Within-Firm Pay Inequality*

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Abstract

Financial regulators and investors alike have expressed concerns about high pay inequality *within* firms. This study examines how within-firm pay inequality varies across firms, how it relates to firms' operating performance and valuations, and whether it is priced by the market. Using a proprietary data set of public and private firms in the UK, we find that pay disparities between top-level jobs—those where managerial skills and responsibility are most important—and bottom-level jobs are increasing in firm size. By contrast, pay differentials between jobs involving either no or only little managerial responsibility are invariant to firm size. Moreover, firms with higher within-firm pay inequality have better operating performance, higher Tobin's Q, and higher equity returns. Our results support the notion that high pay disparities within firms are a reflection of better managerial talent.

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1 Introduction

Rising income inequality has garnered attention in the media and among policy circles.[1] The argument in the public domain is that inequality may be harmful for economic growth (Persson and Tabellini (1994), Alesina and Rodrik (1994), Easterly (2007), IMF (2014)), impair intergenerational mobility (OECD (2011), Corak (2013)), and trigger deep financial and real crises, like the Great Depression and the Great Recession (Rajan (2010), Kumhof, Rancière, and Winant (2015)).

Interest in inequality extends beyond macroeconomics. Financial regulators and investors alike have recently expressed concerns about high pay inequality *within* firms: "High pay disparities inside a company can hurt employee morale and productivity, and have a negative impact on a company's overall performance" (Julie Fox Gorte, PAX World Managment, 2013). In agreement, the Securities and Exchange Commission, as mandated by Section 953(b) of the Dodd-Frank Act, has adopted a new rule requiring companies to disclose the *ratio* of median employee pay to that of the chief executive officer.[2] Market participants have reacted positively to this pay ratio disclosure: "Grosvenor believes that income inequality and a shrinking middle class are real and important issues that our country needs to address. We believe transparency and disclosure such as that called for in the proposal, which disclose a "pay ratio," can be helpful in allowing investors to more accurately judge the effect of pay structure on company performance" (Michael J. Sacks, Grosvenor Capital Management, 2013).[3]

This study examines how within-firm pay inequality varies across firms, how it relates to firms' operating performance and valuations, and whether it is priced by the market.

[1] See, for example, the speech by Alan Krueger (2012), Chairman of the Council of Economic Advisers, on the "The Rise and Consequences of Inequality" at the Center for American Progress, as well as debates in the media and academic circles ignited by Piketty's (2014) book "Capital in the Twenty-First Century."

[2] This new rule is effective October 17, 2015. Firms must comply by the fiscal year beginning on or after January 1, 2017. The pay ratio disclosure applies to all firms except emerging growth companies, smaller reporting companies, and foreign private issuers.

[3] Similarly: "We believe that pay ratio disclosure, required by Section 953(b) of Dodd-Frank, will provide important supplementary information on the financial incentives that drive performance throughout the company, vertically, as well as horizontally, across markets [...] Companies should use this disclosure as an opportunity to provide insights on the role effective management of human capital plays with regard to value creation" (Anne Simpson, CALPERS, 2013).

The first part of our study, which examines the relation between pay inequality and firm size, is guided by the literature on CEO pay. There, it is argued that an efficient assignment of CEO talent to firms implies that more talented CEOs should match with larger firms (Terviö (2008), Gabaix and Landier (2008)). Extending this argument to managerial jobs further down in the corporate hierarchy, efficient matching dictates that larger firms should have more talented managers, implying higher pay disparities between top- and bottom-level jobs at these firms.[4]

Empirical investigation of pay disparities within firms is challenging due to lack of publicly available data. To address this challenge, we employ a proprietary data set of UK firms in which employee pay is observed at the firm-job title-year level. Importantly, job titles are grouped into nine distinct hierarchy levels, allowing us to measure how pay disparities between different hierarchy levels vary across firms. For instance, level 1, our lowest hierarchy level, includes work that "requires basic literacy and numeracy skills and the ability to perform a few straightforward and short-term tasks to instructions under immediate supervision." Typical job titles are cleaner, labourer, and unskilled worker. Level 5, in the middle of the hierarchy ladder, includes work that "requires a vocational qualification and sufficient relevant specialist experience to be able to manage a section or operate with self-contained expertise in a specialist discipline or activity." Typical job titles are engineer, marketing junior manager, and warehouse supervisor. And level 9, the highest hierarchy level, includes "very senior executive roles with substantial experience in, and leadership of, a specialist function, including some input to the organisation's overall strategy." Typical job titles are finance director, HR director, and lawyer - head of legal.

Since our pay-level data are organized by hierarchy levels, we can construct *pay ratios* comparing the pay across different hierarchy levels within a given firm and year. For example, "pay ratio 19" compares the pay of top-level executives, such as finance and HR directors, with the pay of unskilled workers or cleaners at the bottom of the corporate

[4] As in the macro- and labor economics literature, we refer to pay inequality as the disparity in pay between top- and bottom-level jobs. This is different from pay *discrimination*, which pertains to unequal pay (e.g., for men and women) for the same job at the same firm.

hierarchy. Given that we have nine hierarchy levels, this means there are $(9 \times 8)/2 = 36$ pay ratios in total.

Our results are consistent with theories emphasizing the efficient assignment of managerial talent. On average, larger firms exhibit significantly higher pay inequality. Importantly, however, this result is entirely driven by hierarchy levels where managerial skills and responsibility are most important (levels 6 to 9). By contrast, pay ratios where both hierarchy levels involve either no or only little managerial responsibility do *not* increase with firm size (levels 1 to 5). Accordingly, an HR director's pay (level 9) increases *relative* to the pay of an unskilled worker (level 1) as firm size increases. However, the pay of an ordinary HR/Personnel officer (level 4) does *not* increase relative to the pay of an unskilled worker as firm size increases. Our results are not driven by industry composition effects—they also hold if we focus exclusively on within-industry variation. And they also hold if we focus on within-firm variation, meaning they are not driven by unobserved time-invariant heterogeneity across firms.

The documented effect of firm size on pay inequality is economically large. For instance, moving from the 25th to the 75th percentile of the firm-size distribution raises the pay associated with hierarchy level 9 by 280.1% *relative* to the pay associated with hierarchy level 1. By comparison, for the same increase in firm size, the pay associated with hierarchy level 6 increases only by 59.7% relative to the pay associated with hierarchy level 1. Thus, an increase in firm size has a roughly five times bigger impact on pay ratio 19 than it has on pay ratio 16.

If pay inequality is a reflection of managerial talent, we would expect firms with more inequality to have better operating performance and higher valuations. They do. Regardless of whether we consider the firm's return on assets (ROA) or Tobin's Q, we find that high-inequality firms are better performers and have higher valuations. Notably, these results hold even *after* controlling for firm size. Thus, while we are careful not to draw any causal inferences, our results are prima facie not supportive of worries that "high pay disparities inside a company [...] have a negative impact on a company's overall performance" (see above quote).

The final part of our study investigates whether pay disparities within firms are priced by the market. To examine the relation between pay inequality and stock returns, we form a hedge portfolio that is long in high-inequality firms and short in low-inequality firms. Regardless of whether we use the market model or a standard four-factor model, and regardless of whether we consider value- or equal-weighted portfolio returns, we find that the inequality hedge portfolio yields a positive monthly abnormal return of between 1.172% and 1.226%.

What accounts for this positive abnormal return? One interpretation, which is consistent with our previous results, is that high-inequality firms attract better managerial talent, and this is not fully priced by the market. This interpretation is consistent with Edmans (2011), who finds that the market does not fully capture intangibles. A related but slightly different interpretation is that the market correctly values managerial talent but is unable to observe the cross-sectional variation that we observe in our data. After all, our within-firm pay-level data are not publicly available. Finally, there may be omitted risk factors that are priced by the market but not accounted for by the underlying asset pricing model. To explore this hypothesis, we estimate monthly cross-sectional (Fama-MacBeth) regressions of individual stock returns on a firm-level measure of pay inequality and a large set of control variables. We find again that high-inequality firms earn a positive abnormal return, which is roughly of the same order of magnitude as the abnormal return in our time-series regressions.

