smaller for the subsamples of workers with higher levels of education; university graduates, on the contrary, exhibit returns to age almost double compared to all other samples. With reference to the establishment variables of interest, the employer size turns out again positive and significant in all education subsamples; in other words, larger establishments pay a wage premium to all employees (low-, medium- and high-educated) compared to smaller ones. The size of the coefficients tends to be quite close, even though the effect seems relatively stronger for workers with primary education (junior high school), who account for a small fraction of the sample (around 4%). As for the education groups of our interest (senior high and university graduates), each 1% increase in firm size increases their remunerations by about the same amount (4%). However, we cannot exclude the existence of non-linarites for one of the two groups, or of non-linarites of different strength between the two. This is the case here, as if we add a quadratic term for (ln)establishment size in the estimates on education subsamples in Table 2, their coefficients are all positive and statistically significant. However, the size of the coefficient of the quadratic term for the university graduates (0.00308) is more that 50% higher than for senior high school graduates (0.00203) (complete results are available upon request). This suggests that highly educated workers exhibit more than proportional growth of wages due to firm size which is of a higher magnitude compared to the medium educated: as a result, the college wage gap increases with firm size.

Interesting complementary information emerges if replicate the model estimated for the pooled sample in column 2 and add interaction terms between establishment size and levels of education (equation 2). Results are illustrated in Table A1 in the Appendix, column 1. The main effect of (ln)establishment size (0.0458) indicates its impact on the average wage of the workers with the lowest levels of education and reveals that a 1% growth of firm size increases their wages by 4.58%. The interaction terms indicate that for higher levels of education the effect of firm size is still positive, but of slightly smaller size. It amounts to 3.88% for the junior college graduates and to 4.29% and 4.32% for senior high school graduates and for university graduates, respectively. At the same Table A1 also (indirectly) reveals how the education wage gap varies with firm size; at the average, university educated earn 20.70% more than the benchmark category (the junior high school workers), whereas the senior high school educated earn 7.24% more (main effects of *edu_univ* and *edu_senihigh*). The college wage gap (between university and senior high school) is therefore 13.46%. The size/education interaction terms reveal that this gap, however, tends to increases with firm size. For any increase in firm size, the senior high school educated suffer a proportionally higher decline of their wage gap to the junior high school educated (-0.28% on 7.24%) compared to the university educated (-0.25% on 20.70%).

The analysis of the effects of workforce composition by employment contract provides rather interesting insights too. Behind the wage-increasing average effect emerged for the pooled sample (column 2 in Table 2), lies a remarkable heterogeneity of impacts across education subsamples. A higher share of regular employment entails indeed a wage penalty for the employees with primary education (negative sign of the *shrregemp* coefficient in

column 3) and a wage premium for the other groups, with a magnitude clearly increasing with the level of education (columns 4-6). This evidence is corroborative of the idea that higher shares of workforce more permanently linked to the firm go along with a better remuneration of highly educated/skilled employees, as hypothesised in section 3 (H2). To allow a more direct comparison of the different effects of the workforce composition on wages, and their statistical significance, Column 2 of Table A1 in the appendix reports again the estimates of equation [2] on the pooled sample, but adding interaction terms between *shrregemp* and education dummies. Results obviously confirm the wage penalty associated to higher shares of regular workers for the primary educated (main effect of *shrregemp* negative and significant) and the wage premium increasing with higher education levels. In particular, the positive impact of the workforce composition variable on the wages of university graduates is about twice the impact on senior high school graduates.

The descriptive evidence illustrated in section 4 showed that: (i) wage inequalities within education levels are very different and significantly higher for the university graduates; (ii) within all education groups, establishment level effects play a significant role in explaining residual wage inequality; and (iii) the relative size of this effect is asymmetric across groups, with a clear dichotomy between higher and lower education levels. The results illustrated in this section suggest that the two establishment variables we focus on are good candidates to explain the portion of wage inequality between education levels that pertains to the firm level. However, evidence on their impact on the college wage gap (columns 3-6 in Table 2 and Table A1) is still indirect and for a correct identification we need to control for other possible drivers of the wage gap at establishment level. To address these issues we switch, in the next section, to an establishment level analysis and investigate directly the impact of size and workforce composition on a measure of within-firm wage inequality.

6.2 Establishment characteristics and wage inequality between education levels

As explained in section 4, we derive measures of within-establishment wage inequality based on the estimation of *adjusted individual wages*, obtained as the residuals ($\widehat{w}_{ij}$) of establishment Mincer-type wage equations (equation 1). Results of these estimates, carried out for each year separately, are available upon request. This individual residual (log) wage $\widehat{w}_{ij}$ is then used to compute for each establishment and year, the average adjusted wage for workers of various levels of occupation. The difference between these averages (equation 3) is the establishment-specific *adjusted* wage gap between workers with different education levels. Given the aims of our paper, we compute this gap comparing university graduates and upper secondary (senior high school) graduates in the first place; in order to test the robustness of our results, we also calculate the gap between university/senior college graduates and senior high school graduates. The establishment level measure of wage gap is then regressed on a set of establishment regressors that includes our two variables of interest (equation 4). Estimations are again run by means of OLS, pooling all years and always including industry/year and prefecture/year dummies. Robust standard errors are clustered at industry/prefecture/year level. Results of these estimates are reported in Table 3. In the first column we include as regressors our variables of interest only; in the following columns we test the robustness of our results saturating the model with other explanatory variables which include the share of female employment and the average age of workers in the establishment (column 2); the average hourly wage as a proxy of establishment productivity (column 3); the shares of employees with different levels of education (column 4); the average tenure in the establishment (column 5). Variables

