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Employer Size and Supervisor Earnings: Evidence from Britain

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Using British linked employer-employee data, we show that the establishment size effect for supervisors is approximately twice that for non-supervisors. This difference is routinely statistically significant, not explained by other controls and is an important determinant of the difference in earnings between supervisors and non-supervisors. Moreover, we use separate British longitudinal data to confirm both the statistically different effect and that it is not explained by worker fixed effects. Event study evidence and information on skill match suggest that the larger return to supervisors reflects, in large part, match specific returns supporting the view that talented supervisors receive a return on that talent only with larger employers.

Keywords; Supervisor; Hierarchy; Size Wage Effect

JEL Codes: M52, D22

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1. Introduction

Economists have long debated why larger employers pay higher wages. At least seven theoretical explanations have been tested and often found wanting (Oi and Idson 1999; Brown and Medoff 1989; Groshen 1991; Belfield and Wei 2004). Indeed, Fox (2009 pp. 83-84) argues that the failure of economists to satisfactorily explain firm-size wage gaps means we simply do not understand key features of how firms and labor markets work. This paper helps improve that understanding by returning to the vein of theory explored by Fox suggesting that the size effect is largely a hierarchical phenomenon. Larger employers typically have both larger hierarchies and wider spans of control. The return to superior management is greater for these employers and so efficient assignment argues that more talented managers should match with larger employers (Tervio 2008; Gabaix and Landier 2008). We provide a series of indirect tests of this hypothesis.

Using linked employer-employee data from Britain, we find substantially larger returns to employer size for those with supervisory duties. We also confirm a tie between the employer size and skills matching that differ for supervisors. We then examine British longitudinal worker data to both confirm the larger returns for those with supervisory duties and to demonstrate that it persists in the face of worker fixed effect estimates. The two sets of estimates support hierarchy theory by revealing that a disproportionate share of the employer size effect is concentrated among those with supervisory duties. The fact that the result persists in the face of worker fixed effects means that unobserved but time invariant ability is not driving the results. The return may to be effort, learned skills or the match quality *per se* but is not simply a universal ability return (Idson and Feaster 1990). We carefully examine the timing of the wage increase associated with changing jobs to a larger employer and show that this increase for supervisors seems concentrated at the time of the change in a way that is not true for non-supervisors. This hints that it may not be the opportunities for learning on the

new job as much as it is the return to match quality. Thus, we argue that the size premium reflects, in part, that talented supervisors receive a return on that talent only with larger employers.

In what follows, the next section reviews the literature on the size effects with an eye to the importance of hierarchical explanations. The third section presents the data and variables from our two data sources. The fourth section describes the methodology and our key results. The fifth section concludes.

2. The Role of Hierarchy in the Literature

For more than a century economists have observed that larger firms pay higher wages (Moore 1911). The extent, size and source of this correlation have been extensively studied. Brown and Medoff (1989) show that holding worker characteristics constant, doubling firm size is associated with a wage increase from 1.5% to 3.8%. Troske (1999) emphasizes the distinction between plant size and firm size showing that the former is at least as large. Moving workers from a standard deviation below to one standard deviation above the mean plant size generates 13% higher wages while a similar move around the mean firm size generates 11% higher wages. In related work, Bayard and Troske (1999) confirm significant and positive plant size wage premia for manufacturing, retail trade and service industries. Moreover, they emphasize the similarity of the magnitude of the plant size wage premia across all three of these broad sectors. Thus, in contrast to the differences they find in the firm size wage premium, they claim that broad industrial differences do not account for the size, persistence and regularity of the plant (establishment) size wage premium. This emphasis on plant size follows Mellow (1982) who earlier found an unexplained wage effect of 14% associated with moving an otherwise equal (in observables) worker from an establishment with 25 employees to one with more than 1000 employees.

While these results come from the United States, similar evidence exists for many countries. An unexplained establishment size effect has been found for the UK (Main and Reilly 1993; Green et al. 1996; Manning 2003), for Canada (Morissette 1993; Reilly 1995), for Germany (Schmidt and Zimmerman 1991; Gerlach and Schmidt 1995; Andrews et al. 2012), for Austria (Winter-Ebmer 2001; Gruetter and Lalive 2009), for France (Abowd et al. 1999; Fakhfakh and Fitzroy 2006), for Switzerland (Winter-Ebmer and Zweimuller 1999), for Italy (Brunelllo and Colussi 1998), for Nordic countries (Albaek et al. 1998; Pehkonen et al. 2017), for a cross-section of five European countries (Lallemand et al. 2007), for a cross-section of nine OECD countries (Gibson and Stillman 2009), for Latin-American countries (Mizala and Romaguera 1998), and for developing African countries (Strobl and Thornton 2004).

Indeed, the establishment size effect on earnings proves both important in magnitude and remarkably persistent across time and location. Yet, the cause of the effect has been highly disputed. It may reflect higher costs of turnover or monitoring in larger firms, rent sharing, compensating wage differentials, the strength of unions or the ability to specialize (Oi and Idson 1999; Belfield and Wei 2004; Molina-Domene 2017). While these and related theories suggest the size effect is broadly spread across workers and types of jobs, hierarchical theory suggests otherwise. This theory suggests that size is largely relevant only for those in supervisory positions. Larger size brings greater spans of control, more workers to supervise, and also taller hierarchies. Administrative and supervisory tasks in such an environment may influence profit to a greater extent and, importantly, require greater responsibility and skill.