A brief remark about external validity. Arguably, this is always a concern when using data from other countries. That being said, the UK is perhaps the country that is closest to the U.S. in terms of financial markets development and institutions. Moreover, our pay-level data exhibit the same salient feature that has also been documented for the U.S.: average wages are increasing with firm size ("employer size-wage effect"). In fact, the wage-firm size elasticity in our data is virtually identical to that obtained by Brown and Medoff (1989) for the U.S. using May CPS wage data.

Our paper contributes to the literature seeking to understand pay structures within firms. Much of this literature focuses on CEO pay.[5] Some researchers argue that CEO

[5] Murphy (2013) and Edmans and Gabaix (2015) provide surveys of the CEO pay literature.

pay is excessive, and that CEOs are often rewarded for luck (Yermack (2004), Bertrand and Mullainathan (2001), Bebchuk and Fried (2004)). Others argue that high CEO pay is a reward for scarce managerial talent based on the competitive assignment of CEOs in market equilibrium (Terviö (2008), Gabaix and Landier (2008), Edmans, Gabaix, and Landier (2009), Edmans and Gabaix (2011)). Consistent with the latter argument, CEO pay is strongly correlated with firm size, both in the cross-section and time-series.[6] Kaplan and Rauh (2010, 2013) provide further evidence in support of the "scarce talent view" by looking at other professions, such as investment bankers, hedge fund managers, corporate lawyers, and professional athletes. Our paper looks inside the corporate hierarchy. Consistent with the efficient assignment of managerial talent, we find that pay disparities between top- and bottom-level jobs are increasing in firm size. Moreover, controlling for firm size, we find that higher pay disparities are associated with better operating performance, higher firm valuations, and higher equity returns.

Several recent papers point to rising between-establishment wage dispersion as a source of rising overall wage inequality (e.g., Card, Heining, and Kline (2013), Barth et al. (2014), Song et al. (2015)). While our study shares with this literature the focus on firms, we do not decompose aggregate wage dispersion into between- and within-establishment components. Rather, we start from inside the firm by comparing wages associated with different hierarchy levels within a given firm and year. In a second step, we examine how these within-firm pay disparities vary across firms, whether they are related to operating performance and firm value, and whether differences in pay inequality across firms are priced by the market.

The rest of this paper is organized as follows. Section 2 describes the data and summary statistics. Section 3 examines the relation between pay inequality and firm size, both in the cross-section and over time. Section 4 considers operating performance and firm value. Section 5 examines whether within-firm pay inequality is priced by the market. Section 6 offers concluding remarks.

[6]See Gabaix and Landier (2008), Gabaix Landier, and Sauvagnat (2014), and the references cited therein.

2 Data and Summary Statistics

2.1 Pay-Level Data

We have comprehensive firm-level data on employee pay for a broad cross-section of UK firms for the years 2004 to 2013. The data are provided by Income Data Services (IDS), an independent research and publishing company specializing in the field of employment. IDS was established in 1966 and acquired by Thomson Reuters (Professional) UK Limited in 2005. It is the leading organization carrying out detailed monitoring of firm-level pay trends in the UK, providing its data to various public entities, such as the UK Office for National Statistics (ONS) and the European Union.

IDS gathers information on employee pay associated with various job titles within a firm. Firms are typically sampled multiple times. Sampled job titles may differ across firms. Important for our purposes, employers are asked to group job titles into broader hierarchy levels based on managerial responsibility and skill requirements. Thus, if a given job title has different meanings at different firms (e.g., different managerial responsibility), it will be assigned to different hierarchy levels. There are ten hierarchy levels. To increase the sample size in some of our regressions, we combine the lowest two levels into a single level, meaning we have nine hierarchy levels altogether.[7]

Table 1 provides descriptions of all nine hierarchy levels along with examples of typical job titles. For instance, level 1, our lowest hierarchy level, includes work that "requires basic literacy and numeracy skills and the ability to perform a few straightforward and short-term tasks to instructions under immediate supervision." Typical job titles are cleaner, labourer, and unskilled worker. Level 5, in the middle of the hierarchy ladder, includes work that "requires a vocational qualification and sufficient relevant specialist experience to be able to manage a section or operate with self-contained expertise in a specialist discipline or activity." Typical job titles are engineer, marketing junior manager, and warehouse supervisor. And level 9, the highest hierarchy level, includes "very senior executive roles with substantial experience in, and leadership of, a specialist function,

[7] Results based on the original ten hierarchy levels are virtually identically. The only main difference is the smaller sample size in some of the regressions involving the original hierarchy levels 1 and 2.

including some input to the organisation's overall strategy." Typical job titles are finance director, HR director, and lawyer - head of legal.[8]

A strength of our data relative to others (e.g., the U.S. Census Bureau's proprietary Longitudinal Employer-Household Dynamics (LEHD) data set) is that we have pay-level data organized by hierarchy levels. A weakness of our data is that we only observe the average pay associated with a given job title or hierarchy level for a given firm and year. Thus, our observations are at the firm-hierarchy level-year level.

2.2 Firm Size

To obtain measures of firm size, we match the IDS firm names to Bureau van Dijk's Amadeus database. Amadeus provides financial information about public and private firms in the UK and other European countries. That Amadeus includes private firms is important for us as 40% of the firms in our sample are private. All matches have been checked by IDS employees who are familiar with the sample firms. Our matching success rate is 90%, providing us with a sample of 880 firms.

Our main measure of firm size is the number of employees. However, our results are similar if we use either firms' sales or assets (Appendix Table A1 and A2, respectively). Sales are deflated using the consumer price index (CPI) provided by the UK Office for National Statistics (ONS). As is typical of samples that include private and public firms, the firm-size distribution is heavily right-skewed due to the presence of some large public firms. To avoid that outliers drive our results, we winsorize firm size at the 5% level. That being said, our results are similar if we winsorize firm size at the 1% level.[9]

The average firm in our sample is 32 years old, has 10,014 employees, book assets of

[8] Our data do not include CEOs, albeit it is possible to match CEOs to many of the firms in our sample using BoardEx data. In many cases, it is possible to construct measures of board size and tenure. In some cases, BoardEx provides additional information, such as CEO pay and various pieces of information about board members.

[9] The non-winsorized firm-size distribution has a median of 1,705 employees, mean of 12,606 employees, maximum of 508,714 employees, and skewness of 7.19. With 1% winsorizing, the distribution remains heavily right-skewed: mean of 11,844 employees, maximum of 273,024 employees, and skewness of 5.21. The 5% winsorized distribution has a mean of 10,014 employees, maximum of 97,300 employees, and skewness of 3.03.

1,890 million GBP, and sales of 1,610 million GBP. There is substantial variation in firm size. For example, moving from the 25th percentile (381 employees) to the median (1,705 employees) of the firm-size distribution involves an increase in firm size of 348%. Moving from the median to the 75th percentile (6,345 employees) involves a further increase of 272%. Firms are also widely dispersed across industries. The five largest industry categories in our sample are manufacturing (SIC 20-39, 29.8% of firms), services (SIC 70-89, 23.1% of firms), transportation, communication, electric, gas, and sanitary services (SIC 40-49, 16.6% of firms), finance, insurance, and real estate (SIC 60-67, 14.9% of firms), and wholesale and retail trade (SIC 50-59, 12.2% of firms).

2.3 Descriptive Statistics

Table 2 shows the distribution of wages separately for each hierarchy level based on all firm-year observations. Wages are deflated using the consumer price index (CPI) provided by the UK Office for National Statistics (ONS) and winsorized at the 1% level. As can be seen, wages are increasing with hierarchy levels. For instance, the average wage in hierarchy level 1 is 13,778 GBP, the average wage in hierarchy level 5 is 29,352 GBP, and the average wage in hierarchy level 9 is 110,693 GBP. Moving up one level raises the average wage per hierarchy level by 29.8% on average, albeit the magnitude of this increase varies. In particular, at lower hierarchy levels (1 to 3), moving up one level involves a smaller wage increase (between 16.3% and 20.8%) than does moving up one level at medium and higher hierarchy levels (4 to 8)(between 28.7% and 60.5%). Thus, wages are increasing with hierarchy levels, while the rate of increase is larger at medium and higher hierarchy levels.

To obtain measures of within-firm pay inequality, we compute for all $(9 \times 8)/2 = 36$ hierarchy-level pairs the corresponding ratio of wages within a given firm and year ("pay ratio"). Thus, a given firm-year observation implies that we observe wages for both hierarchy levels in that particular firm and year. For ease of comparison, we divide wages associated with higher hierarchy levels by wages associated with lower hierarchy levels, e.g., "pay ratio 12" means that we divide the wage associated with hierarchy level 2 by the wage associated with hierarchy level 1.

