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Macroeconomic Fluctuations as Sources of Luck in CEO Compensation

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Abstract Macroeconomic fluctuations in interest rates, exchange rates, and inflation can be considered sources of good or bad "luck" for corporate performance if management is unable to adjust operations to these fluctuations. Based on a sample of 2,091 US firms, we decompose the impacts of macroeconomic fluctuations on three measures of CEO compensation. Our study provides empirical support for the importance of considering macroeconomic fluctuations in designing CEO incentive schemes. It adds to the managerial power literature on moral hazard and CEO compensation by pinpointing the obvious risk that the CEO in an asymmetric and non-linear reward system will be inclined to prioritize his/her own cash flow at the expense of fulfilling an assumed agency role. The policy conclusion for remuneration committees and board of directors is to filter out macroeconomic influences on performance to be rewarded whenever an asymmetric compensation scheme has been opted for.

Keywords Macroeconomic fluctuations · Luck · Corporate performance · CEO compensation · Moral hazard · Managerial power

Introduction

CEO compensation has increased sharply during the last few decades and drawn significant attention from the general public, politicians, and regulators in the US as well as in Europe, especially during the recent financial crisis.[1] Although the level of compensation in Europe remains below that in the US, the level in most European countries has increased rapidly in the new millennium.[2] According to Fernandes et al. (2012), the difference between the compensation in Europe and the US can be explained to a large extent by the performance-based component of executive compensation in the US compensation, which seems to be associated with a higher risk premium. This observation implies that levels and forms of compensation are not independent.

Incentive schemes are mostly tied to performance measures, which in turn are closely associated with development

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[1] In Gabaix and Landier (2008), it is argued that the sixfold increase of CEO compensation in the US between 1980 and 2003 can be attributed to the sixfold increase of market capitalization of large companies during the same period. In a long time series analysis of CEO compensation, Frydman and Saks (2010) show that prior to 1970 s there was little dispersion across managers and low correlation between pay and firm size prior. After 1970s, incentive pay has grown significantly, correlation between pay and firm size has strengthened, and pay dispersion across executives has widened.

[2] See, for example, Oxelheim and Randöy (2005).

of the macroeconomic environment of the firm. Temporary changes in macroeconomic conditions may play a crucial role as a source of good or bad "luck" in corporate performance and in compensation based on performance (Oxelheim and Wihlborg 2008). Although management lacks influence over macroeconomic conditions, management may be able to influence performance to the extent that operations can be adjusted in response to contemporaneous or anticipated macroeconomic conditions. Thus, lucky or unlucky performance and compensation occurs in response to macroeconomic events if management is unable to respond to these events for lack of anticipation or inability to adjust.

In analyzing the impact of luck on CEO compensation, Bertrand and Mullainathan (2000, 2001) define luck as performance beyond CEO's control. They consider performance effects on fluctuations of oil prices in the energy sector, the impact of exchange rates in traded goods sectors, and changes in performance from year to year around mean industry performance. Garvey and Milbourn (2006) use a market index and an industry index as proxies for stock price performance based on luck. In all cases, the empirical results indicate that compensation depends strongly on luck. Benchmarking can be viewed as an attempt to adjust for luck. Aggarwal and Samwick (1999) and more recently Bizjak et al. (2008) document widespread use of benchmarking.

This paper examines macroeconomic fluctuations such as interest rate, exchange rate, and inflation as sources of luck in CEO compensation. Compensation is typically not linked in a simple way to one well-defined performance measure. We therefore analyze direct as well as indirect influences. We also analyze the impact of macroeconomic fluctuations on awarded versus realized compensation to further make inferences on compensation incentives and managers' timing skills. To the extent, the impact from the macroeconomic environment on corporate performance is substantial and the incentive system asymmetric, and the shareholders run the risk of having a CEO who for personal reasons opts for excessive exposure to macroeconomic fluctuations. Most schemes tend to have a floor for compensation independent of performance, thereby creating asymmetry in compensation schemes (Murphy 2012).

The premise from the contracting literature is that optimal incentive contracts should not include rewards (penalties) for observable lucky (unlucky) performance. However, accepting this means an additional difficulty associated with the measurement of luck or performance outside the control of management.[3] As pointed out by Gopalan et al. (2009), the effect on performance of external shocks beyond management's control can be influenced by management's strategic choices as well as operational decisions in response to external shocks. If so, the incentives of management to take advantage of lucky external events and to dampen the effects of unlucky external events would be removed if compensation is not related to performance effects of lucky circumstances.

The implication of the above discussion is that the appropriate definition of lucky performance depends both on the nature of shocks and the technological, as well as managerial ability to adjust strategy and operation to shocks within a certain time frame. The adjustment of strategy and operation can take the form of flexible investment (real options) in an environment characterized by high uncertainty about external shocks. Adjustment may also take the form of switching production and marketing efforts in response to anticipated and even current events such as exchange rate changes. For instance, a restaurant business may be able to respond very quickly to lucky events by adding tables, while a capital intensive firm may need years to adjust for production capacity. In general, we would expect the service industry including the financial sector to have the technological capability to adjust operations rapidly to take advantage of macroeconomic fluctuations. In this case, skill and effort contribute to performance effects of short-lived macroeconomic shocks.

The macroeconomic price variables chosen in this paper respond rapidly to underlying unobservable macroeconomic shocks and provide information about the extent of macroeconomic influences on compensation and performance. In the empirical analysis, we use US data for two reasons: US firms have the highest share of performance-based remuneration of total compensation and the US is a country that allows analysis of several dimensions for a long period. We distinguish between anticipated and unanticipated macroeconomic effects. If compensation responds to, for example, anticipated events but not to unanticipated events, managers have incentives to adjust operations in response to forecast macroeconomic developments.

Three research questions are investigated. First, we ask to what extent macroeconomic fluctuations contribute to the level and variability of compensation. Second, we analyze whether there are substantial differences between compensation effects of anticipated and unanticipated macroeconomic fluctuations. Third, we ask whether differences between awarded and realized compensation reveal a timing ability of CEOs to exercise options with respect to macroeconomic events.