Meagher and Wilson (2004) test an implication of this theory about how the size effect is distributed. They examine a cross-section of Australian workers showing that the employer size effect is significantly larger among those with supervisory duties. Moreover,

the difference in the returns they find is not explained by the other available controls. While a valuable contribution, it potentially remains consistent with the earlier observation that larger employers hire workers with greater researcher unobserved ability (Abowd et al. 1999) and that the relevant unobserved ability is mostly managerial. In this view, the larger premium for managers reflects larger firms simply hiring superior managers, and the resultant wage increase reflects sorting on ability.

Fox (2009) adds to this by showing that in both the United States and Sweden firm size wage gaps increase with job responsibility. This proves consistent with a hierarchical model in which white-collar workers advance with age in hierarchies and supervise workers (Garicano and Rossi-Hansberg 2004, 2006). Indeed the wage-gaps of white-collar workers increase with age because the managers at larger firms supervise increasingly more workers as they age.

In an important case study, Smeets and Warzynski (2008) and Smeets et al. (2017) find that large spans of control are associated with higher wages within a large high-tech European firm. Caliendo et al. (2015) use data from French manufacturing firms and find that growing firms add hierarchical levels that increase pay dispersion.

More generally, and also supportive of Fox, Mueller et al. (2017) use proprietary pay surveys matched to administrative data to examine pay inequality within firms. They show that pay differentials between jobs (not workers) that involve no managerial responsibility are invariant to firm size. At the same time, the pay disparity between jobs with managerial responsibility and those without grows dramatically with firm size. This hints that there may be more going on than a return to ability alone, as the managerial jobs in larger establishments and the skills required for them differ as reflected by internal wage setting independent of who fills those jobs. Thus, while both an examination of workers and of jobs

argues for the importance of hierarchy theory, open questions remain about the extent to which sorting on unchanging ability drives the results.

We provide the first British examination using both linked employer-employee data and longitudinal data. In the linked data we show that the return to employer size for those with supervisory duties is roughly twice as large as for those without. This difference is routinely statistically significant, not explained by other controls and an important determinant of the difference in earnings between supervisors and non-supervisors. The data also reveals that the pattern of skills matching and the employer size premium differs between supervisors and workers. The longitudinal data also presents a statistically larger return to employer size for supervisors. Importantly, it continues to do so when holding constant individual worker fixed effects. Thus, a given manager moving to a larger employer has a larger percentage increase in earnings than a given non-manager moving to a larger employer.

This suggests to us two possible (and not mutually exclusive) possibilities. Either there is a rapid learning by doing that happens for supervisors at larger workplaces that is rewarded or there are match specific returns to skilled supervisors and larger workplaces. We shed light on these possibilities by first showing that the difference between supervisors and non-supervisors in the fixed-effect estimate is driven entirely by those changing jobs. We then focus on those moving from a smaller to a larger firm in a modified event study. We show that the supervisors have a greater discontinuity at the time of change than the non-supervisors. The latter show a more gradual increase after the change. This suggests that the larger managerial increase may, indeed, reflect match specific returns. The general idea of match specific returns is common in labor economics having been used to explain inter-industry earnings structures (Kim 1998) and returns to degrees (Belman and Heywood 1997) among other labour market issues. The point would be that skilled supervisors are only able

to use and be rewarded on that skill in a larger employer. We see this as both a potentially integral part of understanding hierarchies and as consistent with the empirical evidence we present.

3. Data and Variables

Our initial analysis is based on data from the 2011 Workplace Employment Relations Survey (WERS), a stratified sample of British workplaces (Van Wanrooy et al. 2013). WERS links establishment level questions asked of senior managers with questionnaires from 25 randomly selected employees in each workplace, or from all employees in workplaces with fewer than 25. This link makes it a strong dataset and provides firm level control variables not available in typical worker surveys. To reflect sampling, we use establishment weights to be representative of the population.[1]

Each employee is asked "*Do you supervise any other employees? A supervisor, foreman or line manager is responsible for overseeing the work of other employees on a day-to-day basis*" Yes/No. Employees are also asked "*How much do you get paid for your job here, before tax and other deductions are taken out? If your pay before tax changes from week to week because of overtime, or because you work different hours each week, think about what you earn on average*". Respondents report within 14 bands representing weekly income. The ranges approximate decile bands and the top and bottom 5% of the earnings distribution as estimated from the New Earnings Survey. While 14 carefully chosen bands provide substantial variation, we implement interval regression to avoid biased estimates.

We also know the respondents' usual weekly working hours. To reduce participation issues, we restrict the sample to full-time employees (>=30 hours per week) aged 18-65 years although we will experiment with the treatment of hours. The critical employer size variable

[1] The management questionnaire response rate was 46 percent yielding 1680 workplaces, while the employee questionnaire response rate was 54 percent yielding 21981 employees.

comes from the establishment level questionnaire and identifies the total number of workers in the establishment (matching Meagher and Wilson 2004). After dropping observations with missing data, we have 14,420 workers in 1,813 workplaces.

Our second data examination uses the combined British Household Panel Study (BHPS) and Understanding Society (US) data. The BHPS is random sample of approximately 10,000 individuals in 5,500 households, later, in 1999, increased to 16,000 individuals in 9,000 households. US is the follow-on to the BHPS covering the period 2009 onwards covering approximately 100,000 individuals in 50,000 households. BHPS households comprise a subset of the US sample and can be followed, except for in the first wave of US where the unique BHPS identifier is unavailable. In our main estimates we limit our sample to the BHPS individuals and follow them in the US sample. We stress that our results are materially unaffected by including all individuals from the US sample. We focus on the employed and exclude self-employed workers. We follow the same additional sample selection decisions as for WERS including focusing on full-time workers aged 18-65 years.

