Wage dispersion and firm performance: evidence from Kazakhstan[1]

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Abstract

Purpose - The aim of the paper is to explore within-firm vertical pay inequality and its relation to firm size and firm performance.

Design/methodology/approach - Using firm-level microdata for Kazakhstan, we measure within-firm pay inequality as the wage differential between the top- and the bottom-level job occupations. We carry out our analysis based on panel regression models.

Findings - We find that within-firm pay inequality increases as firms grow. Further, we identify that this trend is mainly driven by top-occupation workers receiving more significant wage increases compared to lower-level workers as firms expand. Once we address concerns about endogeneity, we find that pay inequality is negatively associated with firm performance.

Practical implications - Developing strategies and policies that prioritize fairness and transparency in compensation practices is crucial during the expansion process of firms. By actively discouraging rent-seeking behavior, firms can create a work environment that promotes productivity and sustainability, ultimately leading to improved firm performance. The research findings highlight the importance of implementing context-specific interventions, recognizing that different environments may require tailored approaches to address pay inequality effectively.

Originality/value - This paper contributes to the study of within-firm pay inequality, firm size, and performance in an emerging economy, an area that has been largely overlooked in previous empirical research. Our contrasting findings show the importance of the structural and industrial characteristics of emerging markets that contribute to broader and deeper impact of pay inequality compared to developed economies.

Keywords: pay inequality, job occupations, performance, firm size

JEL codes: J31, L25, M52

1. Introduction

Rising pay inequality has attracted a lot of attention over the past few decades and has emerged as a major challenge. However, its causes are still not well understood. One of the possible reasons behind the diversity in the literature is that inequality has two dimensions: within firms and across firms. According to a variety of theories[2], both within and between firm pay inequality influence worker and firm performance. On the one hand, it is argued that higher pay differentials increase productivity, highlighting their significance for motivating workers' efforts and/or attracting talented employees (Lazear and Rosen, 1981). On the other hand, the widening wage gap is perceived as unethical and unfair, disturbing the work morale and cooperative working environment (Akerlof and Yellen, 1990), thus lowering workers' efforts, individual and firm performance, and productivity. Hence, understanding the impact of pay inequality on firm performance helps to explain the aggregate trends and to identify the line of further development.

A growing body of literature studying pay inequality and firm characteristics, such as firm size and profitability, focuses on advanced economies (Heyman, 2005; Edmans et al., 2014; Mueller et al., 2017). A limited body of work explores emerging or developing countries. However, income inequality is substantially worse in developing nations (Milanovic, 2016), and institutional factors, such as the lack of modern labor legislation, make it even more detrimental to future growth. Many developing and emerging economies have no or very low minimum wages, limited employment protection legislation, or union representation. Also, competition is often lacking, leading to substantial variations in firm size, and management can be tightly linked to government structures, i.e. politically influential managers. In contrast to advanced economies, it is thus far less clear to what extent firm characteristics matter in explaining pay inequality in

[2] Such as relative deprivation (Akerlof and Yellen, 1990), tournament theory (Lazear and Rosen, 1981), technological change and trade (Goldberg and Pavnic, 2016), and allocative efficiency theory (Gabaix and Landier, 2008).

emerging economies, with the institutional environment possibly having a greater impact on wage differentials. With this research we fill in this gap by studying the emerging economy of Kazakhstan.

This paper studies heterogeneity in within-firm vertical pay inequality[3], its relationship to firm size and performance. To this end, we use hitherto unexploited firm-level data on Kazakhstan for the 2012–2015-year period. To measure vertical intra-firm pay inequality, we calculate the pay ratio - the wage differential between the top and the bottom-level job occupations - using firm-level data on wages by occupations.[4] We begin our analysis by studying the relationship between wages and firm size. Consistent with the existing literature, we find that pay inequality increases with firm size in Kazakhstan. This relationship is driven by top occupations experiencing a more significant increase in wages compared to lower occupations as firms expand. Further , we explore to what extent an increase in pay inequality affects firm performance. Using 2SLS regression analysis we address potential endogeneity concerns originating from the fact that better-performing firms are more likely to reward their managers. Opposite to the predictions of most performance-related models, we find a negative association of pay inequality with firm performance. Although a higher pay inequality may serve as a signal to attract more productive or talented workers, we find no evidence to support the idea that incentive-based pay boosts overall firm performance, in the context of Kazakhstan. The reverse correlation tends to indicate rent extraction by top occupations. Alternatively, it may hint at poorly designed pay-schemes or/and lack of modern labor legislation, corruption, and weak law-enforcing institutions, which are common characteristics of the developing world.

[3] As opposed to horizontal pay inequality, where wages are compared between workers with similar tasks, education level, and occupations, vertical pay inequality compares the wages across the hierarchical ladder.
[4] This measure is standard to the studies on vertical pay inequality; used, for example, in Mueller et al. (2017) and Kim and Konings (2019).

Kazakhstan is the largest Central Asian economy with abundant natural resources, with its income primarily reliant on oil and gas revenues and commodities. After the collapse of the Soviet Union, Kazakhstan faced huge challenges, mainly in its transition from central planning to a market-based economy (Subramanian and Abilova, 2020). In 1991, state-owned enterprises accounted for 87 percent of Kazakhstan's employment. The government undertook extensive phases of privatization as part of the structural reform (Lee, 2021), allowing firms to develop their pay and reward structures. However, by 2022, most of its privatization efforts were still lying ahead and the economy remained poorly diversified. Although Kazakhstan increased its GDP and its inequality is in decline, the conflict between new and old institutions, unrestricted political and/or administrative power of dominant groups held the development of the economy back. Therefore, Kazakhstan provides an intriguing setting for examining the role of pay inequality on firm performance.

This paper, additionally, stresses the importance of addressing potential empirical concerns and their proper accountability. There is also a possibility of a well-performing firm rewarding its management, including the CEOs, which introduces endogeneity issues into the model, resulting in biased and inconsistent OLS estimates. Our analysis attempts to address potential endogeneity and omitted variable issues present in the previous empirical work by controlling for firm-fixed effects and implementing an instrumental variable approach.

The rest of the paper is organized as follows. Section 2 summarizes the theoretical background and previous empirical findings. Section 3 describes the data used. Section 4 analyzes the relationship between pay inequality, firm size, and firm performance. Section 5 provides concluding remarks by summarizing the main results of the analysis.

2. Literature Overview

Both research and practice show that pay differences are important. They are related to employee performance (Bloom, 1999), worker satisfaction (Pfeffer and Davis-Blake, 1992), and firm turnover (Kepes et al., 2009). The issue is that the direction and strength of these relationships remain ambiguous. One of the critical reasons for the lack of consistency is because pay variations are conceptualized and operationalized very differently (see Gupta et al. 2012, for the overview of the different literature). For example, within-firm pay inequality is different from across-firm pay differences, as well as, horizontal pay differences having different forces at play compared to vertical pay differences. Research studies that differentiate these concepts and are able to look at all of them are very limited and require extensive data (e.g., Siegel and Hambrick, 2005). In this regard, we position our paper to the strand of pay inequality literature that focuses on the effects of within-firm vertical pay inequality on firm performance. Hence, below we provide a review of related literature.

The literature that studies the effect of within-firm pay inequality on firm performance shows mixed evidence based on two conflicting viewpoints. One argument is based on incentive effects (tournament theory) and suggests that rewarding workers according to their relative productivity stimulates their effort (Lazear and Rosen, 1981). The other argument stresses fairness and cooperation (relative deprivation theory) and points to a negative effect of a dispersed wage structure on firm performance (Akerlof and Yellen, 1990).[5]

[5] The prediction is based on the premise that employees react negatively (damaged labor relations, reduced cooperation, negative attitude and behavior, reduced effort) when they find that their relative wages are lower and below the fair wage they expect for the amount of effort they put in.

Another related strand of research highlights the importance of firm size influencing within-firm pay inequality (Brown and Medoff, 1989; Mueller et al. 2017; Kim and Konings, 2019). These studies find that within-firm pay inequality rises as firms expand, which is predicted by both the talent assignment and rent extraction theories. The talent assignment model suggests that larger firms attract more talented managers, consequently scaling up their managerial talent. According to Rosen (1982), people with superior talent occupying top positions increase firm productivity due to their unique abilities. This occurs when a recursive chain of command technology filters out superior talent. Talent assignment also affects managerial behavior as managers allocate more of their effort toward hiring the skilled workers and firing the unskilled (Bandiera et al., 2007). Hence, firms with more inequality should perform better than firms with less inequality according to this theory. In contrast, in the rent extraction model managers in larger firms are able to extract more rents without contributing to firm performance.

