5-28-2016

Endogeneity in CEO power: A survey and experiment

Zhichuan Li

Citation of this paper:
Li, Z.F. 2016. Endogeneity in CEO power: A survey and experiment. Investment Analysts Journal 45 (3): 149-162.

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Zhichuan (Frank) Li

Ivey Business School
University of Western Ontario
Tel: (519) 661-4112
Email: fli@ivey.ca

December 3, 2015

Abstract

The endogeneity problem has always been one, if not the only, obstacle to understanding the true relationship between different aspects of empirical corporate finance. Variables are typically endogenous, instruments are scarce, and causality relations are complicated. As the first attempt to summarize different econometric methods that are commonly used to address endogeneity concerns in the context of corporate governance, we explore the relation between CEO power and firm performance, as an experiment, to illustrate how these methods can be used to mitigate the endogeneity problem and by how much. After carefully dealing with the endogeneity issues, we find strong evidence that the true relationship between CEO power and subsequent firm performance is negative, suggesting CEOs are overpowered in some firms. Furthermore, we show that all the prevailing econometric remedies are generally effective in mitigating the endogeneity problem to some degree (i.e., to correct the sign from positive to negative), but quantitatively the effects vary considerably. Among all the remedies, GMM has the greatest correction effect on the bias, followed by instrumental variables, fixed effect models, lagged dependent variables, and the addition of more control variables. As for a combination of the methods, firm fixed effects, year fixed effects, and the addition of more meaningful control variables appear to work as well, even without a valid instrumental variable.

JEL classification codes: G34, G32, C58, D23, J33

Keywords: Endogeneity problem, CEO power, CEO entrenchment, Firm performance, GMM, Fixed effects, Instrumental variable, Lagged dependent variable

1. Introduction

In econometrics, the endogeneity problem arises when the explanatory variables and the error term are correlated in a regression model, leading to biased and inconsistent parameter estimates. Particularly, this problem plagues almost every aspect of empirical corporate finance. Examples are corporate governance (Dittmar and Mahrt-Smith, 2007; Bhagat and Bolton, 2008), executive compensation (Palia, 2001), managerial ownership (Aggarwal and Samwick, 2006), board structure (Hermalin and Weisbach, 1998; Boone, Field, Karpoff, and Raheja, 2007; Lehn, Patro, and Zhao, 2009), corporate control (Malmendier and Tate, 2008; Boone and Mulherin, 2008), anti-takeover measures (Comment and Schwert, 1995), firm focus (Campa and Kedia, 2002), firm growth (Demirguc-Kunt and Maksimovic, 1998), ownership structure (Demsetz and Lehn, 1985; Becker, Cronqvist, and Fahlenbrach, 2010), cash flow (Kaplan and Ruback, 1995; Brown, Fazzari, and Petersen, 2009), line of credit (Sufi, 2009), venture capital (Hochberg, Ljungqvist, and Lu, 2010), external finance (Duchin, Ozbas, and Sensoy, 2010), liquidity (Chen, Lesmond, and Wei, 2007), investment policy (DeAngelo, DeAngelo, and Whited, 2010), financial policy (Chava and Purnanandam, 2010), dividend payout (Rubin and Smith, 2009), share repurchase (Brockman, Khurana, and Martin, 2008), firm risk (Low, 2009), technology (Chun et al., 2007), corporate tax status (Graham, Lemmon, and Schallheim, 1998), privatization (Gupta, 2005), and so on.

Most corporate financial decisions are determined endogenously in a complex network of relationships with scarce exogenous shocks and limited information available to the econometrician, which results in omitted variables, simultaneity, and measurement error, three major sources of endogeneity problems.

In this paper, we try to summarize a variety of econometric methods that researchers commonly use to address endogeneity concerns in empirical corporate finance. As an experiment, we explore the relation between CEO power and firm performance in order to illustrate how studies can apply these techniques in corporate finance settings to mitigate the problem and by how much.

Optimal contract theory suggests boards try to minimize agency costs by seeking efficient employment contracts (e.g., Holmstrom, 1979; Grossman and Hart, 1983). The result is that the power assigned to the CEO is optimal and should not have a systematic relationship with firm performance. The counterpart theory, called managerial power theory, argues that boards do not always bargain at arm's length, because of the CEO's influence over them. Thus, the CEO power or compensation may be excessive as compared to the efficient level suggested by optimal contracts (e.g., Bertrand and Mullainathan, 1999; Bebchuk, Fried, and Walker, 2002). Although researchers on both sides have claimed that empirical evidence supports their hypotheses, the data remain inconclusive.