Every wave each employed individual is asked *"Do you have any managerial duties or do you supervise any other employees?"* Individuals can provide mutually exclusive responses that they are a manager, a foreman/supervisor, or that they are not a manager or a supervisor. We note that taking both positive responses as supervisors may include some managers without supervisory responsibilities and recognize this as a potential measurement error. The alternative of excluding managers seems even more fraught with error as the alternative in the breakdown so closely associates supervisor with foreman. This may cause many higher level supervisors to identify as a manager. Thus, we choose the broader definition of both positive responses. The BHPS and US have a range of information on wages and hours worked from which we can compute hourly wages for each respondent-year observation. The employer size question is asked of workers and the responses are in bands.

It asks "*How many people are employed at the place where you work?*" The answers are given in intervals, 1-2; 3-9; 10-24; 25-49; 50-99; 100-199; 200-499; 500-999; and 1000 or more. Some small number of individuals answer either "don't know but fewer than 25" or "don't know but 25 or more". We exclude these individuals from our analysis. As a result of our restrictions, we are left with an estimating sample of 169,895 from 1991 to 2016.

Appendix Table A1 presents descriptive statistics showing a reasonably broad representation across the size categories. Moreover, the supervisors and workers look relatively 'balanced' across a number of key workplace/employment characteristics even as they differ in obvious personal characteristics such as education, wages and age.

4. Methodology and Results

4.1 Linked Data

When using the WERS, we estimate a maximum likelihood interval regression (Stewart 1983) of this underlying model:

$$y_{ih} = \beta_0 + \beta_1 Size_h + \beta'_2 \boldsymbol{x}_{ih} + \beta'_3 \boldsymbol{w}_h + \varepsilon_{ih} \qquad (1)$$

The dependent variable y_{ih} is the log-hourly pay of individual *i* in establishment *h*. The estimated coefficients from the interval regression can be interpreted directly as they reflect the underlying unobserved continuous model (1). We estimate separately for supervisors alone and for workers alone. We also estimate a fully interacted specification that tests the statistical difference in the coefficients between workers and supervisors. Our attention is on the difference in the coefficient on *size*.

The vector of individual controls $\boldsymbol{x}_{ih}$ includes employee age and its square, tenure and its square, dummies for gender, married or cohabitating, union membership, six educational qualification dummies and one vocational qualification dummy, two dummies capturing a

permanent or temporary job (vs. 'fixed period' job), and eight occupation dummies. Workplace controls $\boldsymbol{w}_h$ include dummies for being part of a larger organization or a single independent establishment (vs. 'sole UK establishment of a foreign organisation'), the percentages of the eight occupational groups, the percentages female, part-time and union, eleven industry dummies and nine region dummies. Table 1 presents selected descriptive statistics.

INSERT TABLE 1

Table 2 presents initial results. In all log-linear estimates we divide size by 10,000 to avoid very small coefficients. Thus, in column one, every 100 additional workers is associated with a .0085 increase in log wages for supervisors but only a .0046 increase for workers (Column 2). The stacked interaction in Column 3 estimate shows virtually the same difference but indicates it is a significantly different from zero. In columns 4 - 6 we repeat the estimates using the natural log of employer size. Here the supervisor sample takes a coefficient .064 and that for workers is statistically smaller and only .018. Interestingly, the worker estimate is identical to that found by Meagher and Wilson (2004) for Australia even as our supervisor estimate is larger than their estimate of .042.

INSERT TABLE 2

In columns 7 to 9 we report estimates from a more flexible log-linear model. The dependent variable is the log of *weekly* earnings with the log of weekly hours moved to the right hand side as a control variable. This could be highly relevant as supervisors typically have salaries that are less responsive to increases in hours. If so, this may influence both the weekly return to hours worked and the estimated coefficient on firm size. Indeed, the

coefficient on log hours is smaller for supervisors as shown but it does not dramatically alter the return to firm size. This continues to be roughly twice as large for supervisors.[2]

While these different functional forms tell the same basic story, we also explore a substantial change in sample. Although establishment size effects have been observed in governmental and non-profit sectors (Belman and Heywood 1990), we now limit the sample to only those establishments trading goods in markets. The final panel of Table 2 shows an even larger difference with every additional 100 workers associated with approximately a .0135 increase in log wages for supervisors but only a .0060 increase for workers.

In an effort to tie the results more closely to hierarchy, we experimented with a constructed measure of supervisory intensity. For each establishment we use the individual data to construct the share of all workers who were supervisory. Our thinking is that if the span of control increases in larger firms, there may be a smaller share of managers. It would be implied that span of control was important if including managerial intensity reduces the return to size for supervisors. Our experiments routinely showed no role for managerial intensity and no meaningful change in the return to size for supervisors. On reflection, this seems unlikely to rule out the role of the span of control. First, we recognize that the height of the hierarchy also grows with firm size and that this implies more managers in larger firms. Indeed, we found a correlation of only -0.04 between the share of supervisors and size. Second, our measure of intensity is based on relatively few workers per establishment and may simply be too noisy to be informative.