Table 3 shows the distribution of pay ratios for all 36 possible hierarchy-level pairs. For instance, an average pay ratio of 8.286 associated with hierarchy-level pair 19 implies that the pay associated with hierarchy level 9 is on average 8.286 times the pay associated with hierarchy level 1. As one might expect, pay ratios are increasing with the distance between hierarchy levels. For instance, pay ratio 12 is lower than pay ratio 13, which is lower than pay ratio 14. Moreover, holding the distance between hierarchy levels fixed, pay ratios are higher as both hierarchy levels increase. For instance, pay ratio 13 is lower than pay ratio 24, which is lower than pay ratio 35.

Table 3 also shows the percentage of firm-year observations for which a given pay ratio is greater than one. This percentage is always close or equal to 100%, confirming that employee pay is closely linked to hierarchy levels. Indeed, only 2.2% of firm-year observations exhibit pay ratios that are less than one. Dropping these observations does not affect our results.[10]

When collecting pay-level data, IDS may not sample all hierarchy levels within a given firm in the same year. In particular, low (1,2,3) and high (8,9) hierarchy levels are often sampled in different years, with the implication that pairs involving both levels, such as 19, 29, or 39, have relatively fewer observations. This is not a major concern, however. As we will see below, to the extent that we obtain statistically *insignificant* results, this is always in the context of regressions with sufficiently many observations.

3 Within-Firm Pay Inequality and Firm Size

Our endeavour to examine the relation between pay inequality and firm size is guided by the literature on CEO pay. There, it is argued that an efficient assignment of CEO talent to firms implies that more talented CEOs should match with larger firms (Terviö (2008), Gabaix and Landier (2008)). The underlying idea, which goes back to Rosen (1981, 1982), is that the value created by a match is multiplicative in CEO talent and

[10] That some firm-year observations have pay ratios of less than one suggests that hierarchy levels are an important, but not the only, determinant of employee pay.

firm size: "Intuition suggests that the economic impact of a manager's decisions depends on the amount of resources under his control, so that the observed strong relation of firm size and CEO pay levels is a reflection of scarce executive ability being worth more to larger firms" (Terviö (2008, p. 642)).[11] Hence, larger firms should have more talented CEOs ("assortative matching"). If CEOs are paid according to their marginal product, this implies that CEO pay should be higher at larger firms.

3.1 More Pay Inequality at Larger Firms

If more talented managers match with larger firms, and if managers are paid according to their marginal product, we would expect to see higher pay disparities between top- and bottom-level jobs at these firms.[12] To examine this hypothesis, we perform a fairly stringent test: we run $(9 \times 8)/2 = 36$ separate regressions—one for each pay ratio. This allows us to see if our results are driven by many or just few pay ratios. It also allows us to detect any non-linearities in the relation between pay ratios and firm size.

Table 4 shows the results. Although we run 36 regressions, the results are surprisingly clear. Panel (A) includes all pay ratios in which hierarchy level 1 is compared to higher levels. Moving from left to right, the distance between hierarchy levels increases. As can be seen, the coefficient on firm size is initially insignificant (pay ratios 12, 13, 14, and 15). Beginning with pay ratio 16, it becomes positive and significant (pay ratios 16, 17, 18, and 19). Whenever the coefficient is significant, it is also monotonically increasing in the pay ratio. For example, a one percent increase in firm size increases the pay associated with hierarchy level 6 by 0.0375% relative to the pay associated with hierarchy level 1. By comparison, for the same increase in firm size, the pay associated with hierarchy level 7 increases by 0.0883%, the pay associated with hierarchy level 8 increases by 0.162%,

[11] Similarly: "Assigning persons of superior talent to top positions increases productivity by more than the increments of their abilities because greater talent filters through the entire firm by a recursive chain of command technology. These multiplicative effects support enormous rewards for top level management in large organizations" (Rosen (1982, p. 311)).

[12] Tournament models (e.g., Lazear and Rosen (1981)) make similar predictions. In these models, managerial incentives are provided through pay differentials ("prizes") between lower- and higher-level managerial jobs. Larger firms have more contestants and thus require greater pay differentials, implying higher pay inequality (McLaughlin (1988)).

and the pay associated with hierarchy level 9 increases by 0.179%—all relative to the pay associated with hierarchy level 1. Thus, a one percent increase in firm size has a roughly five times bigger impact on pay ratio 19 than it has on pay ratio 16.

Panels (B) to (D) include all pay ratios in which hierarchy levels 2, 3, or 4 are compared to higher levels. The pattern is similar to that in Panel (A). Precisely, the coefficient on firm size is initially insignificant—or, in one case (pay ratio 23), negative and significant—and then always positive and significant. Moreover, whenever the coefficient is significant, it is also monotonically increasing in the pay ratio.[13] Finally, Panels (E) to (H) include all pay ratios in which hierarchy levels 5, 6, 7, or 8 are compared to higher levels. The pattern is again similar, except that there is no initial region in which the coefficient on firm size is insignificant. That is, the coefficient is always positive and significant, and it is always monotonically increasing in the pay ratio.

In sum, although we run 36 separate regressions, there is a clear pattern in the data. When lower hierarchy levels (1 to 5) are compared to one another, an increase in firm size has no effect on within-firm pay inequality. In contrast, when higher hierarchy levels (6 to 9) are compared to either one another or lower hierarchy levels, an increase in firm size widens the pay differential associated with different hierarchy levels. The magnitude of this effect is increasing in the distance between hierarchy levels. For instance, moving from the 25th to the 75th percentile of the firm-size distribution—an increase in firm size of 1,565%—raises the pay associated with hierarchy level 9 by 280.1% relative to the pay associated with hierarchy level 1. By comparison, for the same increase in firm size, the pay associated with hierarchy level 6 increases only by 59.7% relative to the pay associated with hierarchy level 1.

Our results are consistent with theories emphasizing the efficient assignment of managerial talent. Indeed, not all pay ratios increase with firm size, but only those involving hierarchy levels where managerial skills and responsibility are most important (levels 6 to 9). On the other hand, pay ratios where both hierarchy levels involve either no or only little managerial responsibility are invariant to firm size (levels 1 to 5). Accordingly, an

[13] There is one exception: in Panel (D), the coefficient on firm size decreases slightly when moving from pay ratio 48 to 49.

HR director's pay (level 9) increases *relative* to the pay of an unskilled worker (level 1) as firm size increases. However, the pay of an ordinary HR/Personnel officer (level 4) does not increase relative to the pay of an unskilled worker.[14]

Our results are not driven by industry composition effects. As is shown in Appendix Table A3, all our results hold if we focus exclusively on within-industry variation. Our results are also similar if we measure firm size using either firms' sales or assets in lieu of the number of employees; see Appendix Table A1 and A2, respectively. Finally, as mentioned earlier, our results are also not driven by our choice of combining the lowest two hierarchy levels into a single hierarchy level.

3.2 The Employer Size-Wage Effect Revisited

The invariance of "bottom-level" pay ratios—those comparing hierarchy levels 1 to 5 to one another—with regard to firm size raises questions. Are wages associated with lower hierarchy levels individually invariant to firm size? Or do they merely increase (or decrease) at a similar rate? To address these questions, we now examine wage *levels* instead of ratios.

Table 5 presents the results. The first column, which combines all hierarchy levels, includes hierarchy level fixed effects. Thus, the comparison is between small and large firms within a given hierarchy level. As can be seen, the well documented employer size-wage effect (e.g., Brown and Medoff (1989), Oi and Idson (1999)) also holds in our data. Across all hierarchy levels, a one percent increase in firm size implies a wage increase of 0.0126% on average. This magnitude is similar to the employer size-wage effect documented in Brown and Medoff (1989, Table 1, 1b), who report a wage-firm size elasticity of 0.013% using May CPS wage data.

But not all wages increase with firm size. Indeed, as the remaining columns show, wages at lower hierarchy levels (1 to 5) do *not* increase with firm size—they are either invariant to firm size or, if anything, slightly decreasing. In contrast, wages at higher

[14] This statement is about *relative*, not absolute, pay. In our sample, an HR director always earns more than an ordinary HR/Personnel officer, who in turn always earns more than an unskilled worker. See the last column of Table 3.

hierarchy levels (6 to 9) increase with firm size. For these wages, the rate of increase is greater at higher hierarchy levels, which explains why "top-level" pay ratios, such as 78, 79, or 89, all increase with firm size.