related to the shares of employees belonging to the various classes of experience do not turn up significant and their inclusion does not alter the significance and size of the other coefficients (results available upon request). By adding explanatory variables, we try to reduce potential identification issues on the variables of interest due to omitted variable bias and to their potential correlation with other establishment level characteristics. The signs of the control variables indicate that a higher education wage gap is associated with higher average wage (productivity), larger shares of medium and highly educated, and longer seniority. This evidence is all consistent with our conceptual framework, that associates a larger wage premium for the university graduates to productive context characterised by high performances and intensity of formal (education) and informal (experience) knowledge. Surprisingly, wage inequality is also higher when the share of female employment in the establishment is larger. This outcome deserves further attention in future research activity, in the framework of gender labour market studies.

Table 3. Establishment size and regular employment share as drivers of college wage gap, BSWS data (2005-2018) (university graduates vs senior high-school graduates)

	[1]	[2]	[3]	[4]	[5]
ln_estsize	0.00418***	0.00670***	0.00505***	0.00509***	0.00443***
	[0.000443]	[0.000413]	[0.000407]	[0.000405]	[0.000412]
shrregemp	0.0112***	0.0412***	0.0306***	0.0242***	0.0185***
	[0.00187]	[0.00214]	[0.00226]	[0.00247]	[0.00246]
female share		0.0629***	0.0744***	0.0788***	0.0798***
		[0.00284]	[0.00300]	[0.00307]	[0.00305]
average age		0.00309***	0.00302***	0.00306***	0.00243***
		[0.0000932]	[0.0000917]	[0.0000972]	[0.000106]
average ln(wage)			0.0254***	0.0222***	0.00786***
			[0.00207]	[0.00214]	[0.00253]
edu_senihigh share				0.0229***	0.0193***
				[0.00315]	[0.00318]
edu_junicoll share				0.00476	0.00374
				[0.00442]	[0.00437]
edu_univ share				0.0249***	0.0257***
				[0.00395]	[0.00399]
average tenure					0.00191***
					[0.000121]
_cons	-0.0283***	-0.214***	-0.216***	-0.230***	-0.208***
	[0.00210]	[0.00543]	[0.00536]	[0.00610]	[0.00622]
Industry-year dummies	Yes	Yes	Yes	Yes	Yes
Prefecture-year dummies	Yes	Yes	Yes	Yes	Yes
N	503,650	503,650	503,650	503,650	503,650
R2	0.069	0.078	0.078	0.079	0.080
adj. R2	0.057	0.065	0.066	0.066	0.067
N_hdfe	2	2	2	2	2
df_a	0	0	0	0	0
df_m	2	4	5	8	9
N_clustervars	2	2	2	2	2
N_clust	658	658	658	658	658

Clustered robust at industry/prefecture-year standard errors in brackets
* p < 0.1, ** p < 0.05, *** p < 0.01
Singleton observations are dropped.

With reference to the impact of our variables of interest, results in Table 3 unequivocally indicate that larger establishments exhibit higher (adjusted) wage differences between university graduates and senior high school graduates. Similarly, a larger share of regular workers is associated to larger wage inequality between the two groups of workers. Both establishment characteristics, in accordance with our research hypothesis, are therefore associated to increasing within-firm wage inequality between highly and medium educated workers.

Results are confirmed if we use as the dependent variable the adjusted wage gap between university/senior college (grouped together) and senior high school workers (see Table A2 in the appendix).

It is worth reminding that the education wage gap is calculated on adjusted wages $\widehat{w}_{ij}$, i.e., on the part of individual remuneration that is not explained by personal characteristics of the workers (age, education, etc.) or the general tendency of firms to pay high/low wages to their employees. It is therefore the component of individual wages that differs between observationally identical individuals who work in the same firm and captures unobservable workers' characteristics that generate a wage premium/penalty. Our results indicate that larger establishments and those using more intensively regular contracts are able to employ high educated workers better endowed, compared to the medium educated, with unobservable characteristics (such as innate abilities, the quality of education received, better work ethics) that are remunerated with a wage premium above market average. This evidence is consistent with the mechanisms conjectured in section 3, namely that: (i) larger establishments have organizational and compensation policies allowing them to attract 'better' high-educated employees, crucial to operate in complex and competitive environments; (ii) a high share of regular workers identifies productive contexts in which the accumulation of specific knowledge plays a key role and the attraction of high quality employees for top occupations is crucial to firms' success.

While there is no previous evidence on the impact of workforce composition on wages of different education levels for Japan, our results on the effects on firm size are in line with the idea of a large gap in talent and innate ability across workers in different firm-size groups, as suggested by the fact that graduates of top-ranked universities are much more likely to get a job in large firms in Japan (Fukao, 2018; Higuchi, 1994; NISTEP, 1993).

6.3 Correcting for potential endogeneity/reverse causality issues

While the relatively rich set of controls included is likely to cure most of the potential omitted variable bias, our main estimates could potentially suffer from a form of reverse causality. Particularly, establishment size may itself be driven by the wage dispersion within the firm: if a higher university education gap corresponds to the presence of highly educated workers with better unobserved characteristics in key occupations, they might drive the expansion of the firm. Reverse causality between wage inequality and the share of regular employment is less straightforward, being the latter to a significant extent driven by technological factors (such as the substitutability between regular and non-regular workers) that are industry- (not firm-) specific. Nevertheless, the presence of 'high quality' educated workers in key decision roles might drive human resources policies that affect workforce composition, such as those favouring long-term employment relations if this is believed to boost productivity *via* higher workforce commitment and better incentives to accumulate firm-specific knowledge.