The single biggest issue in this line of research is the endogeneity problem, which is the main reason the literature is largely mixed regarding the above two theories. In fact, researchers either use one or two simple methods to mitigate endogeneity issues or simply ignore the problem.

We experiment in this field to test prevailing econometric methods: lagging independent variables, fixed effects, control variables, lagged dependent variables, and GMM for dynamic models. After carefully dealing with endogeneity issues, we find strong evidence that the true relationship between CEO power and subsequent firm performance is negative, which supports the assertion that CEO "entrenchment" degrades firm performance. We show that all the prevailing econometric remedies work to mitigate the endogeneity bias to some degree (i.e., to correct the sign from positive to negative). Of the remedies, GMM has the greatest correction effect on the coefficient, followed by instrumental variables, fixed effects models, lagged independent variables, and control variables. Using this simple example, we provide a practical guide and starting point for evaluating each method for solving endogeneity problems in the empirical research on agency problem.

2. Data

We construct our sample with annual data for each firm the ExecuComp database comprises for the years 1993-2012. The database includes details of executives at each of the firms in the S&P 500, S&P Midcap 400, and S&P Smallcap 600. In addition, firm financial data are from Compustat.

2.1 The GAP

We examine the potential value destruction that results from the agency cost of overly empowered CEOs. To proxy for CEO power, we use one particular index, the compensation gap between the CEO and the No.2 person in each firm, as a percentage of the CEO's compensation, where the No.2 person is defined as the highest-paid non-CEO executive[1]:

(CEO's total compensation – No.2's total compensation) ÷ CEO's total compensation

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[1] We exclude special cases such as firms with co-CEOs, interim CEOs, missing CEOs, etc. After such screenings, we find about 5% of times that the CEO's pay is not the highest in the firm. Including these negative gaps or not does not significantly change the empirical results reported below.

We focus on this measure for three reasons. First, this pay gap (hereinafter simply called “the GAP”) can be used as a proxy for CEO power. And we believe the gap between the CEO and the No.2 is a better proxy than the pay dispersion between the CEO and the top five executives, which other finance literature often uses (e.g., Bebchuk, Cremers, and Peyer, 2010). The GAP is better because the No.2 person in each firm is the most important executive to check and balance the CEO’s power (Li, 2013); therefore, the No.2 is the most relevant executive in this empirical design. Second, although firm-level governance may be slowly changing, substantial variation occurs in the firm-level GAP over time. This variation allows for statistically powerful tests to study the GAP’s effect on firm value. Third, the GAP is a quantitative measure that is easy to access and straightforward to compute in practice; therefore, it is an ideal tool with which to experiment.

2.2 Tobin’s Q

The dependent variable in our test is firm performance, for which financial economics literature has commonly used Tobin’s Q as a proxy. Tobin’s Q is defined as the ratio of the market value of equity item minus the book value of equity plus the book value of assets to the book value of assets. Table 1 shows the descriptive statistics of the GAP and Tobin’s Q (hereinafter Q).

Table 1 here

3. Endogeneity problem and remedies

Two situations can make the GAP endogenous. The first is that causality either runs from Q to the GAP, or causality runs both ways. A random shock that enters the regression model through the error term affects Q. Because Q affects the GAP, GAP will be correlated with the error term, generating a biased coefficient on the GAP. The second situation is that the GAP and Q have no direct effect on each other, but they are spuriously correlated through some third variable. If we do not explicitly control for the third variable, the error term will absorb the effect of this variable. Thus, the error term will be correlated with the GAP, causing biased and inconsistent estimates.

Model 1 clearly has an endogeneity problem, not only because of the simultaneity between the GAP and Q (i.e., both are endogenously chosen) but also because of the reverse causality from firm performance to the GAP. Intuitively, current and past firm performance may have a positive impact on the GAP. When a firm performs well, its CEO gets most of the credit and could be entitled with more power. From a compensation perspective, because the CEO has much higher pay-for-performance sensitivity than No.2, when performance is good, the pay gap increases.

