Superstars at Work: Increasing Returns to Scale Across Occupations

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Abstract

Labor incomes in the U.S. are characterized by increasingly fat-tails. The "Superstar" theory of wage inequality (Rosen 1981) suggests that this is because ICTs have made certain labor markets more "winner-take-all". This paper explores how the wages of different occupations vary with market size and ICT intensity, to test whether the ICT driven superstar labor theory can explain patterns in US wage inequality. Using a large-scale, high-frequency administrative payroll dataset on the employment history of over 25 million U.S. workers from 2014 through 2022, we measure how wages scale with market size across occupations, industries, and time. We focus on two dimensions of market size: establishment size and commuting zone size. The average job in our data is 11.7% higher paid in an establishment which is twice as large, and 7.5% higher in a commuting zone which is twice as large. Consistent with previous research, CEO wages increase approximately 20% with a doubling of establishment size (Gabaix and Landier, 2008). We proceed beyond this literature by classifying all occupations by how they scale. In our preferred specification, we find CEOs, Athletes, Lawyers, Nuclear Technicians, and four other types of managers see their wages increase the quickest with establishment size. Classifying occupations by their characteristics, we find variation consistent with the hypothesis that wage scaling within firms is related to the level of decision making responsibility. Occupations with the maximum O*NET score for "Impact of Decisions on Co-workers or Company Results" see their wages scale 16% faster with establishment payroll than occupations with the minimum score. Finally, we find workers in AI and IT-focused industries and in establishments with more IT developers experience faster wage scaling with market size, consistent with digitization creating winner-take-all labor markets.

INTRODUCTION AND DATA

Labor incomes in the U.S., in the late 20th and early 21st century, are characterized by increasingly fat-tails. In 1975, the bottom 50 percent of households received 19.5 percent of national pre-tax income in the form of wages, while the top 1 percent received 4.1 percent. By 2019, these shares had declined to 13.6% and risen to 8.2%, respectively. One possible explanation for this trend is technological change, which has made the labor market more "winner-takes-all." According to the "superstar" theory, the rise of information and communication technologies (ICTs) has disproportionately benefited workers at the top of the income distribution, allowing them to more effectively leverage their expertise within firms and market their services across larger markets with fewer frictions.

We measure how wages and talent scale with market size across occupations, industries and time, allowing us to empirically evaluate whether the superstar labor theory can explain the rise in US wage inequality. To do so, we utilize high-frequency administrative payroll data from ADP, one of the world's leading payroll processing firms, to perform an analysis on occupational wage and firm size. This rich dataset covers more than half a million companies and over 25 million employees within the United States, and includes information on payroll transactions such as payment dates and amounts for each worker, characteristics of employees and employers, and administrative data on individuals listed on the payroll. The data is provided regardless of whether the employee received payment during the current pay period. Our study observes payroll transactions from over 25 million workers and their employers at the monthly level between 2014 and 2022. We combine this with government occupational data from O*NET, and geographical and population data from the US census.

We first document how occupational wages have scaled with establishment size (primarily measured by payroll) and commuting zone population size. Table 1 provides results

of regressions where the log wage of an employee is explained by one or two measures of market size, as well as year and industry fixed effects. As can be seen there is a robust relationship between both measures of market size and wage, whether or not attention is restricted to a balanced sample of establishments. The average job in our data is 11.7% higher paid in an establishment which is twice as large, and 7.5% higher in a commuting zone which is twice as large. Column 5, which includes both measures of market size as explanatory variables, shows that wages across all occupations increase 11.3% on average in an establishment twice as large, and increase 6.2% on average in a commuting zone twice as large. These estimates of how wages scale with market size are only slightly attenuated when both are included, suggesting that these are measuring separate dimensions of scaling, rather than both being proxies for the same phenomenon. Our large data sets allow us to estimate these scaling effects highly precisely, with standard errors of less than .1%.

	entire sample	balanced sample	entire sample	balanced sample	entire sample	balanced sample
log of establishment payroll	0.1173***	0.1180***			0.1132***	0.1117***
	(0.0001)	(0.0003)			(0.0001)	(0.0004)
log of commuting zone population			0.0746***	0.0724***	0.0621***	0.0451***
			(0.0001)	(0.0005)	(0.0001)	(0.0005)
N	14085633	856314	14085633	856314	14085633	856314
Adjust R-squared	0.0949	0.1039	0.0292	0.0314	0.1094	0.1114

Table 1. Regression of log wage on measures of market size

Notes: The dependent variable is the log compensation of either superstar workers, while the independent variable is the log of total payroll of an establishment in a given year. Controls are 2-digit NAICS FE, year FE, and O*NET occupation FE. Balanced sample restricts attention to establishments which appear in all years of data.

