

Przychodzen, Wojciech; Gómez-Bezares, Fernando

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Article

CEO–Employee Pay Gap, Productivity and Value Creation

Wojciech Przychodzen ^{1,2,*}  and Fernando Gómez-Bezares ¹ 

¹ Department of Finance, University of Deusto, Avenida de las Universidades 24, Bilbao, 48007 Bizkaia, Spain; f.gomez-bezares@deusto.es

² ESIC Business & Marketing School, Passeig Santa Eulàlia 2, 08017 Barcelona, Spain

* Correspondence: wojciech.przychodzen@esic.edu

Abstract: This study examines the effect of the CEO–employee pay gap on productivity and performance. Using extensive data of 751 constituents of the Standard and Poor’s (S&P) 1500 index between the years 1992–2016, we found a cubic relationship between salary differential and corporate productivity, with a rising gap adversely affecting productivity principally when it is both too low, as well as too high; intermediate pay inequality levels are less influential. A contrast in the productivity effects of the CEO–worker pay gap for firms with high average salaries and more employees was noticeable, whereas positive productivity gains were present even with a high salary gap. Thus, big companies with a highly skilled workforce are able to achieve tangible benefits through higher salary differentiation. On the other hand, companies with lower average salaries and lower capital intensity were characterized by the negative effects of wage dispersion on productivity. As a result, increasing inequality aversion is an important issue affecting performance among smaller, lower skilled labor dependent firms. Additionally, female CEOs had a significant and positive lagged effect on productivity. Finally, firm market valuation was positively stimulated by the increasing pay gap.



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Keywords: productivity; pay gap; corporate governance; executive compensation; fairness; value creation

1. Introduction

CEO pay has been discussed quite extensively in both popular press and academic journals over the last 15 years (Rouen 2020), especially since the onset of the global financial crisis of 2007–2008, for which top executives are largely blamed. According to a 2017 report by the Economic Policy Institute, the average CEO in America’s 350 largest firms by sales earned 271 times the annual average pay of the average worker in 2016, up from approximately 20 times in 1965 and 59 times in 1989. From 1978 to 2016, CEO compensation has increased by 937 percent, while typical workers’ annual salary increased by only 11.2 percent over the same period (EPI 2017). As a result, the current pay gap is increasingly perceived as unfair by the majority of workers, and widening income disparities are declared as a major threat to the global economy (WEF 2014). It is also contradictory to the idea of a fair and just society, where human beings have equal rights.

The above disparities may be consequential for companies’ economic performance due to several possible channels of potential influence. For example, too high of a pay gap between the CEO and average worker may create strong negative emotions among employees, which in turn leads to job dissatisfaction, disengagement and lower productivity (Pfeffer 2007). It can also decrease their willingness to share information and implement innovative ideas necessary for the company to maintain its competitiveness (Kornelakis 2018).

Although the compensation differential between executives and employees has attracted considerable attention, our knowledge of its possible causes and consequences from a corporate economic performance perspective is still rather limited and elusive (Connelly et al. 2016). Some existing studies suggest that there is positive relationship between pay dispersion and productivity (Lallemant et al. 2004; Heyman 2005); others

show the relationship between the CEO–employee pay differential and productivity is insignificant (Faleye et al. 2013); and others present a negative relationship in the above area (Grund and Westergaard-Nielsen 2008). Not only do the above studies report contradictory results, but they also were usually based on a limited number of companies and short time series of data. Furthermore, they did not embrace the most recent developments following the global financial crisis. Only recently, Dai et al. (2017) investigated the relationship between pay gap and firm productivity for a much larger sample of 1328 publicly traded, non-financial companies from China, which is a developing market, between the years 2003–2011. The authors reported that productivity was an inverted-U function of the pay gap. Nevertheless, neither study considered the possibility that an increasing pay gap between the CEO and ordinary worker might adversely affect productivity if the pay gap is both too low as well as too high. Thus, to further explore the topic and provide additional empirical evidence on the issue, this article aims to address the following research question:

What is the nature of the relationship between the CEO–employee pay differential and corporate productivity and performance?

The empirical evidence for this study is based on the data from the Standard and Poor's (S&P) 1500 index listed companies with both executive and non-executive employee compensation data in the Compustat and Standard and Poor's ExecuComp databases over the period from 1992 to 2016. To the best of our knowledge, this is the first long-term empirical study over a period of 25 years that analyzes the possible relationship between the CEO–employee pay gap and productivity among a large sample of 751 unique, publicly traded companies from a developed stock market. The choice of American stocks from the S&P 1500 index was motivated by several considerations. First, the index covers almost 90% of the market capitalization of U.S. equities. Second, the American stock market is the largest in the world in terms of total market capitalization (more than USD 27.3 trillion at the end of 2016). Finally, the United States is also the largest economy in the world in terms of GDP (almost USD 18.5 trillion at the end of 2016) with a population of 323.1 million.

Our analysis shows that there is a cubic relationship between CEO–worker salary differential and firm productivity. Specifically, a rising pay gap adversely affects productivity principally when it is both too low as well as too high. Only within a certain range is there a more nuanced overall productivity effect of rising pay inequality, which can be negative, neutral or positive, depending on the sample and performance measure used. We also performed a series of additional tests to examine other potential explanations of the above relationship. After using alternative pay differential and productivity measures, as well as analyzing possible lagged effects of the CEO–worker pay gap on productivity, our results remain the same. We also found that firms with high average salaries and more employees experience positive productivity gains even if the salary gap exceeds a certain critical point.

The remainder of this study is structured as follows: First, an overview of the existing literature on factors influencing the CEO–worker pay gap as well as its possible consequences for productivity and economic performance will be presented; on that basis, the hypotheses will be developed. Next, the data and variables are described, and an empirical model is formulated. The empirical results are then presented, and key findings are discussed. Finally, the conclusions of the study are drawn, its main limitations identified, and directions for future research suggested.

2. Review of the Literature and Hypothesis Development

There are two fundamental forces that play a significant role in the nature of the relationship between the CEO–worker pay gap and the firm's productivity. The first is inequality aversion, which is strictly connected with the perceived need for the egalitarian distribution of income, social equality and fairness (Wade et al. 2006; Franck and Nüesch 2011). As employees usually compare their salaries with other workers at higher hierarchical layers without proper regard for differences in individual efforts, abilities and inputs (Martin 1993), they tend to overestimate their own efforts relative to those of others (Meyer 1975). Due to this, an increasing pay gap will create negative emotions and engender costs

for individuals in the form of deprivation and general feelings of disutility (Fehr et al. 2006). This, in turn, will provoke seeking means to solve the negative tension (Adams 1965), which intensifies with the rising level of perceived inequality. The above means can resonate in the form of noncooperative behavior, sabotage of coworkers, absenteeism, distrust, strikes and shirking of duties (Henderson and Fredrickson 2001). Identification and solidarity among people may even compound deprivation at the organizational level (Rost and Weibel 2013). Thus, a large CEO–worker pay ratio negatively affects firm productivity and economic performance due to inequality aversion (Lazear 1989; Cowherd and Levine 1992; Bloom 1999; Siegel and Hambrick 2005).