In general, most of the literature on vertical pay inequality and firm performance has focused on advanced economies (Edmans et al., 2014; Mueller et al., 2017) and little work exists on this relationship in emerging or developing economies.[6] A few papers look at the effect of vertical pay gaps on firm performance for firms in China and focus on publicly listed firms (Dai et al., 2017; Luo et al., 2020). These papers suggest that pay gaps and firm performance follow an approximately U-shaped relationship. For advanced economies, more recent studies suggest a positive relationship between pay dispersion and operating performance that is consistent with the tournament and talent assignment theories (for instance, see Mueller et al. (2017) for a study on the United Kingdom, and Rouen (2020) for study on the United States). However, these papers

[6] Moreover, the existing empirical research that studies pay inequality and firm size are largely focused on developed economies as well. For instance, see Brown and Medoff (1989) and Mueller et al. (2017) for studies on the United Kingdom, Kim and Konings (2019) for South Korea, Song et al. (2019) for the United States, and Friedrich (2021) for Denmark.

analyze a subset of firms, either from a survey or publicly listed firms. Our paper includes both public and private firms in the analysis, which provides wider coverage and accounts for the heterogeneity in firm characteristics. Evidently, the literature focusing on emerging and developing countries is still scarce and this paper also contributes to the rising debate on pay inequality in emerging and developing economies and its potential impact on overall growth.

Furthermore, the previous empirical research focuses mainly on performance measures, such as Tobin's Q and ROA. A few studies analyze total factor productivity or labor productivity. To our knowledge, no articles jointly examined the effect of pay inequality on performance and efficiency. Our paper analyzes both performance measures and accounts for a potential endogenous relationship between pay inequality and firm performance - a firm that performs well is also likely to reward its workers. Due to the panel nature of the data, we implement an instrumental variable approach using lags of the control variable as an instrument. The usage of lag variables as instruments is not novel to this literature. In contrast to our study, addressing endogeneity issue is most common to the studies on horizontal pay inequality, the data structure of which allows them to construct instruments based on employee characteristics, such as education and tenure (e.g. Heyman, 2005; Hunnes; 2009; Mahy et al., 2011). However, most of the studies on vertical pay inequality are limited to the use of firm level cross-sectional data, which limits the instrument availability. Table A.1 summarizes the available research in the field.

3. Data

3.1. Descriptive Statistics

Our sample is constructed from two firm-level data sources obtained from the Bureau of National Statistics of the Republic of Kazakhstan.[7] The first dataset is based on the labor report and includes information on the number of employees (measured by the actual number of workers in a company per year), the total salary fund (wages + bonuses)[8] by occupation for each firm in a given year by industrial activities and regions. The second dataset is based on production reports filed by firms with more than 50 employees, which excludes the public sector (i.e. organizations of education, health, banking, pension funds, public funds, and associations). It includes information on firm inputs, such as material costs, fixed assets, and firm output as sales. The merged sample contains 21,090 firms over the period 2012-2015 and covers around 65 percent of total employment in medium and large firms.[9] Table A.2 presents yearly employment comparisons of the sample with the official statistics.

The labor report includes employment and wages by job classifications for every firm. The raw data include nine job classifications grouped into four broad categories based on the international standard classification of education[10]. The first category includes qualification level that corresponds to the basic general education and the secondary (general) education. The second

[7] Access to the dataset is restricted.
[8] Please note that we do not observe bonuses separately from wages in our data. Rather the average wages that we see are total salary bills (which includes both salary and bonuses) over the number of workers by occupation.
[9] Due to a sample selection, a subset of small firms is excluded from the study, thereby creating a selection bias. Nevertheless, our sample covers medium and large private firms in Kazakhstan compared to studies that focus only on publicly listed firms. We admit that by excluding small firms, we truncate the left tail of the pay inequality distribution under the assumption that there is less pay inequality in small firms, on average, compared to large firms. This creates an overestimation of the actual pay inequality as we keep firms that are mostly on the right side of the distribution thus increasing the average pay inequality.
[10] http://uis.unesco.org/en/topic/international-standard-classification-education-isced

category includes those with the initial vocational education and includes industry-specific workers, such as agriculture or art. The third category includes those with secondary vocational education. The fourth category contains workers with higher and postgraduate vocational education. This qualification criterion is used to identify all types of labor activity and the formation of large groups, except for the "Heads (representatives) of government and administrative bodies at all levels, including heads of organizations", i.e., managers and CEOs, since in terms of qualification it is not possible to associate this group with any one of the defined education levels.

Table 1 shows the descriptions of job classifications (column 2) and examples of job positions (column 3) associated with each of them. The job classifications are presented in ascending order of education level: from unskilled workers (level 1) to clerks (level 2), mid-specialists (level 3), senior specialists (level 4), and heads (level 5). A variety of professions are sorted into these five job classifications. For instance, cleaners and taxi drivers are in the category of unskilled workers, whereas IT specialists and lawyers are in the classification level 4 and characterized as senior specialists. Managers, directors, and heads of organizations are in the highest classification level 5.

[**Table 1:** Job occupations, titles, and descriptions]

Table 2 provides the summary statistics for the pooled sample and compares employment and wages[11] by job positions. Wages are deflated using the consumer price index from the Committee of Statistics. From the table, the average firm in our sample employs 228 workers and

[11] Please note that the wages in the data are gross wages. Working with the net wages is more accurate in identifying the wage differentials because, naturally, most government policies use income taxes to redistribute from higher to lower-earning workers, resulting in lower pay inequality in reality. However, unlike most developed countries with progressive taxes, the tax system in Kazakhstan is flat, which makes analysis in gross and net wages to be similar.

pays around 101,500 KZT (*tenge*)[12] per worker per month. The number of workers varies at each occupation level, ranging from 16 workers in occupation level 5 to almost 125 workers in occupation level 2. As expected, average wages are increasing with each occupation level. For instance, on average, the real wage of an unskilled worker is around 49,000 tenge per month, while the manager's real wage is about 260,000 tenge per month.

[Table 2: Summary statistics**]**

3.2. Distribution of pay ratios

Within a firm and a year, we observe 5 job occupations and their associated wages. Following Mueller et al. (2017), for our measure of within-firm pay inequality - relative wage differentials between the top- and the bottom-level jobs - we construct 10 occupation-level pairs and compute their corresponding ratio of wages. Thus, we calculate pay ratios, denoted as r_{jk}[13], which compare associated wages between higher and lower occupation levels as

$$r_{jk} = \frac{Average\ wage\ for\ level\ k}{Average\ wage\ for\ level\ j}, \quad \text{for each } k > j \text{ in firm } i \text{ at time } t, \qquad (1)$$

where *j* and *k* are occupation levels. For example, r_{13} is the wage ratio of a mid-level specialist to an unskilled worker, and r_{15} is the ratio of the average wage of a manager to the average wage of an unskilled worker.

[12] From the National Bank of Kazakhstan, the average exchange rate of the US dollar to the Kazakhstani tenge (USD/KZT) for the period from January 1, 2012, to August 20, 2015, was 1 USD = 164.57 KZT and from August, 21 to December, 31 of 2015 - 1 USD = 286.09 KZT. After the collapse of the oil prices, the government of the country decided to move from a fixed-exchange-rate regime to a free-float in August 2015. This led to a sharp depreciation of the national currency and a steep increase in the inflation rate. See, for instance, Colicev et al. (2022) who look at how the depreciation of the national currency in Kazakhstan affected the cost of living of people.

[13] We suppress the it in the subscript for simplicity, where i denotes firm and t - year.

Table 3 presents the distribution of pay ratios for all ten combinations of occupation-level pairs. We see an increase in pay ratios as we move along the occupation level, i.e. pay ratio 12 is lower than pay ratio 13, and pay ratio 23 is lower than pay ratio 34. This means that the pay difference between, for example, a manager and an unskilled worker (r_{15}) is larger than between a mid-level specialist and an unskilled worker (r_{13}). For an unskilled worker and a mid-specialist (r_{13}) the average pay ratio of 1.87 means that a mid-level worker, on average, earns almost 87 percent more than an unskilled worker (r_{13}=1.87), while a manager earns 389 percent more than an unskilled labor (r_{15}=4.89).

