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ABSTRACT

The occupational structure of an establishment provides a description of its production process by detailing the distribution and relative intensity of tasks performed. In this paper, I investigate whether there are substantive differences in the occupational structures of low- and high-wage service sector establishments. I show that low-wage establishments organize production to use less labor in professional occupations compared to high-wage establishments operating in the same local-labor market and industry. In addition, low-wage establishments employ fewer individuals in information technology occupations, employ fewer managers, and have substantially wider supervisory spans of control. These results indicate that, despite operating in the same narrowly defined labor and product markets, low-wage establishments organize production to less intensively use labor in skilled occupations.

JEL Classification Codes: J23, J31, L23

Key Words: Occupations, Wage Inequality, Organization of Production, Service Industry

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Since the late 1970s, wages for the lowest-earning employees in the United States have stagnated, barely increasing until about 2014 (see, for instance, Acemoglu and Autor [2011]). This has led to growing interest for the role of public policy in ensuring employed individuals earn enough to afford a minimal standard of living, with 34 city and other local areas passing local minimum wage ordinances between 2004 and 2014 (Vaghul and Zipperer 2016).

However, at the establishment level, there is substantial variation in the extent to which a given minimum wage increase binds. For instance, in the sample of service sector establishments I study in this paper, the bottom 10 percent of establishments pay wages below $8.07 per hour to their lowest-paid decile of employees, while the top 10 percent of establishments pay wages above $21.14 to their bottom decile. Thus, for local areas considering minimum wages of $15 an hour, a large fraction of service sector establishments will find few if any of their employees affected by such a minimum wage increase. At the other extreme, 10 percent of establishments pay over 90 percent of their employees below $13.15. For this minority of establishments, a $15 per hour minimum wage would impact nearly all their employees.

Why are there such differences in the wages establishments pay to their lowest-paid workers? I focus on three possible explanations. First, it could be that there are no productivity differences between low- and high-wage establishments operating in the same industry and geographic market, but high-wage firms choose to share more of the economic rents with their employees. Second, it could be that low- and high-wage establishments choose to distribute rents within the firm differently. In particular, high-wage firms may have more wage compression, leading to a flatter wage hierarchy within the firm. In both cases, low- and high-wage establishments should appear otherwise similar except for differences in the wage structure. If the only difference between low-wage and high-wage establishments is the wage structure, it is

more likely that minimum wage increases will only induce changes in the distribution of rents between workers and the employer, rather than inducing firms to change the production process.

On the other hand, there may be substantive differences in the production process between low- and high-wage establishments, leading low-wage establishments to be less productive and, accordingly, pay lower wages. In this case, low-wage establishments may have less capacity to pay higher wages without reorganizing the production process. Depending on whether these differences are due to organizational choices versus permanent heterogeneity in productivity between establishments, sufficiently large minimum wage increases will force these less-productive establishments to either adapt or exit the market.

To distinguish between these three explanations for wage heterogeneity, I measure the wage and occupational structure of establishments, comparing low- and high-wage establishments operating in the same narrowly defined market. By examining the wage structure, I can investigate whether establishments that pay low wages to the bottom 10 percent of their employees also pay lower wages throughout the hierarchy. To measure heterogeneity in the production process, I focus on the occupational structure of establishments. Occupations provide a description of the tasks an individual employee performs; thus, the types of occupations an establishment employs and the number of employees in each occupation provide a description of the production tasks performed in the establishment as a whole.

I use data from the May 2016 wave of the Occupational Employment Statistics Survey to measure heterogeneity between low- and high-wage establishments. I focus on service sector establishments because the service sector is disproportionately low wage (Bureau of Labor Statistics 2016a). I answer two related research questions. First, I measure how much of variation in bottom-decile pay can be explained by fixed characteristics, including industry, geography,

and establishment size. After demonstrating that these fixed characteristics can explain at most half of the variation in 10th percentile wages, I investigate sources of organizational heterogeneity between low- and high-wage establishments. Focusing on variation within narrowly defined industry by geographic area cells, I find that establishments that pay low wages to their bottom 10 percent of employees also pay low wages throughout the hierarchy. However, these differences in hourly pay are roughly constant throughout the wage hierarchy, leading to more within-establishment wage inequality for low-wage establishments. These results are inconsistent with the view that low-wage establishments pay low-wages at the bottom in order to pay higher wages further up the hierarchy.

I find substantial variation in occupational structure between low- and high-wage establishments. Low-wage establishments employ fewer individuals in professional occupations and more individuals in service, clerical, and production occupations. Low-wage establishments have fewer managers but more supervisors, leading to a wider span of control throughout the hierarchy. Finally, low-wage establishments employ fewer individuals in information technology (IT) occupations.

These results offer important context for understanding low-wage labor markets. The fact that almost half of the variation in 10th percentile wages occurs within industry by geographic cells demonstrates that many establishments can productively pay higher-wages to the bottom of their hierarchy. However, the fact that low-wage establishments appear to be organized with a very different distribution of occupations indicates that there are substantive differences in how low- and high-wage establishments organize their production within the same industry. Moreover, the nature of the organizational differences suggests that low-wage establishments may in fact be less productive. The fact that low-wage establishments employ fewer professional

occupations (which are typically high-skill cognitive occupations), as well as fewer IT occupations, indicates that low-wage establishments produce using a less skill-intensive and technology-intensive production process. Such results offer suggestive evidence that wage heterogeneity between establishments may be due to substantive differences in productivity.

LITERATURE REVIEW

This paper contributes to a growing literature documenting heterogeneity between seemingly similar establishments. A variety of papers have documented dispersion in characteristics, including total factor productivity (Syverson 2004), management practices (Bloom and Van Reenen 2007), and wages (Song, Price, and Bloom 2016). Across this literature, it is clear that firms with very different production processes are able to coexist within markets; however, there is some evidence that dispersion is narrower when there is more market competition (e.g., Syverson 2004).

There are several factors that have been shown to relate to wage heterogeneity between establishments. The firm-size wage premium has been well-established (e.g., Troske 1999). Wages may also differ between establishments due to sorting, especially if there are complementarities between the firm's production technology and worker productivity, or complementarities between workers (see, for instance, Abowd, Kramarz, and Margolis [1999]). Wage dispersion also appears to relate to persistent productivity differences across establishments (Haltiwanger, Lane, and Spletzer 2007).

This paper presents a new method to measure heterogeneity in the production process, by using the occupational structure of the establishment. Several papers examine related measures. Maurin and Thesmar (2004) find that the adoption of technology in manufacturing firms is

associated with a reduction in the share of employment in production occupations and administrative occupations and an increase in the share employed in design and marketing occupations. Bresnahan, Brynjolfsson, and Hitt (2002) find higher productivity for firms that adopt IT and organize their workforce in a decentralized fashion. Rajan and Wulf (2006) examine the hierarchy for upper-management positions and find that firms have become increasingly flat in recent years. This may be associated with decentralization, especially because this flattening is associated with greater compensation for these managers who now have a broader span of control; however, this flattening also means that top executives have closer contact with more of their subordinates. Thus, there is reason to believe that low- and high-wage establishments may have different occupation and management structures and that this may be related to the adoption of IT.