Based on an analysis of a panel of 2,091 US firms for the period 1993–2007, we find a large part of the CEO compensation (including salary, bonus, option awards, and pension payments) to be attributed to macroeconomic

[3] The contracting literature indicates that optimal incentive contracts are achieved by means of some kind of benchmarking for "normal" performance and the linking of compensation to a performance measure reflecting skill and effort with as little noise as possible. Milgrom and Roberts (1992) and Rosen (1992) review the contracting literature on incentive effects of compensation schemes.

fluctuations. Our results call for further studies of moral hazard leading to excessive risk taking as a result of rewarding CEOs for luck in a setting with asymmetric and non-linear reward systems.

The paper is organized as follows. In the next section, data sources and stylized facts are presented. The section thereafter presents pay-for-performance elasticities with respect to macroeconomic factors, industry factors, and firm-specific factors. Then follows a section in which we analyze and calculate the contributions of the macroeconomic factors to compensation and performance year by year. Since incentive effects of macroeconomic influences on compensation may depend on whether they are anticipated or not, we in the section thereafter make specific assumptions about expectations formation to illustrate the importance of identifying the contribution of luck correctly. The final section provides concluding comments and policy implications.

Data Sources and Stylized Facts

Compensation data are obtained from Standard and Poor's Execucomp through COMPUSTAT North America. The database covers about 3,000 US companies, both active and inactive. Our sample is from 1992 to 2008 with the estimation period limited to 1993–2007. Year 1992 data are used to calculate the rate of the return on compensation. All the variables are calculated in 1992 values.

Dependent Variable—Various Definitions of CEO Compensation

Three different definitions of CEO compensation are used for the dependent variable in the empirical analysis below:

1. *TOTALCURR* Total current compensation which includes salary and bonus.
2. *TDC1* Total compensation awarded as calculated under the 1992 reporting format. Total compensation is comprised the following: salary, bonus, other annual, total value of restricted stock granted, total value of stock options granted (using Black–Scholes), long-term incentive payouts, and all other total (in thousands $).
3. *TDC2* Total compensation realized as calculated under the 1992 reporting format. Total compensation is comprised the following: salary, bonus, other annual, restricted stock grants, long-term incentive payments, all other, and value of options exercised (in thousands $).

The difference between awarded (*TDC1*) and realized (*TDC2*) is that *TDC1* includes the value of options at the time the options are awarded, while *TDC2* includes the value of options at the time they are exercised. Thus, *TDC1* is what is usually known as compensation incentives, while *TDC2* represents realized payments to the executive. The cash payments on these options may differ substantially from options awarded. The correlation in cross-section between the two variables representing total compensation was 0.58 in 2007, while the correlation for our overall sample period was 0.47. From the point of view of risk management incentives, the pattern of realized compensation should be of particular interest.

In 2006, the FAS 123R changed the reporting requirements for executive compensation. Under the new reporting regime, the cost of all employee stock options as well as other equity-based compensation arrangements have to be reflected in the financial statements based on the estimated fair value of the awards (*TOTAL_ALT1* and *TOTAL_ALT2*). However, we only have a fairly short time series for each reporting firm of these two variables, while *TDC1* and *TDC2* exist for the period before as well as after 2006.[4] Since the correlations between *TDC1* and *TOTAL_ALT1*, and between *TDC2* and *TOTAL_ALT2* in cross-section for 2007 were as high as 0.99 and 0.81, we are comfortable using *TDC1* and *TDC2* as compensation measures.

Properties of Different CEO Compensation Constructs

We begin by investigating the statistical properties of the three compensation series for 3,046 firms in the dataset covering the period 1992–2008. The panel is unbalanced. After excluding some firms with incomplete data, there are 2,091 firms remaining in the compensation dataset. No systematic features are found for excluded observations. Table 1 displays annual means and standard deviations for the levels (in thousands $) and index (year 1992 = 100) of *TOTALCURR*, *TDC1* and *TDC2* for each year.

Table 1 shows that the variations across firms are larger each year in *TDC1* than in *TOTALCURR* as one would expect in the US, where variable compensation such as options granted constitutes a large share of total compensation. The variations across firms are even larger in *TDC2*.

The peaks for *TDC1* and *TDC2* appear to occur at approximately the same time. Stock market peaked in 1999 and 2007. *TDC1* including awarded incentives had its highest peak in 2000, the year after the peak in the stock market index. The peaks for *TDC2* including options

[4] *TOTAL_ALT1* substitutes for *TDC1* except that stock and option awards are valued using the grant date fair value of the award instead of the amount charged to the income statement under FAS 123R. *TOTAL_ALT2* substitutes for *TDC2* except that stock and option awards are valued using the value realized from option exercise or stock vesting instead of the amount charged to the income statement under FAS 123R.

Table 1 Annual compensation levels

Year	# of firms	Cash compensation (TOTALCURR)			Total compensation including option granted (TDC1)			Total compensation including option exercised (TDC2)		
		Mean	Std	Index	Mean	Std	Index	Mean	Std	Index
1992	341	1.128	0.754	100.00	2.311	2.238	100.00	2.968	5.920	100.00
1993	1,002	0.992	0.948	87.89	2.060	2.786	89.13	2.246	7.101	75.68
1994	1,307	0.962	0.825	85.23	2.158	2.818	93.38	1.674	2.240	56.40
1995	1,386	1.017	0.877	90.17	2.314	3.369	100.10	2.063	3.344	69.50
1996	1,456	1.118	1.084	99.14	3.145	6.961	136.06	2.635	5.346	88.76
1997	1,534	1.217	1.298	107.92	3.902	7.759	168.82	3.697	9.846	124.56
1998	1,612	1.207	1.232	106.95	4.550	18.328	196.85	4.629	23.452	155.93
1999	1,688	1.299	1.451	115.13	5.079	11.233	219.75	4.227	11.373	142.42
2000	1,709	1.359	1.637	120.47	6.722	21.506	290.82	6.195	23.012	208.70
2001	1,620	1.315	1.784	116.58	6.350	16.411	274.72	4.503	11.835	151.71
2002	1,629	1.391	1.375	123.27	4.919	7.359	212.80	3.798	8.235	127.95
2003	1,686	1.568	1.869	138.98	4.549	6.093	196.80	4.536	9.233	152.83
2004	1,642	1.763	2.008	156.26	5.216	7.193	225.66	5.909	11.498	199.07
2005	1,578	1.898	2.303	168.27	5.554	7.406	240.28	7.169	16.503	241.52
2006	1,498	1.247	1.927	110.56	5.743	7.818	248.45	7.680	15.223	258.75
2007	1,418	1.086	1.737	96.30	5.909	8.126	255.65	7.806	14.085	262.99

This table displays annual mean, and standard deviation for three CEO compensation levels (Million US Dollar): cash compensation (TOTALCURR), total compensation including option awarded (TDC1), and total compensation including option exercised (TDC2), as well as the index for each variable with 1992 value = 100. The dataset includes 2,091 firms

exercised peaked the same year as stock market index. This can be expected since realized compensation is bound to be positively related to market prices.