[**Table 3:** Distribution of pay ratios]

3. Results

4.1. Pay inequality and firm size

To observe the relationship between pay inequality and firm size, we generate a binned scatterplot, depicted in Figure 1. First, the data is divided into equal-sized bins based on firm size proxied by a log of total assets (x-axis). For each bin, we plot the average value of a log of ratio for each occupation-level pair (y-axis). The fitted line corresponds to the best linear approximation of the conditional expectation function. According to Figure 1, there is a clear positive relationship between firm size and pay inequality between managers and the rest of job occupations.[14] On the other hand, if we compare lower occupation levels (1, 2, 3, and 4) to each other, an increase in firm size has no clear relationship with within-firm pay inequality. These patterns are consistent

[14] Please note that we do not claim a causal relationship between the two variables.

with Mueller et al. (2017) and Kim and Konings (2019) that took a regression-based approach in examining the UK and Korean data, respectively.

[**Figure 1:** Pay inequality and firm size]

Note that the measure of within-firm pay inequality in eq. 1, might be affected by changes in both of the occupation wages (changes in the numerator and denominator of the ratio simultaneously), or changes in one of the elements of the ratio (either the numerator or the denominator). To shed some light on which part of the equation dominates in driving the distribution of the pay ratios, i.e. whether the pay ratio primarily moves because higher job occupations are paid more or because lower occupations are paid less, we recalculate our actual pay ratios by (i) fixing the higher occupation wages to its mean value across firms and allowing lower occupation wages to change, and (ii) vice-versa. Formally, we calculate the following counterfactual pay ratios:

$$\widehat{r_{jk}} = \frac{Average\ wage\ for\ level\ k_{it}}{\sum_i Average\ wage\ for\ level\ j_{it}/N}, \qquad \widetilde{r_{jk}} = \frac{\sum_i Average\ wage\ for\ level\ k_{it}/N}{Average\ wage\ for\ level\ j_{it}}, \quad (2)$$

where N is the number of firms. Fixing one of the wages allows us to explore the relative importance of each variable in driving the variation in the actual pay ratio. The general idea is that the distribution of the actual pay ratio r_{jk} should closely resemble the distribution of (i) $\widehat{r_{jk}}$ if it is primarily driven by wages of the higher occupation (numerator), and of (ii) $\widetilde{r_{jk}}$ if wages of the lower occupation (denominator) are the primary source of pay inequality measure. We plot the density distributions of actual and counterfactual pay ratios for each occupation-level pair in Figure A.1. According to the plot, the distribution of r_{jk} and $\widehat{r_{jk}}$ are similar for each occupation-level pair, hinting those pay ratios primarily move because top positions are paid more and not because

bottom positions are paid less. One reason for this is the scarcity of qualified top managers in places like Kazakhstan, but with more abundant unskilled and semi-skilled workers.

Additionally, we explore whether wages associated with lower occupations are invariant to firm size, or do wages in all occupation levels change at a similar rate? In this regard, we estimate the following equation model for each occupation:

$$ln(wage)it = \beta_1 ln(size)_{it} + \eta_i + \gamma_t + \varepsilon_{it},$$

in firm i at time t, with firm size proxied by the log of total assets.

Table 4 reports the results of firm-fixed effect regression. From the table, wages, on average, are positively associated with firm size. Interestingly enough, the wages of unskilled workers, clerks, and specialists seem to increase at a similar rate (in columns (1) to (4), the confidence intervals overlap a lot), while the wages for managers increase by more as firms grow larger. This observation broadly indicates that larger firms compensate their managers more, presumably to attract a better one. Additionally, it implicitly suggests that the variation in pay ratios is primarily driven by the wages of higher occupations.

[**Table 4:** Wages and firm size]

Ideally, comparing differences in hourly wages is more accurate in dealing with inequality. So, one possible limitation of the data at hand is that we observe monthly wages (calculated as the ratio of total salary fund to the number of workers), which abstracts from the hours worked, possibly biasing the inequality measure. Inability to account for hours worked makes the pay ratio reflect both differences in hours worked across occupations as well as pay differences. Presumably, part-time work increases in lower job occupations because the opportunity cost of not working is lower. Hence, by using the average wages, we implicitly assume the equality of hours worked, which risks overestimating the pay ratios for higher occupations. Nevertheless, unlike in

most developed countries, working part-time is not common in Kazakhstan. According to the World Bank statistics, on average, part-time workers accounted for around 9% of total employment in Kazakhstan in 2015, whereas it is more than 30% for OECD member countries (https://data.worldbank.org/indicator/SL.TLF.PART.ZS?locations=KZ-OE).

Overall, Figure 1 and Table4 support the view that large firms exhibit higher pay inequality, which reflects the differences in pay for top-level job occupation. This relates back to the theories which highlight the importance of firm size in driving within-firm pay inequality. Such a tendency may be explained either by the talent assignment model or the rent extraction model, depending on how the within-firm pay inequality relates to firm performance. In particular, as predicted by the talent assignment model (Rosen, 1981; Tervio, 2008; Gabaix and Landier, 2008), more talented managers should match to larger firms. Naturally, as senior-level workers' actions filter through the entire firm, their talent scales with firm size, whereas for lower-level workers talent is less scalable (Mueller et al. 2017). If more talented managers are allocated to larger firms, then within-firm pay inequality rises with firm size (Brown and Medoff, 1989; Mueller et al., 2017; Kim and Konings, 2019), conditional on the fact that workers are paid according to their marginal product.

The result may also relate to the rent extraction model (Bebchuk and Fried, 2003; Bebchuk et al., 2011) which also predicts that larger firms exhibit higher pay inequality. As there is more rent to extract at larger firms, managers presumably have an incentive to target these firms without contributing to performance.

4.2. Pay inequality and firm performance

To assess the plausibility of either talent assignment or rent-extraction theories, we further analyze how pay inequality is related to firm performance. If rent extraction is a reflection of more

inequality, then we expect firms to have lower operating performance. In contrast, if managerial talent is a reflection of more inequality, firms with more inequality should perform better than firms with less inequality.

As a measure of pay inequality at the firm level, we use pay ratio 15, i.e. the ratio of managers over unskilled workers' wages, to explicitly account for the difference between the highest and the lowest wages. Alternatively, we also use weighted averages of pay ratios of level 5 with levels 1 to 4 (where the weights reflect employment share of levels 1 to 4, accordingly) as a measure of firm-level pay inequality. The baseline results are robust to this alternative (see Table B.2). A higher ratio reflects higher pay inequality. We estimate the following baseline equation to analyze the impact of pay inequality on firm performance:

$$y_{it} = \beta_1 PI_{it} + \beta_2 ln(size)_{it} + \mu_s + \gamma_t + \varepsilon_{it}, \qquad (3)$$

where, y_{it} is the performance indicator of firm *i* at time *t*, such as firm efficiency and profitability. We use total factor productivity (TFP) and labor productivity (LP) as measures of efficiency. Firm profitability measures include return on assets (ROA) and EBITDA margin. To infer total factor productivity, we use a Tornqvist index (Törnqvist, 1936). Labor productivity is output per worker calculated as the ratio of real value-added over average employment. Return on assets is calculated as net income over total assets. The EBITDA margin is the ratio of net income plus depreciation over the total revenue.[15] PI_{it} is the pay inequality of firm *i* at time *t*. To control for firm size, $ln(size)_{it}$, we use the log of total assets as a proxy. μ_s is NACE Rev.2 two-digit level *sector*-fixed effects. γ_t is *year*-fixed effects and ε_{it} is i.i.d. error term. This specification allows us to determine

[15] We present summary statistics for performance indicators in Table A.3.

whether firms that exercise higher pay inequality perform better as predicted by the managerial talent theory or worse as suggested by the rent extraction theory.

Note that our results *a priori* might be driven by the positive association between firm size and performance. As shown in sub-section 4.1, firms exercising higher pay inequality are usually large firms. Hence, caution has to be exercised while making associations between pay inequality and firm performance, and account for any effects that may be due to potential effects between size and performance. To this end, we estimate the model controlling for firm size. We also plot the distributions of pay inequality for different size categories to show that even within the same size category, pay inequality levels are different. See Figure A.2 in Appendix.

