The Million Dollar Rule, Executive Compensation, and Managerial Risk-Taking

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Motivation

- There is an extensive literature in economics estimating the impact of executive compensation on the executive's job performance. Since the actions taken by an executive often can only be properly assessed in the long run, it becomes imperative that the amount of remuneration be dependent upon indicators of performance. An earlier paper on this topic by Eaton and Rosen (1981) shows that stock options may be the most direct means by which the executive's income could be tied to the value of the firm.
- Jensen and Murphy (1990) find a weak relationship between compensation and shareholder wealth. Hall and Liebman (1997) estimate larger pay-performance sensitivities and show that the relationship has been increasing since 1980 due to increasing ownership of stock and stock options. Aggarwal and Samwick (1998) reconcile these findings and show that pay-performance sensitivity is a decreasing function of the firm's stock return volatility.

Motivation

- Rose and Wolfram (2000) explore how changes in the tax code have affected the performance sensitivity of CEO pay at firms. They conclude that tax changes, specifically the 1993 tax legislation that capped the tax deductibility of certain types of executive compensation, have had no significant impact on corporate pay or performance decisions.
- More recently, Gorry et al. (2017) find evidence that tax policy changes influence the composition of executive compensation. Specifically, they show that there is a large tax gain in using stock options to defer income for executives who are affected by the $1 million rule and find empirical evidence of an increase in stock options among this group of executives.

What We Do

- Our paper assesses the effect of corporate tax changes on the nature of executive compensation, and subsequently, on risk-taking behavior by top executives.
- Specifically, section 162(m) of the Internal Revenue Service Code (the $1 million rule), enacted as a provision of the Omnibus Budget Reconciliation Act of 1993, removed the deductibility of executive compensation that exceeds $1 million unless it qualified as incentive-based pay. This policy generated differential incentives for firms to pay executives using stock options depending on whether their executives were paid enough to be affected by the policy. This paper documents first whether the policy influenced the composition of executive pay and then uses the variation in who is affected by the rule (as an instrument) to assess the causal impact of CEO pay on firm risk-taking behavior.

- We provide causal evidence that the $1 million rule influenced executive compensation by showing that there is bunching at the $1 million salary threshold after 1993. Evidence of salary bunching at the $1 million threshold implies that the rule has an impact on the form of compensation received by executives as the policy has been shown to not have an impact on total compensation (Rose and Wolfram, 2002). This finding is consistent with findings that firms subject to the $1 million rule increase their use of stock options as a share of compensation (Gorry et al., 2017).
- We explore how higher sensitivity of CEO wealth to stock volatility (vega) relates to the riskiness of firm behavior, including investment choices, leverage, and the standard deviation of stock returns. The closest paper in the literature to ours is Coles et al. (2006) who estimate the relationship between vega and managerial risk-taking variables controlling for CEO pay performance sensitivity (delta). In contrast to their approach of designing econometric specifications that account for how the firm's assets affect the endogenous compensation structure, we can more directly assess the impact of vega on risk-taking by using policy-induced changes to provide stronger causal evidence on this relationship.

What we find

- We find that in general an increase in vega leads to an increase in riskier investments by firms, and an increase in stock return volatility. However, unlike these earlier papers, we do not find an increase in leverage, business segments and the Herfindahl index as a result of an increase in vega. Some of these differences are a consequence of our methodology, and in particular, our instrument, which is different from that applied in these earlier papers.