In order to account for this potential problem, we rely on two different approaches: propensity scores and instrumental variable estimations.

The use of propensity scores is a standard approach in the literature dealing with wage inequality (Cirillo et al., 2017; Card and De La Rica, 2006; Daouli, 2013). The procedure consists in a first step estimation of the probability (by means of a Probit model) that an establishment holds the characteristics of interest (being large or having a large share of regular workers, in our case), based on a set of possible predictors. In a second step, the propensity scores (i.e., the fitted values of the probit estimates) are included as additional regressors in estimating

the drivers of within-establishment wage inequality (equation 4), along with the variables of interest and the remaining controls. The rationale behind this approach is that the propensity scores allow for the effects on wage inequality of different propensities of establishments (to be large or to employ regular workers), irrespective of their actual size or of share or regular workers (Card and De La Rica, 2006). At the same time, the score controls for the possibility that the establishment variable of interest is correlated with unobserved firm-level characteristics associated with higher wage inequality (Daouli et al., 2013).

To estimate the first step (probit model) for establishment size, we define a dummy variable identifying "large establishments" as those with a size above the industry/prefecture/year median. Correspondingly, regarding the workforce composition, we identify establishment with a "large share of regular workers" as those with a share above the industry/prefecture/year. Following the referenced literature, the list of predictors includes the establishment average hourly wage, the shares of female employment and of tertiary educated, average age and tenure of employees, the share of employees highly experienced (15 years or more) and in top occupations (directors and senior managers), one year lagged average in the same industry/prefecture/year of establishment size, of the share of workers with tertiary education, with a regular contract and in top occupations. Propensity scores are estimated year-by-year and complete tables of the estimates are available upon request[5].

Table 4 displays the outcomes of the estimation of equation 4 (same as in Table 3), augmented with the propensity scores. For the sake of brevity, the table reports only estimates corresponding to columns 1 and 5 of Table 3 (model with only the two variables of interest and the model with all controls), with propensity scores for the establishment size and regular share of employment separately. The propensity score terms (*prob_large_size* and *prob_hig_regshare*) feature significant coefficients, supporting the validity of the procedure; their introduction does not affect our main conclusions on the effects of establishment size and share of regular workers as compared to the baseline estimates in Table 3, which remains positive and significant.

A second approach to account for potential endogeneity of the variables of interest and for reverse causality relies on instrumental variables (IV) methods. We resort to a standard IV framework by implementing a two-stage least square (2SLS) analysis in which we predict the effect of the variables of interest (establishment size and share of regular employment) by means of exogenous variables which describe the characteristics of the industry/prefecture in which the firm is located. The idea behind this approach, largely employed to address similar issue in firm-level analysis (see, e.g., Devicienti et al., 2018; Aristei et al., 2017; Altomonte et al., 2013 and 2016; Perugini et al., 2017) is that such variables are at the same time correlated to the variables of interest of the single firm due to spill over / peer effects or effects on the specific labour market segment (relevance condition of the instruments), but are uncorrelated to the dependent variable in the second stage, in our case wage inequality (validity condition).

[5] Results, very consistent over time, are in general in line with *ex ante* expectations. The probability of being a large establishment increases with higher average wage paid, a larger average tenure, a larger share of top occupations, higher share of female employment, lower average age of employees and a lower share of university graduates. Similarly, a higher propensity to employ regular workers is associated to higher average wage, younger age and longer tenure of employees; however, it is also associated to a lower share of female workers, a higher share of university graduates and a lower share of employment in top occupations.

Table 4. Establishment size and regular employment share as drivers of college wage gap (university graduates vs senior high-school graduates) – propensity score correction

	[1]	[2]	[3]	[4]
prob_large_size	-0.0396***	-0.0927***		
	[0.00452]	[0.00675]		
prob_hig_regshare			-0.0349***	0.0434***
			[0.00408]	[0.00837]
ln_estsize	0.00540***	0.00553***	0.00550***	0.00488***
	[0.000458]	[0.000428]	[0.000461]	[0.000448]
shrregemp	0.0159***	0.0182***	0.0239***	0.0211***
	[0.00199]	[0.00255]	[0.00239]	[0.00260]
female share		0.0940***		0.0917***
		[0.00341]		[0.00440]
average age		0.00179***		0.00281***
		[0.000115]		[0.000149]
average ln(wage)		0.0284***		-0.000281
		[0.00332]		[0.00297]
edu_senihigh share		0.0181***		0.0156***
		[0.00331]		[0.00339]
edu_junicoll share		0.00635		0.00245
		[0.00455]		[0.00460]
edu_univ share		0.0208***		0.0158***
		[0.00406]		[0.00425]
average tenure		0.00223***		0.00150***
		[0.000125]		[0.000158]
_cons	-0.0146***	-0.153***	-0.0259***	-0.240***
	[0.00286]	[0.00724]	[0.00242]	[0.0101]
Industry-year dummies	Yes	Yes	Yes	Yes
Prefecture-year dummies	Yes	Yes	Yes	Yes
N	476,902	476,902	443,980	443,980
R2	0.070	0.081	0.069	0.078
adj. R2	0.058	0.069	0.057	0.067
N_hdfe	2	2	2	2
df_a	0	0	0	0
df_m	3	10	3	10
N_clustervars	2	2	2	2
N_clust	658	658	611	611

Clustered robust at industry/prefecture-year standard errors in brackets
* p < 0.1, ** p < 0.05, *** p < 0.01
Singleton observations are dropped.