Model 1: $Q_{it} = \alpha + GAP_{it}\beta + SIZE_{it}\gamma + \varepsilon_{it}$

	2.871***	0.251***	-0.293***
	(0.04)	(0.09)	(0.03)

Standard errors are in parentheses. ***, **, and * indicate significance at the 1, 5, and 10% levels respectively. This model, and the following models, use log of net asset as a proxy for firm size, where net assets is total assets less cash and short-term investments.

3.1 Lagging independent variable

The main purpose of this test is to investigate the true influence of the CEO power on *subsequent* firm performance. Naturally we regress, by OLS, the Q in the following year (Q_{it+1}) on the GAP and firm size in model 2.

Model 2: $Q_{it+1} = \alpha + GAP_{it}\beta + SIZE_{it}\gamma + \varepsilon_{it}$

Results are in Table 2. Notice this lagging method is a simple but crude way to examine the direction of causality in the time-series lead-lag relationship between the potentially endogenous variables, in this case the GAP and Q. The coefficient of the GAP decreases from 0.251 in model 1 to 0.160 in model 2. This method, though it partially alleviates the simultaneity issue, does not correct bias due to omitted variables. Therefore, we have reason to suspect the positive coefficient of the GAP is still biased. In fact, because the Q_{it} may positively affect the GAP, and Q_{it} is highly correlated with Q_{it+1}, a positive bias occurs on the coefficient of the GAP. That is, the true β should be smaller or even negative.

In many studies, this step serves as a starting point, as in this paper, to a more sophisticated econometric treatment of the endogeneity problem. Some prominent examples that used this approach are Cooper, Gulen, and Ovtchinikov (2010) on the relationship between political contribution and stock return, Polk and Sapienza (2009) on investment and future firm performance, Bettis et al. (2008) on managerial stock vesting and future performance, and Ang and Bekaert (2007) on earnings and cash flow.

3.2 Fixed effects

To deal with the second situation, in which some third variable affects Q and the GAP simultaneously, we include year fixed effects in model 3 and firm fixed effects in model 4. These remedies try to control for unobservable determinants of Q to mitigate omitted variable bias. For example, Graham, Li, and Qiu (2010) and Coles and Li (2013) find firm, manager, and year fixed effects are important determinants of managerial compensation and incentives.

Model 3: $Q_{it+1} = \alpha + GAP_{it}\beta + SIZE_{it}\gamma + \mu_t + \varepsilon_{it}$

Model 3 controls for unobservable year effects (μ_t), and potentially captures temporal aggregate shocks from various market forces that affect both the GAP and future Q.

Model 4: $Q_{it+1} = \alpha + GAP_{it}\beta + SIZE_{it}\gamma + \theta_i + \mu_t + \varepsilon_{it}$

Model 4 further controls for unobservable firm fixed effects (θ_i). These effects may include organizational culture and ethics, which influence the GAP and Q simultaneously. The firm fixed effects model extracts these unobservable firm-specific characteristics from the error term, making the error term uncorrelated or less correlated with the GAP, and providing an unbiased or less biased estimate. Coles and Li (2013) decompose R-squared of the performance equations and find that firm fixed effects can explain about 40% of the variations in Q or ROA. Excluding this important determinant component, estimates of any performance equation may suffer from omitted variable bias. For example, fixed effects play an important role in Bebchuk, Cohen, and Ferrell (2009), Claessens, Feijen, and Laeven (2008), Bottazzi et al. (2008), Khwaja and Mian (2008), and Desai, Foley, and Forbes (2008).

3.3 Control Variables

One caveat of the firm fixed effects model is that it only controls for *time-invariant* firm information. One way to address the problem is to include as many important and time-variant control variables as possible. These variables are the potential factors that jointly influence the Q and GAP. Model 5 controls for various observable factors that are proven to be influential to firm performance and possibly relevant to the GAP. The control variables include research and development expenses, advertising expenses, capital intensity, treasury stock (Palia, 2001), earnings before extraordinary, interest expense, common dividends, new finance, property plant equipment (Dittmar and Smith, 2007), independent directors, G Index, CEO total compensation, CEO pay-performance sensitivity, return on assets (Faleye, 2007), return on sales, leverage, firm volatility, and Delaware company dummy, all of which are shown in numerous studies to relate to firm performance.

