WHY HAS CEO PAY INCREASED SO MUCH?*

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This paper develops a simple equilibrium model of CEO pay. CEOs have different talents and are matched to firms in a competitive assignment model. In market equilibrium, a CEO's pay depends on both the size of his firm and the aggregate firm size. The model determines the level of CEO pay across firms and over time, offering a benchmark for calibratable corporate finance. We find a very small dispersion in CEO talent, which nonetheless justifies large pay differences. In recent decades at least, the size of large firms explains many of the patterns in CEO pay, across firms, over time, and between countries. In particular, in the baseline specification of the model's parameters, the sixfold increase of U.S. CEO pay between 1980 and 2003 can be fully attributed to the sixfold increase in market capitalization of large companies during that period.

I. Introduction

This paper proposes a simple competitive model of CEO compensation. It is tractable and calibratable. CEOs have different levels of managerial talent and are matched to firms competitively. The marginal impact of a CEO's talent is assumed to increase with the value of the firm under his control. The model generates testable predictions about CEO pay across firms, over time, and between countries. Moreover, a benchmark specification of the model proposes that the recent rise in CEO compensation is an efficient equilibrium response to the increase in the market value of firms, rather than resulting from agency issues.

In our equilibrium model, the best CEOs manage the largest firms, as this maximizes their impact and economic efficiency. The paper extends earlier work (e.g., Lucas [1978]; Rosen [1981, 1982, 1992]; Sattinger [1993]; Tervio [2003]) by drawing from extreme value theory to obtain general functional forms for the distribution of top talents. This allows us to solve for the variables of interest

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TABLE I
CEO PAY AND DIFFERENT PROXIES FOR FIRM SIZE

	ln(Total compensation)			
	(1)	(2)	(3)	(4)
ln(Market cap)	0.34	0.27		
	(0.021)	(0.008)		
	(0.021)	(0.012)		
ln(Income)	0.006		0.22	
	(0.0138)		(0.008)	
	(0.0149)		(0.009)	
ln(Sales)	−0.08			0.21
	(0.018)			(0.008)
	(0.020)			(0.014)
Year fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Observations	9,777	9,777	9,777	9,777
R^2	0.498	0.494	0.455	0.439

Explanation. We use ExecuComp data (1992–2004) and select for each year the 1,000 highest-paid CEOs, using the total compensation variable TDC1 at year t, which includes salary, bonus, restricted stock granted, and Black–Scholes value of stock-options granted. We regress the log of total compensation of the CEO in year t on the log of the firm's size proxies in year $t-1$. All nominal quantities are converted to 2000 dollars using the GDP deflator of the Bureau of Economic Analysis. The industries are the Fama–French (1997) 48 sectors. To retrieve firm size information at year $t-1$, we use Compustat Annual. The formula we use for total firm value (debt plus equity) is (data199*abs(data25)+data6-data60-data74). Income is measured as earnings before interest and taxes (EBIT), defined from Compustat as (data13-data14), and sales is measured as data12. We report standard errors clustered at the firm level (first line) and at the year level (second line).

taxes (EBIT), and sales. We regress the logarithms of CEO compensation for our sample of highly paid CEOs on the logarithms of these size proxies, controlling for year and industry. We include year dummies to make sure time series effects do not drive the results.

The picture that emerges in Table I is not ambiguous: The firm's total market value is the only size proxy that has a positive significant coefficient, when putting the three proxies together in the regression (column (1)). It is also the one with the highest predictive power, when used alone to predict compensation (columns (2)–(4)). For this reason, in the remainder of the text, we will use the firm's total market value as our size proxy.[23]

23. Of course, it is conceivable that in other times and places, other proxies might be more appropriate. Some cultures may think that the stock market is too noisy a variable and that accounting variables, such as earnings or sales, are better metrics.