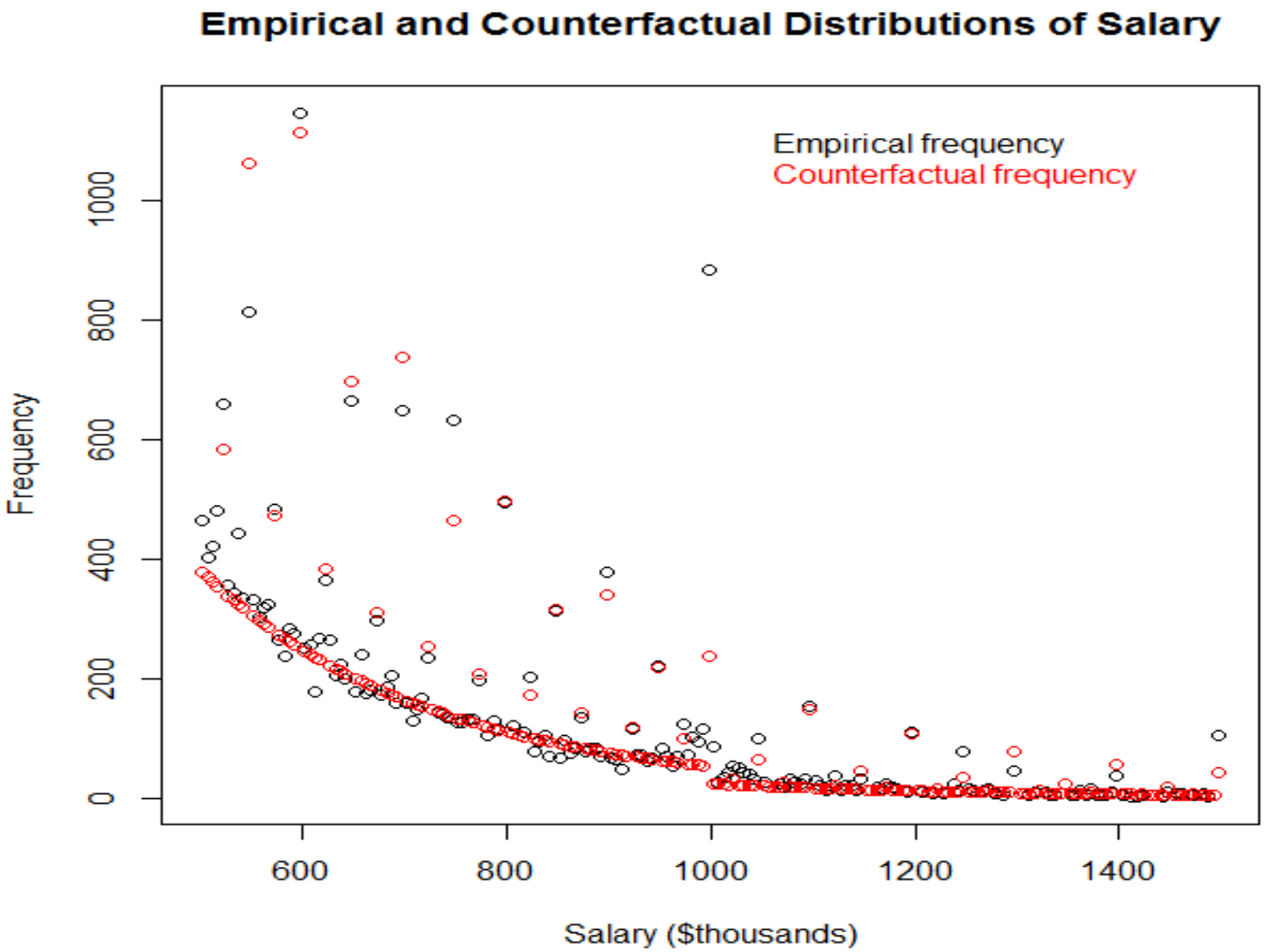
Estimating Bunching

- To estimate bunching in executive salaries due to the million-dollar rule, we must fit a counterfactual distribution to the observed distribution of executive salaries outside the bunching region. We apply this using two datasets of executive salaries. The full dataset includes all executives from the Execucomp dataset from 1992 through 2005 (154,925 observations). This dataset allows for subsample estimates by year and allows us to identify whether the executive is the CEO (which we define as holding the CEO position for the entire fiscal year).