In our case, we were able to identify as good instruments for establishment size the average size of establishments in the same industry/prefecture/year and the average share of university educated in establishments in the same industry/prefecture/year (both lagged four years). The rationale behind this choice is that the size of the competitors signals to the single firm the dimension needed (or optimal) to operate in a given context, shaped by: (i) industry intrinsic characteristics related to organisational/technological aspects (like organisational structure, economies of scale); (ii) specific geographical features (e.g., the size of fixed costs for buildings, the endowment of material/immaterial infrastructures, such as transport facilities, human capital endowments); (iii) and institutional features (e.g., proximity to policy centres, availability of information). The average share of university educated workforce is meant to account for the effects exerted on the same labour market segment by similar firms in the same area; the idea is that firm expansion is linked to the presence of high-skilled human capital with industry-specific knowledge, which is more difficult to recruit and more costly if its demand is higher[6].

[6] We also find that the average share of female employees in the same industry/prefecture is a good instrument for establishment size and enters the first stage regression with a positive sign. Due to the documented gender wage gap, a high average share of female workforce might signal that, in this particular industry/prefecture, labour costs can be reduced significantly by hiring female workers and this might trigger a higher labour intensity and a larger size (that is measure in terms of employees). Results of the second stage of our IV regressions obtained replacing the average share of tertiary

In a similar vein, as instruments for the share of regular workers, we rely on the corresponding average for establishments in the same industry/prefecture/year (lagged one year) and, again, on the average share of university educated in establishments in the same industry/prefecture/year (lagged four years). The idea is that the average share of regular employment of competitors affects the share of the single firms by illustrating the importance of regular workers needed due to industry intrinsic characteristics (like the importance of firm-specific knowledge accumulation) and/or the features of local labour markets. As for the average share of university graduates, the idea is that firms operating in areas/industries with a high demand of high-skilled human capital (industry-specific) face higher costs in recruiting this part of the workforce, which is prevalently hired on a regular contract.

Table 5. Establishment size and regular employment share as drivers of college wage gap (university graduates vs senior high-school graduates) – Instrumental variables correction

	IV for establishment size	IV for % of regular employment
	[1]	[2]
2SLS - First stage		
L4_avg_ln_estsize	0.273***	
	[0.00482]	
L4_avg_univ_grad	-0.149***	
	[0.0224]	
L1_avg_shrregemp3		0.161***
		[0.00407]
L4_avg_univ_grad		-0.0139***
		[0.00356]
2SLS - Second stage		
ln_estsize	0.00586***	0.0456***
	[0.00185]	[0.0170]
shrregemp3	0.0210***	0.00570***
	[0.00341]	[0.000715]
lnwr1	0.00579*	0.0047
	[0.00337]	[0.00355]
female	0.0778***	0.0808***
	[0.00325]	[0.00429]
age	0.00245***	0.00249***
	[0.000127]	[0.000151]
edu_senihigh	0.0189***	0.00368
	[0.00337]	[0.00871]
edu_junicoll	0.00378	-0.0111
	[0.00465]	[0.00978]
edu_univ	0.0245***	0.0104
	[0.00420]	[0.00979]
tenure	0.00180***	0.00170***
	[0.000136]	[0.000171]
Industry-year dummies	Yes	Yes
Prefecture-year dummies	Yes	Yes
N	460,237	417,691
R2	0.011	0.011
adj. R2	0.011	0.011
N_hdfe	2	2
df_a	0	0
df_m	9	9
N_clust	658	611
LM test statistic	368.6	375.7
p-value of underidentification LM statistic	0.000	0.000
dof of underidentification LM statistic	2	2
F statistic for weak identification (Kleibergen-Paap)	1643	782.7
F statistic for weak identification (Cragg-Donald)	6733.4	2607.8
Hansen J statistic for overidentification	1.483	1.739
p-value of Hansen J statistic	0.223	0.187
dof of Hansen J statistic	1	1

Clustered robust at industry/prefecture-year standard errors in brackets
* p < 0.1, ** p < 0.05, *** p < 0.01
Singleton observations are dropped.

education with the average female employment share confirm the positive sign and significance of establishment size on the college gap (complete results available upon request).

The instrumental variable analysis is again performed on the benchmark specification shown in Table 3 (column 5). In the first step, each endogenous variable is regressed on the external instruments discussed above, along with the entire set of exogenous covariates in the second stage. For the sake of brevity, Table 5 shows only the coefficients obtained for the external variables in the first step of the regression and the second-stage parameters (i.e., all remaining control variables are included in the first stage but not reported). Standard statistical tests for the instruments are reported at the bottom of the Table and show that instruments are relevant (i.e., correlated with the endogenous regressors) and that our estimates are not affected by under identification or weak identification issues (Cragg-Donald and Kleibergen Paap statistics). Similarly, the Hansen test of over-identification suggests that these instruments are valid, as they are orthogonal to high/medium education wage gap and are, therefore, exogenous.