As a further examination, WERS contains workers and supervisors in the same workplace. Thus, we construct an average establishment wage differential (taking mid-points) between supervisors and workers. By differencing we aim to create a dependent variable that controls for unobserved firm specific effects influencing the wages of both supervisors and

[2] This pattern remains in a flexible log-log specification and when expanding the sample to anyone working more than 24 hours per week.

workers. We include all the establishment controls and averaged differences of relevant worker controls. This alternative strategy confirms previous results. Increases in establishment size greatly increase the average difference in earnings (see Table 3). To take a dramatic example, the increased gap associated with 1000 more workers is .125 log wages holding other determinants constant. This is larger than what was implied by the separate estimates of supervisors and managers and represents a large share of the .303 average difference in log wages between supervisors and workers.

INSERT TABLE 3

Finally, the WERS does not follow workers over time but does ask interesting questions about the nature of their skills match. Each worker is asked "*How well do the work skills you personally have match the skills you need to do your present job?*" The resulting five-point scale allows workers to identify that their skills match perfectly or provides two categories of the being over-matched (their skills exceed those needed) or two categories of under-matched (their skills fall short of those needed). As we eventually hope to shed light on the importance of match-specific returns, we divided the sample of WERS workers into three categories, matched, over-matched and under-matched. For each category the workers were further divided by supervisor and non-supervisor. This resulted in six log-earnings equations in which employer size was the critical independent variable. The role of employer size differs dramatically between supervisors and non-supervisors.

The results are presented in Table 4. We first examine the traditional log-linear specification. The largest return to increasing employer size for supervisors is clearly among those that identify being perfectly matched. The return shows a point estimate of .908. Those supervisors that are under matched show no return to employer size. This suggests that

among those who simply do not have the required skills, there is no advantage to being in a larger employer. This is confirmed in the log-log estimates which return an elasticity of .066 for those perfectly matched and, again, no size premium for the under matched supervisors. This pattern makes clear that the skill match is important in the employer size premium for supervisors.

The contrast with the non-supervisors is dramatic. The non-supervisors show no strong pattern of returns for those matched or over-matched. The returns are of modest size in the log-linear specification and completely absent in the log-log specification. The sizeable return to size is actually among those who report being under-matched. This suggests the return to size for non-supervisors has much less to do with skill match than that for supervisors and so hints at the importance of matching in explaining the employer size effect.

INSERT TABLE 4

We recognize that many wage determinants may be unobserved to us as researchers and that these may also influence the nature of the skill match and be correlated with employer size. The panel data we examine next may help overcome some of these concerns but we consider it important that the various correlations between employer size and skill match differ dramatically between supervisors and non-supervisors.

4.2 Individual Panel Data

Our estimates for the BHPS/US are based on variants of:

$$y_{it} = \alpha_0 + \gamma Size_{it} + \beta'_2 \boldsymbol{x}_{ih} + \varphi_i + \theta_t + \epsilon_{it} \qquad (2)$$

Where y_{it} is the log-hourly wage of individual *i* at time *t.* Size is a vector of dummy variables capturing firm size, in all equations we use small workplaces (1-9 workers) as the omitted

case. The vector $\boldsymbol{x}$ is individual and firm characteristics and θ_t are a set of year dummies while φ_i are worker level fixed effects. The inclusion of the latter implies that the series of γ coefficients provide the within individual effect of changes in workplace size on individual wages. We estimate (2) separately for those with and without supervisory responsibilities and also provide OLS estimates as a point of comparison.

INSERT TABLE 5

Columns 1 and 2 of Table 5 present OLS log-wage estimates separately for the fully pooled samples of supervisors/managers and all other workers. The controls take very typical coefficients and are available upon request. We focus on the comparison of the wage increments associated with larger workplace size. It seems apparent that both supervisors and other workers receive higher wages at larger workplaces but the extent to which the wages increase differs. Comparing medium size workplaces to the smallest workplaces, the increment is often three times larger in percentage points for supervisors than for other workers. Thus, examining those in size 100 to 199, the wage increment for regular workers is .0683 log points relative to the smallest workplaces. The same increment for supervisors is .192 log points. At the largest size workplaces the relative size of the increments moves somewhat closer. In size over 1000 the increment over small workplaces is .128 for regular workers and a nearly double .245 log points for supervisors. These patterns appear broadly supportive of the earlier estimates in confirming a much larger size premium for supervisors.

Columns 3 and 4 of Table 5 estimate the worker fixed effect equivalents for both supervisors and all other workers. While the general pattern is very similar, the results become more muted in two dimensions. First, the coefficients themselves are routinely smaller for both groups as one might anticipate when holding constant the unobserved individual earning characteristics. Second, and more germane, the relative advantage

associated with size for the supervisors is diminished. The relative advantage in the fixed effect estimates appears to be about twice as large through all but the last two categories. It is smaller than that at the top of the size distribution. This suggests that a larger share of the workplace size increment for supervisors is explained by unobserved characteristics presumably including managerial ability.

To gain another look at this we took the midpoints of each size category and estimate log-log elasticity estimates. These are presented in Table 6. The first two columns show the OLS results with the elasticity nearly twice as large for the supervisors. The second two columns present the fixed effect estimates. Again, the estimates for both types of workers shrink but the relative size of the shrinkage is larger for the supervisors.

INSERT TABLE 6

The final two columns of Table 6 present a fully stacked interaction of the same estimates. The first point is that a statistically significantly larger wage premium for supervisors is evident in both the OLS and the fixed effect estimates. Despite a wide variety of alternative specifications, this remains the case. The return to size is simply larger for supervisors than for other workers even when controlling for worker fixed effects. Yet, again, as the columns 3 and 4 make clear, the extent to which the return is larger shrinks in the worker fixed effect estimates.