TABLE II
PANEL EVIDENCE: CEO PAY, OWN FIRM SIZE, AND REFERENCE FIRM SIZE

	ln(Total compensation)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Top 1000				Top 500			
ln(Market cap)	0.37	0.37	0.37	0.26	0.38	0.32	0.33	0.23
	(0.022)	(0.020)	(0.026)	(0.056)	(0.039)	(0.039)	(0.043)	(0.074)
	(0.016)	(0.015)	(0.015)	(0.043)	(0.020)	(0.019)	(0.026)	(0.057)
ln(Market cap of firm #250)	0.72	0.66	0.68	0.78	0.73	0.73	0.74	0.84
	(0.053)	(0.054)	(0.060)	(0.052)	(0.084)	(0.085)	(0.094)	(0.080)
	(0.066)	(0.064)	(0.061)	(0.083)	(0.089)	(0.088)	(0.081)	(0.11)
GIM governance index			0.022				0.023	
			(0.010)				(0.016)	
			(0.003)				(0.007)	
Industry fixed effects	No	Yes	Yes	No	No	Yes	Yes	No
Firm fixed effects	No	No	No	Yes	No	No	No	Yes
Observations	7,936	7,936	6,393	7,936	4,156	4,156	3,474	4,156
R^2	0.23	0.29	0.32	0.60	0.20	0.29	0.32	0.63

Explanation. We use Compustat to retrieve firm size information at year $t-1$. We select each year the top n ($n = 500$, 1,000) largest firms (in term of total market firm value, i.e., debt plus equity). The formula we use for total firm value is (data199*abs(data25)+data6-data60-data74). We then merge with ExecuComp data (1992–2004) and use the total compensation variable, TDC1 at year t, which includes salary, bonus, restricted stock granted and Black–Scholes value of stock options granted. All nominal quantities are converted into 2000 dollars using the GDP deflator of the Bureau of Economic Analysis. The industries are the Fama–French (1997) 48 sectors. The GIM governance index is the firm-level average of the Gomper–Ishi–Metrick (2003) measure of shareholder rights and takeover defenses over 1992–2004 at year $t-1$. A high GIM means poor corporate governance. The standard deviation of the GIM index is 2.6 for the top 1000 firms. We regress the log of total compensation of the CEO in year t on the log of the firm value (debt plus equity) in year $t-1$, and the log of the 250th firm market value in year $t-1$. We report standard errors clustered at the firm level (first line) and at the year level (second line).

using the Fama and French (1997) 48-industry classification.

$$\ln(w_{i,t+1}) = d_{\text{Industry of firm } i} + e \times \ln(S_{n_*,t}) + f \times \ln(S_{i,t}). \tag{19}$$

Third, we allow for firm fixed effects, allowing the performance impact of talent to be firm-specific.

In this regression, e is an estimate of β/α, f is an estimate of $\gamma - \beta/\alpha$, and therefore $e + f$ estimates γ. From prior research, a plausible null hypothesis is that $\gamma = 1$, that is, constant returns to scale in the CEO production function. Indeed, constant returns to scale is the assumption that works most of the time in calibrated macroeconomics. Furthermore, in recent models of

justification for including an industry fixed effect, or a firm effect, if different industries of firms have a different C.