We start by following the standard organizational literature and estimate eq. 3 using ordinary-least squares (OLS). However, there are some potential issues with applying the simple OLS technique to the model specified in eq. 3. First, given the panel structure of the data, the model is mis-specified if we omit unobserved firm-level characteristics. Usually, OLS estimates suffer from upward bias, and including firm-fixed effects to control for (un)observed firm characteristics would drive the impact of pay inequality on performance down. Think of, for example, the ownership structure of a firm. Private firms are argued to perform better compared to publicly owned firms (Ehrlich et al., 1994; Konings, 1997; De Loecker and Konings, 2006). Moreover, they are expected to exercise a higher pay differential compared to public firms, where wages are more likely to be lower and regulated (Aitken et al., 1996). Hence, omitting the ownership variable will result in a positive bias for OLS estimations.[16]

Additionally, a firm that performs well is also likely to reward its employees, including the CEOs. This might potentially introduce endogeneity issues to the model. Therefore, OLS could

[16] Formally: $Corr(private, y_{it}) > 0$ and $Corr(private, PI_{it}) > 0 \rightarrow Bias(\tilde{\beta}_1) > 0$.

result in biased and inconsistent estimates. To address the issue, we use the instrumental variable (IV) two-stage least-squares (2SLS) estimation technique, where pay inequality is instrumented via its first and second lags. The requirement is that the instruments satisfy instrument exogeneity ($Cov(PI_{it-1}, \varepsilon) = 0$ and $Cov(PI_{it-2}, \varepsilon) = 0$) and instrument relevance ($Cov(PI, PI_{it-1}) \neq 0$ and $Cov(PI, PI_{it-2}) \neq 0$) conditions. We verified the instrument relevance from the first stage of the 2SLS estimation and the validity of instruments using Hansen's overidentification restrictions (Hansen, 1982). Under the null hypothesis, the instruments are not correlated with the error term (H_0: $E(\varepsilon, X) = 0$, where X is a vector of instruments), i.e. instruments are valid. The decision rule is a failure to reject the null, i.e. the p-value is greater than the common significance levels (0.05).

[**Table 5:** Pay inequality and firm performance]

Table 5 presents the results of the relationship between firm performance and pay inequality using OLS (columns (1) and (4)), firm-fixed effects (columns (2) and (5)) and IV (columns (3) and (6)) estimation techniques. Panel A presents two measures of productivity: total factor productivity and labor productivity, whereas Panel B presents two measures of profitability: return on assets (ROA) and EBITDA margin. To infer total factor productivity, we use a Tornqvist index (Törnqvist, 1936). As a robustness, we also infer TFP using two-stage ACF estimation technique (Ackerberg et al., 2015) and adding pay inequality to the control function similar to Amiti and Konings (2007); De Loecker and Warzynski (2012), which control for firm import and export status, respectively. The results are robust and presented in Table B.1 of the Appendix.

The OLS estimation coefficients on pay inequality suggest a positive and significant relationship between firm performance and pay inequality. This identifies firms that exhibit higher pay inequality as better performers compared to those with less pay inequality. However, once we control for unobserved firm-level characteristics (columns (2) and (5)), the impact of pay

inequality on firm performance weakens, suggesting OLS be positively biased. In fact, the effect of pay inequality on firm performance disappears. We further explore the relationship by addressing the potential endogeneity problem (columns (3) and (6)). The coefficients of FE estimations decrease further with the IV estimation technique. In the case of total factor productivity and return on assets we even observe a negative and significant effect of pay inequality. Formally, for instance, moving from the 25th to 75th percentile of the pay inequality distribution[17] decreases the total factor productivity by 7.2 percentage points. Similarly, moving from the 25th to 75th percentile of the pay inequality distribution decreases the return on assets (ROA) by 0.9 percentage points.

The reverse impact supports the thesis of the rent extraction theory, where within-firm pay inequality is negatively related to firm performance. Although a higher pay dispersion may serve as a signal to attract more productive or talented workers, we find little evidence to support the idea that incentive-based pay can boost overall firm performance. While we do not directly test the rent extraction theory, the results do indicate that pay inequality in the Kazakh context does not lead to increased performance.

Alternative explanations for the negative conditional correlation between pay inequality and firm performance also include institutional factors such as unionization and/or labor laws. Pay inequality in developing economies is often explained by the lack of modern labor legislation

[17] The difference between the 25th and 75th percentile of the pay inequality distribution is equal to 3.

reflected in no or very low minimum wages, limited employment protection legislation, or little or no union representation. Also, competition is often lacking, resulting in large differences in firm size, and management structures are often closely linked to government practices. These in turn may widen the wage dispersion and potentially hamper firm performance. Moreover, pay schemes may also have an adverse effect on performance. For instance, if such schemes reward short-term aims, this can result in managers making decisions that may harm the firm in the long run. Hence, a combination of poorly designed pay schemes and misalignment of incentives may damage firm performance in the long run. Furthermore, compared with managers who have high bargaining power over their compensation, unskilled workers' salary is largely determined by the market price. As such, factors related to manager level employees can have a significant impact on the pay ratio, and at the same time on firm performance. For example, a manager may get a higher salary (relative to employees') because the manager has more power negotiating power or because the corporate governance of the firm is not very effective. In both situations, a manager may also lack incentives to work hard, resulting in lower firm performance.

Finally, it is important to note that standard inequality literature models the relationship between inequality and growth in linear terms. However, this approach has been exposed to some criticism (Banerjee and Duflo, 2003). Using a non-parametric approach, the authors present a non-linear relationship between inequality and growth. Despite several studies, the evidence on the trade-off between the two is inconclusive. We briefly check for the non-linear relationship between the pay inequality and firm outcomes to see how the quadratic approximations match with the underlying data (see Figure A.3). We observe a slight non-linear relationship. Hence, primarily for the completeness of the analysis, we extend the model specified in eq. 3 to include the quadratic term of the pay inequality measure to capture potential non-linearities. The results are presented

in Table 6. The estimates suggest that there is little evidence of a clear non-linear relationship between pay inequality and performance in the data. Although, the coefficient on the quadratic term is negative and significant implying a reversed U-shape relationship, the magnitude is negligible. And, similarly to the baseline, once we account for possible biases and inconsistencies in OLS estimations, we fail to observe any positive association of pay inequality on firm performance.

[**Table 6:** Pay inequality and firm performance]

4. Conclusion

In this study, we investigated the relationship between vertical within-firm pay inequality and its relation to firm size and firm performance using micro-level data for the emerging economy of Kazakhstan. This is particularly relevant, as much of the extant literature is based on the analysis of pay inequality and its determinants and effects of advanced economies. However, for structural and industrial reasons, emerging markets provide a different context where pay inequality may be broader and deeper in comparison. In this study, we augment the literature of the relationship between within-firm inequality and firm performance by examining firm-level data in Kazakhstan. To measure pay inequality at a firm level, we constructed pay ratios using the wage differentials between the top and bottom-level occupations.

Consistent with prior research, our findings suggest a positive relationship between pay inequality and firm size. Our study additionally revealed that this relationship is driven by a greater increase in wages for top job occupations compared to lower job occupations as firms grow. Finally, pay inequality has a negative conditional correlation with firm performance. While we are careful not to draw any causal inferences, our results provided moderate support for the

rent-seeking behavior theory which states that individuals seek to improve their wealth without reciprocally contributing to productivity. The negative association could also be explained by country-specific characteristics such as lack of modern labor legislation, high levels of corruption, and poor law enforcement, which are common for some emerging economies. Consequently, in developing economies, where the institutions are weak and check and balances tend to be ineffective, rent-seeking behavior can further retard economic growth by diverting resources from productive use, reducing competition, and restricting innovation, which is crucial for further economic development.

Our research has significant implications for both practice and future research. First, the finding that wage inequality increases with firm size in top job positions suggests that as firms expand, they face growing challenges related to pay inequality. To effectively address and mitigate this issue, it is crucial to develop strategies and policies that promote fairness and transparency in compensation practices alongside the expansion process. Second, the negative conditional correlation between pay inequality and firm performance highlights the need for firms to exercise caution regarding the potential adverse effects of high levels of pay inequality. It indicates that significant pay gaps within a firm can have detrimental consequences for overall performance. Firms should also be aware of the negative effects associated with employees seeking personal gain without contributing to productivity, as suggested by the rent-seeking behavior theory.