Table 5 establishes two main results. First, while the employer size-wage effect also holds in our data—wages are increasing with firm size on average—it is entirely driven by the upper tail of the wage distribution. Second, and equally important, the invariance of "bottom-level" pay ratios to firm size is not driven by wages in the numerator and denominator both increasing (or decreasing) at a similar rate. Rather, both wages are individually invariant to firm size.

3.3 Pay Inequality and Firm Growth

We already remarked that our results are not driven by industry composition effects—they also hold if we focus exclusively on within-industry variation (Appendix Table 3). We now focus on within-firm variation, thereby accounting for any unobserved time-invariant heterogeneity across firms.

Our ability to include firm fixed effects is limited by sample size considerations. As mentioned earlier, IDS samples firms multiple times. The average sampling rate is 3.6 times, and the median is 3 times. However, not every sampling includes all hierarchy levels. As a consequence, some pay ratios have relatively few within-firm repeat observations. In light of this limitation, we form two broad groups of pay ratios. One consists of "top-bottom" (e.g., 17, 18, 19, 27, 28, etc.) and "top-level" (e.g., 67, 78, 89, etc.) pay ratios. These are the pay ratios that are *significantly* related to firm size in Table 4. The other group consists of "bottom-level" (e.g., 12, 23, 34, etc.) pay ratios. These pay ratios are *not* significantly related to firm size in Table 4. Together, both groups span all possible 36 pay ratios in Table 4.

The question is whether the results in Table 4 continue to hold after including firm fixed effects. That is, accounting for time-invariant heterogeneity across firms, does "top-bottom" and "top-level" pay inequality—but not "bottom-level" pay inequality—increase as firms grow bigger over time? Given that we form broad groups of pay ratios, we can additionally include hierarchy-level pair fixed effects and even hierarchy-level pair × firm fixed effects. Thus, our estimates provide us with the average relation between changes in pay inequality and changes in firm size over time for a given hierarchy-level pair at a given firm.

Table 6 reports the results. Columns (1), (3), and (5) show results for "bottom-level" pay ratios, while columns (2), (4), and (6) show results for "top-bottom" and "top-level" pay ratios. Columns (1) and (2) include firm fixed effects, columns (3) and (4) include hierarchy-level pair and firm fixed effects, and columns (5) and (6) include hierarchy-level pair × firm fixed effects. (As in Table 4 and elsewhere, all regressions include year fixed effects.) As is shown, the coefficient on firm size is insignificant among "bottom-level" pay ratios. By contrast, it is significant among "top-bottom" and "top-level" pay ratios, even after including hierarchy-level pair × firm fixed effects. Together, these results suggest that pay disparities between top and bottom hierarchy levels—but also among different top hierarchy levels—become larger as firms grow in size. Importantly, these results confirm that our main results in Table 4 are not driven by unobserved time-invariant heterogeneity across firms.

4 Operating Performance and Firm Value

If within-firm pay inequality is a reflection of managerial talent, we would expect firms with more inequality to have better operating performance and higher valuations. To examine this hypothesis, we make use of the fact that Amadeus not only provides us with firm size but also with financial information allowing us to construct measures of operating performance and firm value. Given our previous results showing that pay inequality is positively related to firm size, we must make sure that we are not simply picking up correlations between firm size and either operating performance or firm value. For this reason, we run all regressions both with and without firm-size controls. While pay inequality is strongly related to firm size, there is sufficient residual variation in pay inequality even among firms of similar size.

To obtain a measure of pay inequality at the firm level, we compute for each firm-pay ratio-year observation its percentile rank within the pay-ratio sample distribution. (E.g., pay ratio 19 at firm X in year Y lies at the Zth percentile across all observations associated with pay ratio 19.) We then aggregate this information at the firm level by computing the average percentile rank for each firm. Lower average percentile ranks mean lower pay inequality.[15]

Panel (A) of Table 7 examines the relation between within-firm pay inequality and the firm's return on assets (ROA). Column (1) shows that this relation is positive and significant. In column (2), we control for firm size. As can be seen, the coefficient on pay inequality remains virtually unchanged. In columns (3) and 4), we use industry-adjusted ROA as our dependent variable. Industry adjustments are done by subtracting the industry mean across all firms in the same 3-digit SIC industry and year using all firms in the Amadeus database. Results are similar if we use industry medians. As can be seen, the coefficient on pay inequality remains similar to before.

Panel (B) considers the relation between pay inequality and firm value (Tobin's Q). Tobin's Q is the market value of assets divided by the book value of assets, where the market value of assets is the book value of assets plus the market value of common stock minus the sum of the book value of common stock and balance sheet deferred taxes. Given that Amadeus does not provide estimates of market values, we must limit ourselves to publicly traded firms in the UK and construct firm value measures using Datastream, resulting in a somewhat smaller sample. Results largely mirror those in Panel (A). For one, there is a positive and significant association between pay inequality and firm value, which holds even after controlling for firm size and industry-adjusting Tobin's Q. Second, the coefficient on pay inequality is stable across all specifications. Overall, the results in Table 7 demonstrate that high pay-inequality firms are not worse performers. Rather, they have higher operating performance as well as higher firm valuations.

[15] Giving equal weight to all 36 pay ratios could lead to situations in which firms with large "top-bottom" pay ratios (17, 18, 19, 27, 28, 29, 37, 38, 39)—high-inequality firms by any sensible standards—are classified as low-inequality firms only because they have compressed "mid-level" (e.g., 34, 45, 56) or "bottom-level" (e.g., 12, 23) pay ratios. For this reason, we only use "top-bottom" pay ratios when computing our measure of firm-level pay inequality.

5 Is Pay Inequality Priced by the Market?

To examine the relation between pay inequality and equity returns, we form a hedge portfolio that is long in high-inequality firms and short in low-inequality firms. Naturally, we must limit ourselves to firms that are publicly traded in the UK. Our measure of firm-level pay inequality is the same as in the previous section. To reflect changes in within-firm pay inequality over time, we rebalance portfolios at the beginning of each year. We compute both equal- and value-weighted portfolio returns. Portfolio weights are constructed using firms' end-of-year market capitalizations. A firm is classified as "high inequality" in year t if its pay inequality measure as of year t lies in the top tercile across all firms in our sample. Likewise, a firm is classified as "low inequality" in year t if its pay inequality measure as of year t lies in the bottom tercile of the distribution. The sample period is from 1/2005 to 9/2014 (117 months). Excess returns are computed by subtracting 3-month UK Treasury bill returns from raw returns.

Table 8 shows results from time-series regressions of monthly excess returns. For brevity, the table only displays the intercept, or alpha (α), of each regression. Panel (A) shows results for the high- minus low-inequality hedge portfolio. Panels (B) and (C) show results separately for the high- and low-inequality portfolio, respectively. In all three panels, columns (1) and (2) report results for value-weighted portfolios, while columns (3) and (4) report results for equal-weighted portfolios. Factors for the UK are obtained from the XFi Centre for Finance and Investment at the University of Exeter.[16]

Columns (1) and (3) report results from regressions of monthly excess returns on an intercept and the market factor (RMRF). As can be seen, the alpha associated with the inequality hedge portfolio is both statistically and economically significant. The value-weighted alpha is 1.177%, while the equal-weighted alpha is 1.142%. In both value- and equal-weighted regressions, the alpha associated with the high-inequality portfolio is positive, wheras the alpha associated with the low-inequality portfolio is negative. That being said, in the value-weighted regression, the alpha associated with the high-inequality

[16] See http://business-school.exeter.ac.uk/research/areas/centres/xfi/research/famafrench/. This is essentially the UK counterpart to Kenneth French's U.S. website. See Gregory, Tharyan, and Christidis (2013) for a description.

portfolio is relatively small compared to the alpha associated with the low-inequality portfolio. Hence, most of the abnornmal return associated with the hedge portfolio is driven by the low-inequality portfolio. Such asymmetries are less pronounced if returns are equally weighted. While the alpha associated with the high-inequality portfolio is smaller, both alphas contribute to the overall hedge portfolio alpha.