The estimates suggest to us that a portion of managerial skill is unobserved by the researcher and that the apparent return to this skill is larger in larger workplaces. Yet, having said that, the difference in the workplace size premium between supervisors and other workers remains even in the fixed effect estimates. Thus, the larger return to size for supervisors is more complicated than simply more skilled managers being attracted to large workplaces. If this attraction were the only story, one might anticipate the return to size to be

largely similar between supervisors and other workers in the fixed effect as that ability is differenced out.[3]

We have argued that the large fixed effect estimate for supervisors could either reflect a unique opportunity for training and investment at larger employers, or the presence of specific match returns between managerial skill and employer size that do not exist independent of that match. Either possibility supports the notion that large hierarchies provide opportunities in which more skilled supervisors are observed receiving a return to that skill only in larger workplaces.

Our ability to disentangle these possibilities is limited but we have confirmed that the sizeable fixed effect estimate is largely generated by those who move jobs, and so employer size. Indeed, the within job match fixed effects for supervisors and non-supervisors are essentially the same size as each other. Thus, the real difference we have been observing is that between supervisors and non-supervisors who change jobs. The smaller returns to employer size within match may be sensible as measurement error for such workers could be substantial but it also indicates the importance of the job changers and demands greater scrutiny of those who change jobs as this is where the fixed-effect estimates differ.[4]

In an effort to provide additional scrutiny, we select a specific sample and imagine an event study around the taking of a new job at an establishment with a different size. Again, we emphasize that these likely represent a selected sample of workers and employers who will benefit from the job change. We take that as given. At issue is whether the change for supervisors appears to include a discrete jump in earnings or whether it seems dominated by a

[3] An alternative explanation is that the diminution of the firm-size wage effect in the fixed effects models reflects attenuation bias. This would be more marked when workers do not change firms and changes in firm size across time may reflect measurement error by respondents. In unreported results, we re-estimated our fixed effects models for a sub-sample of workers who changed jobs where attenuation bias should be less of a concern. The firm size estimates were essentially the same as those reported in the main tables.

[4] The coefficient on the employer size variable interacted with supervisor is actually negative for the within match sample (the analogous estimation to that in column 6 of Table 6). The job change sample suggests a positive and significant interaction (at the 5% level) of .0069 essentially identical to that in the estimate in Table 6. The complete results are available upon request.

period of growth in earnings in the periods immediately after the moving event. The latter would be supportive of larger employers providing opportunities for skill formation and learning by doing that smaller employers do not provide.

We limit our sample to those who start in an employer with one hundred or fewer workers, who change employer only once in our examination of them and for whom we can examine at least six years of data around the change. Moreover, we focus only on those who leave their employer with one hundred or fewer workers to move to a larger employer. Our base is three years before the change and we control for all the standard wage determinants. We do this separately for those who began the six year window as a supervisor and for those who began the six year window as a non-supervisor. A series of year dummies capture the annual wage change.

INSERT FIGURE 1

The summary of these estimates are shown in Figure 1 which consists of three panels. All three panels show the general increase in wages over the period. The first panel focuses on the supervisors. The year from -1 to zero shows the pay change associated with the job change and it is the largest increase across the study window for supervisors. The remaining years show a flat first full year in the new job and then a gradual increase.

This can be contrasted with the non-supervisors who change jobs. In panel 2, the non-supervisors' wage increase is modest or absent for the job change but then begins to increase more rapidly.[5] To be sure, this is not only a selected sample but the nature of the selection may differ between supervisors and non-supervisors. Yet, the dramatic increase associated with the move and relatively modest increase after, suggests the return to supervisors moving may not reflect greater opportunity for growth and investment. One would anticipate that

[5] The third panel eliminates the few supervisors who report moving to non-supervisory positions. This panel confirms the large increase associated with change year and the only modest increase after that.

such opportunities would persist after the immediate job change. Instead, the huge increase associated with the change (especially when compared with non-supervisors) puts the spotlight on capturing the return to a superior match where ability matters but only with a large employer.

5. Conclusions

The results we present confirm that the employer size effect in Britain is substantially larger for supervisors than for non-supervisors. This confirmation draws attention to the importance of hierarchy. Our results are consistent with the returns to supervisory talent being a critical component of the employer size effect. Yet, the result is not a simple consequence of inherently more productive managers who would be highly rewarded anywhere moving toward larger employers. There appears to be a match specific component in which supervisors with greater talent earn the return on that talent only in the larger employers where it is valuable.

An initial indication of this was that the return to employer size is absent for supervisors who are under-matched to their required job skills and that the interaction of skill match and employer size differs between supervisors and non-supervisors. The panel data revealed that even with worker fixed effects, the larger employer effect for supervisors remained. Importantly, this fixed effect difference was entirely driven by the movers. Thus, we more closely examined those who changed jobs to a larger employer. Again, the pattern of results differs between supervisors and non-supervisors. The supervisors seemed to receive a larger and more discrete jump associated with the move. There did not appear to be a pattern of greater opportunity for learning and investment that was provided by larger firms and so showed up in the year or two after a move. This again supports the importance the likelihood of underutilized skills becoming valuable at larger employers.

These results are far from the last word but they support the contention that some of the higher employer size premium for supervisors is match-specific. Only in larger employers can superior supervisory skills be most completely rewarded. This strikes us as a crucial point in understanding hierarchy. The size of the organization and span of control introduce the possibility that exemplary supervisory skills will be used and rewarded in ways that simply cannot happen in smaller and flatter organizations.