Furthermore, the finding that wage inequality increases with firm size in top job positions prompts further investigation into the underlying factors driving this trend, creating an opportunity to explore the reasons behind differential pay growth among various job occupations within expanding firms. Future research can delve into factors such as job complexity, skill requirements, market demand, and bargaining power to better understand why certain positions experience more

substantial wage increases than others. The negative relationship between pay inequality and firm size emphasizes the need for context-specific interventions. In emerging economies like Kazakhstan, there is a sizable gray economy that is not included in the official statistics, where pay and incentives may be driven by market factors. It is also a question of whether the existence of such gray economic activities is partly driven by pay inequality and rent-seeking behavior in the 'official' economy. Consequently, comparative studies across different countries and industries could shed light on the role of institutional factors, such as labor legislation, corruption levels, and law enforcement, in shaping pay inequality and its implications for performance. Acknowledging weak institutions, corruption, and inadequate law enforcement, policymakers and firms operating in similar environments should prioritize initiatives aimed at strengthening labor legislation, enhancing anti-corruption measures, and improving law enforcement capabilities. These efforts are important in creating an environment that discourages rent-seeking behavior and fosters economic growth. It is crucial to recognize that tackling these issues may necessitate a comprehensive approach involving collaboration between government, civil society, and businesses.

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Tables and Figures

Table 1: Job occupations, titles, and descriptions

Job occupation level	Job title	Examples of job position	Job description according to the SCO (State Classifier of Occupations)
(1)	(2)	(3)	(4)
1	Unskilled workers	Cleaner, cloakroom attendant, taxi driver	Unskilled workers perform simple mechanical work, mainly associated with the use of hand tools and the cost of some effort. Most of the professions in this classification group are characterized by a low level of qualifications, corresponding, as a rule, to the presence of basic general or secondary general education or secondary general education and individual training in the workplace.
2	Clerks, service and sales workers, machine operators and assemblers, and agricultural workers	Secretary, waiter, hairdresser, handicraft worker	The employees of this enlarged group mainly perform functions related to information support of various fields of activity, keeping records of inventories, cash and transportation, and customer service. Their implementation presupposes appropriate professional experience or practical training. For most of the occupations (professions) of this enlarged group, the required qualifications are achieved through individual training or special training according to the established program on the basis of secondary general education.
3	Mid-level specialists	Technician, midwife, sales manager	The functions of mid-level specialists of an average qualification level are to perform simple and medium level of complexity of engineering and

			technical works, as well as works of similar complexity. Their implementation presupposes the presence of a certain theoretical training and skills in the practical application of principles and methods from the field of special knowledge.
4	Senior-level specialists	IT specialist, lawyer, engineer	Senior-level specialists carry out the development and research of scientific theories and concepts, contributing to the enrichment and increase in the amount of knowledge accumulated by society in various fields of activity, their practical application and systematic dissemination through training. Most of the occupations (professions) united by this classification group are distinguished by a high degree of complexity of the work performed and require a level of qualification corresponding to higher vocational education (the fourth qualification level), as well as its higher levels, determined by additional special knowledge and skills and characterized by the presence of an academic degree.
5	Heads (representatives) of authorities and management of all levels, including heads of organizations.	Department head, HR director, chief marketing officer	Heads (representatives) of authorities and management at all levels, including heads of organizations, develop and make managerial decisions, regulate, implement, coordinate and control their implementation.

Source: Adapted from National Classification of Occupations of the Republic of Kazakhstan.

Table 2: Summary statistics

	obs.	mean	sd	min	max
Employment	21090	227.75	641.76	1.00	32323.00
1-Unskilled worker	21090	29.78	67.20	0.00	1985.00
2-Clerk	21090	124.90	490.52	0.00	25782.00
3-Mid-level worker	21090	26.76	56.29	0.00	1240.00
4-Senior-level worker	21090	30.39	76.29	0.00	2117.00
5-Manager	21090	15.92	63.56	0.00	3261.00
Wage/worker/month	20898	101459.77	87773.54	6148.82	706810.50
1-Unskilled worker	15703	48746.01	28277.38	6973.66	216707.00
2-Clerk	17583	75865.70	44781.65	8907.13	322489.59
3-Mid-level worker	17630	89839.14	66814.53	9124.40	569779.88
4-Senior-level worker	19384	134181.59	114126.36	9776.12	949681.13
5-Manager	20681	260456.73	285715.36	7114.83	2401515.75

This table shows the average number of employees and the average real wages (per worker per month) for each job occupation across all firm-year observations. Wages are in KZT (tenge). The sample is for the 2012–2015-year period.

Source: Authors' own work.

Table 3: Distribution of pay ratios

r_{jk}	**obs**	**avg.wage**	**10**	**25**	**50**	**75**	**90**
12	14285	1.68	1	1.203	1.519	1.956	2.551
13	14070	1.865	1.014	1.282	1.646	2.165	2.868
14	14854	2.62	1.289	1.673	2.229	3.047	4.227
15	15555	4.89	1.862	2.556	3.662	5.564	8.872
23	15161	1.204	.701	.895	1.101	1.362	1.732
24	16311	1.692	.948	1.151	1.46	1.921	2.635
25	17399	3.163	1.323	1.728	2.389	3.582	5.6
34	16746	1.512	.984	1.115	1.324	1.67	2.217
35	17417	2.845	1.302	1.645	2.216	3.221	4.918
45	19106	1.968	1.075	1.292	1.643	2.224	3.126

This table presents the distribution of pay ratios for occupation-level pairs. The pay ratio is calculated as the ratio of higher-level wages to lower-level wages, eq. 1. Occupation codes are described in Table 1.

Source: Authors' own work.

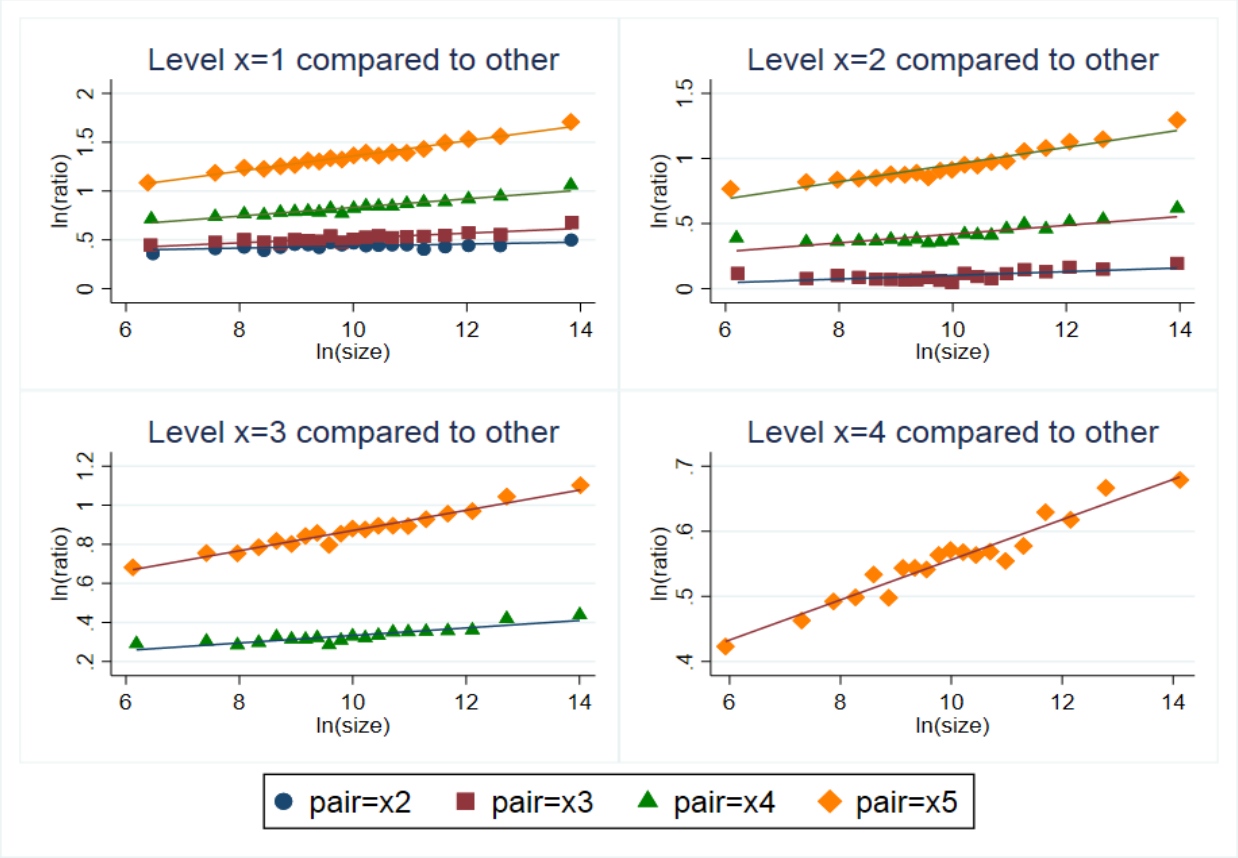
Table 4: Wages and firm size

	(1)	(2)	(3)	(4)	(5)
	Unskilled	**Clerk**	**Specialist**	**Senior specialist**	**Manager**
	b/ci95	b/ci95	b/ci95	b/ci95	b/ci95
ln(size)	0.05	0.046	0.04	0.059	0.098
	[0.032,0.069]	[0.032,0.061]	[0.020,0.060]	[0.042,0.076]	[0.077,0.119]
Constant	10.13	10.602	10.782	10.938	11.081
	[9.946,10.314]	[10.461,10.743]	[10.585,10.979]	[10.771,11.104]	[10.877,11.285]
R^2	0.155	0.164	0.113	0.118	0.09
Obs.	15699	17580	17627	19371	20668