In addition, this paper relates to a large literature on the effect of the minimum wage on labor markets. A robust subliterature has focused on comparing the effect of minimum wage increases on establishments that paid below and above the new minimum wage before the policy was enacted (see, for instance, Card and Krueger [1994]; Dube, Naidu, and Reich [2007]). This paper can shed light on why we see such heterogeneity within markets in the first place. There is little evidence that minimum wage increases lead firms to exit the market (see Belman and Wolfson 2015); however, there does appear to be employment spillovers to workers who should not have been directly affected by the legislation, suggesting firms may reorganize production in response to minimum wage increase (Cengiz et al. 2017; Jardim et al. 2017). This relates to a classic literature on labor-labor substitution, which emphasizes how minimum wage policies may lead to spillovers in the labor market (e.g., Hamermesh and Grant 1979).

METHODOLOGY

The primary methodological innovation of this paper is to use the occupational structure as a measure for the production process of the establishment. The Standard Occupational Classification system (SOC) classified occupations primarily based on the work performed in the job (Bureau of Labor Statistics 2010). Thus, the distribution of employment across occupational categories provides a description of the work performed at the establishment. Although six-digit occupational categories provide less information than a job title or a job description, the occupational system provides a common categorization across establishments. This allows us to compare occupational structure between establishments.

DATA

I use data from the Occupational Employment Statistics (OES) survey, a semiannual survey of establishments.[1] The OES survey is designed to produce high-quality estimates of occupational wages across industries and geography. This survey reaches approximately 200,000 establishments every six months. I use data from the first wave of 2016, which was collected in the second quarter of 2016. The OES is designed to be nationally representative and is a random sample stratified by metropolitan and nonmetropolitan area, industry, and establishment size Bureau of Labor Statistics 2016b). The final sample for May 2016 includes 195,691 establishments, employing over 3.4 million employees. This represents approximately 1.3 percent of all U.S. employment in May 2016 (Bureau of Labor Statistics 2016c).

[1] Note that establishments are either a firm with a single location or a particular location of a multiestablishment firm. Due to the way the data are collected, the basic unit of analysis is the establishment, rather than the firm.

The OES survey has a unique structure in which each establishment reports the number of employees in each cell of a matrix consisting of detailed occupational categories crossed with 12 wage bins (see Appendix Table A1 for the precise wage intervals). This allows for the construction of occupational structure variables, which are unavailable in other major data sources in the United States. Nonetheless, the data have several limitations. Crucially, there is no worker-level information beyond the employment count within each cell. In addition, the OES definition of employment includes all full-time and part-time workers, as well as workers on leave, which may skew employment patterns for establishments that rely more heavily on part-time labor.

The wages reported in the OES include regular wages, tips, and bonuses, but exclude extra pay, such as overtime. The primary wage variable I will focus on is the 10th percentile establishment wage, which represents the wage bin in which the 10th percentile employee is employed. For establishments of 10 or fewer employees, this is the lowest paid employee. To assign a single wage to the range of wages in each wage bin, I use the internal OES-produced interpolated average wage for the bin, which is constructed using data from the National Compensation Survey.

I restrict my analysis to service sector establishments, which includes establishments in the industries listed in Table 1. This follows the definition used by the Census Quarterly Services Survey (U.S. Census Bureau 2017). Since I am interested in the occupational structure within establishments, I restrict my analysis to establishments with at least five employees. This cuts the sample to 91,673 establishments. In Table 2 I report means, standard deviations, and 10th and 90th percentiles for key dependent variables.

To compare between low- and high-wage establishments, the first step is to define the cells within which to compare. I define cells based on six-digit industry code (NAICS) and 712 commuting zones. I follow Tolbert and Sizer (1996) in defining commuting zones, which consist of contiguous aggregates of counties based on historic commuting patterns. For less than 2 percent of the data, either the county is missing or the establishment is located in an area that is not part of the defined commuting zones.[2] In this case, I construct a "balance" commuting zone for every state or territory. All results are robust to excluding data from these balance commuting zones or using metropolitan statistical areas as the geographic area.

I create three subsamples of the data, the largest of which includes all service sector establishments with at least 5 employees and includes 91,673 establishments. The second subsample restricts the sample to establishments that are in the same commuting zone by industry cell as two other establishments, which reduces the sample to 49,578 establishments. The final subsample restricts the sample to establishments in cells of 10 establishments, which further reduces the sample to 15,690. These two restricted subsamples allow me to determine if an establishment is low- or high-wage within its narrowly defined market. Figure 1 represents the distribution of commuting zones that are present in the smallest subsample of data.

SPECIFICATIONS

The goal of this paper is to examine the characteristics of heterogeneity in low-wage compensation across establishments. The first question is how much of that variation can be explained by industry or geography. In Figure 2, I show how 10th percentile establishment wages

[2] Commuting zones are defined for the 50 U.S. states. The OES also covers the District of Columbia, Guam, Puerto Rico, and the U.S. Virgin Islands.

vary across two-digit industries. Here we see that Utilities have the highest 10th percentile wages, on average over $30 per hour, while Accommodation and Food Services have 10th percentile wages of under $10 per hour. Similarly, local prices, minimum wage laws, and other characteristics of geographic areas mean that wages may vary substantially across commuting zones.

To address this, I run a series of specifications with fixed effects and report the R-squared statistic. In particular, I regress

$$\log(w10)_{ig} = \alpha + \gamma_g + \varepsilon_{ig}$$

where $log(w10)_{ic}$ is the logarithm of the 10th percentile wages for establishment i in group g. Group g is successively defined as six-digit industry, commuting zones, nine establishment size bins, and the interaction of industry by commuting zone. Specifically, I divide establishments into the following size categories: 5–9, 10–19, 20–49, 50–74, 75–99, 100–499, 500–749, 750–1999, and 2000 plus. I report the R-squared and adjusted R-squared, which measures the fraction the variation in log 10th percentile wages is reduced by including each set of fixed effects. I run this specification on the three samples of the data. Specifications are weighted using the OES sampling weights, and standard errors are clustered at the commuting zone level.

After I establish that a substantial fraction of the variation in 10th percentile wages occurs within industry by commuting zone cells, I then examine how wage and occupational structures differ between low- and high-wage establishments within these industries by commuting zone cells. I divide cells by median 10th percentile wages, defining establishments that pay below median wages as low-wage and those that pay median or above wages as high-wage. I estimate the following linear regression:

$$DV_{ic} = \alpha + \beta I_i + \gamma_c + \varepsilon_{ic}$$

where DV_{ic} is a series of dependent variables for establishment i in cell c that is either low-wage ($I_i = 1$) or not. I run the specifications on the 3-establishment cell and 10-establishment cell subsamples. Standard errors are clustered at the commuting zone level and each specification is weighted by OES sampling weights.

DEPENDENT VARIABLES

To summarize establishment-level compensation practices and occupational structure, I construct a variety of statistics. First, I construct the logarithm of 10th percentile, 25th percentile, median, 75th percentile, and 90th percentile wages. I construct wage inequality measures, including the ratio of 90th percentile log wages to 10th percentile log wages (90/10), 50th percentile log wages to 10th percentile log wages (50/10) and 90th percentile log wages to 50th percentile log wages (90/50).

To summarize the occupational structure of the establishment, I divide all occupations into one of four mutually exclusive occupational categories based on the grouping used by Acemoglu and Autor (2011). The first category, which I call "professional" occupations, includes management, science, legal, education, and health care occupations (SOC codes 11–29). The second category, which I call "clerical" occupations, includes office and administrative support occupations as well as sales occupations (SOC codes 41–43). The third category, "production" occupations, includes construction, installation, production, and transportation occupations (SOC codes 45–53). Finally, the fourth category, "service" occupations, includes health care support, food preparation, and maintenance occupations (SOC codes 31–39). In order to more directly investigate whether high-wage establishments produce using more technology, I turn next to computer-related occupations, which are categorized under SOC codes 15.11xx. These include

computer analysts, database administrators, computer support specialists, and other related occupations.