Results again indicate and confirm that potential endogeneity issues do not question our findings on the pro-wage inequality role of increasing establishment size and share of regular works. On the contrary, for establishment size, the coefficient obtained with the IV estimates is larger than with OLS, indicating that if a bias exists, it is a downward bias. In the case of regular employment share the coefficient declines in IV estimates compared to OLS, but its sign and significance are unchanged.

7. Concluding remarks

This paper contributes to the literature that investigates the portion of wage inequality due to employers' heterogeneity. We look at the dimension of wage inequality related to education levels, the college wage gap in particular. The empirical analysis is on the Japanese labour market that, within a generalized picture of growing wage differences in favour of higher education levels, represents a peculiar case of an economy where the college wage gap remained substantially stable over time. To this aim, we make use of the rich information provided by the Basic Survey on Wage Structure (BSWS) from 2005 to 2018. The core of our analysis lies in investigating differences in returns to education and within-firm education wage inequality in relation to two main employers' characteristics: size and composition of the workforce by regular/non-regular workers. We argue that such features are good candidates to explain within-firm college wage gap, as they are able to describe productive contexts with different capacities to attract and keep employees with (non-observable) better characteristics for firms' success. Our main findings are that increasing establishment size and share of regular workers tend to increase the wage gap between high- and medium-educated workers, once all observable individual and job characteristics are controlled for. Our education wage gap is indeed calculated on adjusted wages, i.e., on the component of individual wages that differs between observationally identical individuals who work in the same firm; the metric therefore captures unobservable workers' characteristics that generate a wage premium/penalty. Our interpretation is that larger establishments and those using more intensively regular contracts are able and have stronger incentives to employ high educated workers better endowed, compared to the medium educated, with unobservable characteristics (such as innate abilities, the quality of education received, better work ethics, stronger motivations, etc.), that are remunerated with a wage premium above market average. We argue that this is due to the fact that, on one side larger establishments have organizational structures and compensation/recruitment policies allowing them to attract 'better' high-educated employees, crucial to operate in their complex and competitive environments. On the other side, a high share of regular workers identifies

productive contexts in which the accumulation of specific knowledge plays a key role and the attraction of high-quality employees for top occupations (hence, with high education) is crucial to firms' success.

Our results are robust to different definitions of education wage gap; propensity score correction methods and instrumental variables estimates also show that they are immune from possible biases deriving from endogeneity, reverse causality and omitted variable biases. Future extensions of our research in this field include first of all enriching the dataset with matched employer-employee information, which will provide a longitudinal structure of the sample (of establishments) and a richer set of control variables at firm level. Besides allowing the employment of panel data econometric approaches, with their numerous advantages, this will enable us to proceed along the promising avenue of exploring the link between additional firm characteristics (technology, R&D, IT and intangible capital intensity, internationalisation patterns) and various dimensions of wage inequality.

References

Abowd, J.M., Kramarz, F. and Margolis, D.N. 1999. "High Wage Workers and High Wage Firms", *Econometrica*, 67 (2): 251-334.

Acemoglu, D. 2000. "Technical change, Inequality and the Labour Market", *NBER Working Paper*, n. 7800, Cambridge, MA

Acemoglu, D., and Autor, D. 2011. "Skills, Tasks and Technologies: Implications for Employment and Earnings." In *Handbook of Labour Economics* – Vol. 4, O. Ashenfelter and D. Card (Eds), 1043–1171. Amsterdam: Elsevier.

Acemoglu, D., and Pischke, S. 1999. "Beyond Becker: Training in Imperfect Labour Markets", *Economic Journal*, 109: 112–142.

Aghion, P., Bergeaud, A., Blundell, R. and Griffith, R. 2019. "The Innovation Premium to Soft Skills in Low-Skilled Occupations", *CEP Discussion Papers, 1665,* Centre for Economic Performance, LSE, London.

Akerlof, G. A., and Yellen, J. L. 1990. "The Fair Wage-effort Hypothesis and Unemployment", *The Quarterly Journal of Economics,* 105: 255–283.

Allgulin, M. and Ellingsen, T. 2002. "Monitoring and Pay", *Journal of Labor Economics*, University of Chicago Press, 20(2): 201-216.

Altomonte, C., Aquilante, T., Békés, G., and Ottaviano, G.I.P. 2013. "Internationalization and Innovation of Firms: Evidence and Policy", *Economic Policy*, 28 (76): 663–700.

Altomonte, C., Gamba, S., Mancusi, M.L., and Vezzulli, A., 2016. "R&D Investments Financing Constraints, Exporting and Productivity", *Economics of Innovation and New Technology,* 25(3): 283–303.

Aristei, D., Sterlacchini, A., and Venturini, F., 2017. "Effectiveness of R & D Subsidies during the Crisis: Firm-Level Evidence across EU Countries", *Economics of Innovation and New Technology*, 26 (6): 554–573.

Arulampalam, W., Booth, A. L., and Bryan, M. L. 2004. "Training in Europe", *Journal of the European Economic Association*, 2(2–3): 346–360.

Asano, H., Ito, T. and Kawaguchi, D. 2013. "Why Has the Fraction of Nonstandard Workers Increased? A Case Study of Japan", *Scottish Journal of Political Economy*, 60, 360–389.

Asao, Y. 2011 "Overview of Non-regular Employment in Japan", Mimeo, The Japan Institute for Labour Policy and Training

Autor, D. H. 2001. "Why do Temporary Help Firms Provide Free General Skills Training?", *The Quarterly Journal of Economics*, 116(4): 1409–1448.