This table shows the results of firm-fixed effect regression analysis of the wages (in logs) associated with a given occupation level on firm size (proxied by the log of total assets) and year dummies. The first number represents the estimated coefficient. 95% CI in squared parentheses. All coefficients reported in the table are statistically significant at 1%.

Source: Authors' own work.

Figure 1: Pay inequality and firm size



This graph depicts binned scatterplots of log of pay ratios on firm size (proxied by the log of total assets) by occupation-level pair. The line traces the linear fit.

Source: Authors' own work.

Table 5: Pay inequality and firm performance

	(1)	(2)	(3)	(4)	(5)	(6)
A. Efficiency						
		TFP			***Labor Productivity***	
	OLS	FE	IV	OLS	FE	IV
Pay inequality	0.020***	-0.004	-0.024*	0.024***	0.000	-0.009
	(0.003)	(0.003)	(0.013)	(0.003)	(0.002)	(0.011)
ln(size)	-0.014	-0.018	-0.059	0.336***	0.228***	0.135***
	(0.009)	(0.026)	(0.056)	(0.008)	(0.021)	(0.049)
Constant	0.044	0.200	0.852	1.860***	4.397***	5.710***
	(0.146)	(0.370)	(0.817)	(0.133)	(0.302)	(0.718)
Obs.	13408	13408	4645	14016	14016	4820
Hansen test (p-value)			0.199			0.124
Year FE	yes	yes	yes	yes	yes	yes
Sector FE	yes	no	no	yes	no	no
Region FE	yes	no	no	yes	no	no
Firm FE	no	yes	yes	no	yes	yes
B. Profitability						
		ROA			***EBITDA***	
	OLS	FE	IV	OLS	FE	IV
Pay inequality	0.001***	0.000	-0.003***	0.001	0.000	0.001
	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)	(0.003)
ln(size)	0.000	0.003	0.015***	0.006***	0.010	-0.009
	(0.001)	(0.003)	(0.005)	(0.002)	(0.006)	(0.014)
Constant	0.001	-0.015	-0.186***	0.147***	0.185**	0.448**
	(0.008)	(0.042)	(0.066)	(0.037)	(0.093)	(0.204)
Obs.	15356	15356	5288	15172	15172	5224
Hansen test (p-value)			0.964			0.443
Year FE	yes	yes	yes	yes	yes	yes
Sector FE	yes	no	no	yes	no	no
Region FE	yes	no	no	yes	no	no
Firm FE	no	yes	yes	no	yes	yes

Standard errors in parentheses. * p<0.1, ** p<0.05, *** p<0.01

This table shows the results for the OLS, firm-fixed effect, and IV regression analyses where the dependent variables are firms' total factor productivity in logs (TFP), labor productivity in logs (LP), return on assets (ROA), and EBITDA margin (EBITDA). Log of total assets is used as a size control. For IV, we use the first and second lags of the endogenous variable (pay inequality) as instruments.

Source: Authors' own work.

Table 6: Pay inequality and firm performance

	(1)	(2)	(3)	(4)	(5)	(6)
A. Efficiency						
		TFP			***Labor Productivity***	
	OLS	FE	IV	OLS	FE	IV
Pay inequality	0.045***	0.002	-0.02	0.043***	0.004	0.019
	(0.005)	(0.005)	(0.028)	(0.005)	(0.004)	(0.028)
Pay inequality^2	-0.001***	0.000	0.000	-0.001***	0.000	-0.001
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)
ln(size)	-0.017*	-0.019	-0.062	0.333***	0.227***	0.128***
	(0.009)	(0.026)	(0.057)	(0.008)	(0.021)	(0.050)
Constant	0.008	0.189	0.884	1.838***	4.388***	5.707***
	(0.146)	(0.370)	(0.817)	(0.133)	(0.303)	(0.721)
Obs.	13408	13408	4645	14016	14016	4820
Hansen test (p-value)			0.304			0.239
Year FE	yes	yes	yes	yes	yes	yes
Sector FE	yes	no	no	yes	no	no
Region FE	yes	no	no	yes	no	no
Firm FE	no	yes	yes	no	yes	yes
B. Profitability						
		ROA			***EBITDA***	
	OLS	FE	IV	OLS	FE	IV
Pay inequality	0.002***	0.000	-0.003	0.001	0.001	0.003
	(0.000)	(0.000)	(0.002)	(0.001)	(0.001)	(0.007)
Pay inequality^2	-0.000***	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ln(size)	0.000	0.003	0.015***	0.006***	0.010	-0.009
	(0.001)	(0.003)	(0.005)	(0.002)	(0.006)	(0.014)
Constant	-0.001	-0.014	-0.187***	0.146***	0.184**	0.440**
	(0.008)	(0.042)	(0.067)	(0.037)	(0.093)	(0.204)
Obs.	15356	15356	5288	15172	15172	5224
Hansen test (p-value)			0.700			0.345
Year FE	yes	yes	yes	yes	yes	yes
Sector FE	yes	no	no	yes	no	no
Region FE	yes	no	no	yes	no	no
Firm FE	no	yes	yes	no	yes	yes

Standard errors in parentheses. * p<0.1, ** p<0.05, *** p<0.01

This table shows the results for the OLS, firm-fixed effect, and IV regression analyses where the dependent variables are firms' total factor productivity in logs (TFP), labor productivity in logs (LP), return on assets (ROA), and EBITDA margin (EBITDA). Log of total fixed assets is used as a size control. For IV, we use the first and second lags of the endogenous variables (pay inequality and its quadratic form) as instruments. Note that for the labor productivity model we use first and second lags of pay inequality and first lag of its quadratic form as instruments to pass the overidentification test.

Source: Authors' own work.

Appendix

A. Additional Figures and Tables

Table A.1: Theoretical and empirical literature

Theory	Prediction for the relationship between pay inequality and firm performance	Empirical findings	Firm performance measure	Endogeneity addressed	Countries studied	Firm size control
Vertical pay inequality						
Tournament Lazear and Rosen, 1981	Positive	Lambert et al. (1993)	ROA, RET	No	United States	Yes
		Eriksson (1999)	Log profit/sales	No	Denmark	Yes
		Lee et al. (2008)	Profit per worker	Yes	United States	Yes
		Kale et al. (2009)	ROA, Tobin's Q	Yes	United States	Yes
		Dai et al. (2017)	Total factor productivity	Yes	China	Yes
		Mueller et al. (2017)	ROA, Tobin's Q	No	United Kingdom	Yes
		Luo et al. (2020)	ROA, Tobin's Q	Yes	China	Yes
Relative Deprivation Martin (1981) Akerlof and Yellen (1990)	Negative	Bebchuk et al. (2011)	ROA, Tobin's Q	Yes	United States	Yes
		Shin et al. (2015)	ROA, Stock market returns	Yes	South Korea	Yes
		Crawford et al. (2021)	ROA, market adjusted buy-and-hold return for the bank during the fiscal year	Yes	United States	Yes

This table shows the summary of the main theoretical and empirical papers on within-firm vertical pay inequality and firm performance.
Source: Authors' own work.