To summarize the managerial structure of the organization, I construct three variables. First, I use the share of employees that are in the management SOC category. This measure does not include supervisors, who are coded in the major occupation with the workers they supervise. Thus, I also construct a measure for the supervisor share of establishment employment, as well as a measure for the sum of management and supervisors. Finally, I construct several measures of span of control. First, I construct the average supervisory span of control, which is defined as the total number of nonsupervisory employees divided by the total number of supervisors. In addition, I construct a measure of managerial span of control, which is the number of supervisors per manager, as well as total span of control, which is the number of nonsupervisory workers per the total number of supervisors and managers.

RESULTS

In Figure 3 I plot the kernel density of the distribution of the gap between establishments' 10th percentile wages and median 10th percentile wages. There is substantial variation in the gap. Due to minimum wage laws and OES methodology that collects wages in bins, we see that the density is truncated to the left, with the smallest establishment wage falling $2.47 below the median. However, to the right we see 10th percentile wages as much as $23.60 per hour above median 10th percentile wages.[3]

[3] To preserve data confidentiality, these density plots graph the distribution of percentiles of the underlying distribution. Thus, the minimum value is the 1st percentile score and the maximum value is the 99th percentile score.

Although we see substantial variation across establishments in 10th percentile wages, this could be driven by differences in local labor or product markets. For instance, if establishments in high-cost-of-living areas pay higher wages, this could mechanically lead to variation in the distribution of 10th percentile wages. Similarly, if there is variation between industries in staffing, this could drive differences in 10th percentile wages. Thus, in Figure 4, I reproduce the plot from Figure 3 (in blue) but add two additional plots. First, I calculate the gap between each establishment's 10th percentile wage and the median 10th percentile wage for the commuting zone, plotting the density in red. The gap to commuting zone median smooths out the distribution and reduces the truncation on the left, with a largest negative wage gap of $4.64 below commuting zone median. However, we still see substantial variation in wages, with the largest wage gap of $23.71. The overall shape of the distribution is quite similar to the nonadjusted data. This suggests that geography is unlikely to be able to explain much of the variation in 10th percentile wages.

Second, I calculate the gap between each establishment's 10th percentile wage and the median 10th percentile wage for the six-digit NAICS industry, plotting the density in green. Here we see a bigger change compared to the raw data, with substantially more weight of the density close to the zero and less weight in the tails. Nonetheless, we still see extreme values, with the smallest wage gap of $8.01 below median industry wage and the largest positive wage gap of $21.00. Thus, while we expect industry can account for more of the variation in 10th percentile wages across establishments than commuting zones, there still remains substantial unexplained variation in wages.

VARIATION IN WAGES WITHIN AND BETWEEN CELLS

Before examining heterogeneity between low- and high-wage establishments, I first more formally quantify how much of the variation in 10th percentile wages can be explained by fixed characteristics of establishments. In particular, I consider geography (commuting zone), industry (six-digit NAICS), and establishment size (nine categories defined above). In addition, I consider nonparametrically defined industry by commuting zone cells, which allows for distinct local averages for industries in different geographic areas, as well as industry by commuting zone by establishment size.

Table 3 shows the fraction of the variation in 10th percentile wages that can be accounted for by these fixed effects. Since I am interested in the maximal share of the variation that can be attributed to these fixed effects, I report the unadjusted R-squared, which provides a larger estimate than the R-squared that has been adjusted for the number of regressors. I include three sets of specifications. First, I include all establishments to include the largest sample (91,673 establishments). However, this leads to many industry by commuting zone cells with only one member, leading to an artificially high R-squared statistic. In the second column, I restrict the sample to establishments in industry by commuting zones with cells of at least three members, which cuts the sample to 49,578 establishments. Finally, in the last column I restrict the sample to establishments in cells of at least 10, which leaves a sample of 15,690.

In the first row, we see that common variation within commuting zones can account for at most 7 percent of the variation in 10th percentile wages. In contrast, in the second row we see that industries have more explanatory power, accounting for up to 30 percent of the variation. This is consistent with the density graphs in Figures 3 and 4, which show a substantial fraction of the variation in wages remaining after controlling for industry. In the third row, I investigate the

role of establishment size. Although establishment size has been closely linked with wages (see, for instance, Troske [1999]), size has little explanatory power in accounting for wages at the bottom of the wage distribution, explaining at most 0.4 percent.

I next turn to nonparametrically defined cells, which are defined as industry by commuting zone cells. These cells can account for substantially more of the variation, with as much as 60 percent of the variation in 10th percentile wages in the set of all establishments. However, many of these cells have only one member, which artificially inflates the unadjusted R-squared. If we instead consider the adjusted R-squared, it falls to 26 percent. When I instead restrict the data to cells that have at least 3 or 10 members, the gap between the unadjusted and adjusted R-squared is reduced. Thus, a conservative estimate is that about half of the variation in 10th percentile establishment wages can be accounted for by industry and commuting zone cells. In Appendix Table A2, I show that industry by geographic cells can account for at most 60 percent of the variation across a wide variety of wage statistics.

Finally, for completeness, I include cells defined as industry by commuting zone by establishment size bin. These more narrowly defined cells can explain a larger fraction of 10th percentile wages than industry and commuting zone alone. However, since more productive establishments may be able to grow larger, for my preferred specifications I do not condition on establishment size.

These results indicate that, although there are substantial commonalities in pay within industries, a significant fraction of the variation in 10th percentile wages occurs within narrowly defined industry by geography cells. This motivates the next section of the paper, in which I investigate how the wage and occupational structure differs across low- and high-wage establishments within these industry by geography cells.

COMPARING ESTABLISHMENTS

Now that I have established that a substantial fraction of the variation in 10th percentile wages remains after controlling for narrowly defined industry by geographic cells, I explore other characteristics that are correlated with paying comparatively low or comparatively high wages within these narrowly defined cells. What could be driving such heterogeneity? I focus on two distinct explanations: differences in compensation practices and differences in productivity.

Suppose low- and high-wage establishments are equally productive but high-wage establishments choose to share a larger fraction of the profits with workers. In this case, we should not see any systematic differences in the organizational structure of low- and high-wage establishments. This is the ideal scenario for minimum wage legislation, since low-wage establishments have enough of a profit margin to be able to afford to raise wages without requiring any reorganization or disemployment effects.

Alternatively, there could be substantive productivity differences between low- and high-wage establishments. The source of heterogeneity that I focus on in this paper is the occupational structure. If high-wage establishments organize production to have more employees performing high-skilled tasks or use more technology, this may indicate that low-wage establishments will need to reorganize to adapt to minimum wage increases.

However, there are other sources of productivity differences that I cannot disentangle from this data set. For instance, if high-wage establishments pay high wages in order to employ more productive employees, or if the higher wages induce more effort via efficiency wages, these establishments may be more productive. Each case has opposite implications for minimum wage legislation. If high-wage establishments employ the best workers, the scarcity of talent will prevent low-wage establishments from emulating high-wage establishments, making it difficult

for these low-wage establishments to adapt in response to a high-minimum wage. On the other hand, if high wages serve as efficiency wages, any low-wage worker could become more productive if given access to higher wages. For instance, if a living wage allows individuals to afford stable transportation and child care, this could lead to increased productivity.