Consistent with previous research, we find CEO wages increase approximately 20% with a doubling of establishment size as measured by payroll (Gabaix and Landier, 2008). Figure 2 displays this result, and also extends this analysis to the top 30 most common occupations in our

data. In this figure, the orange squares report point estimates and confidence intervals from a regression of workers' log wage on their firms' log payrolls, restricting attention to one occupation at a time. By this metric, Athletes, Lawyers, Nuclear Technicians, and four other types of managers round out the top eight occupations in terms of wage scaling with firm size. Figure 2 also displays occupational wage scaling for 'superstar' employees for each occupation. We define "superstar" workers as the employees with the highest average monthly income in a given O*NET occupation within a specific establishment. To do this, we use data at the establishment-month-individual level and calculate the average monthly taxable income for each individual when working for a particular employer in a specific occupation.[1] We then select the highest-paid individual in each occupation within a specific firm and year. The figure also presents coefficients from a regression of superstar employee wage on market size, measured as commuting zone population. In these regressions, we include controls for two digit NAICS fixed effects and year fixed effects. Over time, our point estimates on the scaling effect of CEO wage with establishment size, whether measured through payroll or employment, increase (table omitted for length). This is also consistent with the superstar labor hypothesis.

Table 2 reports the wage scaling of superstar and all workers in establishments across AI-intensive and non-intensive industries[2], using three measures of market size. The findings reveal that wage scaling is consistently higher in AI-intensive industries, consistent with the IT leading to winner-take-all labor markets theory. Across industries, workers in AI and IT focused industries -- namely Information, Finance, and Scientific and Technical Services -- saw their wages scale faster with market size, when controlling for occupation and year fixed effects (table 2). This result is robust to the measure of market size and whether only superstar or all

[1] If an individual switches O*NET job occupation codes in their working window with one employer, they are counted as two individuals.
[2] We select these industries based on the finding of Goldfarb et al.,(2020) that these are three industries with the top share of AI employment.

employees are considered. We also conducted a regression of log wage on log establishment size on its own and interacted with the fraction of employees who are IT developers[3]. We find that an establishment that was composed of 50% software developers would see its superstar employees' wages grow 12% faster if payrolls were to double versus a firm without any IT developers (table omitted for length).

	AI-intensive industries NAICS = 51, 52, 54			Other industries		
Panel A: Log wage of the superstar workers						
Log of total payroll	**0.17195*** (0.0120)**			**0.1439*** (0.0060)**		
Log of employment size		0.0844*** (0.0157)			0.0681*** (0.0062)	
Log of population in the commuting zone			0.0088*** (0.0074)			0.0063*** (0.0042)
No. of observations	2,983,776	2,983,776	2,983,776	11,106,104	11,106,104	11,106,104
Adj- R2	0.0965	0.0207	0.0062	0.1169	0.0587	0.0479
Panel B: Log wage of all workers						
Log of total payroll	0.1398*** (0.0101)			0.1254*** (0.0057)		
Log of employment size		0.0533*** (0.0114)			0.0492*** (0.0039)	
Log of population in the commuting zone			0.018*** (0.0051)			0.0160*** (0.0027)
No. of observations	2,983,776	2,983,776	2,983,776	11,106,104	11,106,104	11,106,104
Adj- R2	0.1029	0.0222	0.0191	0.1422	0.0803	0.0779
Year FE	Y	Y	Y	Y	Y	Y
O*NET occupation FE	Y	Y	Y	Y	Y	Y

Table 2. Heterogenous scaling effects by industry
Notes: this table reports the scaling effects of market size on the wages of superstar workers and all workers in an establishment for AI intensive and non-intensive industries. AI-intensive industries include NAICS 51 Information; NAICS 52 Finance and Insurance; and NAICS 54 Professional, Scientific and Technical Services.

Classifying occupations by their characteristics, we find variation consistent with the hypothesis that wage scaling within firms is related to the level of decision making responsibility. Occupations with the maximum O*NET score for "Impact of Decisions on Co-workers or Company Results" see their wages scale 16% faster with establishment payroll than occupations with the minimum score, in a regression with industry and year fixed effects (table omitted for length).