The second force shaping the nature of the relationship between compensation differential and productivity at the organizational level is competition for pay and promotion. It is connected with explicit permission for less egalitarian salaries distribution by individuals, as long as the relationship between inputs and outcomes is reasonably well-related to their marginal contributions and does not fundamentally exceed some generally accepted standard (Carrell and Ditttrich 1978). Thus, large pay gaps are beneficial for firm productivity and performance, as they provide strong motivation among lower-level employees to increase their efforts in order to be promoted and gain the reward in the form of a much higher salary in the higher level of hierarchy (Rosen 1986; Banker et al. 2016). The above, tournament-like, incentives are also present among top management team members, as high pay differences among them elicit involvements to eventually win the contest and become the CEO (Henderson and Fredrickson 2001; Kale et al. 2009). Furthermore, high pay differentials between successive levels of hierarchy enable the company to recruit more talented employees (Arya and Mittendorf 2005). However, when wage dispersion becomes exceedingly large, it might actually harm productivity even among workers positively motivated by large pay gaps. For instance, they might start to promote self-serving efforts at the expense of necessary cooperation (Henderson and Fredrickson 2001). Furthermore, firms with large pay gaps relative to benchmark firms also tend to experience higher managerial turnover (Kale et al. 2014) and are more often targets of shareholder activism aimed at significant executive pay reduction (Ertimur et al. 2010). Finally, the exceedingly large pay gap between the CEO and average worker might be demotivating for rank-and-file employees, as it can be perceived among them as out of reach.

Existing studies usually draw separately from competition for pay and promotion or inequality aversion theory in order to explain the possible relationship between pay gap and firm performance (Connelly et al. 2016). However, there is a complex set of interactions between the above forces in the context of CEO–worker pay differential and corporate productivity. By taking into consideration both inequality aversion and competition for pay and promotion effect at the same time, we can take a more nuanced perspective and shed additional light on the issue. Specifically, when wage dispersion is relatively low, a rising salary gap does not motivate employees to increase their efforts sufficiently enough to overcome the modest level of deprivation connected with it. Thus, productivity decreases at a diminishing pace. Then, when wage dispersion reaches a certain threshold, we can observe three possible outcomes. First, positive competition for pay effect can begin to dominate the increasing, albeit slowly, inequality aversion. As a result, productivity begins to rise at a growing pace. Second, competition for pay effect can counterbalance inequality aversion. As a result, productivity does not further decrease. Finally, positive competition for pay effect might not be strong enough to counterbalance slowly increasing inequality aversion. Thus, an increase in productivity does not occur; however, it decreases at a further diminishing, very low pace. When wage dispersion exceeds a certain point, tournament-like incentives also begin to affect economic performance in a negative way parallel to ascending level of deprivation and both effects are mutually reinforcing, causing tangible decrease in productivity. Therefore, we formulate the following hypothesis:

Hypothesis. *The relationship between CEO–employee pay differential and corporate productivity is nonlinear and cubic.*

3. Data and Variables

The empirical evidence for this study is based on data from the Standard and Poor's (S&P) 1500 index listed companies with both executive and non-executive employee compensation data in the Compustat and Standard and Poor's ExecuComp databases over the period from 1992 to 2016. All the workers' remuneration and financial variables data were derived from the Compustat database. The final sample consisted of 751 companies with 7469 firm-year observations. Table 1 shows that the sectors deemed financials, industrials and consumer discretionary are dominant, while telecommunications services, real estate and consumer staples sectors are rather underrepresented. Due to the fact that firms operating in the financial sector are relatively overrepresented (48.3 percent of the whole sample), separate analyses for it against all the other sectors have been undertaken in order to ensure robustness (See Section 4).

Table 1. Sample distribution.

	GIC Sector Code	No. of Companies	% of Sample
Energy	10	19	0.025
Materials	15	26	0.035
Industrials	20	93	0.124
Consumer Discretionary	25	80	0.107
Consumer Staples	30	12	0.016
Health Care	35	51	0.068
Financials	40	363	0.483
Information Technology	45	25	0.033
Telecommunication Services	50	7	0.009
Utilities	55	67	0.089
Real Estate	60	8	0.011
Total		751	1

3.1. Main Variables

In this paper, we decided to measure corporate productivity with the usage of revenue per employee (REVENPE), calculated as total revenue divided by the number of employees. The above ratio is a common proxy for firm productivity in the existing literature (Datta et al. 2005; Chowdhury et al. 2014). Furthermore, it enables us to capture the first order, immediate effects of the pay gap on average worker performance in terms of output. To reduce the asymmetry of the distribution of data and following past research, we used the natural logarithm of revenue per employee as a measure of firm productivity in our econometric models (Sun et al. 2007; Cronqvist et al. 2009).

To ensure that the obtained results are robust, we also used total factor productivity (TFP) as an additional measure of firm performance. It measures the increase in total output of a given company that is not connected to increases in total inputs. Thus, it enables us to consider an additional important characteristic—technological efficiency. To compute TFP for a given firm, we first assumed that the production function takes the form of the Cobb–Douglas function (Faleye et al. 2013; Dai et al. 2017), which is expressed as:

$$Y_{it} = AL_{it}^{\alpha} K_{it}^{\beta} \quad (1)$$

where Y_{it} is net sales for a given company i in a given year t ; L_{it} is the number of employees for a given company i in a given year t ; and K_{it} is the net property, plant and equipment value for a given company i in a given year t . Then, we performed natural log transformation of Equation (1) and estimated parameters A , α and β for each separate sector. Finally, we computed total factor productivity for each firm in each year by estimating the residual of the natural log transformation of the Cobb–Douglas production function specific to the industry that it represents.