Explanatory Variables—Macroeconomic Price Variables

Macroeconomic conditions can be identified by either quantity variables like GDP, GDP growth, investments, and employment, or by price variables such as interest rates, inflation rates, exchange rates, and stock market index. Although the former group of variables describes macroeconomic conditions, they are typically observed with a substantial lag. As Oxelheim and Wihlborg (2008) note, price variables are easily observable signals of underlying macroeconomic shocks and developments. A shock would have a certain effect on a group of price variables (i.e., interest rate) as well as on quantity variables (i.e., GDP growth). Only the former would be observable at the time a shock occurs. Therefore, price signals can be useful tools for a firm wishing to decompose compensation and performance into "intrinsic factors" and macroeconomic factors. Another advantage of using price variables like interest rates and exchange rates in the decomposition is that they adjust quickly to both domestic and foreign conditions affecting a firm's performance.

Table 2, Panel A, describes the means and standard deviations for the macroeconomic variables, interest rate, inflation rate relative to the previous year, and annual exchange rate changes.[5] The interest rates are the annual average 1-year Treasury rates (T-bill rate). Inflation rates are the year-to-year changes in the level of consumer prices (CPI). The exchange rates are the annual average Euro per Dollar rates after 1998. Before 1998, the German Mark per Dollar is used. Other dollar-exchange rates are not included because they are highly correlated. All the macroeconomic factors are obtained from DataStream. The stock market index is not included because this variable does not add explanatory power when the interest rate is included. In the Table, we can see that the average 1-year T-bill rate is 4.6 % and the average annual inflation rate is 2.6 %. The average annual exchange rate change is −0.006 with a standard deviation of 0.093. The dollar's depreciation over the whole period is expected to favor exporting firms.

We make a distinction between anticipated and unanticipated changes of macro-variables with the anticipated interest rate in the next period assumed to be equal to current interest rate. Thus, we define unanticipated interest rate as the interest rate changes from year to year.

$$\text{Anticipated interest rate}_t = i_{t-1}$$

[5] Changes in real US GDP relative to the previous year were included in the regressions below but removed since this variable did not add explanatory value. As noted in the text, it is desirable to be able to capture macroeconomic condition with price variables alone.

Table 2 Year-by-year descriptive statistics for the macroeconomic and microeconomic factors

Year	US 1-year rate		Exchange rate change		US inflation rate	
	Mean	Std.	Mean	Std.	Mean	Std.
Panel A: macroeconomic factors						
1993	0.037	0.001	0.006	0.030	0.027	0.018
1994	0.057	0.012	−0.010	0.020	0.026	0.017
1995	0.062	0.005	−0.006	0.032	0.025	0.021
1996	0.058	0.003	0.007	0.021	0.033	0.023
1997	0.061	0.001	0.012	0.029	0.017	0.016
1998	0.055	0.004	−0.062	0.199	0.016	0.013
1999	0.058	0.005	0.013	0.021	0.027	0.026
2000	0.069	0.004	0.005	0.037	0.033	0.035
2001	0.037	0.010	0.004	0.024	0.016	0.042
2002	0.022	0.005	−0.014	0.026	0.023	0.030
2003	0.014	0.001	−0.015	0.030	0.019	0.040
2004	0.022	0.006	−0.006	0.020	0.031	0.040
2005	0.041	0.005	0.012	0.019	0.035	0.065
2006	0.053	0.002	−0.009	0.019	0.025	0.053
2007	0.051	0.004	−0.009	0.017	0.040	0.041
1993–2007	0.046	0.017	−0.006	0.093	0.026	0.005

Year	Sales		Tobin's Q	
	Mean	Std.	Mean	Std.
Panel B: microeconomic factors				
1993	6.767	11.485	1.749	1.087
1994	4.077	8.670	1.682	0.976
1995	3.703	9.419	1.871	1.300
1996	3.757	9.472	1.902	1.242
1997	3.910	9.732	2.042	1.365
1998	3.919	9.539	2.194	2.215
1999	4.127	10.721	2.443	3.596
2000	4.275	11.912	2.214	2.263
2001	4.082	10.876	2.047	1.526
2002	3.926	10.942	1.649	1.058
2003	4.134	11.511	1.987	1.377
2004	4.384	12.557	2.018	1.495
2005	4.687	12.726	1.955	1.436
2006	5.346	15.437	1.916	1.078
2007	5.892	16.788	1.871	1.245
1993–2007	4.350	11.759	1.989	1.735

$$\text{Unanticipated interest rate}_t = i_t - i_{t-1}.$$

The anticipated percentage exchange rate change (euro/$) over the next year is reflected in the current one-year interest rate differential (uncovered interest rate parity). Thus,

$$\text{Anticipated } \Delta \text{ exchange rate}_t = i_{t-1}^{\text{Euro}} - i_{t-1}^{\text{USD}}$$

$$\text{Unanticipated } \Delta \text{exchange rate}_t = \left((\text{Euro/USD})_t - (\text{Euro/USD})_{t-1}\right) - \left(i_{t-1}^{\text{Euro}} - i_{t-1}^{\text{USD}}\right).$$

The anticipated inflation over the next year is equal to the inflation last year. In other words, a change in the inflation rate from 1 year to another is considered unanticipated. Thus,

$$\text{Anticipated } \Delta\text{CPI} = \text{cpi}_{t-1} - \text{cpi}_{t-2}$$

$$\text{Unanticipated } \Delta\text{CPI} = (\text{cpi}_t - \text{cpi}_{t-1}) - (\text{cpi}_{t-1} - \text{cpi}_{t-2}).$$

All proxies for anticipated and unanticipated changes in macro-variables are subject to uncertainty and potential

criticism. Nevertheless, we make assumptions about expectations formation since incentive effects of compensation sensitivities to these components of macroeconomic fluctuations can be quite different.