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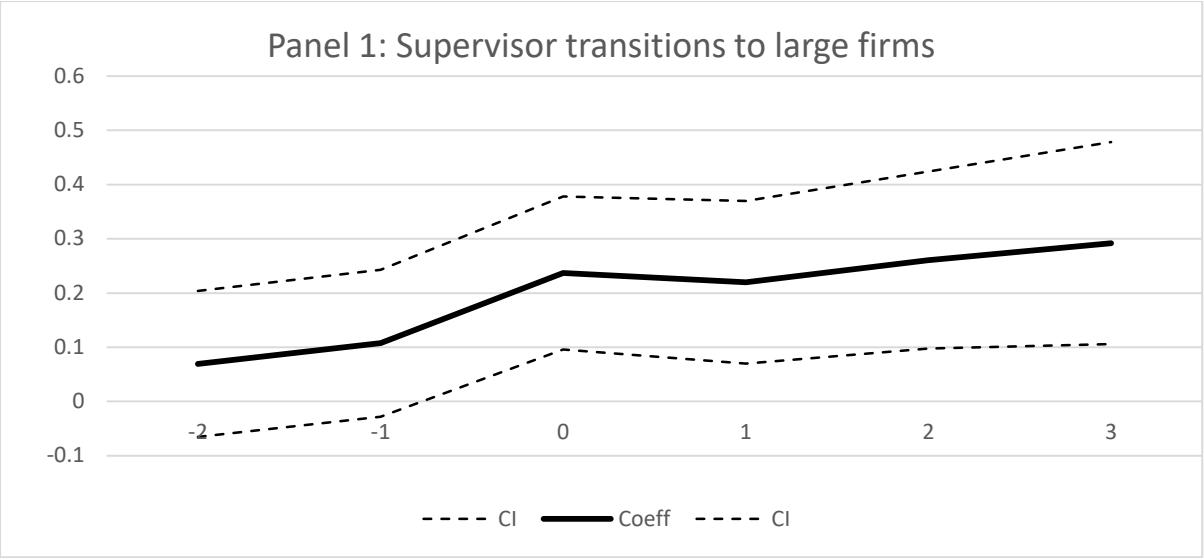
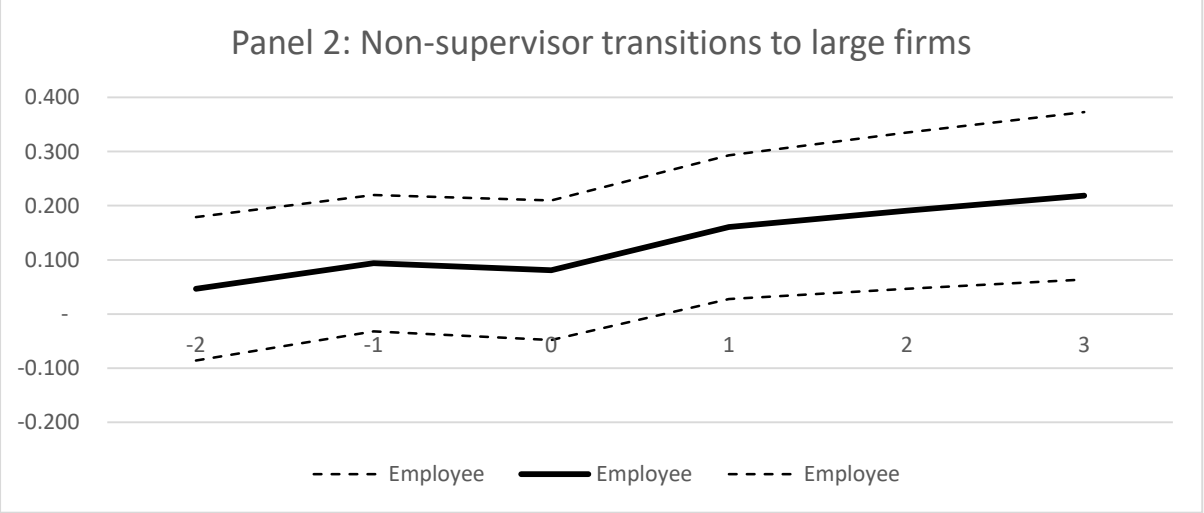
Figure 1: Event Study for Job Changers in the BHPS