We measured the compensation differential between the CEO and average worker with the ratio of total CEO compensation (salary + bonus + other annual + restricted stock grants + long term incentive plan payouts + all other + value of option grants) to the

average ordinary employee compensation (CEOTOT_OE). The latter was computed by dividing the difference between total staff expense and total chief executive (with clearly defined annual title) compensation disclosed in Standard and Poor's ExecuComp database by the number of employees besides the CEO. Table 2 presents the CEO–worker pay gap evolution over the years 1992–2016. For robustness purposes, we also calculated the average compensation of other top executive officer (OTEO) by dividing total other executives (with clearly defined annual titles) remunerations disclosed in ExecuComp by the number of executives; we then estimated the compensation differential between OTEO and average worker (OTEOTOT_OE). We used the above variable as an additional measure of wage dispersion.

Table 2. CEO–worker pay gap evolution over time.

Year	No. of Observations	Mean	Median
1992	331	44.651	24.486
1993	344	48.606	27.824
1994	348	55.024	34.749
1995	337	60.396	36.257
1996	328	77.575	42.935
1997	308	103.347	48.389
1998	299	96.290	52.771
1999	272	106.341	56.599
2000	258	118.187	61.601
2001	261	115.603	63.934
2002	261	109.110	55.952
2003	274	94.422	48.114
2004	266	100.921	53.792
2005	252	116.033	56.796
2006	280	106.224	48.185
2007	330	100.942	37.900
2008	314	80.654	31.020
2009	315	71.191	30.732
2010	313	89.447	36.195
2011	310	87.670	39.485
2012	306	97.256	38.827
2013	303	93.989	41.586
2014	300	93.915	44.307
2015	296	90.463	46.014
2016	263	92.784	48.824
TOTAL	7469	88.454	41.505

3.2. Control Variables

There are several variables that may affect the productivity of a firm. For example, a CEO simultaneously serving as the chairman of the board may act in his own self-interests, which can stimulate inefficient behavior and reduce overall efficiency (Chiang and Lin 2007). As a result, we control for the same person holding both the CEO and board chair positions by introducing a binary variable (CEODUAL) with the value of zero if the CEO is not a chairman and one otherwise. Females are often characterized by higher risk and inequality aversion than males, which affects their investment and operational decisions (Vandergrift and Brown 2005; Le et al. 2011; Khan and Vieito 2013; Noja et al. 2021). To address the above issue, we control for the gender of the CEO by introducing a dummy variable (GENDER) that equals zero if the CEO is male and one otherwise. CEO age might also influence firm productivity in different ways. For example, older executives tend to be more conservative and usually follow lower-growth strategies (Barker and Mueller 2002). Furthermore, as they may have only a few years until possible retirement, they can have different attitudes than younger CEOs toward riskier investment activities requiring a longer payoff period, such as research and development and new technologies. Thus, we introduced further control variable describing the CEO's age (CEOAGE).

Existing empirical studies have also consistently documented that corporate productivity is affected by the general complexity of a company's operations, connected to its size, risk, growth opportunities, performance, sector affiliation and R&D activism (Haltiwanger et al. 1999; Wakelin 2001; Faleye et al. 2013; Dai et al. 2017; Dai and Cheng 2018). As a

result, in the introduced empirical models we control for the size of the firm, using the natural logarithm of the book value of total assets (LnTA); risk, using financial leverage (total debt to total assets ratio—LEV) and monthly returns volatility (measured by the standard deviation of the monthly stock market returns over the previous 3 years—RISK); growth potential (book to market value of equity—BV_MV); performance (measured by the return on equity calculated as net income divided by the book value of equity of a given company—ROE); sector affiliation (binary variable for firm's sector in line with GIC code (as stated in Table 1); and R&D activism, measured as the relation between research and development expenses and corresponding total sales (RD_SALES).

4. Empirical Results

Table 3 presents a summary of descriptive statistics for our sample of companies. The mean (median) CEO total compensation over the analyzed period was USD 4.57 (USD 2.33) million, with corresponding numbers for OTEO of USD 2.52 (USD 1.36). At the same time, an average (median) ordinary worker salary was USD 73,904 (USD 57,594), respectively. Thus, the mean (median) CEO–worker pay ratio was approximately 88.5 (41.5), and OTEO–worker pay ratio 46.6 (23.5). This means that the average CEO needed to work only 4.1 days in order to earn the average worker annual salary. In the case of OTEO, the above period was 7.8 days accordingly. More than 54.4% of all CEOs in our sample concurrently served as board chairs. The average chief executive officer was 68 years of age, and women accounted for only approximately 2.1% of all CEOs. The average company in our sample had an annual revenue per employee of approximately USD 458,400, spent approximately 1.7% of sales for research and development and had a debt constituting slightly more than 28% of assets. Analyzed companies were mostly dispersed and skewed in research and development to sales, risk and revenue per employee area.

Table 3. Summary statistics for main variables.

	No. of Observations	Mean	Median	Min	Max	Skewness	Kurtosis
Revenue per employee (in thousands of USD)	7469	458.396	249.543	−6.240	94149.230	27.090	887.141
TFP	7469	0.022	0.010	−5.421	5.761	1.251	8.568
Return on Equity	7455	0.123	0.124	−6.678	9.144	2.964	178.566
CEO total compensation (in thousands of USD)	7469	4573.796	2328.046	64.583	230033.700	8.798	201.835
OTEO total compensation (in thousands of USD)	7469	2519.063	1362.924	65.425	71380.200	5.409	52.135
Ordinary employee total pay (in thousands of USD)	7469	73.904	57.594	0.540	1830.109	5.278	75.041
CEO total/Employee	7469	88.454	41.505	1.549	3248.402	7.427	81.539
OTEO total/Employee	7469	46.624	23.491	1.694	1380.506	7.764	88.353
Ln TA	7469	8.598	8.530	1.575	15.006	0.355	0.245
Book/Market	7121	0.659	0.556	0.012	7.407	3.730	26.741
Total Debt/Total Assets	7469	0.280	0.214	0.000	2.321	1.680	4.100
Risk (SD monthly return)	7137	10.271	8.403	1.788	651.305	33.067	1345.271
Research and Development/Sales	7469	0.017	0.000	0.000	37.005	62.063	4474.379
CEO–Chair Duality	7469	0.544	1.000	0.000	1.000	−0.178	−1.969
Gender	7469	0.021	0.000	0.000	1.000	6.703	42.942
CEO Age	7469	68.205	68.000	35.000	99.000	0.001	−0.438

Before the formal regression model has been constructed, the Pearson Correlation Coefficients between selected explanatory variables have been calculated in order to test

for the multicollinearity threat (see Table 4). High correlation between CEO and OTEO salary (0.897) has been reported. The above shows that highly paid chief executive officers are indeed capable of ensuring higher remuneration packages for their top management team's members. Table 4 additionally shows that the CEO–worker pay gap is also wider when the CEO concurrently serves as the chairman. Thus, higher level of formal influence of executives over the proceedings of the board enables them to achieve better salary conditions relative to ordinary employees. Finally, CEO duality is also much more characteristic of male and older executives.