Panel B shows the main firm-specific accounting variables, *Sales* and *Tobin's Q*, through which the macroeconomic fluctuations may express themselves indirectly. The *Tobin's Q* is defined as (Market value of equity + Book value of debt)/(Book value of equity + Book value of debt). Average *Sales* of our firms are 4.4 million dollars and *Tobin's Q* is 1.989.

Control Variables

Our firm-specific control variables are *CEO age* and *CEO tenure*. Average *CEO age* in our sample is 56 years, while average *CEO tenure* is about 7 years. These data are not included in the table to save space. In addition to firm-specific control variables, we control for industry and year effects using dummies.

Explaining Compensation with and without Macroeconomic Factors

We first analyze which performance measures are most strongly linked to CEO compensation before turning the analyses to the impact of macroeconomic fluctuations on compensation.

Identifying the Link Between CEO Compensation and Performance Variables

Early studies of executive compensation across firms focus on the relation between CEO compensation and measures of firm performance (Coughlan and Schmidt 1985; Murphy 1985, 1986; Jensen and Murphy 1990; Abowd 1990; Leonard 1990), while other studies analyze whether CEOs are rewarded for performance relative to a market or industry benchmark (Antle and Smith 1986; Gibbons and Murphy 1990; Bertrand and Mullainathan 2001; Bebchuk and Grinstein 2005; Garvey and Milbourn 2006). In order to first identify the most important firm-specific factors explaining CEO compensation, the compensation data (*TOTALCURR*, *TDC1*, and *TDC2*) are matched with firm size and performance variables.

A pooled regression (1) is estimated for the period 1993–2007 including 17 industry dummies and 14-year dummies but no macroeconomic variables. Fixed effects and random effects models are compared below when macroeconomic factors are included instead of year dummies. The dependent variable (real compensation) is defined as *TOTALCURR*, *TDC1*, and *TDC2*, respectively, since the sensitivities to these compensation measures cannot be expected to be the same.

$$\begin{aligned}\text{Log}(\text{Compensation}_{i,t}) &= \alpha_0 + \alpha_1 \text{Log}(\text{Sales}_{i,t}) \\ &+ \alpha_2 \text{Log}(\text{Performance}_{i,t}) + \sum_{i=1}^{4} \beta_i \text{Control variables}_i \\ &+ \sum_{i=1}^{17} \gamma_i \text{Industry dummies}_i + \sum_{i=1}^{14} \theta_i \text{Year dummies}_i + \varepsilon_{i,t}\end{aligned} \tag{1}$$

The firm's total (real) sale is used as a proxy for firm size. A number of performance variables are tested in Eq. (1) to find which one(s) explains compensation the best. *Tobin's Q* is adopted as the performance measure in our specifications. Variations in this variable are dominated by variations in the market value of equity.

All variables in the regressions in this study are in logarithms. Therefore, the regression coefficients are interpreted as "pay-for-performance elasticities." One advantage of using the elasticity approach is that it produces a better "fit" in terms of marginal effects. The other advantage is that the elasticity is relatively invariant to firm size (Gibbons and Murphy 1992; Murphy 1999).

Table 3 reports the parameter estimations from three pooled regression models for the period 1993–2007 using Eq. (1). The table shows that firm-specific variables including sales revenue, CEO age, tenure, and firm performance all contribute positively to executive compensation. The cash component of compensation is the least sensitive to *Sales*, and performance as measured by *Tobin's Q*. Compensation including options awarded and exercised (*TDC1* and *TDC2*) is more sensitive to these firm level variables. *TDC2* is also considerably more sensitive to *Tobin's Q* than *TDC1*. *CEO age* and *CEO tenure* both contribute positively to cash and total compensation. Industry dummies indicate that compensation levels vary substantially across industries.[6] The time dummies for *TDC1* and *TDC2* in particular seem to be much larger after 2000 than before. We do not report industry and year dummies throughout the paper for reason of brevity.

Equation (1) is also tested cross-sectionally for each individual year. The results are not included here for reasons of space and because the compensation elasticities with respect to sales and performance were quite stable over time for TDC2 and TDC1. The greatest variation over time in elasticities was

[6] The sectors in Table 4 are the following with the number of firms in parenthesis: 1 = Oil and Gas (22); 2 = Food Tobacco Products (28); 3 = Paper and Paper Products (48); 4 = Chemical Products (64); 5 = Manufacturing (35); 6 = Computer Hardware & Software (66); 7 = Electronic equipment (35); 8 = Transportation (51); 9 = Scientific Instruments (38); 10 = Communications (10); 11 = Electric and Gas Services (58); 12 = Durable Goods (8); 13 = Retail (32); 14 = Eating and Drinking Establishments (20); 15 = Financial Services (38); 16 = Entertainment Services (4); 17 = Health (5); and 18 = All Others (72).

Table 3 Pooled regression model with sector and time dummy variables

	Log (TOTALCURR)	Log (TDC1)	Log (TDC2)
Log (Sales)	0.289***	0.409***	0.415***
	(71.79)	(91.01)	(86.26)
Log (Tobin's Q)	0.116***	0.366***	0.505***
	(8.90)	(25.13)	(32.29)
Age	0.067***	0.047***	0.055***
	(7.60)	(4.83)	(5.19)
Age^2/100	−0.054***	−0.044***	−0.043***
	(−6.88)	(−5.02)	(−4.56)
Tenure	0.011***	0.008***	0.035***
	(5.44)	(3.59)	(14.29)
Tenure^2/100	−0.028***	−0.042***	−0.102***
	(−4.09)	(−5.63)	(−12.67)
Constant	2.482***	2.776***	1.983***
	(9.94)	(9.98)	(6.64)
Industry dummies	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes
Observations	18,665	18,665	18,665
Number of firms	2,091	2,091	2,091
R−squared	0.28	0.40	0.40

This table reports the parameter estimations from three pooled regression models for the period 1993–2007. The dependent variables are Log (TOTALCURR), Log (TDC1), and Log (TDC2). The industries are identified in footnote 6 in the text. *t*-values are in parentheses

*, **, and *** denote significance at the 0.10, 0.05, and 0.01 level or better

observed for cash compensation. Thus, it seems that the relative composition of compensation varies over time.