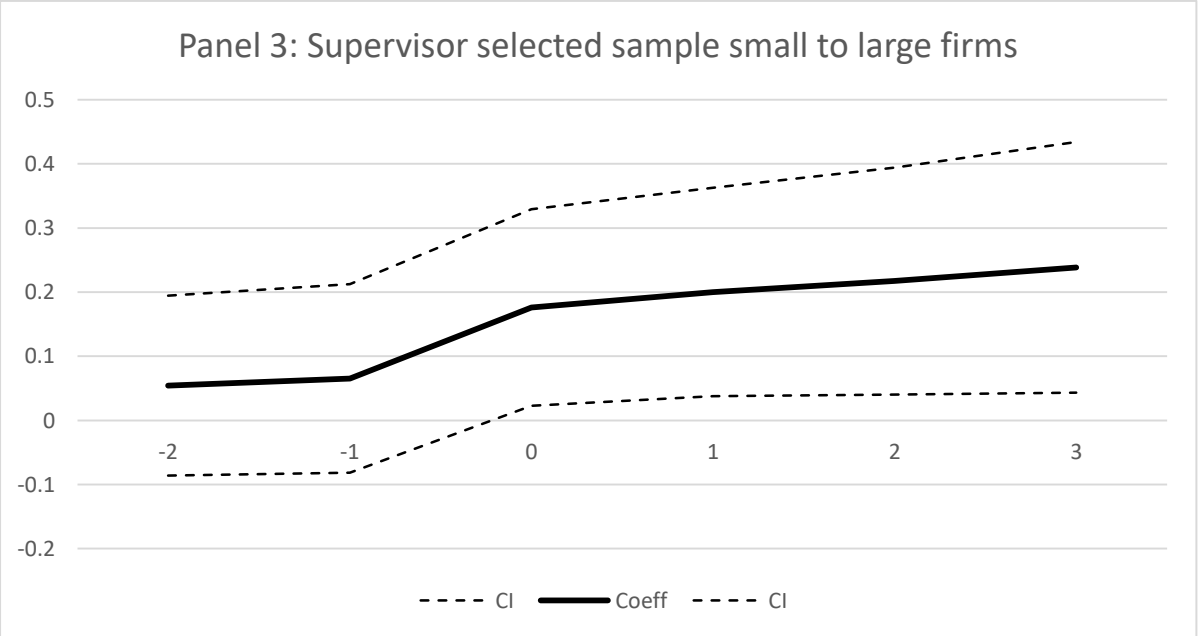


Table 1. Selected Descriptive Statistics (WERS)

	Supervisors		Workers	
Variable	Mean	Standard deviation	Mean	Standard deviation
Weekly earnings	717.41	647.25	424.79	319.27
Working hours per week	38.883	4.733	38.010	4.242
Number of employees*	60.324	193.440	51.503	187.896
Age	41.899	11.019	39.453	12.383
Male	0.526	0.499	0.492	0.500
Married	0.719	0.449	0.650	0.477
Degree	0.187	0.390	0.170	0.376
Postgraduate	0.081	0.273	0.055	0.228
Vocational qualification	0.068	0.252	0.076	0.264
Tenure	8.680	7.324	6.756	6.871
Permanent job	0.972	0.166	0.949	0.220
Temporary job	0.006	0.077	0.021	0.145
Trade union member	0.195	0.396	0.206	0.405
Observations	5,465		8,955	

Notes. The WERS sample includes full-time workers (>=30 hours per week) in the age group 18-65. Estimates reflect establishment weights. Earnings are calculated using interval midpoints. *Unweighted estimates for number of employees in the supervisor sample is [514.032 (s.d.=1259.13)] and in the worker sample is [472.271 (s.d.=1101.265)].

Table 2. Maximum Likelihood Interval Regression Results (WERS)

	LnHourlyWage			LnHourlyWage			LnWeeklyEarnings			LnHourlyWage (Trading Sector)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Supervisor	Worker	Diff Interact	Supervisor	Worker	Diff Interact	Supervisor	Worker	Diff Interact	Supervisor	Worker	Diff Interact
Number of employees	0.854***	0.463***	0.383**				0.818***	0.381***	0.432***	1.348***	0.596***	0.750***
	(0.173)	(0.139)	(0.167)				(0.159)	(0.122)	(0.158)	(0.338)	(0.209)	(0.272)
Log number of employees				0.064***	0.018**	0.045***						
				(0.010)	(0.007)	(0.010)						
LnHours per week							0.312***	0.551***	0.451***			
							(0.121)	(0.064)	(0.069)			
Log-likelihood	-13566.8	-21755.8	-35615.6	-13515.4	-21745.8	-35537.6	-13035.3	-20777.5	-34131.2	-7359.0	-11839.9	-19292.3
Observations	5,465	8,955	14,420	5,465	8,955	14,420	5,465	8,955	14,420	3,003	4,940	7,943

Notes. For reasons of brevity we only report estimates for the variables of interest. Individual controls include age and its squared term, tenure and its squared term, female, married/cohabiting, union membership, six educational dummies, vocational qualification, permanent job, temporary job, and eight occupational dummies. Workplace controls include if the establishment is part of a larger organization or a single independent establishment, percentages of eight occupational groups, percentages of female, part-time and trade union members, eleven industry dummies and nine region dummies. Estimates use establishment weights with standard errors corrected for heteroscedasticity and clustered at the establishment level. Levels of significance: *** p<0.01, ** p<0.05.

Table 3. OLS Estimates -- Dependent Variable is the Average Log Hourly Wage Difference Between Supervisors and Workers at Each Establishment (WERS)

	Log-Linear Model	Log-Log Model
	(1)	(2)
Number of employees	1.253***	
	(0.274)	
Log number of employees		0.160***
		(0.043)
R-squared	0.121	0.128
Observations	1,367	1,367

Notes. Estimates include the full vector of establishment controls as outlined in the Notes of Table 2, and the average establishment difference of individual characteristics between supervisors and workers. Estimates use establishment weights. Standard errors are corrected for heteroscedasticity and are clustered at the establishment level. Level of significance: *** p<0.01.