Model 5: $Q_{it+1} = \alpha + GAP_{it}\beta + SIZE_{it}\gamma + CONTROL_{it}\delta + \theta_i + \mu_t + \varepsilon_{it}$

After controlling for these observable determinants and unobservable fixed effects, we show, in Table 2, that the coefficient of the GAP decreases gradually from model 2 to model 5 and finally changes to negative. The results are robust to adding more control variables or omitting some variables in the model. Furthermore, because of an upward bias on the coefficient of the GAP, this result gives us a great deal of confidence in claiming the negative impact of the GAP on subsequent Q.

Table 2 here

3.4 Instrumental Variable

Clearly, we can never exhaust all the factors that determine firm performance. The residual endogeneity may still lead to an inconsistent estimation of the direct effect of the GAP on firm performance. To isolate this direct effect, we employ an instrumental variable (IV) approach in which the instruments should be correlated with the GAP but not with the structural residual of the Q.

The first instrument we use is the average GAP for all the companies in the firm's two-digit zip code, excluding the firm itself. Theoretical and empirical evidence suggest compensation practices in the local geographic region may affect the compensation packages in individual firms through the local labor market, social interaction, and compensation peer group benchmarking (e.g., Glaeser, Sacerdote, and Scheinkman, 1996; Kedia and Rajgopal, 2009). A natural concern may be that local compensation practices could affect a firm's performance through a channel other than the firm's own compensation behaviors. For instance, positive local economic shocks might cause increased GAP and Q simultaneously. Such correlations are unlikely for two reasons. First, our sample firms are S&P 1500, such that performance shocks should be broader than the two-digit zip-code level. Second, any shocks strongly related to geography are possibly related through industry clusters, and we control for industry effects.

The second instrument is Director-No.2, a dummy variable equal to 1 if the No.2 serves as a board director during the fiscal year and 0 if not. Whether the No.2 is a board member is highly correlated with the GAP. Note that Director-No. 2 is not directly related to the firm performance when we control for board independence (% of outside directors), so that the well-documented relation between board independence and the performance is held constant. Therefore, this dummy variable can influence firm performance only indirectly through the GAP.

The first-stage model in Table 3 predicts the GAP with exogenous instruments and all explanatory variables from the performance equation; the second stage regresses future performance on the predicted GAP. After instrumenting for the GAP, we find a negative causal effect of the GAP on firm performance. The F test shows that the instruments correlate strongly with the GAP with F-stats much larger than the "rule of thumb" critical value of 10 (Staiger and Stock, 1997). The Hansen-J test for over-identification fails to reject the null of valid instruments, increasing confidence that the instruments are exogenous. However, the P-value (24%) of the Hausman's (1978) test for endogeneity does not suggest statistically significant differences between IV (which are consistent in any case) and OLS estimates (consistent and efficient if the GAP is exogenous), implying the GAP itself may be exogenous and OLS results may be preferable on the grounds of efficiency.

Table 3 here

In corporate finance literature, researchers struggle to find good instrumental variables. A few successful examples are Lin et al.'s (2011) study of corporate borrowing, Giroud, Mueller, Stomper, and Westerkamp's (2010) investigation of leverage and managerial incentives, Bennedsen, Nielsen, Perez-Gonzalez, and Wolfenzon's (2007) research on CEO succession in family firms, and Laeven and Levine's (2009) study on the endogeneity of ownership structure.

3.5 Lagged dependent variable

Model 6: $Q_{it+1} = \alpha + GAP_{it}\beta + SIZE_{it}\gamma + Q_{it}\delta + CONTROL_{it}\lambda + \varepsilon_{it}$

In model 6, we now include the lagged dependent variable (Q_{it}) because the time series of firm performance is relatively persistent and we want to make sure the attendant autocorrelation does not affect our estimates. Furthermore, the history of the dependent variable includes all the past firm information, observable and unobservable, for which other methods cannot possibly control. This model is in the spirit of the Granger causality concept, which tests whether the GAP, based on past performance Q_{it}, has incremental explanatory power for future performance Q_{it+1}. Boehmer and Kelley (2009) use this method to account for the persistency in stock pricing error. Dittmann, Maug, and Schneider (2010) study the determinants of the percentage of bankers on the board by including a lagged banker percentage. Linck, Netter, and Yang (2009) use this method to study slowly changing board structure. Gatchev, Pulvino, and Tarhan (2010) examine a variety of financial decisions based on one-year lagged decisions. Bae, Kang, and Wang (2011) control for lagged leverage to predict future leverage. In a slightly different manner, Lemmon, Roberts, and Zender (2008) show that a firm's initial leverage is a key factor in explaining the leverage afterward.