Macroeconomic influences on compensation and performance

We now investigate whether macroeconomic variables affect compensation independent of variation in *Tobin's Q* and *Sales before* analyzing macroeconomic influences on *Tobin's Q* and *Sales*. The total macroeconomic influence on compensation is calculated as sum of these effects.

A random effects model (Eq. 2) is estimated with firm-specific variables, macro-variables (anticipated and unanticipated), as well as some control variables.

$$\begin{aligned}\text{Log}(\text{Compensation}_{i,t}) &= \alpha_0 + \alpha_1 \text{Log}(\text{Sales}_{i,t}) \\ &+ \alpha_2 \text{Log}(\text{Tobin's } Q_{i,t}) + \sum_{i=1}^{4} \beta_i \text{Control variables}_i \\ &+ \theta_1 \text{Log}(1 + \text{ Anticipated interest rate}_{i,t}) \\ &+ \theta_2 \text{Log}(1 + \text{ Unanticipated interest rate}_{i,t}) \\ &+ \theta_3 \text{Log}(1 + \text{ Anticipated } \Delta CPI_{i,t}) + \theta_4 \text{Log}(1 \\ &+ \text{ Unanticipated } \Delta CPI_{i,t}) \\ &+ \theta_5 \text{Log}(1 + \Delta \text{ Anticipated exchange rate}_{i,t}) \\ &+ \theta_6 \text{Log}(1 + \Delta \text{ Unticipated exchange rate}_{i,t}) \\ &+ \theta_7 \text{Log}(\text{exchange rate}_{i,t-1}) + \sum_{i=1}^{17} \gamma_i \text{Industry dummies}_i \\ &+ u_i + \varepsilon_{i,t}. \end{aligned} \tag{2}$$

Table 4 shows the compensation elasticities with respect to *Sales*, *Tobin's Q*, and the macroeconomic variables using Eq. (2). Age, tenure, and industry dummies are included as above. The compensation variables are *TOTALCURR*, *TDC1*, and *TDC2* as given above. In Table 5, Model 1 for *TDC1* and *TDC2* includes all the macroeconomic variables, while insignificant variables in Model 1 have been removed in Model 2.

Table 4 shows that Sales and Tobin's Q are significant in all the models. The conventional measure of total compensation awarded (*TDC1*) depends negatively on both anticipated and unanticipated interest rates, negatively on unanticipated inflation, and negatively on all three exchange rate factors indicating that an appreciation of the dollar is associated with a decline in compensation (Model 2). The magnitude of several coefficients is large. For example, the coefficient of the unanticipated interest rate implies that a 1 % point increase in the interest rate is associated with a 7 % decline in compensation. The smallest effects of macro-variables are associated with anticipated inflation (zero) and unanticipated exchange rate changes (−0.141). The zero effect of anticipated inflation implies that there is no effect of anticipated inflation on real compensation.

The results for compensation including options exercised each period (*TDC2*) are different in some respects. The performance (Tobin's Q) sensitivity has increased relative to results without macro-variables in Table 3. Furthermore, the effects of unanticipated inflation are insignificant. This observation is an indication that managers are not able to exercise option based on timing

Table 4 Random effects model with firm-specific factors and interest rate, exchange rate, and inflation as macroeconomic factors

	Log (TOTALCURR)	Log (TDC1)		Log (TDC2)	
		Model 1	Model 2	Model 1	Model 2
Log (Sales)	0.278***	0.398***	0.398***	0.419***	0.419***
	(24.19)	(32.59)	(32.67)	(34.81)	(34.83)
Log (Tobin's Q)	0.185***	0.368***	0.368***	0.652***	0.651***
	(6.30)	(7.62)	(7.62)	(18.42)	(18.46)
Age	0.067***	0.046**	0.046**	0.052**	0.052**
	(3.41)	(2.10)	(2.08)	(2.35)	(2.35)
Age^2/100	−0.057***	−0.044**	−0.044**	−0.043**	−0.043**
	(−3.26)	(−2.28)	(−2.27)	(−2.18)	(−2.18)
Tenure	0.010***	0.004	0.004	0.040***	0.040***
	(2.98)	(0.94)	(0.94)	(9.85)	(9.85)
Tenure^2/100	−0.015	−0.019	−0.019	−0.106***	−0.106***
	(−1.19)	(−1.54)	(−1.53)	(−6.68)	(−6.69)
Log (1 + Anti. interest rate)	−10.622***	−2.949***	−3.364***	−4.818***	−4.924***
	(−18.92)	(−4.39)	(−5.50)	(−5.98)	(−6.14)
Log (1 + UnAnti. interest rate)	−8.745***	−6.485***	−7.002***	−1.979**	−2.255***
	(−13.80)	(−8.74)	(−10.09)	(−2.34)	(−2.77)
Log (1 + Ananti. ΔCPI)	−6.966***	−2.254	–	14.765***	15.677***
	(−4.98)	(−1.60)	–	(8.93)	(12.71)
Log (1 + UnAnti. ΔCPI)	5.159***	−5.840***	−4.333***	−1.240	–
	(4.77)	(−4.12)	(−3.95)	(−0.90)	–
Log (1 + Anti. ΔExchange rate)	−6.472***	−4.547***	−4.884***	−5.050***	−5.106***
	(−9.20)	(−6.53)	(−7.08)	(−6.47)	(−6.50)
Log (1 + UnAnti. ΔExchange rate)	0.217***	−0.125***	−0.141***	−0.416***	−0.426***
	(8.99)	(−3.82)	(−4.54)	(−12.85)	(−13.57)
Log (Exchange rate$_{t-1}$)	0.277***	−0.591***	−0.579***	−0.771***	−0.763***
	(7.11)	(−14.68)	(−14.44)	(−20.08)	(−20.24)
Constant	3.325***	3.702***	3.671***	2.330***	2.309***
	(6.16)	(6.25)	(6.19)	(3.85)	(3.83)
Industry dummy	Yes	Yes	Yes	Yes	
Observations	18,665	18,665	18,665	18,665	18,665
Number of firms	2,091	2,091	2,091	2,091	2,091
R-squared	0.27	0.37	0.37	0.37	0.37