It is worth emphasizing that the analysis rests on the assumption that these establishments are operating in the same product and labor markets. I argue that this is reasonable, since six-digit industry codes are quite specific. For instance, my analysis looks at differences between low- and high-wage limited service restaurants in Chicago. Although there may be substantial product differentiation, these establishments are producing similar enough products that it is reasonable to believe low-wage establishments could emulate the production process of high-wage establishments, and if low-wage establishments left the market, consumers could be expected to substitute to other such establishments.

HETEROGENEITY IN ORGANIZATIONAL STRUCTURE BETWEEN LOW- AND HIGH-WAGE ESTABLISHMENTS

Next, I compare wage statistics and occupational structure parameters between low- and high-wage establishments. As explained in the methodology section, I define low-wage establishments as those that pay below-median 10th percentile wages within their industry by commuting zone cell. That is, I compare characteristics between low- and high-wage establishments that are close substitutes—as close as possible—in the labor and product market.

Wage Structure of Establishments

In Table 4, I first examine various wage statistics. In the first row, we see that low-wage establishments pay 10th percentile wages that are 0.4 log points less than high-wage

establishments, which represents a difference of about 36 percent, or over $4 less per hour. Of course, since low-wage establishments are defined as those with below-median 10th percentile wages, they will mechanically pay lower 10th percentile wages. More interesting is the difference in wages between low- and high-wage establishments for higher-paid workers. At the 25th percentile wage, low-wage establishments pay about 30 percent less, which falls to 28 percent less at the 50th percentile wage, 26 percent at the 75th percentile wage, and only 21 percent less at the 90th percentile wage. Thus, although low-wage establishments pay lower wages to workers throughout the establishment hierarchy, the relative gap in wages lessens for individuals further up the wage hierarchy.

This is evident when we examine establishment wage inequality statistics. Here we see that the ratio of 90th percentile to 10th percentile log wages is 1.35 for high-wage establishments but 1.5 for low-wage establishments. Thus, although low-wage establishments pay lower wages throughout the hierarchy, their higher-wage workers are comparatively well paid, leading to more unequal wages. For both low- and high-wage establishments, the 90-50 ratio is larger than the 50-10 ratio, indicating that inequality is somewhat steeper at the top of the hierarchy compared to the bottom.

These results indicate that establishments do not appear to pay low wages to their bottom 10 percent of employees because they are transferring rents across workers within the establishment. Since even the highest paid individuals are paid less at low-wage establishments, it indicates that, if there are no productivity differences between low- and high-wage establishments, owners are earning more rents from workers throughout the hierarchy.

Occupational Structure of Establishments

Now that I have shown that there are wage differences between low- and high-wage establishments that permeate the whole organizational hierarchy, I turn to measures that can capture differences in the production process between low- and high-wage establishments. As discussed in the methodology section, I focus on the occupational distribution. Occupations provide a description of the tasks performed in the establishment, so examining differences in the shares of occupations provides a measure of the heterogeneity in how production is organized.

In Table 5, I compare occupational structures between low- and high-wage establishments. In the first row we see that while professional occupations comprise 32–34 percent of total employment in high-wage establishments, low-wage establishments employ 13 percentage points fewer. This represents a 38 percent difference. On the other hand, in all other occupational categories, low-wage establishments employ a larger share than high-wage establishments. Figure 5 shows these differences.

Thus, even though these establishments operate in the same local area (commuting zone) and produce in the same narrowly defined industry (six-digit NAICS by commuting zone cells), establishments that pay low wages to the bottom 10 percent of their employees produce using employees who perform a substantially different distribution of tasks, as measured by the occupational distribution.

What can we learn about these low-wage establishments' production process from the fact that they employ approximately 40 percent fewer individuals in professional occupations? Professional occupations include a variety of white-collar, cognitive-type occupations. These include management, business, and financial occupations, as well as engineers, scientists, skilled medical professionals, educators, and legal occupations. These occupations are primarily staffed with skilled individuals with specialized education. Thus, if establishments employ fewer

professional occupations, it indicates that they are organized to use labor that is lower skilled and less trained, suggesting that these establishments may be less productive.[4]

In addition, I examine whether low-wage establishments produce using less technology. As an indirect measure, I examine computer-related occupations, which are categorized under SOC codes 15.11xx. These include computer analysts, database administrators, computer support specialists, and other related occupations. If an establishment employs individuals in these occupations, it is an indicator that the production process in the establishment utilizes relatively more technology. There is evidence that at least in certain circumstances, adoption of IT can improve establishment productivity (see, for example, Bartel, Ichniowski, and Shaw 2007; Bresnahan et al. 2002). Nonetheless, since I am focusing on service sector establishments, on average I expect the take-up of these occupations to be relatively low. Indeed, in the summary statistics we see that, on average, these occupations comprise at most 3 percent of employment in establishments in this sector.

The last rows of Table 5 show that, on average, 3–4 percent of employment in high-wage establishments is in computer occupations, depending on the sample. By contrast, low-wage establishments are comprised of only 1–2 percent computer occupations on average, an approximately 50 percent lower share of computer occupations. Thus, although these occupations comprise a relatively small share of total service sector employment, establishments that pay below-median 10th percentile wages within industry by commuting zone cells have substantially fewer of these IT workers. This suggests that low-wage establishments produce using a less technology-intensive production process compared with high-wage establishments.

[4] Another possible explanation for the differences in occupational structure is outsourcing. If high-wage establishments are high-wage because they have outsourced the low-wage jobs, this could lead these establishments to have relatively fewer service, clerical, and production occupations, and relatively more professional and management occupations.

Management Structure of Establishments

Now that I have shown that low- and high-wage establishments operate using a substantially distinct wage and occupational structures in the same market, I next turn to the management structure. There are several reasons why the management structure may vary between low- and high-wage establishments. First, if an establishment is more centralized, we would expect to see a narrower span of control, since managers are exerting more control over their subordinates (e.g., Bolton and Dewatripont 1994). If employees sort between establishments, we would expect the high-wage establishments in the commuting zone to be able to employ higher-ability workers, who in turn are more likely to be able to perform more independently. Second, if managers sort between establishments, we would expect high-wage establishments to employ higher-skill managers, who in turn can supervise a wider span of control (Ortín‐Ángel and Salas‐Fumás 2002). Thus, both theories predict that high-wage establishments should have wider span of control. I first investigate differences in establishment size between low- and high-wage establishments and then turn to measures of supervisor and manager share of employment and measures of span of control.

In Table 6, I show that the average high-wage establishment has between 33 and 38 employees, depending on the sample. However, low-wage establishments have 7–10 additional employees compared to high-wage establishments, depending on the sample. This means within the same industry by commuting zone cell, low-wage service sector establishments are approximately 20 percent larger than high-wage establishments. This result is surprising and stands in stark contrast to a substantial literature that shows that larger employers tend to pay higher wages (Troske 1999). One possible explanation is that low-wage establishments employ a

higher share of part-time labor, which would inflate the employment numbers. This result warrants further investigation.

Next, I examine the share of managers and supervisors. I define managers as occupations coded in the management two-digit SOC group. Managers are contained within the broader group of professional occupations, which we saw were a substantially smaller share of employment in low-wage firms compared with high-wage firms. In contrast, supervisors are lower-level management positions, and are categorized with the occupation they directly supervise; thus, these individuals are contained within the service, clerical, or production occupational categories.

While managers comprise 10 percent of high-wage establishment employment, low-wage establishments are only 8 percent managers. This is smaller than the gap we see for professional occupations more broadly. On the other hand, when we examine the supervisor share, there are only slightly more supervisors in low-wage establishments compared with high-wage establishments.