[3] We define IT developers based on the O*NET occupation code, including 15-1131.00 Computer Programmers; 15-1132.0 Software Developers, Applications; 15-1133.0 Software Developers, Systems Software; and 15-1134.00 Web Developers.

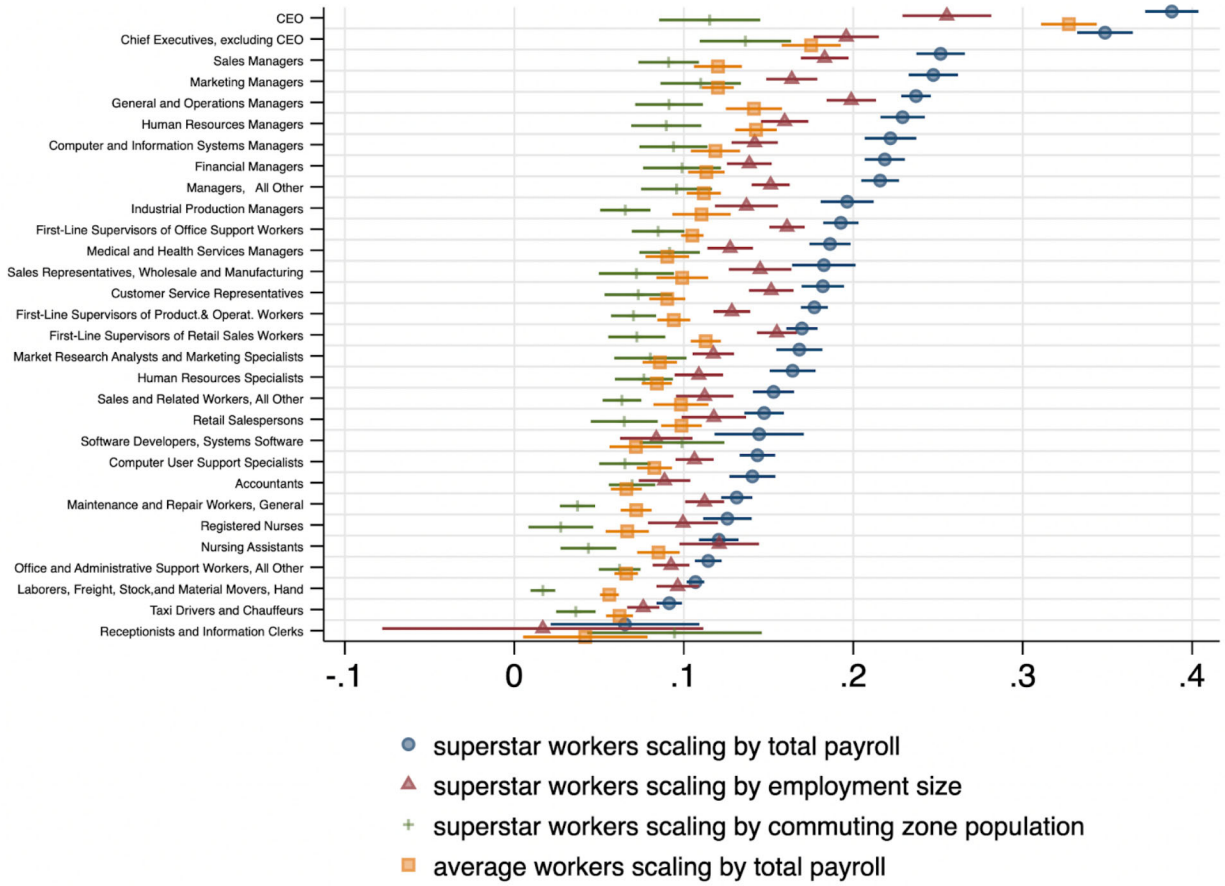

Figure 2. Scaling effects of 30 selected occupations

This figure shows the elasticities of compensation for "superstar" and all workers with respect to market size for 30 selected occupations based on 30 separate regressions. The dependent variable is the log compensation of either superstar or average workers, while the independent variable is log market size. Market size is measured by the total payroll of an establishment in a given year, the number of establishment employees, and the total population in the commuting zone. The commuting zone is based on the majority of employee home addresses. Controls are 2-digit NAICS FE and year FE. The occupations selected are the 30 most common.

REFERENCES

Gabaix, X., & Landier, A. (2008). Why has CEO pay increased so much?. *The quarterly journal of economics*, *123*(1), 49-100

Rosen, S. (1981). The economics of superstars. *The American economic review*, *71*(5), 845-858