This table reports the parameter estimations from three random effects models. The dependent variables are Log (TOTALCURR), Log (TDC1), and Log (TDC2). The time period is 1993–2007. The industries are identified in footnote 6 in the text. *t*-values are in parentheses

*, **, and *** denote significance at the 0.10, 0.05, and 0.01 level or better

expertise with respect to changes in this macroeconomic variable. We return to this issue below.

We also add a term (Export sales/Total sales), as well as this ratio interacting with all exchange rate variables, to possibly capture firm-specific effects of exchange rate changes. The export sales ratio was obtained for 523 firms out of the total sample of 2,091. The results are not presented because neither the export/sales ratio itself, nor the interaction terms were significant.[7] Thus, we are not able to identify a higher sensitivity of compensation to exchange rate changes in firms with high export dependence.

In what way do the macroeconomic variables influence CEO compensation indirectly via influences on *Sales* and *Tobin's Q*, which systematically affect compensation? To answer the above question, we regress these two variables on the set of macroeconomic and dummy variables used in Eq. (2) and Table 4. In addition, log *Tobin's Q* is an independent variable in the regression for log *Sales* and vice versa.

Table 5 shows that the size and performance (Tobin's Q) influence each other. *Sales* have a small but significant

[7] Oxelheim and Randöy (2005) find that this variable affects the exchange rate sensitivity of compensation in a group of small countries.

Table 5 Random effects model with tobin's Q and Sales as dependent variables

	Q equation	Sales equation
Log (Sales)	−0.031***	–
	(−3.89)	–
Log (Tobin's Q)	–	−0.088***
	–	(−3.18)
Log (1 + Anti. interest rate)	−1.432***	−2.107***
	(−4.25)	(−4.94)
Log (1 + UnAnti. interest rate)	−2.629***	−3.326***
	(−8.73)	(−7.17)
Log (1 + Ananti. ΔCPI)	1.134	10.322***
	(1.52)	(10.18)
Log (1 + UnAnti. ΔCPI)	4.873***	0.813
	(10.10)	(1.33)
Log (1 + Anti. Δ Exchange rate)	−4.701***	−3.364***
	(−15.93)	(−7.23)
Log (1 + UnAnti. Δ Exchange rate)	−0.041***	−0.403***
	(−3.41)	(−22.44)
Log (Exchange $rate_{t-1}$)	0.089***	−0.764***
	(5.32)	(−24.12)
Constant	0.582***	6.947***
	(9.06)	(78.13)
Industry dummies	Yes	Yes
Observations	18,665	18,665
Number of firms	2,091	2,091
R-squared	0.16	0.07

This table reports the parameter estimations from two random effects models. The industries are identified in footnote 6 in the text. The time period is 1993–2007. *t*-values are in parentheses

*, **, and *** denote significance at the 0.10, 0.05, and 0.01 level or better

negative effect on *Tobin's Q* when controlling for macroeconomic factors, and *Tobin's Q* has a small significant negative effect on *Sales*.[8]

All the macroeconomic variables have a significant effect on both *Tobin's Q* and *Sales*. Anticipated and unanticipated interest rates have a negative impact on both variables, while inflation has a positive impact. Anticipated and unanticipated appreciations of the dollar are associated with negative effects on *Tobin's Q* and *Sales*. Thus, the macroeconomic effects of interest rate increases, and dollar appreciations on compensation are negative through the direct channels captured in Table 4 as well as the indirect channels captured in Table 5. The effect of increased inflation on *TDC1* is negative through the direct channel in Table 4 but positive through the impact on *Tobin's Q* and *Sales* in Table 5.

[8] These results indicate that sales generally are higher than what value maximization would call for.

The Impact of Macroeconomic Fluctuations on CEO Compensation

We have found that there is a direct as well as an indirect effect of macroeconomic factors on *Sales* and *Tobin's Q*. To determine the magnitude of the macroeconomic impact, we combine the elasticities estimated in the previous section with actual changes in macroeconomic factors each year to "filter out" the share of compensation explained by macroeconomic conditions. First, we ask how much macroeconomic fluctuations contribute to the level and variability in compensation. Second, we analyze whether there are substantial differences between compensation effects of anticipated and unanticipated macroeconomic fluctuations. Third, we ask whether differences between awarded and realized compensation reveal an ability of CEOs to exercise options with timing expertise with respect to macroeconomic events.

Table 6 shows the total effect of macroeconomic variables, while Table 7 shows the effects of unanticipated changes. In each of the tables, column (1) shows the percent of salary plus bonus (*TOTALCURR*) explained by macroeconomic factors each year at constant levels of *Tobin's Q* and *Sales*. Columns (2) and (3) show the corresponding effects of macroeconomic variables on total compensation awarded (*TDC1*) and total compensation realized (*TDC2)*. Columns (4) and (5) show the percent of changes in *Tobin's Q* and *Sales* explained by the same variables. Column (6) presents the sum of the effects in columns (1), (4), and (5) using the coefficients in Table 5 as weights. Thus, column (6) shows the percentage of current compensation each year explained by macroeconomic factors. Columns (7) and (8) show the macroeconomic effects on compensation awarded (*TDC1*) and realized (*TDC2*), respectively.

The macroeconomic effects in Table 6, columns (1) through (3), are calculated based on deviations from mean levels of the macro-variables each year times the appropriate coefficients in Table 4. The procedure for calculating macroeconomic effects on *Tobin's Q* and *Sales* is the same, but the coefficients are obtained from Table 5.