Next, I examine measures of span of control, which is a way of summarizing the management structure of an occupation. It is defined as the number of subordinates per managerial worker. We can divide each establishment into a three-level hierarchy. At the bottom are all the employees who are neither supervisors nor managers, in the middle are all the supervisory workers and at the top are all the managerial workers. Thus, we can define three measures of span: 1) the ratio of the bottom level to the sum of the two top levels (supervisors + managers), 2) the ratio of the bottom level to the middle level, and 3) the ratio of the middle level to the top level.

We see that low-wage establishments have wider spans of control across all three measures. For both low-wage and high-wage establishments, the span of control is widest for supervisors (11–12 for high-wage, 15–16 for low-wage) and substantially lower for supervisors to managers (0.8 for high-wage, 1.0 for low-wage). Thus, on average, there are more managers than supervisors in high-wage establishments, compared with parity in low-wage establishments. However, for both measures, we see that low-wage establishments have span measures that are approximately 25–33 percent larger.

Thus, low-wage establishments are larger but also more bottom heavy, with more nonmanagerial workers, slightly more supervisors, and substantially fewer managers. This reflects the wider spans of control for managers and supervisors, in which each managerial worker is responsible (on average) for overseeing more employees. Despite this wider span of control, in Table A3 I show that managers in low-wage establishments are also paid substantially less than managers in high-wage establishments.

In contrast to theories of optimal hierarchy based on managerial talent, supervisors and managers in low-wage establishments both supervise wider spans of control and are lower paid. In contrast to theories of optimal hierarchy based on decentralization, we see wider spans of control at low-wage establishments, which, if individuals sort between establishments, are more likely to be staffed by less-skilled individuals.

One possible explanation for this anomalous result is that low-wage establishments may employ a larger share of part-time workers, which cannot be distinguished in the OES data. If this is the case, supervisors at low-wage establishments may be able to supervise a larger number of subordinates without additional managerial effort or talent. Nonetheless, we also see that there are more supervisors per managers at low-wage establishments. If this were due to more part-

time supervisors, we would expect to see supervisors comprise a substantially larger share of employment at low-wage establishments, which is not the case. Thus, while part-time work may explain some of the differences in span of control measures between low-wage and high-wage establishments, there are likely additional factors at play.

CONCLUSIONS

In this paper I have documented that over half of the variation in 10th percentile wages occurs within narrowly defined industry and geographic cells. I find that establishments that pay below-median 10th percentile wages for the cell pay lower wages to all workers and are more unequal. These wage results indicate that establishments that pay low wages to their bottom decile are not simply transferring rents between employees.

Instead, I find evidence that these establishments produce using a substantively different production process—namely, employing a smaller share of professional occupation and IT occupations. This is suggestive evidence that these low-wage establishments may pay lower wages in part because they are less productive overall. If this is true, adapting to increases in the minimum wage may require more than simply reducing profits. If it is relatively easy for these establishments to mimic high-wage establishments, we may see minimum wage increases spur these establishments to modify their production process, potentially increasing their productivity overall.

However, it may be difficult for establishments to modify their productivity. For instance, if high-wage establishments are more productive because they employ higher-skill employees, scarcity of talent in the labor market will prevent low-wage establishments from simply hiring higher-skill employees. In addition, the occupational structure may reflect investment in a

particular production process or organizational structure, which may be difficult to change. In these cases, we are more likely to see establishment exit in response to minimum wage increases.

Although there is little evidence that establishments have exited in response to past minimum wage increases (Belman and Wolfson 2015), this will depend on the magnitude of the minimum wage increase as well as market conditions. Nonetheless, my results suggest that these affected establishments are more likely to be selected from the less-productive tail of the establishment distribution. Thus, even if minimum wage increases are large enough to induce firm exit, such exit is more likely to serve as a mechanism for creative destruction, opening up the market for entry or expansion by higher-productivity firms.

Although this paper is descriptive, several conclusions may be useful for economic development policy. First, for local areas considering implementing a local minimum wage ordinance, a reasonable target would be a minimum wage that is low enough that some establishments within narrowly defined industries (such as limited service restaurants) already pay wages above the threshold. This ensures that the wage is sustainable and allows employers to have a reasonable opportunity for adjustment. Second, since any minimum wage increase has the possibility of causing firms to reorganize or shut down, policymakers should be prepared to offer targeted retraining, job search assistance, or other active labor market policies to individuals employed in industries that are more likely to be affected. This can help minimize the cost of adjustment falling most heavily on the low-wage individuals who were intended to benefit from the higher wages.

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Table 1 List of Service Sector Industries (two-digit NAICS)

NAICS	Industry group
22	Utilities
48	Transportation
49	Warehousing
51	Information
52	Finance and Insurance
53	Real Estate Rental and Leasing
54	Professional, Scientific, and Technical Services
55	Management of Companies and Enterprises
56	Administrative and Support and Waste Management and Remediation Services
61	Educational Services
62	Health Care and Social Assistance
71	Arts, Entertainment, and Recreation
72	Accommodation and Food Services
81	Other Services (except Public Administration)

SOURCE: Author's calculations.

Table 2 Summary Statistics

	Cell >=10				Cell >=3				All establishments			
	Mean	SD	p10	p90	Mean	SD	p10	p90	Mean	SD	p10	p90
10th ptile. wage	13.52	7.81	8.07	21.14	13.11	7.20	8.07	21.14	12.84	6.71	8.07	21.14
50th ptile. wage	21.10	16.05	8.57	43.27	19.98	14.26	8.54	34.15	19.30	13.08	8.54	34.15
90th ptile. wage	43.89	38.20	13.15	88.10	40.54	34.90	13.15	88.10	38.59	32.86	13.15	69.01
Total emp.	39.42	178.05	5.00	69.00	34.32	172.57	5.00	69.00	30.78	151.93	5.00	55.00
Mgr. share	0.10	0.11	0.00	0.23	0.10	0.11	0.00	0.23	0.10	0.11	0.00	0.23
Sup. share	0.05	0.07	0.00	0.14	0.05	0.07	0.00	0.14	0.05	0.07	0.00	0.15
Computer share	0.03	0.14	0.00	0.03	0.03	0.12	0.00	0.01	0.02	0.11	0.00	0.00
Prof. share	0.32	0.35	0.00	0.88	0.30	0.34	0.00	0.87	0.29	0.34	0.00	0.86
Service share	0.43	0.42	0.00	1.00	0.38	0.41	0.00	1.00	0.34	0.41	0.00	1.00
Clerical share	0.21	0.28	0.00	0.67	0.24	0.29	0.00	0.73	0.25	0.29	0.00	0.75
Production share	0.05	0.16	0.00	0.10	0.08	0.21	0.00	0.31	0.11	0.25	0.00	0.57
Observations		15,690				49,578				91,673		
Span	7.82	17.43	0.91	16.00	7.37	14.57	1.00	15.25	7.11	13.14	1.00	15.00
Observations		13,008				40,197				70,871		
Non-sup. to sup.	12.26	21.83	2.60	23.75	11.55	18.65	2.50	23.00	11.08	16.94	2.50	22.00
Observations		8,612				26,739				46,525		
Sup. to mgrs.	0.83	1.85	0.00	2.00	0.81	1.77	0.00	2.00	0.79	1.72	0.00	2.00
Observations		10,785				32,778				55,974		

NOTE: Cells are defined by the number of establishments of the same industry in the same commuting zone. The span of control is the ratio of nonmanagerial employment to managers, while non-sup. to sup. is the ratio of nonmanagerial employment to supervisors and sup. to mgrs. is the ratio of supervisors to managers.
SOURCE: Author's calculations.