None of the independent variables were characterized by pairwise correlation coefficients higher than 0.318, indicating a limited threat of multicollinearity. Curiously, although an increasing pay gap between the CEO and ordinary worker was negative for productivity (measured both by the natural logarithm of revenue per employee and total factor productivity), the opposite was true for market valuation (measured as the book value of equity divided by the market value of equity) where an increasing gap led to higher appraisal. The same contradiction occurred for CEO age; increasing age of the CEO was harmful for productivity, but stimulated market valuation at the same time. To shed more light on the issue, we decided to separately analyze the determinants of the BV/MV ratio.

We empirically test the hypothesis formulated in Section 2 with the use of the model specified in Equation (2):

$$\ln REVENPE_{it} = \alpha + \beta \ln CEOTOT_OE_{it} + \gamma \ln CEOTOT_OE_{it}^2 + \delta \ln CEOTOT_OE_{it}^3 + \theta Controls_{it} + \varepsilon_{it} \quad (2)$$

where $\ln REVENPE_{it}$ is the natural logarithm of revenue per employee for given company in a given year; $\ln CEOTOT_OE_{it}$ is the natural logarithm of pay gap between the CEO and average worker for a given company in a given year; and $Controls_{it}$ is the set of control variables which may affect firm productivity described in Section 3.2 for a given firm in a given year. We used the natural logarithm of the CEO–worker pay gap in the model (2) in order to diminish the dispersion in the distribution of the data and obtain more easily interpretable parameters β , γ and δ . For clarity reasons, the approximations of shapes of all obtained cubic functions were presented in Figure 1.

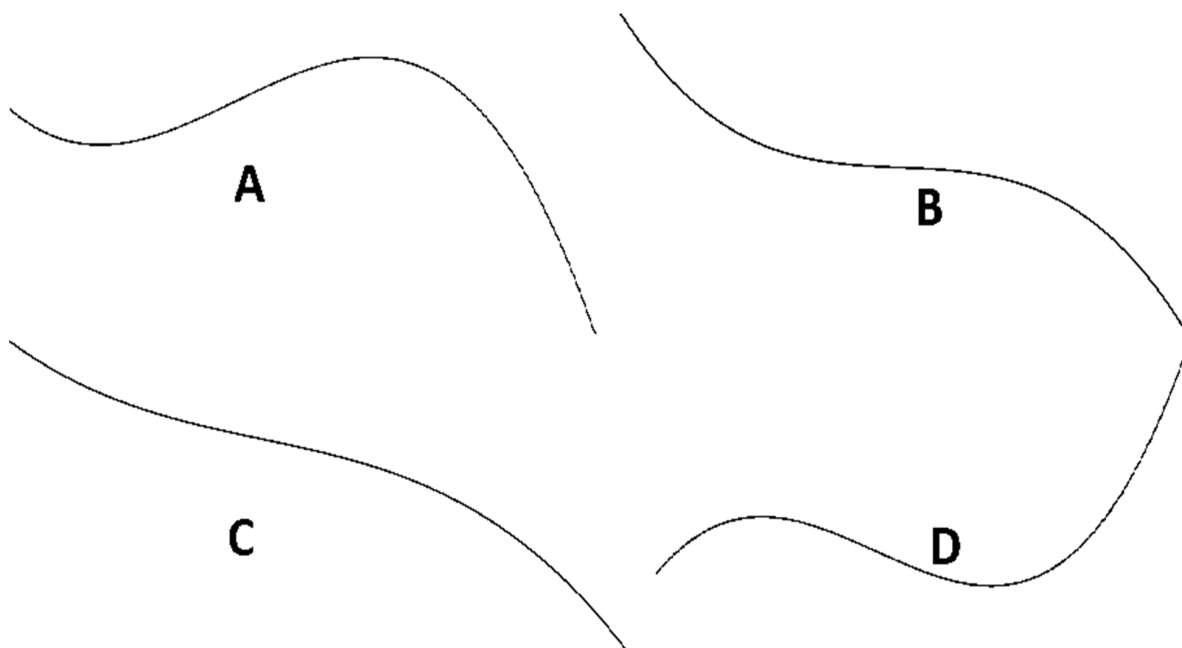


Figure 1. General approximations of shapes of obtained cubic functions (vertical axis—productivity; horizontal axis—pay gap).

Table 4. Correlation coefficients.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
lnREVENPE (1)	1															
TFP (2)	0.668 ***	1														
ROE (3)	0.046 ***	0.058 ***	1													
CEOTOT (4)	0.195 ***	0.311 ***	0.056 ***	1												
OTEOTOT (5)	0.239 ***	0.330 ***	0.061 ***	0.897 ***	1											
OETOT (6)	0.522 ***	0.406 ***	−0.044 ***	0.269 ***	0.361 ***	1										
CEOTOT_OE (7)	−0.233 ***	−0.030 **	0.094 ***	0.509 ***	0.404 ***	−0.174 ***	1									
OTEOTOT_OE (8)	−0.235 ***	−0.025 **	0.093 ***	0.452 ***	0.445 ***	−0.166 ***	0.942 ***	1								
lnTA (9)	0.408 ***	0.219 ***	0.050 ***	0.470 ***	0.521 ***	0.176 ***	0.140 ***	0.160 ***	1							
BV_MV (10)	0.096 ***	−0.018	−0.318 ***	−0.087 ***	−0.082 ***	0.041 ***	−0.142 ***	−0.148 ***	0.090 ***	1						
LEV (11)	0.092 ***	0.090 ***	−0.005	0.127 ***	0.144 ***	0.075 ***	0.078 ***	0.077 ***	0.160 ***	0.046 ***	1					
RISK (12)	−0.053 ***	−0.011	−0.087 ***	−0.020 *	−0.022 *	0.011	0.026 **	0.012	−0.100 ***	0.126 ***	0.112 ***	1				
RD_SALES (13)	−0.036 ***	−0.036 ***	0.026 **	−0.008	−0.009	0.058 ***	−0.011	−0.012	−0.040 ***	−0.032 ***	0.081 ***	0.019	1			
CEODUAL (14)	0.003	0.023 *	0.021 *	0.162 ***	0.153 ***	−0.003	0.083 ***	0.074 ***	0.225 ***	−0.026 **	−0.019 *	−0.023 **	−0.029 **	1		
GENDER (15)	−0.011	0.020	−0.030 ***	−0.041 ***	−0.047 ***	−0.013	−0.022 *	−0.027 **	−0.068 ***	0.017	0.007	0.033 ***	−0.004	−0.066 ***	1	
CEOAGE (16)	−0.093 ***	−0.150 ***	0.021 *	−0.045 ***	−0.038 ***	−0.201 ***	−0.023 **	−0.022 *	0.036 ***	−0.046 ***	−0.076 ***	−0.059 ***	0.005	0.290 ***	−0.118 ***	1

*, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

The results of the Equation (2) parameters estimation (Table 5) for the full sample of firms support the view that there is a cubic relation between the CEO–employee pay differential and corporate productivity, as the coefficient estimate on $\ln CEOTOT_OE_{it}^3$ was highly significant (p -value < 0.01). The detailed shape of the function (see Figure 2) shows that an increasing pay gap between the CEO and ordinary workers adversely affects productivity for all levels of pay differential. Thus, positive competition for pay and promotion effect does not dominate over inequality effect. However, within a certain range negative overall productivity effect of a rising CEO–employee pay gap is rather moderate. Regarding the control variables, firms with a higher asset base, return on equity, market valuation, leverage, and research and development expenditures in relation to sales are generally more productive in terms of reported revenue per employee. Interestingly, the results also show that younger CEOs seem to have a greater ability to positively affect firm productivity. Next, we repeated the Equation (2) parameters estimation for financial and non-financial firms separately, since financial firms account for almost half of our sample. Table 5 shows that a cubic relation between CEO–employee pay differential and corporate productivity also exists in both subsamples (with the same shape as in the case of full sample—see Figure 1, shape C). In the case of financial firms, a higher market valuation was no longer a statistically significant factor improving productivity, while research and development expenditure intensity had a much higher positive effect on it than in the case of other non-financial firms. Furthermore, higher exposure to financial risk (LEV) had a negative effect on revenue per employee in the case of companies operating outside of the financial sector. We also estimated the parameters of Equation (2) using an alternative measure of pay gap—compensation differential between OTEO and the average worker. Obtained results were similar.

Table 5. Pay gap and productivity (measured as $\ln REVENPE_{it}$).

Variable	Full Sample	Financial Firms	Other Non-Financial Firms
$\ln CEOTOT_OE$	−0.570 *** (0.130)	−0.379 ** (0.179)	−0.201 (0.210)
$\ln CEOTOT_OE^2$	0.116 *** (0.033)	0.043 (0.048)	0.014 (0.051)
$\ln CEOTOT_OE^3$	−0.011 *** (0.003)	−0.004 *** (0.001)	−0.004 ** (0.002)
ROE	0.196 *** (0.034)	0.382 *** (0.071)	0.156 *** (0.043)
LnTA	0.149 *** (0.006)	0.086 *** (0.008)	0.326 *** (0.010)
BV_MV	−0.037 ** (0.018)	−0.021 (0.028)	−0.054 ** (0.027)
LEV	0.420 *** (0.042)	0.635 *** (0.048)	−0.352 *** (0.079)
RISK	0.001 (0.001)	0.022 *** (0.003)	0.000 (0.001)
RD_SALES	0.130 ** (0.057)	7.450 *** (1.756)	0.056 (0.063)
CEODUAL	0.000 (0.018)	0.005 (0.023)	−0.026 (0.030)
GENDER	0.090 (0.060)	0.040 (0.081)	−0.076 (0.091)
CEOAGE	−0.013 *** (0.001)	−0.014 *** (0.001)	−0.012 *** (0.002)
Constant	6.279 *** (0.186)	6.371 *** (0.251)	4.731 *** (0.301)
Industry dummies	Yes	No	Yes
Adjusted R ²	0.400	0.344	0.423
Observations	6872	3787	3085
Function shape (see Figure 1)	C	C	C

*, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

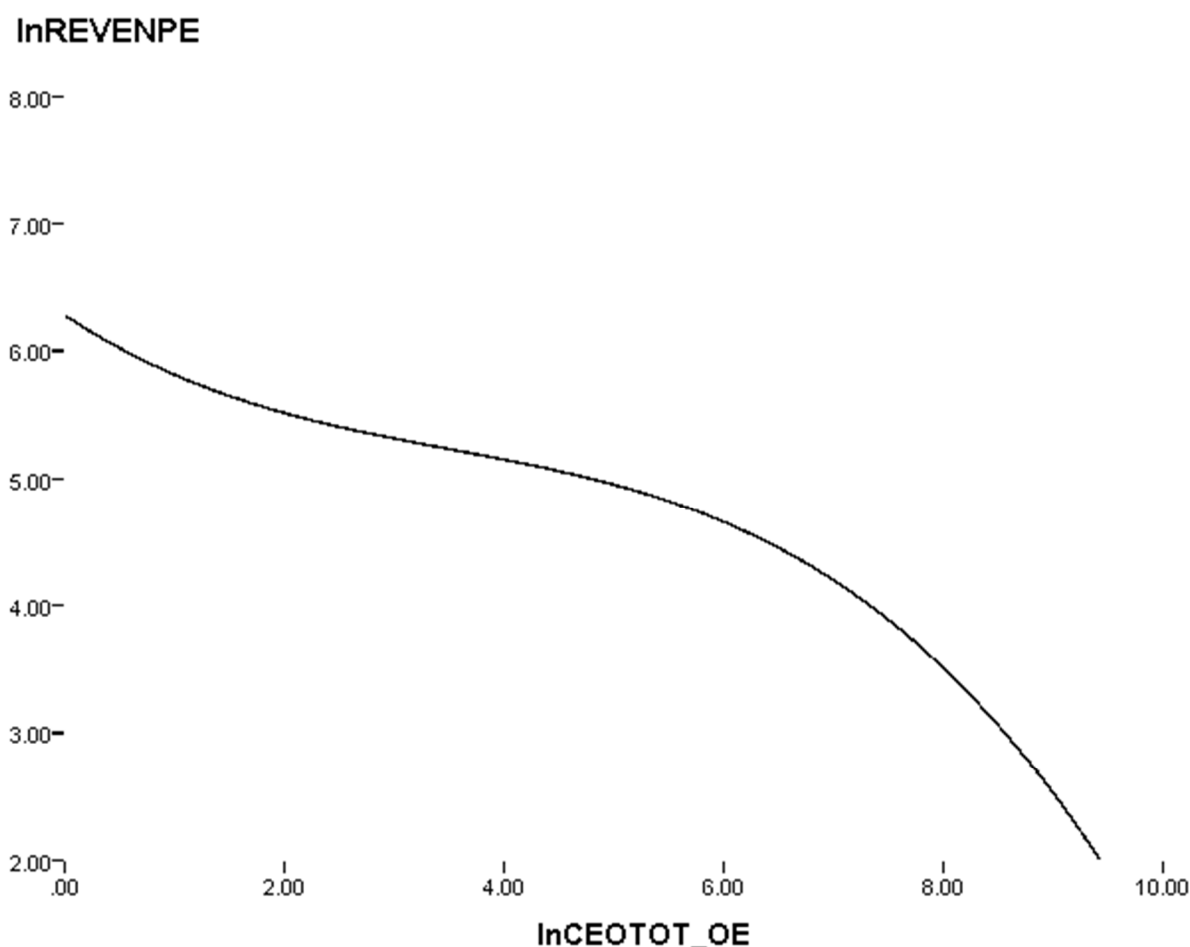


Figure 2. Shape of the cubic function representing the relation between pay gap and productivity (measured as $\ln\text{REVENPE}_{it}$) for full sample of firms.

To test if the above results are robust, we undertook a number of sensitivity analyses. First, we used total factor productivity as a different measure of firm productivity and re-estimated the Equation (2) parameters. Table 6 presents the results of the above approach. It provides further support for the cubic relationship between CEO–worker pay gap and corporate productivity for the full sample as well as both subsamples (financial and non-financial firms). In all of the above cases, the coefficient estimates on $\ln\text{CEOTOT_OE}_{it}^3$ were statistically significant. The obtained functions' shapes showed that the positive overall productivity effect of a rising CEO–employee pay gap within a certain range existed only among financial firms (see Figure 1, shape A), while in both other cases the overall productivity effect in the above range was neutral (see Figure 1, shape B). Interestingly, although measuring performance with the use of TFP had a lower explanatory power for the full sample and firms from non-financial sectors, the opposite was true for financial firms. Furthermore, firm leverage, risk and R&D activism intensity were important control variables positively affecting productivity only in the latter case. Finally, increasing financial risk exposure and CEO duality negatively affected total factor productivity among non-financial firms. Then, as the actual level of pay may also affect employee productivity, we estimated separate regressions specified in Equation (2) for firms with lower and higher salaries (see the first two columns of Table 7). The first are companies with a lower average salary per employee than the sample first quartile. The second are firms with a higher average salary per employee than the sample third quartile. We expect less well-paid employees to be much more sensitive to higher pay gaps in terms of potential loss of productivity. This indeed is the case, as the obtained function for firms with lower salaries

took the shape C presented in Figure 1; competition for pay effect does not dominate over inequality effect for any level of wage dispersion between the CEO and ordinary workers. Furthermore, more highly paid employees are positively motivated to higher effort by a rising salary gap, even if it exceeds a certain, critical point. The shape of function among firms with high salaries took the form D (see Figure 1).

Table 6. Pay gap and productivity (measured as TFPit).

Var iable	Full Sample	Financial Firms	Other Non-Financial Firms
lnCEOTOT_OE	−0.840 *** (0.121)	−1.502 *** (0.208)	−0.023 (0.148)
lnCEOTOT_OE ²	0.204 *** (0.030)	0.334 *** (0.056)	0.012 (0.036)
lnCEOTOT_OE ³	−0.017 *** (0.002)	−0.023 *** (0.005)	−0.004 * (0.002)
ROE	0.248 *** (0.030)	0.576 *** (0.075)	0.182 *** (0.030)
LnTA	0.110 *** (0.006)	0.082 *** (0.009)	0.151 *** (0.007)
BV_MV	−0.044 *** (0.016)	−0.034 (0.030)	−0.029 (0.019)
LEV	0.034 (0.039)	0.502 *** (0.050)	−0.665 *** (0.057)
RISK	0.001 (0.001)	0.022 *** (0.003)	0.000 (0.001)
RD_SALES	−0.002 (0.047)	6.685 *** (1.655)	−0.007 (0.045)
CEODUAL	0.001 (0.016)	0.014 (0.023)	−0.062 *** (0.021)
GENDER	0.029 (0.052)	0.124 (0.078)	0.001 (0.065)
CEOAGE	−0.011 *** (0.001)	−0.011 *** (0.001)	−0.011 *** (0.001)
Constant	0.848 *** (0.172)	1.689 *** (0.282)	−0.188 (0.212)
Industry dummies	Yes	No	Yes
Adjusted R ²	0.344	0.426	0.188
Observations	6872	3787	3085
Function shape (see Figure 1)	B	A	B

*, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

Table 7. Pay gap and productivity (measured as lnREVENPE_{it}) among different firm groups.

Variable	Lower Salaries	Higher Salaries	Fewer Workers	More Workers	Lower Capital Intensity	Higher Capital Intensity
lnCEOTOT_OE	−0.314 (0.306)	0.518 * (0.271)	−1.239 *** (0.303)	0.739 *** (0.191)	−0.334 (0.305)	−1.008 *** (0.245)
lnCEOTOT_OE ²	0.063 (0.069)	−0.184 ** (0.077)	0.307 *** (0.092)	−0.123 *** (0.043)	0.018 (0.073)	0.199 *** (0.065)
lnCEOTOT_OE ³	−0.006 ** (0.003)	0.016 ** (0.007)	−0.023 *** (0.009)	0.004 * (0.002)	−0.003 (0.005)	−0.015 *** (0.005)
ROE	0.026 (0.048)	0.417 *** (0.069)	0.577 *** (0.077)	0.038 (0.032)	0.109 * (0.063)	0.064 (0.077)
LnTA	0.101 *** (0.014)	0.087 *** (0.014)	0.044 ** (0.018)	0.388 *** (0.010)	0.223 *** (0.018)	0.171 *** (0.011)
BV_MV	−0.153 *** (0.047)	−0.031 (0.044)	0.031 (0.040)	−0.032 (0.026)	−0.126 ** (0.050)	−0.112 *** (0.033)
LEV	0.185 ** (0.087)	0.493 *** (0.075)	0.496 *** (0.083)	0.190 *** (0.064)	0.002 (0.130)	0.634 *** (0.055)
RISK	−0.001 (0.001)	0.018 *** (0.004)	0.005 * (0.002)	0.000 (0.001)	0.000 (0.001)	0.006 ** (0.003)
RD_SALES	0.095 (0.143)	−0.196 *** (0.074)	0.012 (0.065)	3.073 *** (0.663)	3.034 *** (0.846)	0.071 (0.110)
CEODUAL	−0.006 (0.032)	−0.099 ** (0.040)	0.125 *** (0.036)	−0.007 (0.028)	−0.023 (0.045)	−0.063 ** (0.028)
GENDER	−0.168 (0.133)	−0.438 *** (0.133)	−0.063 (0.096)	0.001 (0.138)	−0.202 (0.138)	0.045 (0.079)

Table 7. Cont.