Columns (2) and (4) report results from estimating a standard four-factor model, which includes, besides the intercept and RMRF, the book-to-market factor (HML), size factor (SMB), and momentum factor (UMD). Results mirror those obtained from using the market model. In both the value- and equal-weighted regression, the alpha associated with the inequality hedge portfolio is statistically and economically significant (1.172% and 1.226%, respectively). Moreover, in the value-weighted regression, most of the abnornmal return associated with the hedge portfolio is driven by the low-inequality portfolio. By contrast, in the equal-weighted regression, both alphas contribute to the overall hedge portfolio alpha.

What accounts for the positive alpha associated with the inequality hedge portfolio? One interpretation, which is consistent with our previous results, is that high-inequality firms attract better managerial talent, and this is not fully priced by the market. This interpretation is consistent with Edmans (2011), who finds that the market does not fully capture intangibles (specifically, employee satisfaction). A related but somewhat different interpretation is that the market correctly values managerial talent but is unable to observe the cross-sectional variation that we observe in our data. After all, our within-firm pay-level data are not publicly available. Finally, there may be omitted risk factors that are priced by the market but not accounted for by the underlying asset pricing model. To some extent, our operating performance and firm value results already speak to this issue. To further explore this issue, we now turn to Fama-MacBeth regressions allowing us to include a wide array of control variables.

Table 9 reports the Fama-MacBeth coefficients from monthly cross-sectional regressions of individual stock returns on a "high inequality" dummy and control variables. The dummy is equal to one if a firm's pay inequality measure (see above) as of year t lies in the top tercile of the distribution and zero if it lies in the bottom tercile. The sample is restricted to firms in the top and bottom terciles. Thus, high-inequality firms are the same firms that make up the high-inequality portfolio in Table 8. Control variables include size (stock market capitalization), book-to-market, dividend yield, and stock price, all lagged, as well as compound returns from months t-3 to t-2 (Ret2-3), from t-6 to t-4 (Ret4-6), and from t-12 to t-7 (Ret7-12). The control variables are standard in Fama-MacBeth regressions of this sort (e.g., Gompers, Ishii, and Metrick (2003), Giroud and Mueller (2011), Edmans (2011)).

The results broadly confirm those reported in Table 8. Regardless of which controls we include, pay inequality is associated with significantly higher equity returns. The coefficients are also similar to those in Table 8. As Gompers, Ishii, and Metrick (2003) note, the dummy coefficient in the Fama-MacBeth regression can be interpreted as a monthly abnormal return. Accordingly, the monthly abnormal return to high-inequality firms is between 0.992% and 1.408% higher than the monthly abnormal return to low-inequality firms. By comparison, the monthly abnormal return to the inequality hedge portfolio in Table 8 is between 1.172% and 1.226%, which is roughly of the same order of magnitude.

6 Concluding Remarks

Financial regulators and market participants have voiced concerns about high pay inequality within firms. Using a proprietary data set of public and private firms in the UK, we examine how within-firm pay inequality varies across firms, how it relates to firms' operating performance and valuations, and whether it is priced by the market. Our results support the notion that high pay inequality is a reflection of better managerial talent. High-inequality firms have better operating performance and higher Tobin's Q. They also have higher equity returns, suggesting that managerial talent is not fully priced by the market. Lastly, we find that pay disparities within firms are increasing in firm size, which is consistent with theories emphasizing the efficient assignment of managerial talent.

Aggregate income inequality has risen steadily over the past decades.[17] While this

[17] See Atkinson, Piketty, and Saez (2011) for some basic facts and a review of the literature.

is somewhat speculative, our results suggest that some of this rise in aggregate income inequality may be related to firm growth.[18] Between 1986 and 2010, average employment by the 50 (100) largest firms in the U.S. has risen by 55.8% (53.0%). Likewise, over the same time period, average employment by the 50 (100) largest firms in the UK has risen by 51.3% (43.5%). In some countries, like Austria, Canada, Germany, Greece, Netherlands, or Spain, growth rates for the largest 50 or 100 firms are even higher, ranging from 73.1% to 200.3%.

In untabulated results, we explore the relation between firm growth by the 50 or 100 largest firms in a country and aggregate income inequality, as measured by the log 90/10 wage differential. The countries in our sample are Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Italy, Netherlands, Spain, Sweden, United Kingdom, and United States. The sample period is from 1981 to 2010, albeit it varies by country. Regressions include country and year fixed effects. Regardless of whether we consider the 50 or 100 largest firms in a country, there is a positive and strongly significant association between firm growth and income inequality at the country level. Interestingly, if we use a linear time trend in lieu of ountry fixed effects, adding firm growth to the regression reduces the coefficient on the time trend by almost 40%. Thus, part of what might be perceived as a global trend toward more income inequality may actually come from an increase in employment by the largest firms in the economy.

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[18]Section 3.1 shows that larger firms exhibit more within-firm pay inequality. Section 3.3 shows that within-firm pay inequality increases over time as firms grow larger.

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Table 1
Hierarchy Levels

Hierarchy Level	Examples of Job Titles	IDS Description
1	Cleaner, Labourer, Unskilled Worker	Work requires basic literacy and numeracy skills and the ability to perform a few straightforward and short-term tasks to instructions under immediate supervision. Previous experience is not necessary (IDS Level 1). Work requires developed literacy and numeracy skills and the ability to perform some routine tasks within procedures that may include keyboard and practical skills and initial contact with customers. Some previous experience is required (IDS Level 2).
2	Administrative Assistant, Driver, Operator	Work requires specific administrative, practical, craft or technical skills gained by previous experience and qualifications to carry out a range of less routine work and to provide specialist support, and could include closer contact with the public/customers (IDS Level 3).
3	Technician, Craftsman, Skilled Worker	Work requires broad and deep administrative, technical or craft skills and experience to carry out a wider range of activities including staff supervision, undertaking specialist routines and procedures and providing some advice (IDS Level 4).
4	Craftsman - Multiskilled, HR/Personnel Officer, Retail Manager	Work requires detailed experience and possibly some level of vocational qualification to be able to oversee the operation of an important procedure or to provide specialist advice and services, involving applied knowledge of internal systems and procedures (IDS Level 5).
5	Engineer, Marketing Junior Manager, Warehouse Supervisor	Work requires a vocational qualification and sufficient relevant specialist experience to be able to manage a section or operate with self-contained expertise in a specialist discipline or activity (IDS Level 6).
6	Area Sales/Account Manager, Engineer - Senior, Manager - Middle	Work is concerned with the provision of professional services and requires an experienced and qualified professional to provide expertise and advice and operate independently. Also includes operational managers responsible for service delivery (IDS Level 7).
7	Engineering Manager, Lawyer -Senior, Operations Manager	Work requires deep professional experience and qualifications in a specific discipline to be able to carry out a range of specialist technical or scientific activities, which may include the management of a team or services. May also include specialist management roles responsible for delivery of a major service (IDS Level 8).
8	Finance Function Head, IT Function Head, Sales Function Head	Senior managerial roles involved in managing an important activity or providing authoritative expertise, also contributing to the organisation as a whole through significant experience (IDS Level 9).
9	Finance Director, HR Director, Lawyer - Head of Legal	Very senior executive roles with substantial experience in, and leadership of, a specialist function, including some input to the organisation's overall strategy (IDS Level 10).

Table 2
Distribution of Wages by Hierarchy Level

This table shows the distribution of wages for each hierarchy level across all firm-year observations. Wages are in GBP. Hierarchy levels are described in Table 1. The sample period is from 2004 to 2013.

Hierarchy Level	Obs.	Avg. Wage	25%	50%	75%
1	696	13,778	11,090	13,413	16,001
2	890	16,248	13,122	16,354	18,731
3	852	19,621	16,471	19,715	22,371
4	1,034	22,815	19,662	22,562	25,344
5	955	29,352	24,783	28,496	32,901
6	868	38,878	31,961	36,806	43,330
7	696	52,977	40,632	48,793	60,587
8	461	85,014	57,967	74,236	100,813
9	240	110,693	77,844	101,494	131,004

Table 3
Pay Ratios

This table shows the distribution of pay ratios for all 36 hierarchy-level pairs. Pay ratio is the ratio of wages associated with a hierarchy-level pair in a given firm and year. Hierarchy levels are described in Table 1. Ratio > 1 (%) denotes the percentage of firm-year observations for which the pay ratio exceeds one. The sample period is from 2004 to 2013.