Estimating Bunching

- Executive compensation in our sample approximately follows a lognormal distribution, a commonly observed distribution for salary and wage data. The $1 million threshold occurs near the beginning of the right tail of the distribution, which prevents us from fitting the counterfactual distribution using the flexible polynomial approach in Kleven and Waseem (2013), Kopczuk and Munroe (2014), and Chetty et al. (2011). We instead construct our counterfactual using a lognormal distribution.
- Estimating the counterfactual mass in the absence of bunching occurs in three steps: estimating the parameters of the lognormal distribution using maximum likelihood; scaling the lognormal PDF to the observed distribution excluding the bunching region (a region around $1 million), with adjustments for the tendency to bunch at focal numbers; and fitting this to the distribution in the bunching region.
- As salary increases in the right tail of the distribution, the density function approaches zero but a polynomial must diverge from zero. Fitting this shape approximately required at least a 10^{th} degree polynomial, which was insufficient to produce a smooth curve in the bunching region.

- The million-dollar rule introduces a distortion to salaries near or above $1 million. To estimate the parameters of the lognormal distribution, we truncate the distribution at the lower bound of the bunching region (usually $950,000). We then estimate these parameters using a special version of maximum likelihood.


Empirical and Counterfactual Distributions of Salary
Empirical frequency
Counterfactual frequency
Frequency
0
200
400
600
800
1000
600
800
1000
1200
1400
Salary ($thousands)

Dataset	Executives	Observations	Observed mass	Counterfactual mass	Mass ratio	SE
Full	All	154379	2157	1052.95	2.049	0.052
Full	CEOs	19928	1316	664.08	1.982	0.065
Full	Non-CEOs	134451	841	466.94	1.801	0.073
Reduced	All	90174	1408	666.50	2.113	0.068
Reduced	CEOs	13135	970	497.71	1.949	0.069
Reduced	Non-CEOs	77039	438	223.93	1.956	0.108

Estimates in this table use a bunching region of $950,000 to $1.05 million, and a fitting region of $500,000 to $1.5 million. Standard errors are estimated by bootstrapping with 1,000 repetitions. All estimates are highly significant against a null hypothesis mass ratio of 1. The full sample uses all executives with salary information, and the reduced sample uses only executives matched with detailed firm data. CEOs are defined as those in the CEO position for the entire fiscal year.

Year	Observations	Observed mass	Counterfactual mass	Mass ratio	SE
1992-2005	154379	2157	1052.95	2.0485	0.0525
1992	7985	38	36.47	1.0420	0.1818
1993	9746	45	42.83	1.0506	0.1715
1994	10589	73	46.25	1.5784	0.2040
1995	11037	82	50.90	1.6111	0.2012
1996	11569	92	55.85	1.6474	0.1913
1997	11912	114	63.71	1.7892	0.1909
1998	12478	148	77.18	1.9176	0.1884
1999	12021	170	80.94	2.1003	0.1812
2000	11384	177	86.09	2.0559	0.1818
2001	11226	197	96.62	2.0389	0.1711
2002	11374	233	105.93	2.1996	0.1696
2003	11641	235	113.12	2.0774	0.1604
2004	10755	263	118.31	2.2229	0.1674
2005	9262	249	122.48	2.0329	0.1537

Estimates in this table use a bunching region of $950,000 to $1.05 million, and a fitting region of $500,000 to $1.5 million. Standard errors are estimated by bootstrapping with 1,000 repetitions. All estimates except for 1992 and 1993 are highly significant against a null hypothesis mass ratio of 1. The observations are from the full sample of all executives with salary information.

Empirical Results

- Test to see if higher sensitivity of CEO wealth to stock volatility has different impacts on risk taking behaviors.
- Delta is defined as the change in the dollar value of the executive's wealth for a one percentage point change in stock price. Vega is calculated as the change in dollar value of the executive's wealth for a 0.01 change in the annualized standard deviation of stock returns. These definitions are similar to Cole et al. (2006), Guay (1999) and Core and Guay (2002).
- Instrument for *vega* by using a dummy variable that is one if the CEO's salary is greater than $1 million and the million-dollar rule is in force.