Variable	Lower Salaries	Higher Salaries	Fewer Workers	More Workers	Lower Capital Intensity	Higher Capital Intensity
CEOAGE	−0.006 *** (0.002)	−0.008 *** (0.002)	−0.014 *** (0.002)	−0.001 (0.001)	−0.020 *** (0.002)	0.003 ** (0.002)
Constant	5.574 *** (0.456)	5.426 *** (0.368)	7.769 *** (0.370)	0.124 (0.312)	6.013 *** (0.436)	5.520 *** (0.343)
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R ²	0.531	0.442	0.460	0.757	0.378	0.592
Observations	1690	1697	1731	1735	1695	1705
Function shape (see Figure 1)	C	D	A	D	C	B

*, **, and *** denote significance at the 10%, 5%, and 1% level, respectively. Firms with lower salaries are those with an average salary per employee lower than the sample first quartile (USD 40,576). Firms with higher salaries are those with average salary per employee higher than the sample third quartile (USD 83,170). Firms with fewer workers are those employing fewer employees than the sample first quartile (1739). Firms with more workers are those employing more employees than the sample third quartile (19,576). Firms with low capital intensity are those characterized by capital turnover ratio (calculated as revenues divided by total assets) higher than the sample third quartile (0.951). Firms with high capital intensity are those characterized by capital turnover ratio lower than the sample first quartile (0.074).

The analysis has also been extended to examine whether the productivity effects of increasing pay gap might be different among firms employing fewer or more workers. We define firms with fewer workers as those employing fewer employees than the sample first quartile and firms with more workers as those employing more employees than the sample third quartile. In the case of firms employing a larger number of workers are usually characterized by significantly higher media coverage, more complex operations and thus larger CEO salaries, the positive effect of competition for pay and promotion may outweigh inequality aversion among staff members. In both cases, the third and fourth columns of Table 7 estimating Equation (2) parameters reveal that the relationship between CEO–employee pay differential and corporate productivity is nonlinear and cubic, with a statistically significant coefficient estimate on $\ln CEOTOT_OE_{it}^3$. However, for the subsample of firms with fewer workers, the function shape took the form A (see Figure 1), showing that when the pay gap between the CEO and ordinary employee exceeds a certain point, both inequality aversion and the negative effect of competition for promotion are mutually reinforcing and negatively affect economic performance. The opposite is true for firms with more workers, where, as expected, competition for promotion effect for high levels of the pay gap is still positive for productivity and strong enough to outweigh the negative inequality effect (see Figure 1, shape D). Additionally, capital intensity of a given firm might also affect the pay gap/productivity relationship. Employees of companies that require large amounts of financial resources to support the production of goods or services might be less prone to negative inequality and competition for pay effects on productivity, which is characteristic for the high pay gap. To test the above assumption, we estimated separate regressions specified in Equation (2) for two subsets of firms: lower capital intensity companies, characterized by a capital turnover ratio (calculated as revenues divided by total assets) higher than the sample third quartile; and higher capital intensity companies, characterized by a capital turnover ratio lower than the sample first quartile (see columns five and six of Table 7). The obtained results show that there is no significant relationship between pay gap and revenue per employee in the group of lower capital intensity firms. Contrary to our assumption, in the case of higher capital intensity firms, employees are still prone to negative inequality and competition for pay effects on productivity for high levels of pay gap between the CEO and average worker; the function shape took the form B (see Figure 1).

To test if there are any lagged effects of the CEO–worker pay gap on productivity, we also re-estimated Equation (2) parameters using the natural logarithm of revenue per employee for a given company in a subsequent year as the dependent variable. The results presented in Table 8 show that there are indeed significant lagged effects in the above area, with similar explanatory power that in the case of same-year effects. They also further confirm the cubic shape of the relationship between CEO–worker pay differential and firm productivity. Interestingly, CEO gender had a significant influence on subsequent revenue

per employee, with the positive effect of women CEOs for the full sample and subsample of other non-financial firms.

Table 8. Pay gap and productivity (measured as $\ln\text{REVENPE}_{it+1}$)—lagged effects.

Variable	Full Sample	Financial Firms	Other Non-Financial Firms
$\ln\text{CEOTOT_OE}$	−0.800 *** (0.133)	−0.828 *** (0.178)	−0.164 (0.206)
$\ln\text{CEOTOT_OE}^2$	0.174 *** (0.033)	0.159 *** (0.047)	0.017 (0.050)
$\ln\text{CEOTOT_OE}^3$	−0.015 *** (0.003)	−0.010 *** (0.004)	−0.005 * (0.003)
ROE	0.121 *** (0.036)	0.266 *** (0.069)	0.096 ** (0.041)
LnTA	0.140 *** (0.006)	0.075 *** (0.008)	0.258 *** (0.010)
BV_MV	−0.068 *** (0.019)	−0.055 * (0.028)	−0.062 ** (0.026)
LEV	0.582 *** (0.048)	0.878 *** (0.056)	−0.275 *** (0.086)
RISK	0.000 (0.001)	0.016 *** (0.003)	0.000 (0.001)
RD_SALES	0.210 ** (0.084)	7.326 *** (1.713)	0.184 ** (0.086)
CEODUAL	−0.002 (0.019)	0.003 (0.023)	−0.026 (0.029)
GENDER	0.111 * (0.063)	0.016 (0.083)	0.146 * (0.087)
CEOAGE	−0.013 *** (0.001)	−0.014 *** (0.001)	−0.014 *** (0.002)
Constant	6.613 *** (0.191)	7.074 *** (0.250)	4.984 *** (0.297)
Industry dummies	Yes	No	Yes
Adjusted R ²	0.412	0.209	0.476
Observations	6195	3450	2745
Function shape (see Figure 1)	B	A	C

*, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

Finally, as we reported a negative correlation between both increasing CEO–worker pay gap and increasing age of the CEO and BV/MV ratios (see Table 4), we end our additional tests with the analysis of the possible determinants of market valuation. The results of this regression (BV_MV as dependent variable) are presented in Table 9. They show that increasing pay differential between the average worker and CEO, as well as increasing CEO age, are both statistically significant stimulators of firm market valuation. The above is contradictory to the results obtained for productivity (measured by both revenue per employee and TFP—see Table 4) and might show short-term market inefficiency. Furthermore, increasing ROE and R&D to sales ratios also had a positive effect on market valuation in all groups of firms. The opposite was true for size and risk. Increasing exposure to financial risk was an important suppressor of BV/MV ratio (and thus good for value creation) in the case of financial firms, while it acted as stimulator in the other non-financial firms group. Interestingly, CEO duality was harmful for the market valuation of firms doing business outside the financial sector.