The total macroeconomic impact on compensation in Table 6 varies from year to year as a result of macroeconomic fluctuations, and the impact differs among the compensation measures. Comparing macroeconomic effects on cash compensation (*TOTALCURR*) in column (6) with total compensation awarded (*TDC1*) in column (7) and total realized compensation (*TDC2*) in column (8), it can be observed that the time patterns are different. The impact on cash compensation varies from a negative 16 % to a positive 29 %. The corresponding figures for *TDC1* (*TDC2*) are negative 14 (negative 16) % to positive 30 (44) %. Thus, the variation in realized compensation

Table 6 Contribution of the anticipated plus unanticipated macroeconomic factors to compensation

Year	Macro effects in current compensation given Q and Sales (%) (1)	Macro effects in TDC1 given Q and Sales (%) (2)	Macro effects in TDC2 given Q and Sales (%) (3)	Q equation (%) (4)	Sales equation (%) (5)	Total macro effects in current compensation (1) + w_q × (4) + w_s × (5) (%) (6)	Total macro effects in TDC1 (1) + w_q × (4) + w_s × (5) (%) (7)	Total macro effects in TDC2 (1) + w_q × (4) + w_s × (5) (%) (8)
1993	−12.48	−8.33	−6.25	−11.22	−3.76	−16.30	−14.15	−13.40
1994	−12.22	−8.76	6.94	−3.85	0.13	−13.26	−10.24	5.42
1995	−7.84	1.66	6.28	5.61	5.97	−5.18	6.04	12.52
1996	3.80	7.45	4.94	10.24	4.82	7.54	13.26	12.37
1997	−0.19	6.44	3.95	6.06	1.05	1.69	9.23	7.17
1998	−16.65	18.73	24.54	6.63	25.03	−10.18	30.36	43.61
1999	16.10	3.41	−14.06	10.84	−9.53	17.35	4.31	−15.72
2000	3.78	−9.19	−11.72	9.30	−9.33	4.64	−8.84	−13.90
2001	−4.63	14.24	4.91	1.96	10.33	−2.17	18.73	12.46
2002	3.99	12.97	7.17	−6.62	6.58	3.37	12.70	8.68
2003	27.20	8.15	0.83	3.95	2.35	28.73	10.56	4.02
2004	23.89	3.74	11.04	3.67	4.00	25.65	6.64	15.18
2005	20.51	−0.52	14.49	9.61	4.48	24.01	4.92	21.43
2006	−0.55	2.73	18.93	5.91	10.38	3.01	8.81	28.17
2007	−9.91	4.77	11.76	1.66	9.76	−7.64	8.93	18.81
93–07	5.01	5.16	6.69	4.60	5.01	7.21	8.79	11.88

This table reports the predicted anticipated and unanticipated symmetric macro effects in different years as well as the whole period 1993–2007 using coefficients in Table 4 (Models 2 for TDC1 and TDC2). In the column (6), (7), and (8), w_q and w_s are the coefficients for the variables Log (Tobin's Q) and Log (Sales) in Table 5

Table 7 Contribution of the unanticipated macroeconomic factors to compensation

Year	Unanticipated macro effects in current compensation given Q and Sales (%) (1)	Unanticipated macro effects in TDC1 given Q and Sales (%) (2)	Unanticipated macro effects in TDC2 given Q and Sales (%) (3)	Q equation (%) (4)	Sales equation (%) (5)	Total unanticipated macro effects in current compensation (1) + w_q × (4) + w_s × (5) (%) (6)	Total unanticipated macro effects in TDC1 (2) + w_q × (4) + w_s × (5) (%) (7)	Total unanticipated macro effects in TDC2 (3) + w_q × (4) + w_s × (5) (%) (8)
1993	5.48	4.82	−0.22	0.99	0.44	5.84	5.37	0.48
1994	−22.06	−10.31	−3.51	−6.92	−6.11	−25.11	−15.26	−10.38
1995	−5.56	−6.20	3.43	−0.05	2.84	−5.04	−5.20	5.26
1996	5.52	−4.33	−2.52	1.29	−1.82	5.54	−4.47	−3.17
1997	−1.73	−5.80	−7.86	−4.29	−8.26	−4.45	−10.47	−15.03
1998	−15.01	11.02	25.92	0.50	24.71	−10.30	20.09	42.22
1999	3.65	−9.69	−6.16	1.71	−5.61	3.08	−11.02	−9.10
2000	0.05	−20.73	−9.57	2.22	−9.39	−1.07	−23.22	−14.75
2001	22.73	15.47	5.79	5.54	8.62	25.87	20.77	13.72
2002	5.48	18.30	6.55	−1.71	7.00	6.29	20.13	10.38
2003	6.16	12.29	9.66	6.12	10.54	9.81	18.51	19.09
2004	−7.53	4.10	1.95	0.05	1.17	−7.30	4.54	2.72
2005	−12.90	−9.50	−5.38	−1.45	−6.82	−14.56	−12.52	−10.42
2006	−12.47	−6.50	−2.69	−4.21	−4.21	−14.42	−9.69	−7.20
2007	−1.18	1.99	3.91	−0.68	3.74	−0.68	3.06	6.06
93–07	−1.09	0.60	2.00	0.20	1.88	−0.69	1.36	3.31

This table reports the predicted unanticipated macro effects in different years as well as the whole period 1993-2007 using coefficients in Table 4 (Models 2 for TDC1 and TDC2). In the column (6), (7), and (8), w_q and w_s are the coefficients for the variables Log (Tobin's Q) and Log (Sales) in Table 5

Table 8 Summary of results: average absolute total macro effects and unanticipated macro effects

	Average absolute total macro effect (Table 6)		Average absolute unanticipated macro effect (Table 7)	
	Including effects through Q and Sales (%) (1)	At constant Q and Sales (%) (2)	Including effects through Q and Sales (%) (3)	At constant Q and Sales (%) (4)
TOTALCURR	11.38	10.92	9.29	8.50
TDC1	11.81	6.80	12.29	9.34
TDC2	15.52	9.85	11.33	6.34

(*TDC2*) appears to be the largest. These figures do not indicate that managers have exercised options with systematic forecasting expertise. However, there is weak evidence of forecasting expertise in the difference between the accumulated macroeconomic impact on realized compensation over the whole period (11.88 %) and the accumulated macroeconomic impact on awarded compensation (8.79 %).