Bartolucci, C. and Devicienti, F., 2013. "Better Workers Move to Better Firms: A Simple Test to Identify Sorting" *IZA Discussion Papers* 7601, Institute of Labor Economics (IZA).

Becker, G. 1964. *Human Capital; A Theoretical and Empirical Analysis, with Special Reference to Education*. New York: Columbia University Press, 1964.

Benson, J. 2008. "The Development and Structure of Japanese Enterprise Unions", *The Asia-Pacific Journal | Japan Focus*, 6 (11), Article 2938.

Blanchard, O. and Landier, A. 2002. "The Perverse Effects of Partial Labour Market Reform: Fixed-term Contracts in France", *The Economic Journal*, 112(480): 214–244

Blau F.D. and Kahn, L.M. 1996. "International Differences in Male Wage Inequality: Institutions Versus Market Forces", *Journal of Political Economy,* 104(4): 791-836.

Boeri, T., and Garibaldi, P. 2007. "Two Tier Reforms of Employment Protection: a Honeymoon Effect?", *The Economic Journal* ,117: 357-385

Booth, A. L., Francesconi, M., & Frank, J. 2002. "Temporary Jobs: Stepping Stones or Dead Ends?", *The Economic Journal*, 112(480): F189-F213

Burdett, K., and Mortensen, D.T. 1998 ''Wage Differentials, Employer Size and Unemployment,'' *International Economic Review*, 39(1): 257–273.

Card, D., and S. De La Rica. 2006. "Firm-level Contracting and the Structure of Wages in Spain." *Industrial and Labour Relations,* 59: 573–592.

Card, D., J. Heining, and Kline, P. 2013. "Workplace Heterogeneity and the Rise of West German Wage Inequality", *The Quarterly Journal of Economics*, 128(3): 967-1015.

Ciccone, A. and Perri, G. 2005. "Long-Run Substitutability Between More And Less Educated Workers: Evidence From U.S. States, 1950–1990", *The Review of Economics and Statistics*, 87(4): 652-663.

Cirillo, A. and Ricci, A. 2020. "Heterogeneity Matters: Temporary Employment, Productivity and Wages in Italian Firms", *Economia Politca*, https://doi.org/10.1007/s40888-020-00197-2

Cirillo, V., Sostero, M. and Tamagni, F. 2017. "Innovation and Within-Firm Wage Inequalities: Empirical Evidence from Major European Countries", *Industry and Innovation*, 24(5): 468-491.

Daouli, J., M. Demoussis, N. Giannakopoulos, and I. Laliotis. 2013. "Firm-level Collective Bargaining and Wages in Greece: A Quantile Decomposition Analysis", *British Journal of Industrial Relations,* 51: 80–103.

Devicienti, F., Naticchioni, P. and Ricci, A. 2018. "Temporary Employment, Demand Volatility, and Unions: Firm-Level Evidence", *International Labour Review*, 71(1): 174–207.

Dosi, G., Guarascio, D., Ricci, A., and Virgillito, M. E. 2019. "Neodualism in the Italian Business Firms: Training, Organizational Capabilities and Productivity Distributions", *Small Business Economics*, https ://doi.org/10.1007/s1118 7-019-00295 -x

Fortin, N. and Lemieux, T. 1997. "Institutional Change and Rising Wage Inequality", *Journal of Economic Perspective*, 11(2): 75-96.

Fujimura, H. 2012. "Japan's Labour Unions: Past, Present and Future", *Japanese Labour Review*, 9(1), 6-24.

Fukao, K. 2018. "Stagnation and the Labor Market in Japan", in Cohen-Setton, j., Helbling, T., Posen, A.S and Rhee, C. (eds) *Sustaining Economic Growth in Asia*, Chapter 7, Peterson Institute for International Economy, Washington, DC.

Fukao, K. and Perugini, C. 2020. "The Long-Run Dynamics of the Labor Share in Japan", *The Review of Income and Wealth*, published on line, DOI: https://doi.org/10.1111/roiw.12465.

Fukao, K., Makino, T. Ikeuchi, K. Kwon, H. and Kim, Y. 2014. "Productivity and Wage Differences by Firm Size (in Japanese)," the *Japanese Journal of Labour Studies*, 649: 14-29.

Genda, Y. 1996. "'Abiliy' or 'Training': Ability Difference Hypothesis on Firm-Size Wage Differences (in Japanese)", *The Japanese Journal of Labour Studies*, 430: 17-29.

Gordon, A. 2017. "New and Enduring Dual Structures of Employment in Japan: The Rise of Non-Regular Labor 1980s–2010s", *Social Science Japan Journal,* 20(1): 9–36.

Heckman, J. and Rubinstein, Y. 2001. "The Importance of Noncognitive Skills: Lessons from the GED Testing Program", *The American Economic Review*, 91(2): 145-149.

Higuchi, Y. 1994. "University Education and Income Distribution (in Japanese)," in Ishikawa, T. (ed), *Income and Wealth Distribution in Japan*, University of Tokyo Press.

Houseman, S. 2001. "Why Employers Use Flexible Staffing Arrangements: Evidence from an Establishment Survey", *Industrial and Labor Relations Review*, 55(1): 149–170.