Table 3 R-Squared from Fixed Effect Regressions on 10th Percentile Establishment Wages

	All establishments		Cells >=3		Cells >=10	
Specification:	R-sq.	Adj-R sq.	R-sq.	Adj-R sq.	R-sq.	Adj-R sq.
Comm. zone FE	0.068	0.060	0.070	0.059	0.068	0.061
Industry FE	0.265	0.262	0.282	0.278	0.304	0.299
Est. size FE	0.002	0.002	0.003	0.003	0.004	0.004
Industry × comm. zone FE	0.608	0.260	0.514	0.410	0.421	0.384
Industry × comm. zone × Est. size FE	0.785	0.153	0.727	0.369	0.609	0.421
Observations	91,673		49,578		15,690	

NOTE: Each entry reports the R-squared and adjusted R-square from a separate regression. Specifications include industry, commuting zone, and establishment size fixed effects. Cells are defined by the number of establishments of the same industry in the same commuting zone.
SOURCE: Author's calculations.

Table 4 Wage Differences between Low- and High-Wage Establishments

Dependent variable	Independent var.	Cell >=10	Cell>=3
10th percentile wages	Low-wage est.	−0.44***	−0.042***
		(0.02)	(0.01)
	Constant	2.59***	2.56***
		(0.00)	(0.00)
25th percentile wages	Low-wage est.	−0.35***	−0.034***
		(0.02)	(0.01)
	Constant	2.71***	2.68***
		(0.00)	(0.00)
50th percentile wages	Low-wage est.	−0.33***	−0.031***
		(0.02)	(0.01)
	Constant	2.92***	2.88***
		(0.00)	(0.00)
75th percentile wages	Low-wage est.	−0.30***	−0.026***
		(0.02)	(0.01)
	Constant	3.18***	3.13***
		(0.00)	(0.00)
90th percentile wages	Low-wage est.	−0.24***	−0.22***
		(0.03)	(0.01)
	Constant	3.50***	3.44***
		(0.00)	(0.00)
Average wage	Low-wage est.	−9.48***	−8.29***
		(0.60)	(0.37)
	Constant	26.08***	24.27***
		(0.10)	(0.06)
90-10 ratio	Low-wage est.	0.15***	0.15***
		(0.01)	(0.01)
	Constant	1.35***	1.35***
		(0.00)	(0.00)
90-50 ratio	Low-wage est.	0.05***	0.05***
		(0.01)	(0.00)
	Constant	1.20***	1.20***
		(0.00)	(0.00)
50-10 ratio	Low-wage est.	0.07***	0.07***
		(0.00)	(0.00)
	Constant	1.12***	1.12***
		(0.00)	(0.00)
Observations		15,690	49,578

NOTE: Each cell reports the coefficients and standard errors from a separate regression with indicators for low-wage establishments and industry-by commuting zone fixed effects. All specifications are weighted, and standard errors are clustered at the commuting zone level.
SOURCE: Author's calculations.

Table 5 Occupational Distribution

Dependent variable	Independent var.	Cell >=10	Cell>=3
Professional share	Low-wage est.	−0.13***	−0.11***
		(0.01)	(0.01)
	Constant	0.34***	0.32***
		(0.00)	(0.00)
Service share	Low-wage est.	0.04***	0.04***
		(0.01)	(0.01)
	Constant	0.42***	0.38***
		(0.00)	(0.00)
Clerical share	Low-wage est.	0.06***	0.05***
		(0.01)	(0.00)
	Constant	0.20***	0.23***
		(0.00)	(0.00)
Production share	Low-wage est.	0.03***	0.02***
		(0.00)	(0.00)
	Constant	0.04***	0.07***
		(0.00)	(0.00)
Computer occupations share	Low-wage est.	−0.02***	−0.02***
		(0.00)	(0.00)
	Constant	0.04***	0.03***
		(0.00)	(0.00)
Observations		15,690	49,578

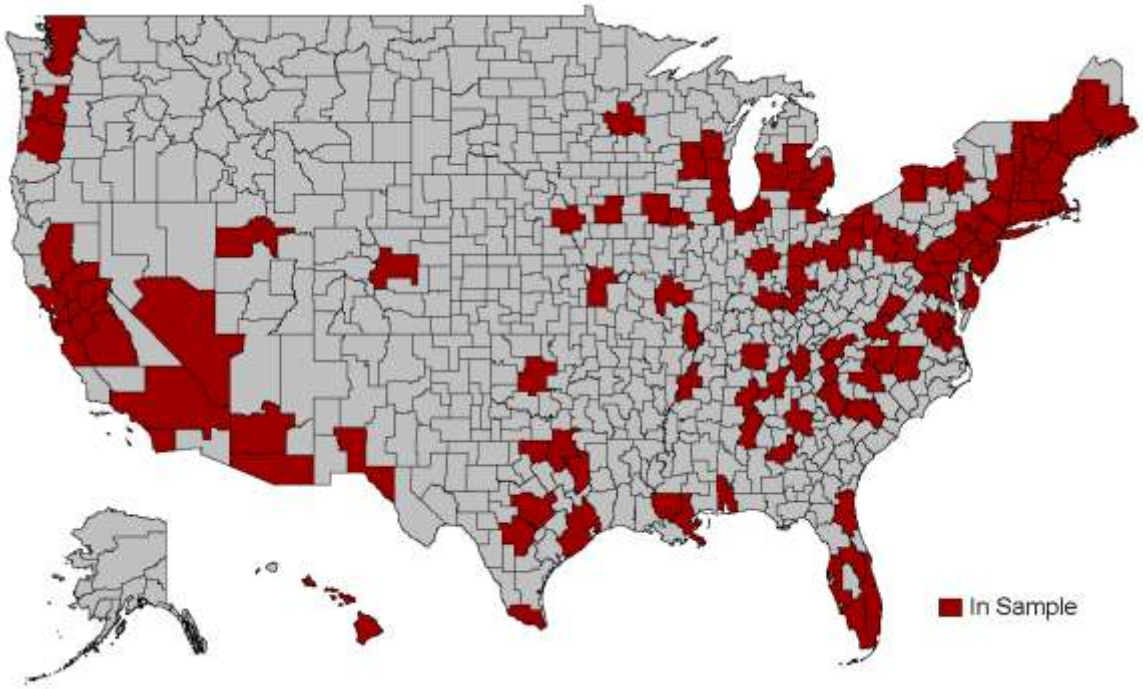
NOTE: Each cell reports the coefficients and standard errors from a separate regression with indicators for low-wage establishments and industry-by commuting zone fixed effects. All specifications are weighted, and standard errors are clustered at the commuting zone level.
SOURCE: Author's calculations.