Table 4 here

3.6 Dynamic model

Including the lagged value of the dependent variable may be beneficial; however, this setup substantially complicates the estimation. Two properties are well established for a dynamic panel in which the lagged dependent variable is an explanatory variable (Hsiao, 2003). First, the estimated coefficient on the lagged dependent variable in a pooled OLS without firm fixed effects has an upward bias under reasonable assumptions. Second, the estimated coefficient using the standard approach of mean differencing the model is biased downward, especially when T is small (Nickell, 1981; Anderson and Hsiao, 1981). We use Arellano and Bond's (1991) method of GMM to estimate the following model:

Model 7: $Q_{it+1} = \alpha + GAP_{it}\beta + SIZE_{it}\gamma + Q_{it}\delta + CONTROL_{it}\lambda + \theta_i + \varepsilon_{it}$

Arellano and Bond (1991) show that the following moment conditions hold for the equations in first-differences, under the assumption that ε_{it} is not serially correlated and explanatory variables are endogenous:

$$E\,[y_{is}\,\Delta\,\varepsilon_{it}] = 0,\ E\,[x_{is}\,\Delta\,\varepsilon_{it}] = 0 \text{ for all } s < t\text{-}1.$$

Instrumental variables for the equations in first-differences are lagged values of endogenous variables dated t-2. The first-differenced GMM estimator is a more efficient estimator than Anderson and Hsiao's (1981) estimator, as shown by Arellano and Bond (1991). The estimation results are in Table 5.

Table 5 here

From the results, the long-term effect of the GAP, calculated as the coefficient of the GAP ÷ (1- coefficient of lagged Q), is approximately –1.2. For example, if the gap increases by one standard deviation, from median 44% to 66%, Q increases from median 1.48 to 1.75 in the long run. This result implies CEO power has a significant long-term impact on firm performance.

Some examples that successfully utilize the GMM method include Kang, Liu, and Qi (2010), who study the effect of SOX on corporate investment, Huang and Ritter (2009), who test the theories of capital structure and speed of adjustment, Brown, Fazzari, and Peterson (2009), who use GMM as their primary approach to examine the impact of finance supply on R&D, Campello (2006), who studies the effects of debt financing, and Coles, Li, and Wang (2014), who explore the industry pay gap.

3.7 Combination of methods

The first row in Table 6 indicates bias correction using a single method. The GMM alone has the greatest correction effect, which changes the original coefficient 0.16 to -0.856, followed by the IV approach (from 0.16 to -0.214), firm fixed effects, lagged dependent variables, control variables, and year fixed effects. Assuming the GMM's correction is 100%, we calculate the correction percentage for other methods and arbitrary combinations of two methods. For example, 1.77% for the year fixed effect is computed as (0.160-0.142)/(0.160-(-0.856)). Without using GMM, the largest correction is from a combination of lagged dependent and IV methods, mitigating about half of the total bias. If a valid instrumental variable is not available, which is common in corporate finance research, the next best choice appears to be firm fixed effects, combined with year fixed effects or control variables, which correct more than 23% of the bias.

Table 6 here

4. Conclusion

No current literature investigates the relation between the CEO-No.2 pay gap and firm performance. Arguably, the endogeneity problem exists in this setting. Using this setting as a preliminary experiment, we try to address the concern by summarizing different econometric approaches and quantifying their effectiveness.

In our specific experiment, after carefully dealing with the endogeneity issues, we find strong evidence that the true relationship between CEO power and subsequent firm performance is negative, suggesting CEOs are overpowered in some firms. Furthermore, we show that all the prevailing econometric remedies are generally effective in mitigating the endogeneity bias to some degree (i.e., to correct the sign from positive to negative), but quantitatively the effects vary considerably. Among all the remedies, GMM has the greatest correction effect on the coefficient, followed by instrumental variables, fixed effects models, lagged dependent variables, and control variables. As for a combination of the methods, firm fixed effects, year fixed effects, and the addition of more meaningful control variables appear to work as well, even without a valid instrumental variable.