Table 4. The Returns to Employer Size by Skill Match (WERS)

	Over-matched		Exactly-matched		Under-matched	
	(1)	(2)	(3)	(4)	(5)	(6)
	Log-linear	Log-log	Log-linear	Log-log	Log-linear	Log-log
Panel A - Supervisors						
Number of employees	0.833***		0.908***		0.106	
	(0.221)		(0.178)		(0.445)	
Log number of employees		0.052***		0.066***		-0.017
		(0.012)		(0.013)		(0.028)
Observations	2,834		2,445		203	
Panel B - Workers						
Number of employees	0.373***		0.456***		1.721***	
	(0.144)		(0.151)		(0.568)	
Log number of employees		0.011		0.014		0.057***
		(0.008)		(0.008)		(0.017)
Observations	4,752		3,859		395	

Notes. For reasons of brevity we only report estimates for the variable of interest. Individual controls include age and its squared term, tenure and its squared term, female, married/cohabiting, union membership, six educational dummies, vocational qualification, permanent job, temporary job, and eight occupational dummies. Workplace controls include if the establishment is part of a larger organization or a single independent establishment, percentages of eight occupational groups, percentages of female, part-time and trade union members, eleven industry dummies and nine region dummies. Estimates use establishment weights with standard errors corrected for heteroscedasticity and clustered at the establishment level.
Levels of significance: *** p<0.01.

Table 5. Firm Size – Wage Effects, OLS and Individual Fixed Effects, BHPS/US 1991-2016

	OLS		Individual Fixed Effects	
	(1)	(2)	(3)	(4)
	Manager/Supervisor	Workers	Manager/Supervisor	Workers
Firm Size				
10-24	0.084***	0.040***	0.036***	0.017***
	(0.01)	(0.004)	(0.006)	(0.005)
25-49	0.119***	0.046***	0.055***	0.025***
	(0.006)	(0.004)	(0.006)	(0.005)
50-99	0.165***	0.065***	0.070***	0.044***
	(0.006)	(0.004)	(0.006)	(0.005)
100-199	0.192***	0.068***	0.086***	0.040***
	(0.006)	(0.005)	(0.007)	(0.005)
200-499	0.200***	0.085***	0.094***	0.057***
	(0.006)	(0.004)	(0.006)	(0.005)
500-999	0.221***	0.110***	0.100***	0.074***
	(0.007)	(0.005)	(0.007)	(0.006)
1000+	0.245***	0.128***	0.104***	0.084***
	(0.006)	(0.005)	(0.007)	(0.006)
Union Coverage	0.008*	0.012***	0.012**	0.021***
	(0.004)	(0.003)	(0.005)	(0.004)
Covered Union Member	0.031***	0.091***	0.015***	0.041***
	(0.004)	(0.003)	(0.005)	(0.004)
Observations	49,952	65,770	49,952	65,770
R-squared	0.407	0.386	0.166	0.187
Individuals			16,586	22,611

Notes. Controls included male, age, age^2, marital status, a-level, diploma, degree or higher, employer provided training, public sector, temporary contract, region, year, industry and occupation fixed effects. Standard errors are in parentheses and are clustered at the individual level in columns 1 and 2. Levels of significance: *** p<0.01, ** p<0.05, * p<0.1.

Table 6. Firm Size and Log Hourly Wages, BHPS 1991-2016

	(1)	(2)	(3)	(4)	(5)	(6)
	OLS		Individual Fixed Effects		All (manager/supervisor and workers)	
	Manager/Supervisor	Workers	Manager/Supervisor	Workers	OLS	FE
Ln(midsize)	0.044***	0.024***	0.022***	0.012***	0.025***	0.017***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Manager * Ln (midsize)					0.019***	0.007***
					(0.001)	(0.001)
Constant	0.833***	0.915***	0.684***	0.694***	0.886***	0.688***
	(0.022)	(0.0144)	(0.029)	(0.020)	(0.012)	(0.016)
Observations	73,301	96,594	73,301	96,594	169,895	169,895
R^2	0.401	0.383	0.142	0.178	0.465	0.218
Individuals			19,411	26,889		36,126

Notes. Controls included male, age, age^2, marital status, a-level, diploma, degree or higher, employer provided training, public sector, temporary contract, region, year, industry and occupation fixed effects. In columns 5 and 6 "All" stands for pooling managers/supervisors and workers. The estimates are based on log-log specifications by using mid-point approximations of continuous firm size. Standard errors are in parentheses and are clustered at the individual level in columns 1, 2 and 5. Levels of significance: *** p<0.01, ** p<0.05, * p<0.1.

APPENDIX

Table A1. Summary Statistics, BHPS/US 1991-2016

	All	Manager/Supervisor	Employees
Ln Hourly Wage	2.003	2.169	1.878
Firm Size (Midpoint)	337.558	349.449	328.559
Firm Size			
1-9	0.136	0.145	0.132
10-24	0.147	0.151	0.144
25-49	0.135	0.132	0.137
50-99	0.127	0.124	0.128
100-199	0.113	0.109	0.116
200-499	0.135	0.122	0.144
500-999	0.073	0.072	0.074
1000+	0.134	0.145	0.125
Male	0.561	0.565	0.558
Age	39.25	40.84	38.11
Married	0.536	0.603	0.484
A-Level	0.227	0.218	0.234
Diploma	0.109	0.135	0.090
Degree or Higher	0.265	0.347	0.202
Employer Provided Training	0.205	0.244	0.174
Public Sector	0.320	0.344	0.301
Temporary Contract	0.033	0.016	0.047
Covered by Union	0.527	0.517	0.534
Covered Union Member	0.338	0.337	0.338

Notes. The BHPS/US sample includes those individuals observed in the BHPS who are also followed in the US sample. It includes only those individuals in paid employment (exclude self-employed) who work full-time (>=30 hours per week) and are in the age group 18-65.