Hierarchy-Level Pair	Obs.	Avg. Pay Ratio	25%	50%	75%	Ratio > 1 (%)
12	559	1.171	1.083	1.154	1.234	96
13	474	1.364	1.217	1.332	1.474	98
14	449	1.635	1.371	1.579	1.791	100
15	383	1.959	1.620	1.875	2.204	100
16	295	2.517	1.964	2.342	2.928	100
17	193	3.376	2.500	3.084	3.954	100
18	74	5.920	3.616	4.742	6.817	100
19	23	8.286	4.798	7.429	9.820	100
23	660	1.208	1.108	1.173	1.281	95
24	597	1.417	1.222	1.365	1.548	97
25	511	1.728	1.430	1.652	1.907	99
26	415	2.225	1.814	2.122	2.506	100
27	251	2.899	2.208	2.683	3.364	100
28	99	4.981	2.986	3.962	6.006	100
29	36	7.301	5.064	6.379	9.383	100
34	631	1.208	1.083	1.177	1.292	90
35	542	1.496	1.264	1.428	1.634	98
36	436	1.928	1.582	1.853	2.190	100
37	275	2.507	1.909	2.260	2.904	100
38	109	4.384	2.600	3.472	5.310	100
39	46	6.515	4.212	5.735	8.670	100
45	648	1.295	1.129	1.249	1.406	94
46	542	1.655	1.383	1.575	1.846	99
47	399	2.230	1.755	2.090	2.551	100
48	202	3.547	2.493	3.237	4.157	100
49	112	5.442	3.979	4.970	6.398	100

Table 3 (continued)

Hierarchy-Level Pair	Obs.	Avg. Pay Ratio	25%	50%	75%	Ratio > 1 (%)
56	693	1.315	1.161	1.278	1.429	94
57	557	1.770	1.497	1.702	1.975	99
58	346	2.720	2.059	2.463	3.055	100
59	193	3.826	2.837	3.641	4.534	100
67	576	1.362	1.220	1.338	1.468	96
68	391	2.013	1.598	1.875	2.209	100
69	214	2.806	2.088	2.685	3.296	100
78	397	1.480	1.240	1.391	1.601	98
79	213	2.121	1.700	1.981	2.391	100
89	201	1.529	1.294	1.464	1.682	98

Table 4
More Pay Inequality at Larger Firms

The dependent variable is the pay ratio (in logs) associated with a given hierarchy-level pair. Firm size is the number of employees (in logs). All regressions include year fixed effects. Standard errors (in parentheses) are clustered at the firm level. The sample period is from 2004 to 2013. *, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively.

Panel (A):

Pay Ratio	12	13	14	15	16	17	18	19
lg_empl	-0.001	-0.005	0.008	0.009	0.038***	0.088***	0.162***	0.179***
	(0.004)	(0.005)	(0.007)	(0.009)	(0.012)	(0.015)	(0.026)	(0.039)
Constant	0.171***	0.373***	0.462***	0.626***	0.568***	0.445**	-0.232	0.372
	(0.030)	(0.049)	(0.066)	(0.093)	(0.133)	(0.213)	(0.195)	(0.252)
Observations	559	474	449	383	295	193	74	23
R-squared	0.024	0.040	0.070	0.050	0.147	0.377	0.505	0.740

Panel (B):

Pay Ratio	23	24	25	26	27	28	29
lg_empl	-0.011***	-0.005	-0.009	0.006	0.061***	0.133***	0.152***
	(0.004)	(0.005)	(0.007)	(0.009)	(0.012)	(0.026)	(0.038)
Constant	0.268***	0.391***	0.632***	0.662***	0.482***	0.198	0.714**
	(0.034)	(0.051)	(0.068)	(0.083)	(0.123)	(0.196)	(0.326)
Observations	660	597	511	415	251	99	36
R-squared	0.037	0.029	0.061	0.027	0.209	0.398	0.361

Panel (C):

Pay Ratio	34	35	36	37	38	39
lg_empl	0.004	0.007	0.019*	0.072***	0.147***	0.159***
	(0.005)	(0.008)	(0.010)	(0.015)	(0.029)	(0.037)
Constant	0.147***	0.320***	0.396***	0.246	0.476***	0.247
	(0.045)	(0.067)	(0.085)	(0.154)	(0.166)	(0.284)
Observations	631	542	436	275	109	46
R-squared	0.024	0.027	0.044	0.239	0.347	0.407

Panel (D):

Pay Ratio	45	46	47	48	49
lg_empl	-0.001	0.021***	0.057***	0.105***	0.102***
	(0.005)	(0.007)	(0.008)	(0.013)	(0.019)
Constant	0.207***	0.271***	0.147	0.330***	0.888***
	(0.042)	(0.057)	(0.094)	(0.072)	(0.257)
Observations	648	542	399	202	112
R-squared	0.023	0.061	0.195	0.323	0.266

Table 4 (continued)

Panel (E):

Pay Ratio	56	57	58	59
lg_empl	0.020***	0.041***	0.089***	0.091***
	(0.005)	(0.006)	(0.011)	(0.013)
Constant	0.087*	0.092	0.276***	0.742***
	(0.047)	(0.070)	(0.063)	(0.143)
Observations	693	557	346	193
R-squared	0.071	0.160	0.272	0.221

Panel (F):

Pay Ratio	67	68	69
lg_empl	0.018***	0.056***	0.062***
	(0.004)	(0.009)	(0.012)
Constant	0.049	0.119**	0.602***
	(0.041)	(0.053)	(0.137)
Observations	576	391	214
R-squared	0.059	0.166	0.131

Panel (G):

Pay Ratio	78	79
lg_empl	0.033***	0.046***
	(0.008)	(0.010)
Constant	0.031	0.361***
	(0.047)	(0.079)
Observations	397	213
R-squared	0.101	0.106

Panel (H):

Pay Ratio	89
lg_empl	0.024***
	(0.009)
Constant	0.272***
	(0.092)
Observations	201
R-squared	0.050

Table 5
The Employer Size-Wage Effect Revisited

The dependent variable is the wage (in logs) associated with a given hierarchy level. Firm size is the number of employees (in logs). All regressions include year fixed effects. The regression in column "All" additionally includes hierarchy level fixed effects. Standard errors (in parentheses) are clustered at the firm level. The sample period is from 2004 to 2013. *, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively.

Hierarchy Level	All	1	2	3	4
lg_empl	0.013***	-0.021***	-0.006	-0.011	0.001
	(0.005)	(0.006)	(0.007)	(0.007)	(0.005)
Constant	4.789***	5.020***	5.123***	5.361***	5.470***
	(0.036)	(0.053)	(0.056)	(0.055)	(0.043)
Observations	6,692	696	890	852	1034
R-squared	0.825	0.079	0.013	0.036	0.027

Hierarchy Level	5	6	7	8	9
lg_empl	0.0004	0.026***	0.054***	0.088***	0.104***
	(0.006)	(0.006)	(0.007)	(0.013)	(0.014)
Constant	5.631***	5.656***	5.701***	6.001***	6.089***
	(0.049)	(0.050)	(0.089)	(0.075)	(0.110)
Observations	955	868	696	461	240
R-squared	0.041	0.061	0.151	0.223	0.227

Table 6
Pay Inequality and Firm Growth

The dependent variable is the pay ratio (in logs) associated with a given hierarchy-level pair. The sample in columns (1), (3), and (5) consists of all "bottom-level" pay ratios: 12, 13, 14, 15, 23, 24, 25, 34, 35, and 45. The sample in columns (2), (4), and (6) consists of all "top-bottom" and "top-level" pay ratios: 16, 17, 18, 19, 26, 27, 28, 29, 36, 37, 38, 39, 46, 47, 48, 49, 56, 57, 58, 59, 67, 68, 69, 78, 79, and 89. Firm size is the number of employees (in logs). Columns (1) and (2) include firm fixed effects, columns (3) and (4) include hierarchy-level pair and firm fixed effects, and columns (5) and (6) include hierarchy-level pair × firm fixed effects. All regressions additionally include year fixed effects. The sample consists of all firm-hierarchy-level pairs with at least one repeat observation. Standard errors (in parentheses) are clustered at the firm level. The sample period is from 2004 to 2013. *, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
lg_empl	-0.005	0.061**	0.004	0.061***	0.005	0.075***
	(0.015)	(0.025)	(0.013)	(0.022)	(0.014)	(0.029)
Constant	0.362***	0.148	0.141	-0.162	0.289**	0.071
	(0.119)	(0.208)	(0.103)	(0.182)	(0.114)	(0.239)
Observations	3,960	4,305	3,960	4,305	3,960	4,305
R-squared	0.235	0.291	0.612	0.792	0.795	0.888