Table A.2: Sample coverage, 2012-2015

Year	CSRK	Sample	Coverage, %
2012	1906200	1207538	63,35
2013	1946300	1248007	64,12
2014	1707900	1250192	73,20
2015	1726800	1097474	63,56

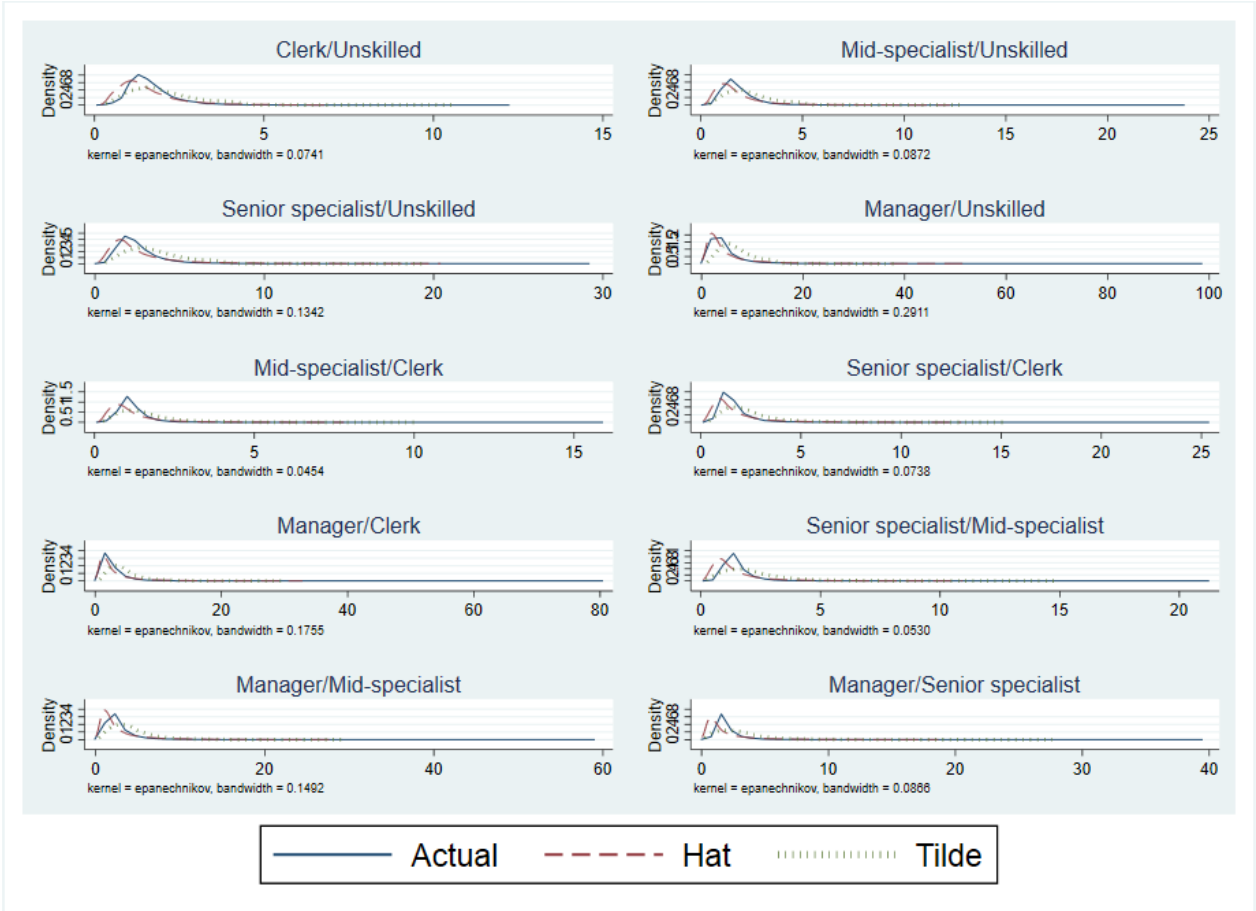
This table compares the sample employment with the aggregate employment in medium and large firms in Kazakhstan.
Source: Authors' own work.

Table A.3: Summary statistics: performance indicators

	obs.	mean	Sd.	min	max
ln(TFP) (T)	18070	-0.013	1.099	-3.11	3.704
ln(LP)	18867	7.799	1.428	4.25	12.166
ROA	20655	0.019	0.076	-0.354	0.43
EBITDA	20358	0.363	0.334	-0.708	1.949
ln(TFP) (ACF)	18070	5.203	1.764	0.364	9.531

This table presents summary statistics for performance indicators used in the paper. Ln(TFP) (T) refers to total factor productivity estimated using the Tronqvist index (Tronqvist, 1936). Ln(TFP) (ACF) refers to total factor productivity estimated using the Ackerberg-Caves-Frazer method (Ackerberg et al., 2015).
Source: Authors' own work.

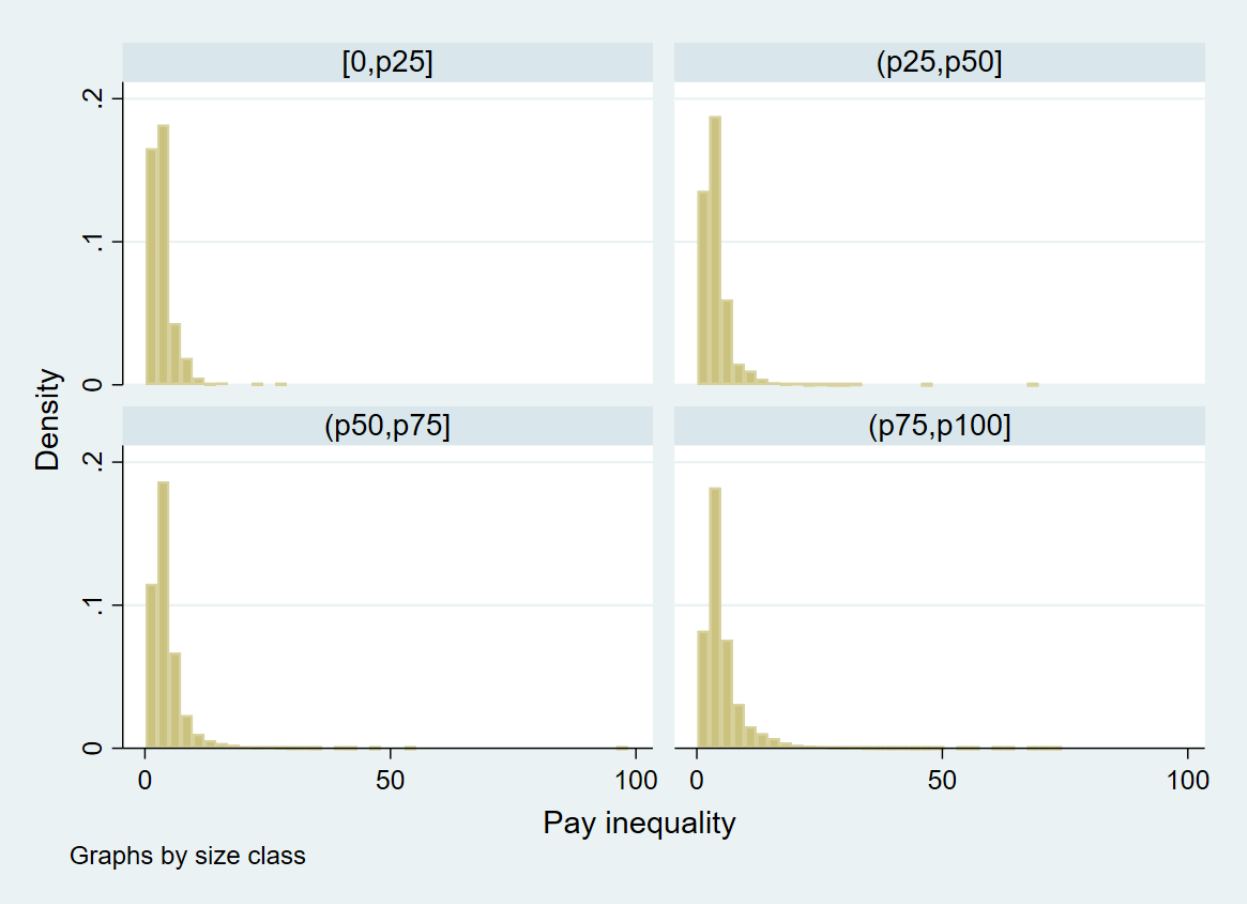
Figure A.1: Distribution of actual and counterfactual pay ratios



This graph plots the Kernel densities of actual and counterfactual pay ratios for each occupation-level pair, *jk*. "Actual" refers to the pay ratio calculated from eq. 1. "Hat" refers to the pay ratio in which the denominator of the ratio is fixed to the average wage of occupation *j* across all firms. "Tilde" is the pay ratio in which the numerator of the ratio is fixed to the average wage of occupation *k* across all firms, eq 2.