Table 6 Management Structure

Dependent variable	Independent var.	Cell >=10	Cell>=3
Total employment	Low-wage est.	7.11***	10.08***
		(2.38)	(1.96)
	Constant	38.19***	32.77***
		0.41	0.3
	Observations	15,690	49,578
Manager share	Low-wage est.	−0.02***	−0.02***
		(0.01)	(0.00)
	Constant	0.10***	0.10***
		(0.00)	(0.00)
	Observations	15,690	49,578
Supervisor share	Low-wage est.	0.004	0.005**
		(0.00)	(0.00)
	Constant	0.05***	0.05***
		(0.00)	(0.00)
	Observations	15,690	49,578
Span (all nonmanagers to managers)	Low-wage est.	3.78***	3.13***
		0.56	0.3
	Constant	7.20***	6.89***
		(0.09)	(0.30)
	Observations	13,008	40,197
Sup. span (all nonmanagers to supervisors)	Low-wage est.	3.99***	3.41***
		0.73	0.44
	Constant	11.67***	11.06***
		(0.11)	(0.06)
	Observations	8,612	26,739
Manager span (supervisors to managers)	Low-wage est.	0.19***	0.25***
		0.04	0.04
	Constant	0.79***	0.77***
		(0.01)	(0.01)
Observations		10,785	32,778

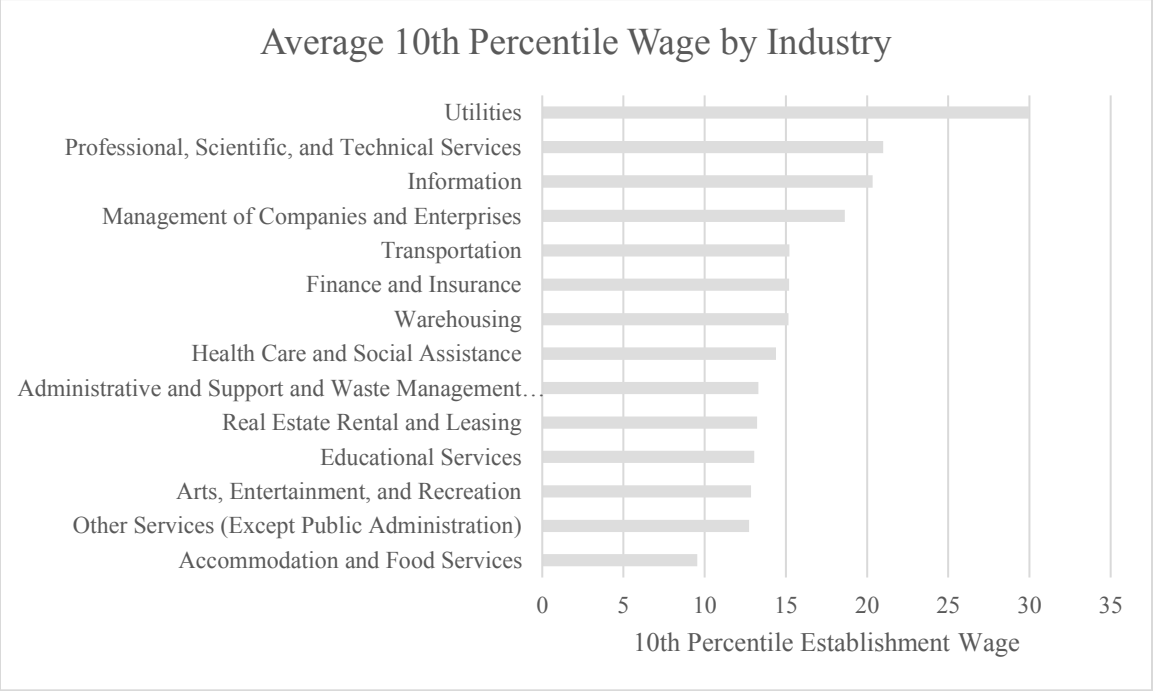
NOTE: Each cell reports the coefficients and standard errors from a separate regression with indicators for low-wage establishments and industry-by commuting zone fixed effects. All specifications are weighted, and standard errors are clustered at the commuting zone level. The number of observations changes with specifications, because not all establishments employ individuals in management or supervisory occupations.
SOURCE: Author's calculations.

Figure 1 Commuting Zones in 10-Establishment Cell Sample



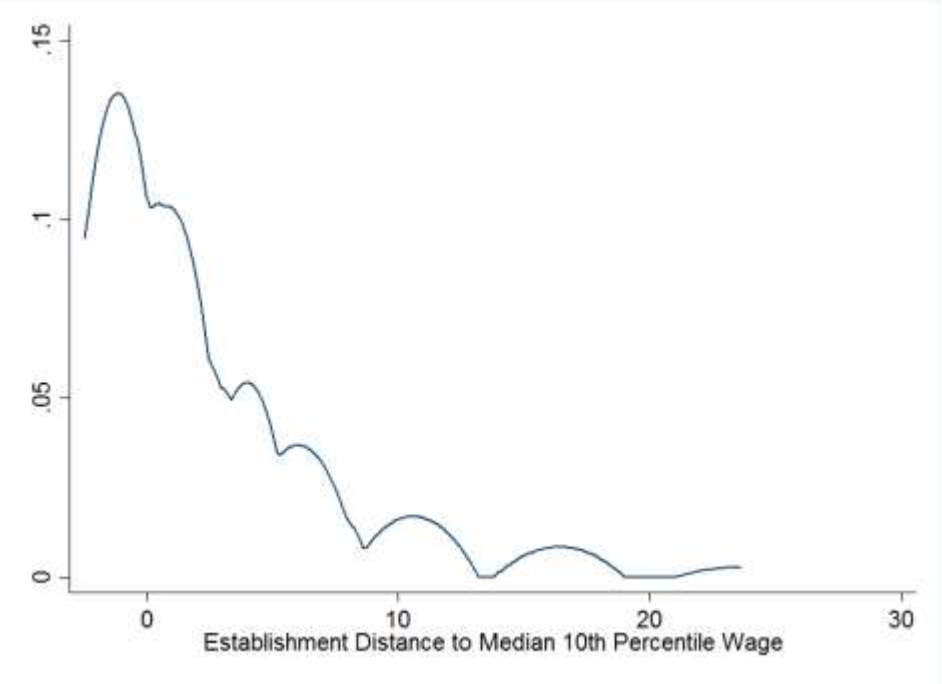
SOURCE: Author's calculations.

Figure 2 Average 10th Percentile Establishment Wages, by Industry, for 10-Establishment Cell Sample



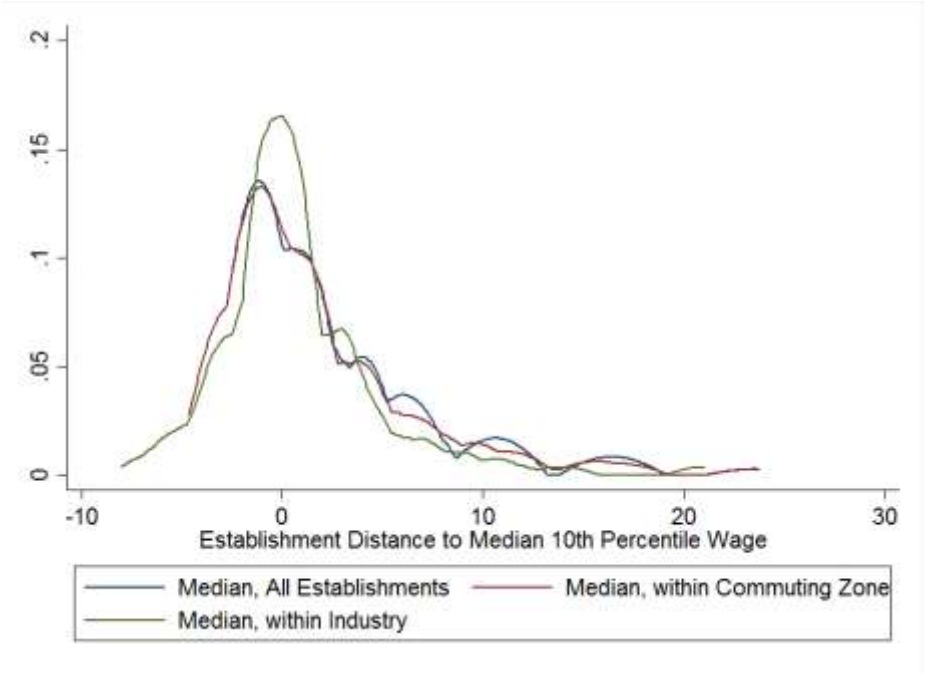
SOURCE: Author's calculations.