Although these methods are far from complete and each of them has its own drawbacks and difficulties, we provide a starting point for evaluating them in the context of corporate finance research.

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Table 1
Summary Statistics of the Gap and Tobin's Q

This table provides summary statistics for the GAP and Tobin's Q using cross-sectional yearly data from 1993 to 2012. The GAP is the compensation gap between CEO and No.2 person as a percentage of the CEO's compensation; Tobin's Q is the ratio of the market value of equity item minus the book value of equity plus the book value of assets to the book value of assets.

	N	Mean	Median	Std Dev	Min	Max	Lower Quartile	Upper Quartile
Gap	19,024	0.43	0.44	0.22	0	99.99	0.27	0.59
Tobin's Q	19,024	1.97	1.48	1.77	0.30	78.56	1.15	2.15

Table 2

OLS and Fixed Effects

The cross-sectional annual data are from year 1993 to 2012. The dependent variable Q_{it+1} is Tobin's Q in the following year. The explanatory variable GAP = (CEO's total compensation – No.2's total compensation)÷ CEO's total compensation. Control variables include research and development expenses, advertising expenses, capital intensity, treasury stock, earnings before extraordinary, interest expense, common dividends, new finance, property plant equipment , G Index, CEO total compensation, CEO pay performance sensitivity, return on asset, return on sales, leverage, firm volatility, Delaware company dummy. In firm fixed effect model, Firm dummies are based on firm's GVKEY in Compustat. Standard errors are clustered at the firm level, and presented in parenthesis. ***, **, and * indicate significance at the 1, 5, and 10% levels, respectively.

	Model 2	**Model 3**	**Model 4**	**Model 5**
Intercept	3.580***	3.617***	N/A	N/A
	(0.05)	(0.07)		
GAP	0.160***	0.142***	-0.078	-0.089*
	(0.06)	(0.06)	(0.05)	(0.05)
Size	-0.230***	-0.230***	-0.760***	-0.794***
	(0.01)	(0.01)	(0.02)	(0.02)
Fixed Effects	N	Year	Year+Firm	Year+Firm
Control variables	N	N	N	Y
N	19,018	19,018	19,018	18,872
Adjusted R^2	0.059	0.070	0.366	0.375

Table 3

IV Approach

The table shows 2SLS estimations of the GAP-Q relationship, using cross-sectional yearly data from 1993 to 2012. The first stage uses Near Firm GAP and Director-No.2 as instrument variables. The dependent is GAP*100 where GAP = (CEO's total compensation – No.2's total compensation) ÷ CEO's total compensation. Near Firm GAP is the average GAP for all the companies in the firm's two-digit zip code, excluding the firm itself. Director-No.2 is a dummy variable with 1 if the No.2 serves as a board director during the fiscal year and 0 if not. The second stage then regresses the Q_{t+1} on the predicted value of the GAP. Control variables include CEO Pay, Board size, Institutional Holding, Board Independence, Q_t, Firm volatility, Firm size, Firm Size squared, R&D, Advertising, ROA, Year dummies and Industry dummies. F-stat is the joint significance of the instruments in the first stage regression. Hansen J-stat is the statistics for over-identification test of the valid instruments. Standard errors are clustered at the firm level, and presented in parenthesis. P-values are in brackets. ***, **, and * indicate significance at the 1, 5, and 10% levels, respectively.

	First Stage	Second Stage
Dependent Variable	**GAP**	**Qt+1**
Predicted GAP	N/A	-0.49*
		(0.28)
Near Firm GAP (IV)	5.78**	N/A
	(2.67)	
Director-No.2 (IV)	-10.22***	N/A
	(0.39)	
Board Independence	8.08***	0.01
	(1.50)	(0.13)
Institutional Holding	-0.11	0.00
	(4.76)	(0.00)
Board Size	0.07	-0.02**
	(0.10)	(0.01)
Qt	0.11	0.35***
	(0.07)	(0.07)
ROA	-0.03***	0.00
	(0.01)	(0.01)
Firm Volatility	1.36***	-0.28***
	(0.81)	(0.08)
R&D	-3.01	3.05***
	(3.64)	(1.00)
Advertisement	12.49*	2.17***
	(6.62)	(0.61)
CEO Pay	0.28***	0.01**
	(0.02)	(0.00)
Firm Size	4.69***	-0.11
	(0.65)	(0.08)