Source: Authors' own work.

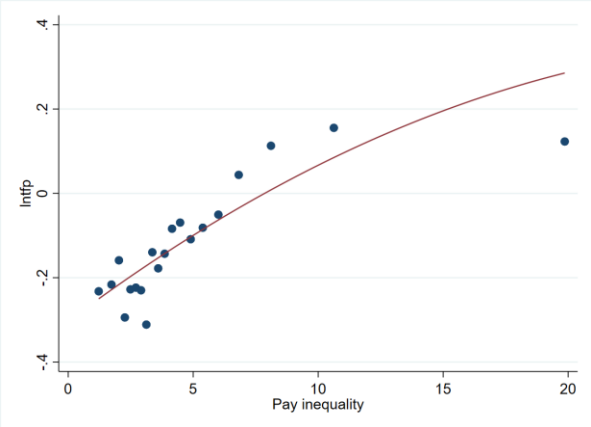
Figure A.2: Pay inequality distribution by size



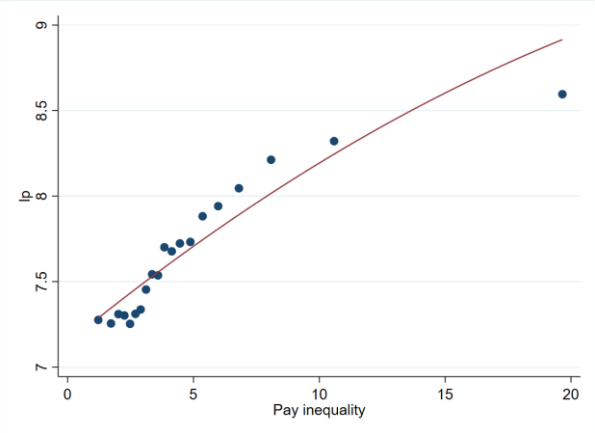
The size classes are determined by total assets.

Source: Authors' own work.

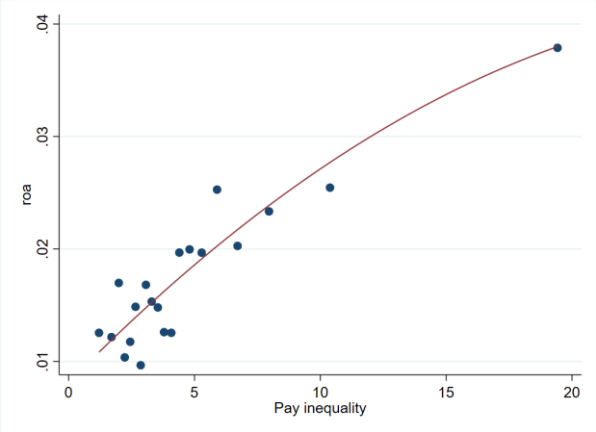
Figure A.3: Performance and pay inequality



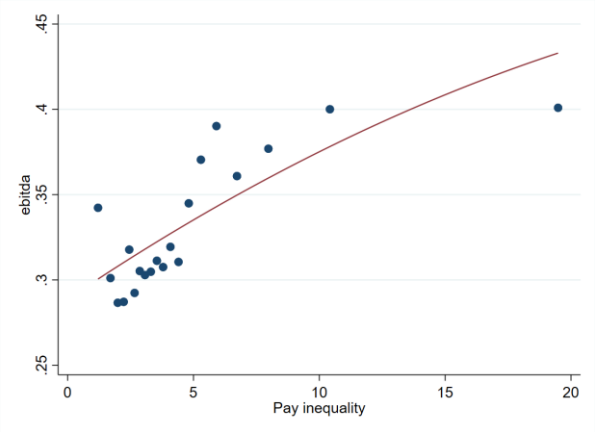
(a) TFP



(b) Labor productivity



(c) ROA



(d) EBITDA

These graphs depict binned scatterplots of (a) log of TFP; (b) log of labor productivity; (c) ROA; and, (d) EBITDA margin on pay inequality. The line traces the quadratic fit line.
Source: Authors' own work.

B. Robustness Checks

Table B.1: Pay inequality and firm productivity: Control function approach

	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	**FE**	**IV**	**OLS**	**FE**	**IV**
Pay inequality	0.025***	-0.004	-0.031**	0.051***	0.000	-0.019
	(0.003)	(0.003)	(0.014)	(0.005)	(0.005)	(0.029)
Pay inequality^2				-0.001***	0.000	0.000
				(0.000)	(0.000)	(0.000)
ln(size)	0.101***	0.083**	-0.124***	0.098***	0.083**	0.015
	(0.009)	(0.023)	(0.046)	(0.009)	(0.023)	(0.059)
Constant	0.739***	3.741***	6.432***	0.700***	3.733***	4.611***
	(0.144)	(0.340)	(0.651)	(0.143)	(0.340)	(0.853)
Obs.	13449	13449	4651	13449	13449	4651
Hansen test (p-value)			0.051			0.097
Year FE	yes	yes	yes	yes	yes	yes
Sector FE	yes	no	no	yes	no	no
Region FE	yes	no	no	yes	no	no
Firm FE	no	yes	yes	no	yes	yes

Standard errors in parentheses

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

This table shows the results for the OLS, firm-fixed effect and IV regression analyses where the dependent variable is firms' total factor productivity in logs (TFP) inferred using the 2-stage control function approach (ACF). Log of total assets is used as a size control. For IV, we use the first and second lags of the endogenous variable (pay inequality) as instruments. Note that for the model in the third column, we use first and second lags of pay inequality and first lag of its quadratic form as instruments to pass the overidentification test.

Source: Authors' own work.

Table B.2: Pay inequality and firm performance: PI based on weighted average

	(1)	(2)	(3)	(4)	(5)	(6)
A. Efficiency						
		TFP			***Labor Productivity***	
	OLS	FE	IV	OLS	FE	IV
Pay inequality	0.018***	-0.013**	-0.109**	0.019***	-0.004	-0.022
	(0.006)	(0.006)	(0.050)	(0.006)	(0.005)	(0.034)
ln(size)	-0.001	-0.031	-0.007	0.336***	0.228***	0.203***
	(0.010)	(0.030)	(0.063)	(0.010)	(0.025)	(0.053)
Constant	-0.117	0.374	0.202	1.893***	4.345***	4.599***
	(0.162)	(0.436)	(0.917)	(0.150)	(0.362)	(0.783)
Obs.	10663	10663	3593	11122	11122	3725
Hansen test (p-value)			0.067			0.074
Year FE	yes	yes	yes	yes	yes	yes
Sector FE	yes	no	no	yes	no	no
Region FE	yes	no	no	yes	no	no
Firm FE	no	yes	yes	no	yes	yes
B. Profitability						
		ROA			***EBITDA***	
	OLS	FE	IV	OLS	FE	IV
Pay inequality	0.002***	0.000	0.000	0.004***	0.002	0.012
	(0.000)	(0.000)	(0.003)	(0.002)	(0.002)	(0.011)
ln(size)	0.000	0.003	0.019***	0.010***	0.014*	-0.008
	(0.001)	(0.003)	(0.005)	(0.003)	(0.008)	(0.015)
Constant	0.006	-0.018	-0.268***	0.101***	0.101	0.389*
	(0.009)	(0.042)	(0.069)	(0.041)	(0.111)	(0.215)
Obs.	12223	12223	4093	12072	12072	4042
Hansen test (p-value)			0.583			0.438
Year FE	yes	yes	yes	yes	yes	yes

Sector FE	yes	no	no	yes	no	no
Region FE	yes	no	no	yes	no	no
Firm FE	no	yes	yes	no	yes	yes

Standard errors in parentheses. * p<0.1, ** p<0.05, *** p<0.01

This table shows the results for the OLS, firm-fixed effect, and IV regression analyses where the dependent variables are firms' total factor productivity in logs (TFP), labor productivity in logs (LP), return on assets (ROA), and EBITDA margin (EBITDA). Pay inequality is computed as a weighted average of pay ratios of level 5 with levels from 1 to 4, where the weights reflect employment share of levels from 1 to level 4, accordingly. Log of total assets is used as a size control. For IV, we use the first and second lags of the endogenous variable (pay inequality) and first lag of its quadratic form as instruments.

Source: Authors' own work.