	(A) Vega ($000)	(B) log(1 + Vega)	(C) Delta ($000)	(D) log(1 + Delta)
Sec. 162(m) instrument	0.219***	0.272***	-1.220*	0.456***
	(0.0161)	(0.0459)	(0.646)	(0.0475)
Delta ($000)	0.00157*			
	(0.000841)			
log(1 + Delta)		0.160***		
		(0.0153)		
log(Total compensation)	0.0656***	0.795***	-1.764***	0.164***
	(0.00558)	(0.0262)	(0.490)	(0.0242)
log(Sales)	0.0268***	0.0983***	1.837***	0.371***
	(0.00285)	(0.0134)	(0.441)	(0.0159)
Sales growth rate	0.00299	-0.00434	0.329	0.0742
	(0.00216)	(0.0111)	(0.236)	(0.0562)
Market-book equity ratio	0.0112***	-0.0381***	0.615***	0.344***
	(0.00299)	(0.0120)	(0.100)	(0.0131)
Free cash flow / Assets	-0.00601	0.0237	2.241	0.508***
	(0.0291)	(0.128)	(1.373)	(0.156)
Total stock return	-0.00438***	-0.0174***	0.0161	0.0342***
	(0.000686)	(0.00333)	(0.0321)	(0.00371)
Leverage	-0.00740	0.336***	-4.213***	-0.574***
	(0.0133)	(0.0749)	(1.163)	(0.0947)
log(Firm age)	-0.00632*	0.111***	-0.0731	-0.137***
	(0.00362)	(0.0179)	(0.0906)	(0.0190)
Industry FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	7,996	7,996	7,996	7,996
R-squared	0.342	0.594	0.118	0.438
F-stat	184.5***	35.13***	3.56*	92.19***

The section 162(m) instrument is defined as 1 if salary is at least $1 million in 1994 or later, and 0 otherwise. All regressions use OLS, with robust standard errors. The F-statistic presented is for the test of excluding the instrument. Significance at 10%, 5% and 1% is denoted by *, ** and *** respectively.

	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)
	R&D investment		R&D (unconditional)		PPE investment		Intangible investment	
Vega ($000) [inst]	0.127***		0.0672***		-0.00702		-0.0834***	
	(0.0246)		(0.0120)		(0.00798)		(0.0319)	
log(1 + Vega) [inst]		0.0979***		0.0561***		-0.00541		-0.0653***
		(0.0246)		(0.0124)		(0.00653)		(0.0252)
Delta ($000)	-0.00228		7.12e-05		-0.000152***		0.000240	
	(0.00163)		(4.91e-05)		(3.47e-05)		(0.000172)	
log(1 + Delta)		-0.0258***		-0.0107***		0.00107		0.0126***
		(0.00615)		(0.00227)		(0.00112)		(0.00416)
log(Total compensation)	-0.000440	-0.0694***	0.00248*	-0.0387***	-0.000870	0.00333	0.0132***	0.0608***
	(0.00249)	(0.0194)	(0.00130)	(0.00986)	(0.000966)	(0.00547)	(0.00499)	(0.0228)
log(Sales)	-0.0279***	-0.0275***	-0.0185***	-0.0209***	-0.00152**	-0.00158	0.000236	0.00321
	(0.00375)	(0.00444)	(0.00246)	(0.00316)	(0.000732)	(0.00103)	(0.00233)	(0.00365)
Sales growth rate	0.00830***	0.00800***	0.00861***	0.00927***	0.000622	0.000517	-0.00131	-0.00118
	(0.00171)	(0.00177)	(0.00166)	(0.00171)	(0.000921)	(0.000836)	(0.00129)	(0.00143)
Market-book equity ratio	0.00631***	0.0148***	0.00542***	0.00932***	0.00445***	0.00392***	0.0106***	0.00481
	(0.00193)	(0.00271)	(0.00126)	(0.00152)	(0.000525)	(0.000636)	(0.00322)	(0.00349)
Free cash flow / Assets	0.00154	0.00722	-0.0145	-0.0137	0.00765	0.00720	-0.0236	-0.0313
	(0.0528)	(0.0581)	(0.0404)	(0.0416)	(0.00683)	(0.00681)	(0.0381)	(0.0387)
Total stock return	-0.00145***	-0.000533	-0.000999***	-0.000247	0.000592***	0.000522***	0.000558	-6.61e-05
	(0.000330)	(0.000612)	(0.000194)	(0.000341)	(0.000170)	(0.000197)	(0.000604)	(0.000711)
Leverage	0.0220*	0.00707	0.00181	-0.0204**	-0.00171	0.00112	-0.0129	0.0138
	(0.0113)	(0.0155)	(0.00645)	(0.00877)	(0.00394)	(0.00469)	(0.0129)	(0.0172)
log(Firm age)	0.00522**	-0.0111**	0.00411***	-0.00295	-0.00391***	-0.00318***	-0.00330	0.00454
	(0.00227)	(0.00497)	(0.00134)	(0.00186)	(0.000846)	(0.00118)	(0.00316)	(0.00410)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4,213	4,213	7,533	7,533	6,784	6,784	5,086	5,086