Macroeconomic effects of unanticipated changes in macro-variables in Table 7 are calculated the same way as in Table 6 with the difference that only unanticipated effects of macro-variables and corresponding coefficients are included. The mean levels of unanticipated changes in macro-variables are zero.[9]

The effects of unanticipated macroeconomic fluctuations, which firms are less able to adjust to, in Table 7 are large as well. The largest negative effect on cash compensation in column (6) is −25 % in 1994, while the largest positive effect is +26 % in 2001. The corresponding figures for *TDC1* are −23 % in 2000 and +21 % in 2001, while for *TDC2*, they are −15 % in 2000 and +42 % in 1998. It seems that realized compensation (*TDC2*) is subject to smaller extreme negative effects of unanticipated macroeconomic fluctuations as well as larger extreme positive effects. This indicates that managers to some extent have been able to avoid exercising options in periods when unanticipated macroeconomic conditions are at the most disadvantageous while taking advantage of the most advantageous conditions. This is the evidence of occasional forecasting expertise. There is weak evidence in Table 7 that this expertise might be systematic in that the unanticipated macroeconomic impact on *TDC2* (3.31 %) is greater than the corresponding impact on *TDC1* (1.36 %).

Table 8 presents the *Average Absolute Macro Effects* on the different compensation measures based on Table 6 for total macro effects and Table 7 for unanticipated macro effects under the assumption of symmetry. The *Average Absolute Macro Effects* show the average share of compensation explained by macroeconomic conditions. Total macroeconomic conditions explain approximately equal shares of *TDC1* and current compensation in column (1). Macroeconomic conditions explain a larger average share of realized compensation (*TDC2*). Unanticipated macro effects explain a relatively large share of awarded compensation (*TDC1*) during the period 1993–2007 in column (3). These are the effects that most likely are beyond managers' control.

[9] The effects of the lagged exchange rate levels are neglected since calculation of this effect requires an assumption about what the exchange rate would be under "neutral" macroeconomic conditions.

Concluding Remarks

We analyze macroeconomic influences on CEO compensation in a panel of 2,091 US firms for the period 1993–2007 using exchange rate changes, interest rates, and inflation rates as indicators of macroeconomic fluctuations. The same set of macroeconomic factors was applied for all firms. These macroeconomic price variables can be viewed as signals of underlying macroeconomic shocks. As such, they are easily observable and useful for decomposing performance and compensation into an "intrinsic" component and a macroeconomic component. We estimate the impact of the macroeconomic factors on current compensation, awarded compensation, and realized compensation which takes into account exercised options.

Three channels of macroeconomic influences on compensation are identified. Macroeconomic factors affect Sales and Tobin's Q, and macroeconomics fluctuations affect compensation indirectly through these two variables. Sales and Tobin's Q are also found to have a direct impact on CEO compensation. After estimating the elasticities of performance variables and compensation to anticipated and unanticipated macroeconomic factors, we use the coefficients in combination with macroeconomic developments each year to calculate how three different measures of compensation would have developed had macroeconomic influences been filtered out. The results indicate that a large share of the annual changes in CEO compensation in the US is explained by macroeconomic factors. The accumulated effect on compensation over our entire sample period ranges between 7 % in current compensation and 12 % in realized compensation.

Specifically, three research questions have been investigated in this paper. First, we ask how much macroeconomic fluctuations contribute to the level and variability of compensation. The empirical evidence shows that the macroeconomic impact on cash compensation varies from a negative 16 % to a positive 29 %.

The second research question investigates whether there are substantial differences between compensation variations due to anticipated and unanticipated macroeconomic fluctuations. The latter represents a source of good or bad luck in firms with ability to adjust to anticipated macroeconomic fluctuations. The results show that the range for anticipated average absolute effects was from 11 to 16 %, while for unanticipated average absolute effects was from 9 to 12 %. The very wide fluctuations in compensation would provide appropriate incentives only in the presumably small share of the economy with sufficient flexibility to adjust operations very rapidly in response to contemporaneous macroeconomic shocks. In most firms, we expect that sensitivity of compensation to macroeconomic fluctuations will distort or weaken incentives of management to focus on effort and skill where they can be applied most effectively.

Finally, we ask whether differences between awarded and realized compensation reveal an ability of CEOs to exercise options with timing expertise with respect to macroeconomic events. Based on the regression results, it seems that the managers are able to occasionally time the exercising of options with expertise but this expertise may not be systematic.

Regulation seems to be emerging in many countries stating that the reward for improved performance should not be fully realized unless the improved performance is observed for a period of 3–5 years. Increased compensation would be linked to performance surpassing a benchmark for some duration. The argument behind such proposals would be that improved performance is likely to be caused by other factors than manager's skill and effort, i.e., luck, if performance does not exceed a benchmark for duration of time. A serious problem associated with the proposals to reward only "sustainable" performance is to determine when and how performance above (below) the benchmark should be rewarded (penalized) for being the result of skill and effort rather than luck. The impression of a great performance 1 year without macroeconomic tailwind may 3 years later be gone by bad luck in the shape of a macroeconomic headwind.

Our study provides empirical support for the importance of considering macroeconomic fluctuations in designing CEO incentive schemes. It adds to the managerial power literature on moral hazard and CEO compensation Bebchuk & Fried (2005) by pinpointing the obvious risk that the CEO in an asymmetric and non-linear reward system will be inclined to prioritized his/her own cash flow at the expense of fulfilling an assumed agency role. The implication of our analysis for remuneration committees and board directors is to filter out macroeconomic effects whenever an asymmetric compensation scheme is used. Whether total or only unanticipated macroeconomic effects should be filtered out depends on the technological and managerial capability to adjust operations in response to macroeconomic conditions.

It must also be recognized that firms are sensitive to different degrees to different sets of macroeconomic variables. Future research should aim to further disentangle incentive effects of macroeconomic fluctuations for individual firms with different degrees of adjustability of operations.

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