Table 9. Determinants of market valuation (measured as BV_MV).

Variable	Full Sample	Financial Firms	Other Non-Financial Firms
ROE	−0.560 *** (0.022)	−0.972 *** (0.038)	−0.383 *** (0.027)
lnCEOTOT_OE	−0.090 *** (0.007)	−0.081 *** (0.008)	−0.076 *** (0.010)
LnTA	0.050 *** (0.004)	0.063 *** (0.005)	0.022 *** (0.007)
LEV	0.019 (0.028)	−0.131 *** (0.028)	0.302 *** (0.055)
RISK	0.005 *** (0.000)	0.034 *** (0.001)	0.003 *** (0.001)
RD_SALES	−0.180 *** (0.038)	−2.356 ** (1.019)	−0.141 *** (0.042)
CEODUAL	0.001 (0.012)	−0.020 (0.013)	0.047 ** (0.020)
GENDER	0.011 (0.040)	−0.041 (0.047)	0.012 (0.061)
CEOAGE	−0.004 *** (0.001)	−0.002 *** (0.001)	−0.004 *** (0.001)
Constant	0.836 *** (0.052)	0.386 *** (0.059)	0.971 *** (0.087)
Industry dummies	Yes	No	Yes
Adjusted R ²	0.210	0.374	0.195
Observations	6872	3787	3085

*, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

5. Discussion and Conclusions

High CEO compensation in comparison to ordinary workers has recently become a matter of increased public concern. Economic theory names two main forces at play in regard to the possible relationship between an increasing CEO–employee pay differential and firm’s productivity—inequality aversion and competition for pay and promotion. However, existing research usually draws separately on one or the other and largely ignores the possible interaction between them. By combining both above approaches and using data for 751 constituents of the S&P 1500 index over the years 1992–2016, we confirmed a cubic relationship between CEO–worker pay gap and corporate productivity. Specifically, a rising salary differential adversely affects productivity principally when it is both too low as well as too high. Only for intermediate levels of pay gap can we observe different overall productivity effects. First, competition for pay and promotion might not be strong enough to dominate over increasing inequality aversion with moderate negative productivity effect. Second, competition for pay effect can counterbalance inequality aversion, with neutral overall productivity effect. Finally, in the case of financial firms and total factor productivity as a measure of firm performance, competition for pay effect may dominate over increasing inequality aversion with a positive overall productivity effect of a rising CEO–employee pay gap. We also found significant lagged effects of the pay gap on revenue per employee, with similar explanatory power that in the case of same-year effects. It suggests that the CEO–worker pay differential is incorporated into corresponding employee actions on a continuous basis. We must also be aware of the fact that the pay gap is a structural characteristic that remains relatively stable over time.

Furthermore, we found different productivity effects of the CEO–worker pay gap in different corporate settings, which also have important implications for corporate governance and investors alike. For example, in contrast to companies with low average salaries and fewer workers, firms with high average salaries and more employees experience positive productivity gains even if the salary gap exceeds a certain critical point. This might show that positive tournament-like efficiency incentives are especially strong among companies with highly skilled workforce and diversified operations. Furthermore, better-paying companies are more prone to significant productivity effects connected to different CEO characteristics, including CEO–chair duality (negative influence of CEO also serving as the chairmen of the board), age (negative influence of rising CEO age) and

gender (negative influence of female CEO). One possible explanation is the fact that a more educated labor force pays more attention to top management attributes. It also shows that better-paying companies are rather male-dominated environments. CEO–chair duality also suppressed revenue per employee among companies characterized by high capital intensity. In contrast, the above was beneficial for productivity of firms with fewer workers, where the same person acting as CEO and chairman of the board might create a feeling of a more stable working environment among staff members necessary for increased effort and dedication. Further empirical research is needed to understand additional moderating effects in the pay gap–productivity relationship (e.g., management attitudes, board diversity and gender composition, corporate culture).

We provide some new evidence on a possible market inefficiency; although increasing pay gap is generally negative from a productivity perspective, it is still desirable from the value creation perspective, measured as the BV/MV ratio. The empirical findings of this paper also showed a rather prevalent negative effect of increasing CEO age on productivity (with the sole exception of companies characterized by low asset turnover ratios). As older CEOs were at the same time desirable from the market valuation perspective most likely due to their unique knowledge, experience and access to vast informal networks, subsequent studies should attempt to analyze possible reasons of the above inconsistency in greater detail. Additionally, the R&D expenditure intensity has a very strong and positive impact on productivity among financial firms. This, together with the higher explanatory power of total factor productivity than revenue per employee in our productivity–pay gap models in the above subsample, seems to show an increasing pressure to use resources more efficiently in the financial sector. Furthermore, it suggests that rising pay gaps between CEOs and ordinary workers in financial firms might negatively affect productivity in a more subtle manner. Thus, the opportunity remains for future in-depth studies focused on this particular sector and specific channels of possible effects of rising CEO–worker gap on TFP.

As our study focused on a limited number of U.S. companies over the period from 1992–2016, it might also be fruitful for future research to examine the pay gap–productivity link across a wider spectrum of firms, more equally distributed among different sectors from several different countries and different periods. This would increase the general applicability of the presented results. Furthermore, as we only used compensation of those executives covered in Standard and Poor’s ExecuComp database that had a clearly defined annual title to calculate our CEO–worker pay gap ratio, there is a risk of its potential misestimation, especially since ExecuComp does not embrace all individual top management team members’ remuneration. Furthermore, the results suggest that the salary differential between the CEO and average employee may influence various aspects of a firm’s productivity and performance in different ways (revenue per employee and TFP vs. BV/MV ratio). Thus, the choice of appropriate productivity/performance variables can have significant implications for the empirical results of future studies in this area. Finally, as the last global financial crisis of 2007–2008 had a severe negative impact on the U.S. stock market, future in-depth studies focused on the specific periods of economic/financial turmoil in the context of pay gap–productivity/performance relationship in the corporate sector can provide additional insights on the topic. Such studies can further refine our results.

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