Figure 3 Kernel Density of Distance between Establishment 10th Percentile Wage and Median 10th Percentile Wage for All Establishments



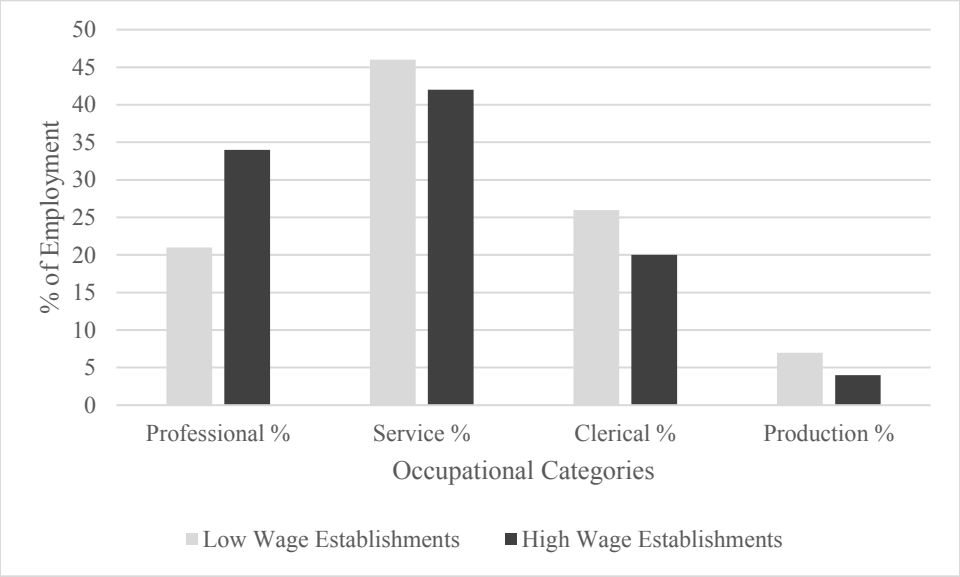
SOURCE: Author's calculations.

Figure 4 Kernel Density of Distance between Establishment 10th Percentile Wage and Median 10th Percentile Wage, for All Establishments, by Commuting Zone, and by Industry



SOURCE: Author's calculations.

Figure 5 Distribution of Employment across Occupational Categories



NOTE: Low-wage establishments indicate establishments that pay below-median 10th percentile wages within industry by commuting zone cells, for the 10-cell establishment sample.
SOURCE: Author's calculations.

Table A1 May 2016 OES Wage Bins

	Hourly wage	Annual salary
Range A	Under $9.25	Under $19,240
Range B	$9.25–$11.74	$19,240–$24,439
Range C	$11.75–$14.74	$24,440–$30,679
Range D	$14.75–$18.74	$30,680–$38,999
Range E	$18.75–$23.99	$39,000–$49,919
Range F	$24.00–$30.24	$49,920–$62,919
Range G	$30.25–$38.49	$62,920–$80,079
Range H	$38.50–$48.99	$80,080–$101,919
Range I	$49.00–$61.99	$101,920–$128,959
Range J	$62.00–$78.74	$128,960–$163,799
Range K	$78.75–$99.99	$163,800–$207,999
Range L	$100.00 and over	$208,000 and over

SOURCE: Bureau of Labor Statistics documentation.

Table A2 R-Squared for Additional Dependent Variables

	All establishments		Cells >=3		Cells >=10	
Dependent variable:	R-sq	Adj-R-sq	R-sq	Adj-R-sq	R-sq	Adj-R-sq
10th ptile. wage	0.61	0.26	0.51	0.41	0.42	0.38
25th ptile. wage	0.63	0.30	0.55	0.45	0.47	0.43
50th ptile. wage	0.66	0.35	0.59	0.50	0.52	0.49
75th ptile. wage	0.67	0.38	0.60	0.51	0.54	0.51
90th ptile. wage	0.70	0.44	0.63	0.55	0.60	0.57
Average wage	0.73	0.49	0.67	0.60	0.63	0.61
90-10 ratio	0.63	0.30	0.53	0.42	0.47	0.44
90-50 ratio	0.58	0.21	0.45	0.33	0.37	0.33
50-10 ratio	0.61	0.27	0.49	0.39	0.42	0.38
Manager share	0.62	0.29	0.48	0.37	0.39	0.35
Supervisor share	0.61	0.27	0.45	0.34	0.33	0.29
Computer occs. share	0.77	0.56	0.73	0.68	0.70	0.69
Professional share	0.84	0.69	0.79	0.74	0.78	0.77
Service share	0.91	0.83	0.88	0.86	0.87	0.86
Clerical share	0.82	0.66	0.76	0.70	0.70	0.68
Production share	0.87	0.76	0.75	0.69	0.51	0.48
Total employment	0.31	-0.29	0.25	0.09	0.14	0.09
Observations	91,673		49,578		15,690	

NOTE: Each entry reports the R-squared and adjusted R-square from a separate regression. All specifications include industry by commuting zone fixed effects. Cells are defined by the number of establishments of the same industry in the same commuting zone.
SOURCE: Author's calculations.

Table A3 Wages for Subgroups of Occupations

Dependent variable	Independent var.	Cells >=10
10th ptile. mgmt. wages	Low-wage est.	−0.16***
		(0.03)
	Constant	3.22***
		(0.00)
	Observations	13,008
10th ptile. non-mgmt. wages	Low-wage est.	−0.42***
		(0.02)
	Constant	2.58***
		(0.00)
	Observations	10,767
10th ptile. low-wage occs.	Low-wage est.	−0.23***
		(0.02)
	Constant	2.51***
		(0.00)
	Observations	13,335
10th ptile. mid-wage occs.	Low-wage est.	−0.34***
		(0.02)
	Constant	2.72***
		(0.01)
	Observations	13,335
10th ptile. high-wage occs.	Low-wage est.	−0.15***
		(0.03)
	Constant	3.32***
		(0.01)
	Observations	12,095

NOTE: Each cell reports the coefficients and standard errors from a separate regression with indicators for low-wage establishments and industry-by commuting zone fixed effects. Each dependent variable is defined as the 10th percentile wage among individuals employed in the occupation of interest within the establishment. Low-wage occupations are defined as the five major occupations with lowest median wages (Healthcare support, Food Preparation and Serving Related, Building and Grounds Cleaning and Maintenance, Personal Care and Service, Sales and Related, Farming, Fishing, and Forestry), high-wage occupations are the five major occupations with the highest median wages (Management, Business and Financial, Computer and Math, Architecture and Engineering, Life, Physical, and Social Sciences, and Legal), and mid-wage occupations are the balance. All specifications are weighted, and standard errors are clustered at the commuting zone level. The number of observations changes with specifications, because not all establishments employ individuals in all occupational categories.
SOURCE: Author's calculations.