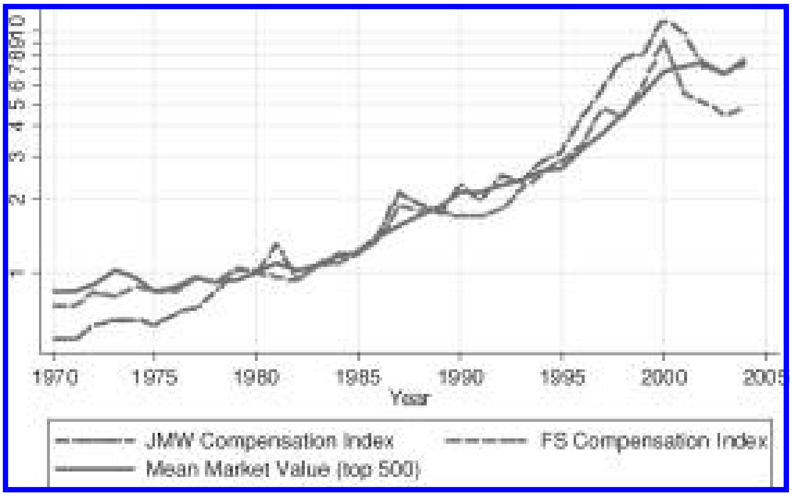

FIGURE I
Executive Compensation and Market Capitalization of the Top 500 Firms

Notes. FS compensation index is based on Frydman and Saks (2005). Total Compensation is the sum of salaries, bonuses, long-term incentive payments, and the Black–Scholes value of options granted. The data are based on the three highest-paid officers in the largest 50 firms in 1940, 1960, and 1990. The JMW Compensation Index is based on the data of Jensen, Murphy, and Wruck (2004). Their sample encompasses all CEOs included in the S&P 500, using data from Forbes and ExecuComp. CEO total pay includes cash pay, restricted stock, payouts from long-term pay programs, and the value of stock options granted from 1992 onward using ExecuComp's modified Black–Scholes approach. Compensation prior to 1978 excludes option grants and is computed between 1978 and 1991 using the amounts realized from exercising stock options. Size data for year t are based on the closing price of the previous fiscal year. The firm size variable is the mean of the largest 500 firm asset market values in Compustat (the market value of equity plus the book value of debt). The formula we use is mktcap = (data199*abs(data25)+data6-data60-data74). To ease comparison, the indices are normalized to be equal to 1 in 1980. Quantities were first converted into constant dollars using the Bureau of Economic Analysis GDP deflator.

parsimonious explanation, one that fits the main facts without appealing to shifts in unobserved variables. Section V.E presents other possible explanations.

A Time-Series Estimate of γ. Another way to look at the question is to reestimate γ from the 1970–2003 time-series evidence and test whether the constant-returns-to-scale hypothesis ($\gamma = 1$) is rejected. We need some assumptions. Assume that the distribution of talent for the top, say, 1,000 CEOs has remained the same (so that $D(n_*)$ has remained constant). Then a simple consistent estimate of γ is offered by looking at the respective increase in

TABLE III
CEO PAY AND THE SIZE OF LARGE FIRMS, 1970–2003

	Δ ln (Compensation)	
	Jensen–Murphy–Wruck index	Frydman–Saks index
Δ ln Market	1.14	0.87
	(0.28)	(0.30)
Constant	0.002	0.001
	(0.032)	(0.033)
Observations	34	34
Adj. R^2	0.29	0.18

Explanation. We estimate for $t \geqslant 1971$

$$\Delta_t(\ln w_t) = \widehat{\gamma} \times \Delta_t \ln S_{*,t-1},$$

which gives a consistent estimate of γ. We show Newey–West standard errors in parentheses, allowing the error term to be autocorrelated for up to two lags. The Jensen, Murphy, and Wruck index is based on the data of Jensen, Murphy, and Wruck (2004). Their sample encompasses all CEOs included in the S&P 500, using data from Forbes and ExecuComp. CEO total pay includes cash pay, restricted stock, payouts from long-term pay programs, and the value of stock options granted, using after 1991 ExecuComp's modified Black–Scholes approach. Compensation prior to 1978 excludes option grants and is computed between 1978 and 1991 using the amounts realized from exercising stock options. The Frydman–Saks index is based on Frydman and Saks (2005). Total compensation is the sum of salaries, bonuses, long-term incentive payments, and the Black–Scholes value of options granted. The data are based on the three highest-paid officers in the largest 50 firms in 1940, 1960, and 1990. Size data for year t are based on the closing price of the previous fiscal year. The firm size variable is the mean of the biggest 500 firm asset market values in Compustat (the market value of equity plus the book value of debt). The formula we use is mktcap=(data199*abs(data25)+data6-data60-data74). Quantities are deflated using the Bureau of Economic Analysis GDP deflator. Standard errors are in parentheses.

(Lewellen [1968] covers the period 1940–1963.) Frydman and Saks find essentially no change in the level of CEO compensation during 1936–1970. In the context of our model, assuming no change in talent supply and no distortions, that would mean a γ indistinguishable from 0.[32] The flatness of executive compensation during this period is a "new puzzle" raised by Frydman and Saks (2005) that would require a specific study.

Without attempting a resolution of the puzzle, we list a few possibilities. One possible factor might lie on the supply side of the CEO market. Perhaps more people accumulated the skills necessary to become CEOs, thereby putting a downward pressure

32. Ongoing updates of the Frydman–Saks paper are making this characterization more precise. Also, the ratio of the median wage to the median firm value is not constant (as in the simplest version of our theory) in their data. Instead, normalizing to 1 in 1936, it goes to 0.4 in the 1950s–1960s, and then is back to around 0.7 in 2000 (Frydman and Saks 2005, Figure 2). In the simplest version of our theory (constant distribution of talent at the top, assumption that the Frydman Saks sample is representative of the universe of top firms), the ratio would remain constant and equal to 1.