Houseman, S. and Osawa, M. 2003. 'The Growth of Nonstandard Employment in Japan and the United States: A Comparison of Causes and Consequences', in S. Houseman and M. Osawa (eds) *Nonstandard Work in Developed Economies*, Kalamazoo, MI: W.E. Upjohn Institute for Employment Research, 175–214.

Inoue, M., Nishikitani, M., and Tsurugano, S. 2016. "Female Non-Regular Workers in Japan: Their Current Status and Health", *Industrial Health*, 54(6): 521–527.

Kalantzis, Y., Kambayashi, Y., and Lechevarier, S. 2012. "Wage and Productivity Differentials in Japan: the Role of Labor Market Mechanisms", *Labour*, 26(4): 514-541.

Kambayashi, R., Kawaguchi D. and Yokoyama I. 2008. "Wage Distribution in Japan, 1989-2003", *Canadian Journal of Economics*, 41(4): 1329-1350.

Kambayashi, R., and Kato, T. 2016. "Long-Term Employment and Job Security over the Past 25 Years: A Comparative Study of Japan and the United States", *Industrial and Labor Relations Review*, 10(2): 359-394.

Karabarbounis, L., and Neiman, B. 2014. "The Global Decline of the Labor Share", *Quarterly Journal of Economics*, 129(1): 61–103.

Kato, T. 2016 "Productivity, Wages and Unions in Japan", *Conditions of Work and Employment Series*, 73, ILO, Geneva.

Katz, L., and Revenga, A. 1989. "Changes in structure of wages: The United States vs. Japan". *Journal of the Japanese and International Economies*, 3(4): 522-553.

Kawaguchi, D., and Mori, Y. 2016. "Why has Wage Inequality Evolved so Differently between Japan and the US? The Role of the Supply of College-Educated Workers", *Economics of Education Review*, 52: 29–50.

Kawaguchi, D., and Ueno, Y. 2013. "Declining Long-term Employment in Japan", *Journal of the Japanese International Economies*, 28: 19-36.

Keizer, A. B. 2008. "Non-Regular Employment in Japan: Continued and Renewed Dualities", *Work, Employment and Society*, 22(3): 407–425.

Lazear, E. P. 1986. "Salaries and Piece Rates", *The Journal of Business,* 59: 405–31.

Lise, J., Sudo, N., Suzuki, M., Yamada, K., and Yamada, T. 2014. "Wage, income and consumption inequality in Japan, 1981-2008: From boom to lost decades", *Review of Economic Dynamics* 17: 582–612.

Miyamoto, J. 2016. "Growth and Non-regular Employment", *The B.E. Journal of Macroeconomics*, 16(2): 523-554.

Mollick, A.V. 2011. "The World Elasticity of Labor Substitution across Education Levels", *Empirical Economics*, 41: 769–785.

Morikawa, M. 2010. "Labor Unions and Productivity: An Empirical Analysis Using Japanese Firm-level Data", *Labour Economics*, 17(6): 1030-1037.

Moscarini, G., and Postel-Vinay, F. 2013. "Stochastic Search Equilibrium", *Review of Economic Studies*, 80: 1545-.

Murphy, K. J. 1999. "Executive Compensation", *Handbook of Labor Economics,* Chapter 38, Vol. 3: 2485–2563.

NISTEP (National Institute of Science and Technology Policy. 1993. *Kogakubu Sotsugyo-sei no Shinro to Shokugyo Ishiki ni Kansuru Nichi-Bei Hikaku* (Japan–US comparison of the career to pursue and job consciousness of graduates from Departments of Technology). Chosa Shiryo (ResearchMaterial) No. 28.NISTEP.

O'Mahony, M., Vecchi, M., Venturini, F. (2020) "Capital heterogeneity and the Decline of the Labor Share", *Economica*, published on line (https://doi.org/10.1111/ecca.12356)

Odagiri, H. (1994) Growth through Competition, Competition through Growth. Oxford: Clarendon Press.

OECD. 1996. *Employment Outlook*, OECD Publishing, Paris.

OECD. 2017a. Employment Outlook. June, OECD Publishing, Paris.

OECD. 2017b. *OECD Economic Survey of Japan*, OECD Publishing, Paris.

Ono, H. 2010. "Lifetime Employment in Japan: Concepts and Measurements", *Journal of the Japanese and International Economies*, 24: 1–27.

Perugini, C. Vecchi, M. and Venturini, F. 2017. "Globalisation and the Decline of the Labour Share: A Microeconomic Perspective", *Economic Systems*, 41(4): 524-536.

Perugini, C., and Pompei, F. 2017. "Temporary Jobs, Institutions, and Wage Inequality within Education Groups in Central-Eastern Europe", *World Development*, 92: 40-59.

Rebick, M. 2005. *The Japanese Employment System: Adapting to a New Economic Environment*. Oxford: Oxford University Press.

Snijders, T. A. B. and Bosker, R. 1999. *Multilevel Analysis: An Introduction to Basic and Advanced Multilevel Modeling*, Thousand Oaks, CA: Sage Publications Ltd.

Song, J., Price, D.J., Guvenen, F., Bloom, N., von Watcher, T. 2019. "Firming up inequality", *The Quarterly Journal of Economics,* 134(1): 1-50.

Usui, C. and Colignon, R.A. 1996. "Corporate Restructuring: Converging World Pattern or Societally Specific Embeddedness?", *The Sociological Quarterly,* 37(4): 551–78.

Van Reenen, J. 1996. "The Creation and Capture of Rents: Wages and Innovation in a Panel of U.K. Companies", *The Quarterly Journal of Economics,* 111: 195–226.