Firm Size Squared	-0.27***	0.00
	(0.04)	(0.01)
Intercept	10.08***	2.52***
	(3.85)	(0.40)
Fixed Effects	Year+Industry	Year+Industry
	F(2,1467)=161.69***	Hansen J-stat=0.07
	[0.00]	[0.80]
N	13,036	13,036
Adjusted R^2	0.11	0.37

Table 4

Lagged Dependent Variable

The cross-sectional annual data are from year 1993 to 2012. The dependent variable Q_{it+1} is Tobin's Q in the following year. The explanatory variable GAP = (CEO's total compensation – No.2's total compensation) ÷ CEO's total compensation. The lagged dependent variable is $Q_{it.}$ Control variables include research and development expenses, advertising expenses, capital intensity, treasury stock, earnings before extraordinary, interest expense, common dividends, new finance, property plant equipment , G Index, CEO total compensation, CEO pay performance sensitivity, return on asset, return on sales, leverage, firm volatility, Delaware company dummy. Standard errors are clustered at the firm level, and presented in parenthesis. P-values are in brackets. ***, **, and * indicate significance at the 1, 5, and 10% levels, respectively.

	Model 6a	**Model 6b**	**Model 6c**
Intercept	2.957***	2.703***	2.752***
	(0.07)	(0.08)	(0.08)
GAP	-0.025**	-0.062***	-0.090***
	(0.11)	(0.11)	(0.02)
Size	-0.181***	-0.181***	-0.546***
	(0.01)	(0.01)	(0.02)
Q_t	0.351***	0.348***	0.322***
	(0.05)	(0.05)	(0.06)
Fixed Effects	N	Year	Year
Control variables	N	N	Y
N	19,018	19,018	18,872
Adjusted R^2	0.273	0.278	0.365

Table 5

GMM

The first model is different GMM and the second is system GMM. The cross-sectional annual data are from year 1993 to 2012. The dependent variable Q_{it+1} is Tobin's Q in the following year. The explanatory variable GAP = (CEO's total compensation – No.2's total compensation) ÷ CEO's total compensation. Control variables include research and development expenses, advertising expenses, capital intensity, treasury stock, earnings before extraordinary, interest expense, common dividends, new finance, property plant equipment , G Index, CEO total compensation, CEO pay performance sensitivity, return on asset, return on sales, leverage, firm volatility, Delaware company dummy. In firm fixed effect model, Firm dummies are based on firm's GVKEY in Compustat. Standard errors are clustered at the firm level, and presented in parenthesis. P-values are in brackets. ***, **, and * indicate significance at the 1, 5, and 10% levels, respectively.

	Difference GMM	**System GMM**
Intercept	3.206***	4.241***
	(0.44)	(0.67)
Gap	-0.856***	-0.788**
	(0.21)	(0.39)
Size	-0.258***	-0.344***
	(0.06)	(0.10)
Q_t	0.320***	0.298***
	(0.04)	(0.04)
Control variables	N	N
N	18,909	18,909

Table 6
Correction Effects of the Methods

This table provides the coefficients of the GAP estimated by different methods or combinations of two methods. In parenthesis are the correction effects as a percentage, assuming GMM's effect is 100%. NA means the combination is not feasible.

	None	**Year FE**	**Firm FE**	**Control Variable**	**IV**	**Lagged Dependent**	**GMM**
None	0.160	0.142	-0.031	-0.015	-0.214	-0.025	-0.856
		(1.77%)	(18.80%)	(17.22%)	(36.81%)	(18.20%)	(100%)
Year FE			-0.078	-0.021	-0.218	-0.062	NA
			(23.42%)	(17.81%)	(37.20%)	(21.85%)	
Firm FE				-0.087	-0.301	NA	NA
				(24.31%)	(45.37%)		
Control Variable					-0.277	-0.073	-0.779
					(43.01%)	(22.93%)	(92.42%)
IV						-0.385	NA
						(53.64%)	
Lagged Dependent							NA