Table 7
Operating Performance and Firm Value

In Panel (A), the dependent variable is the firm's return on assets (ROA). ROA is EBITDA divided by the book value of assets. Columns (2) and (4) control for firm size. Firm size is the number of employees (in logs). In columns (3) and (4), ROA is industry-adjusted by subtracting the industry mean across all firms in the same 3-digit SIC industry and year using all firms in Amadeus. Pay Inequality at the firm level is described in Section 4. Panel (B) is analogous to Panel (A), except that the dependent variable is Tobin's Q, the sample is restricted to publicly traded UK firms in Datastream, and industry-adjustments are based on all Datastream firms in the same 3-digit SIC industry and year. Tobin's Q is the market value of assets divided by the book value of assets, where the market value of assets is the book value of assets plus the market value of common stock minus the sum of the book value of common stock and balance sheet deferred taxes. Standard errors (in parentheses) are clustered at both the firm and year level. The sample period is from 2004 to 2013. *, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively.

Panel (A): Return on Assets

	ROA		Ind.-Adj. ROA	
	(1)	(2)	(3)	(4)
Pay Inequality	0.042**	0.042*	0.044**	0.053**
	(0.020)	(0.025)	(0.0200)	(0.026)
lg_empl		-0.0004		-0.003
		(0.003)		(0.003)
Constant	0.081***	0.084***	0.006	0.022
	(0.010)	(0.019)	(0.011)	(0.019)
Observations	718	704	710	696
R-squared	0.023	0.021	0.037	0.038

Panel (B): Tobin's Q

	Tobin's Q		Ind.-Adj. Tobin's Q	
	(1)	(2)	(3)	(4)
Pay Inequality	0.568**	0.698**	0.671***	0.636**
	(0.270)	(0.344)	(0.247)	(0.317)
lg_empl		-0.009		0.027
		(0.043)		(0.040)
Constant	1.341***	1.370***	-0.687***	-0.838***
	(0.064)	(0.236)	(0.099)	(0.207)
Observations	440	386	437	384
R-squared	0.086	0.099	0.077	0.082

Table 8
Time-Series Regressions of Monthly Excess Returns

This table reports alphas (α) from time-series regressions of monthly excess returns. Excess returns are computed by subtracting 3-month UK Treasury bill returns from raw returns. Panel (A) shows results for a hedge portfolio that is long in high-inequality firms and short in low-inequality firms. A firm is classified as "high inequality" in year *t* if its pay inequality measure as of year *t* lies in the top tercile across all firms in the sample. Likewise, a firm is classified as "low inequality" in year *t* if its pay inequality measure as of year *t* lies in the bottom tercile of the distribution. Pay Inequality at the firm level is described in Section 4. Portfolios are rebalanced at the beginning of each year. Panel (B) shows results separately for the high-inequality portfolio, while panel (C) shows results separately for the low-inequality portfolio. Columns (1) and (3) include the intercept (α) and market factor (RMRF). Columns (2) and (4) include the intercept (α), market factor (RMRF), book-to-market factor (HML), size factor (SMB), and momentum factor (UMD). Columns (1) and (2) report results for value-weighted portfolios. Columns (3) and (4) report results for equal-weighted portfolios. The sample period is from 1/2005 to 9/2014 (117 months). *, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively.

Panel (A): Inequality Hedge Portfolio

	Value-weighted		Equal-weighted	
	(1)	(2)	(3)	(4)
alpha	1.177***	1.172***	1.142***	1.226***
t-statistic	(0.444)	(0.378)	(0.362)	(0.388)

Panel (B): High-Inequality Portfolio

	Value-weighted		Equal-weighted	
	(1)	(2)	(3)	(4)
alpha	0.219	0.205	0.456*	0.477*
t-statistic	(0.304)	(0.285)	(0.265)	(0.262)

Panel (C): Low-Inequality Portfolio

	Value-weighted		Equal-weighted	
	(1)	(2)	(3)	(4)
alpha	-0.958***	-0.967***	-0.686**	-0.749**
t-statistic	(0.353)	(0.349)	(0.342)	(0.315)

Table 9
Fama-MacBeth Return Regressions

This table reports Fama-MacBeth coefficients from monthly cross-sectional regressions of individual stock returns on a "high inequality" dummy and control variables. The dummy is equal to one if a firm's pay inequality measure as of year *t* lies in the top tercile of the distribution and zero if it lies in the bottom tercile. The sample is restricted to firms in the top and bottom terciles. Pay Inequality at the firm level is described in Section 4. Control variables include size (stock market capitalization), book-to-market (BM), dividend yield, and stock price, all lagged, as well as compound returns from months t-3 to t-2 (Ret2-3), from t-6 to t-4 (Ret4-6), and from t-12 to t-7 (Ret7-12). The sample period is from 1/2005 to 9/2014 (117 months). Standard errors are in parentheses. *, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3)	(4)	(5)
High Inequality	1.065***	1.143***	1.030***	1.408***	0.992**
	(0.342)	(0.335)	(0.333)	(0.471)	(0.437)
Size		-0.056	-0.148	-0.257*	-0.080
		(0.111)	(0.111)	(0.139)	(0.131)
BM			-1.168*	-0.468	-0.172
			(0.618)	(0.936)	(0.546)
Div. Yield				5.363	-0.152
				(5.210)	(0.722)
Stock Price					0.003**
					(0.001)
Ret2-3					0.038
					(0.039)
Ret4-6					-0.003
					(0.038)
Ret7-12					-0.064
					(0.039)
Constant	-0.05	0.248	1.602	1.461	0.396
	(0.463)	(1.077)	(1.061)	(1.096)	(1.305)
Observations	2,628	2,628	2,580	2,580	2,566
R-squared	0.002	0.003	0.000	0.001	0.001

Appendix

Table A1
Measuring Firm Size Using Firms' Sales

This table presents variants of the regressions in Table 4 in which firm size is measured using firms' sales (in logs). All regressions include year fixed effects. Standard errors (in parentheses) are clustered at the firm level. The sample period is from 2004 to 2013. *, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively.

Pay Ratio	12	13	14	15	16	17	18	19
lg_sales	-0.001	-0.007	0.002	0.001	0.025**	0.077***	0.133***	0.150***
	(0.003)	(0.004)	(0.006)	(0.008)	(0.010)	(0.015)	(0.028)	(0.035)
Constant	0.166***	0.435***	0.484***	0.668***	0.503***	-0.003	-0.330	-0.729
	(0.043)	(0.070)	(0.094)	(0.134)	(0.183)	(0.298)	(0.379)	(0.575)
Observations	580	490	462	394	302	198	78	26
R-squared	0.024	0.050	0.072	0.042	0.109	0.312	0.417	0.618

Pay Ratio	23	24	25	26	27	28	29
lg_sales	-0.014***	-0.012**	-0.016**	-0.005	0.047***	0.110***	0.110***
	(0.003)	(0.005)	(0.007)	(0.008)	(0.010)	(0.024)	(0.037)
Constant	0.405***	0.537***	0.812***	0.780***	0.242	-0.527	0.245
	(0.047)	(0.077)	(0.106)	(0.127)	(0.173)	(0.372)	(0.572)
Observations	686	618	532	432	261	104	40
R-squared	0.066	0.049	0.078	0.024	0.156	0.369	0.249

Pay Ratio	34	35	36	37	38	39
lg_sales	-0.002	-0.003	0.009	0.059***	0.111***	0.137***
	(0.005)	(0.007)	(0.009)	(0.014)	(0.029)	(0.034)
Constant	0.214***	0.424***	0.402***	-0.090	-0.099	-1.101*
	(0.073)	(0.108)	(0.140)	(0.239)	(0.373)	(0.551)
Observations	648	557	445	280	112	48
R-squared	0.021	0.022	0.026	0.193	0.287	0.368