Wang, R., and Weiss, A. 1998. "Probation, Layoffs, and Wage-Tenure Profiles: a Sorting Explanation", *Labour Economics*, 5(3): 359–383.

Winter-Ebmer, and R., Zweimüller, J. 1999. "Intra-firm Wage Dispersion And Firm Performance", *Kyklos,* 52(4): 555–572.

APPENDIX

Table A1. Establishment size and regular employment share effects on wages, pooled sample and interaction effects (2005-2018)

	[1]	[2]
female	-0.220***	-0.220***
	[0.00226]	[0.00228]
age	0.0472***	0.0472***
	[0.000792]	[0.000794]
age_square	-0.000520***	-0.000520***
	[0.00000817]	[0.00000819]
edu_senihigh	0.0724***	-0.00281
	[0.00377]	[0.00270]
edu_junicoll	0.140***	0.0397***
	[0.00490]	[0.00371]
edu_univ	0.207***	0.0803***
	[0.00576]	[0.00459]
tenure	0.0133***	0.0134***
	[0.000142]	[0.000143]
expr_1to5y	0.103***	0.103***
	[0.00319]	[0.00319]
expr_5to10y	0.112***	0.112***
	[0.00501]	[0.00501]
expr_10to15y	0.110***	0.109***
	[0.00637]	[0.00637]
expr_15ymore	0.114***	0.113***
	[0.00820]	[0.00820]
reg_defper	-0.133***	-0.132***
	[0.00304]	[0.00304]
noreg_indefper	-0.309***	-0.315***
	[0.00288]	[0.00279]
noreg_defper	-0.295***	-0.297***
	[0.00315]	[0.00313]
wd	-0.00588***	-0.00595***
	[0.000404]	[0.000408]
wh_sch	-0.00443***	-0.00442***
	[0.0000768]	[0.0000771]
wh_ex	-0.00110***	-0.00111***
	[0.0000426]	[0.0000428]
ln_estsize	0.0458***	0.0425***
	[0.00116]	[0.000845]
shrregemp	0.0461***	-0.0587***
	[0.00397]	[0.00480]
c.edu_senihigh#c.ln_estsize	-0.00281***	
	[0.000818]	
c.edu_junicoll#c.ln_estsize	-0.00703***	
	[0.00110]	
c.edu_univ#c.ln_estsize	-0.00258**	
	[0.00121]	
c.edu_senihigh#c.shrregemp		0.0879***
		[0.00347]
c.edu_junicoll#c.shrregemp		0.0984***
		[0.00431]
c.edu_univ#c.shrregemp		0.155***
		[0.00577]
_cons	0.139***	0.229***
	[0.0179]	[0.0177]
Industry-year dummies	Yes	Yes
Prefecture-year dummies	Yes	Yes
Occupation-year dummies	Yes	Yes
N	13,142,685	13,142,685
R2	0.739	0.739
adj. R2	0.738	0.739
N_hdfe	3	3
df_a	1890	1890
df_m	22	22
N_clustervars	3	3
N_clust	658	658

Clustered robust at establishment/industry/prefecture-year standard errors in brackets
* p < 0.1, ** p < 0.05, *** p < 0.01
Singleton observations are dropped.

Table A2. Establishment size and regular employment share as drivers of college wage gap, BSWS data (2005-2018) (university and junior college graduates vs senior high-school graduates)

	[1]	[2]	[3]	[4]	[5]
ln_estsize	0.00499***	0.00695***	0.00617***	0.00609***	0.00546***
	[0.000348]	[0.000334]	[0.000327]	[0.000328]	[0.000333]
shrregemp	0.00594***	0.0250***	0.0203***	0.0145***	0.00879***
	[0.00143]	[0.00167]	[0.00171]	[0.00189]	[0.00187]
female share		0.0402***	0.0456***	0.0489***	0.0498***
		[0.00216]	[0.00233]	[0.00239]	[0.00237]
average age		0.00209***	0.00207***	0.00212***	0.00147***
		[0.0000716]	[0.0000711]	[0.0000743]	[0.0000781]
average ln(wage)			0.0118***	0.00832***	-0.00666***
			[0.00162]	[0.00172]	[0.00205]
edu_senihigh share				0.0188***	0.0154***
				[0.00244]	[0.00245]
edu_junicoll share				0.00761**	0.00624*
				[0.00362]	[0.00359]
edu_univ share				0.0235***	0.0245***
				[0.00304]	[0.00306]
average tenure					0.00201***
					[0.0000955]
_cons	-0.0266***	-0.152***	-0.153***	-0.165***	-0.143***
	[0.00158]	[0.00430]	[0.00427]	[0.00472]	[0.00472]
Industry-year dummies	Yes	Yes	Yes	Yes	Yes
Prefecture-year dummies	Yes	Yes	Yes	Yes	Yes
N	571,192	571,192	571,192	571,192	571,192
R2	0.046	0.051	0.051	0.051	0.053
adj. R2	0.034	0.039	0.040	0.040	0.041
N_hdfe	2	2	2	2	2
df_a	0	0	0	0	0
df_m	2	4	5	8	9
N_clustervars	2	2	2	2	2
N_clust	658	658	658	658	658

Clustered robust at industry/prefecture-year standard errors in brackets

* p < 0.1, ** p < 0.05, *** p < 0.01

Singleton observations are dropped.