Pay Ratio	45	46	47	48	49
lg_sales	-0.005	0.017***	0.050***	0.096***	0.101***
	(0.004)	(0.006)	(0.008)	(0.014)	(0.019)
Constant	0.279***	0.170*	-0.203	-0.530**	0.147
	(0.072)	(0.097)	(0.135)	(0.266)	(0.331)
Observations	666	557	412	209	115
R-squared	0.032	0.053	0.183	0.308	0.275

Table A1 (continued)

Pay Ratio	56	57	58	59
lg_sales	0.013***	0.036***	0.068***	0.079***
	(0.004)	(0.005)	(0.011)	(0.013)
Constant	0.038	-0.165*	-0.324	0.149
	(0.068)	(0.099)	(0.230)	(0.206)
Observations	716	577	361	203
R-squared	0.051	0.150	0.212	0.204

Pay Ratio	67	68	69
lg_sales	0.015***	0.042***	0.051***
	(0.004)	(0.008)	(0.011)
Constant	-0.049	-0.094	0.130
	(0.059)	(0.107)	(0.175)
Observations	598	407	225
R-squared	0.055	0.133	0.119

Pay Ratio	78	79
lg_sales	0.030***	0.038***
	(0.007)	(0.010)
Constant	-0.154	0.109
	(0.104)	(0.164)
Observations	415	224
R-squared	0.091	0.098

Pay Ratio	89
lg_sales	0.026***
	(0.008)
Constant	0.067
	(0.126)
Observations	212
R-squared	0.068

Table A2
Measuring Firm Size Using Firms' Assets

This table presents variants of the regressions in Table 4 in which firm size is measured using firms' assets (in logs). All regressions include year fixed effects. Standard errors (in parentheses) are clustered at the firm level. The sample period is from 2004 to 2013. *, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively.

Pay Ratio	12	13	14	15	16	17	18	19
lg_asset	-0.001	-0.004	0.003	0.002	0.021***	0.060***	0.103***	0.134***
	(0.002)	(0.004)	(0.005)	(0.007)	(0.008)	(0.013)	(0.027)	(0.035)
Constant	0.183***	0.414***	0.470***	0.654***	0.458**	0.056	-1.072*	-0.774
	(0.048)	(0.076)	(0.101)	(0.145)	(0.183)	(0.316)	(0.548)	(0.643)
Observations	675	538	500	450	338	223	88	31
R-squared	0.024	0.049	0.077	0.044	0.109	0.251	0.296	0.472

Pay Ratio	23	24	25	26	27	28	29
lg_asset	-0.010***	-0.008**	-0.007	-0.004	0.033***	0.080***	0.085**
	(0.003)	(0.004)	(0.005)	(0.007)	(0.009)	(0.027)	(0.038)
Constant	0.388***	0.530***	0.703***	0.797***	0.307	-0.446	-0.304
	(0.052)	(0.080)	(0.106)	(0.151)	(0.211)	(0.568)	(0.793)
Observations	765	684	601	486	293	120	49
R-squared	0.043	0.039	0.042	0.023	0.109	0.227	0.186

Pay Ratio	34	35	36	37	38	39
lg_asset	-0.004	-0.004	-0.0001	0.035***	0.075***	0.099***
	(0.004)	(0.005)	(0.007)	(0.013)	(0.024)	(0.033)
Constant	0.256***	0.468***	0.543***	0.117	0.057	-0.693
	(0.074)	(0.105)	(0.150)	(0.278)	(0.410)	(0.619)
Observations	712	603	485	301	125	54
R-squared	0.020	0.021	0.018	0.116	0.169	0.255

Pay Ratio	45	46	47	48	49
lg_asset	-0.003	0.008	0.031***	0.060***	0.065***
	(0.004)	(0.006)	(0.008)	(0.014)	(0.022)
Constant	0.274***	0.275**	-0.073	-0.337	0.394
	(0.075)	(0.110)	(0.170)	(0.335)	(0.473)
Observations	729	612	456	240	138
R-squared	0.019	0.038	0.117	0.190	0.133

Table A2 (continued)

Pay Ratio	56	57	58	59
lg_asset	0.007**	0.023***	0.042***	0.047***
	(0.003)	(0.005)	(0.009)	(0.012)
Constant	0.103	-0.068	-0.171	0.400
	(0.076)	(0.108)	(0.252)	(0.258)
Observations	794	643	413	237
R-squared	0.035	0.104	0.132	0.117

Pay Ratio	67	68	69
lg_asset	0.008***	0.026***	0.031***
	(0.003)	(0.007)	(0.010)
Constant	0.017	0.009	0.300
	(0.061)	(0.121)	(0.216)
Observations	672	465	254
R-squared	0.032	0.078	0.064

Pay Ratio	78	79
lg_asset	0.015**	0.024**
	(0.006)	(0.010)
Constant	-0.018	0.215
	(0.119)	(0.210)
Observations	472	257
R-squared	0.056	0.049

Pay Ratio	89
lg_asset	0.020***
	(0.007)
Constant	-0.155
	(0.143)
Observations	243
R-squared	0.058

Table A3
Within-Industry Analysis

This table presents variants of the regressions in Table 4 which include, in addition to year fixed effects, 2-digit SIC industry fixed effects. Standard errors (in parentheses) are clustered at the firm level. The sample period is from 2004 to 2013. *, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively.

Pay Ratio	12	13	14	15	16	17	18	19
lg_empl	-0.003	-0.009	-0.013	-0.012	0.018	0.049***	0.107**	0.185*
	(0.004)	(0.008)	(0.010)	(0.009)	(0.013)	(0.016)	(0.041)	(0.099)
Constant	0.280***	0.125*	0.515***	0.860***	0.951***	0.736***	0.592**	-0.104
	(0.034)	(0.065)	(0.085)	(0.095)	(0.113)	(0.235)	(0.289)	(1.217)
Observations	552	468	442	377	291	190	73	22
R-squared	0.155	0.178	0.287	0.336	0.380	0.588	0.680	0.949

Pay Ratio	23	24	25	26	27	28	29
lg_empl	-0.015***	-0.021***	-0.017**	-0.010	0.031**	0.082**	0.224**
	(0.005)	(0.006)	(0.007)	(0.009)	(0.013)	(0.032)	(0.104)
Constant	0.577***	0.739***	0.953***	0.581***	0.402***	-0.462	-0.648
	(0.031)	(0.078)	(0.059)	(0.070)	(0.134)	(0.511)	(1.225)
Observations	652	589	506	412	249	99	36
R-squared	0.194	0.289	0.347	0.351	0.443	0.607	0.859

Pay Ratio	34	35	36	37	38	39
lg_empl	-0.003	0.0003	0.007	0.042***	0.110***	0.095
	(0.005)	(0.006)	(0.009)	(0.012)	(0.029)	(0.057)
Constant	0.385***	0.700***	0.394***	0.514***	-0.088	0.212
	(0.038)	(0.047)	(0.062)	(0.195)	(0.401)	(0.703)
Observations	622	537	434	274	109	46
R-squared	0.265	0.283	0.319	0.432	0.596	0.790

Pay Ratio	45	46	47	48	49
lg_empl	0.0065	0.023***	0.052***	0.091***	0.111***
	(0.005)	(0.007)	(0.010)	(0.017)	(0.029)
Constant	0.323***	0.188**	-0.031	0.248	0.402*
	(0.043)	(0.095)	(0.138)	(0.246)	(0.232)
Observations	642	539	397	201	111
R-squared	0.150	0.227	0.335	0.510	0.565

Table A3 (continued)

Pay Ratio	56	57	58	59
lg_empl	0.016***	0.035***	0.078***	0.089***
	(0.005)	(0.006)	(0.014)	(0.019)
Constant	0.048	0.114*	0.342	0.954***
	(0.039)	(0.059)	(0.323)	(0.209)
Observations	689	554	344	192
R-squared	0.212	0.309	0.430	0.493

Pay Ratio	67	68	69
lg_empl	0.014**	0.049***	0.043**
	(0.005)	(0.012)	(0.018)
Constant	0.129***	-0.171	1.205***
	(0.043)	(0.200)	(0.228)
Observations	572	388	213
R-squared	0.161	0.290	0.364

Pay Ratio	78	79
lg_empl	0.031***	0.047***
	(0.009)	(0.014)
Constant	-0.159	0.191
	(0.153)	(0.150)
Observations	395	212
R-squared	0.298	0.370

Pay Ratio	89
lg_empl	0.015
	(0.012)
Constant	0.724***
	(0.163)
Observations	200
R-squared	0.288