The dependent variables are all scaled by assets. Our unconditional R&D measure is recodes missing R&D investment as zero. All regressors are lagged one year. All regressions are instrumental variable two-stage least squares. The vega regressors are instrumented using our section 162(m) indicator, which takes values of 1 if salary is at least $1 million in 1994 or later and 0 otherwise. Standard errors presented are robust. Significance at 10%, 5% and 1% is denoted by *, ** and *** respectively.

	(A)	(B)	(C)	(D)	(E)	(F)
	Business segments		Herfindahl index		Leverage	
Vega ($000) [inst]	0.647*		-0.0816		-0.0572*	
	(0.370)		(0.0553)		(0.0343)	
log(1 + Vega) [inst]		0.356		-0.0545		-0.0263
		(0.298)		(0.0453)		(0.0275)
Delta ($000)	0.0217***		-0.000642***		-0.000780***	
	(0.00182)		(0.000195)		(0.000141)	
log(1 + Delta)		-0.0133		0.00403		-0.00640
		(0.0484)		(0.00803)		(0.00451)
log(Total compensation)	-0.0142	-0.311	0.0180***	0.0581	0.0144***	0.0355
	(0.0348)	(0.248)	(0.00596)	(0.0371)	(0.00427)	(0.0234)
log(Sales)	0.144***	0.154***	-0.0505***	-0.0471***	0.0119***	0.0152***
	(0.0214)	(0.0380)	(0.00362)	(0.00593)	(0.00283)	(0.00417)
Sales growth rate	-0.00418	0.00281	-0.000707	-0.00109	0.00262	0.00280
	(0.0104)	(0.00807)	(0.00179)	(0.00178)	(0.00425)	(0.00431)
Market-book equity ratio	-0.149***	-0.126***	0.0223***	0.0204***	-0.0123***	-0.0112***
	(0.0146)	(0.0210)	(0.00256)	(0.00319)	(0.00253)	(0.00323)
Free cash flow / Assets	-0.00898	0.0311	0.0261	0.0285	-0.0354	-0.0338
	(0.203)	(0.216)	(0.0348)	(0.0355)	(0.0493)	(0.0498)
Total stock return	0.0161***	0.0186**	-0.00194**	-0.00238**	-0.00228***	-0.00216***
	(0.00543)	(0.00725)	(0.000880)	(0.00119)	(0.000620)	(0.000777)
Leverage	0.242**	0.0285	-0.0851***	-0.0656***		
	(0.0970)	(0.150)	(0.0181)	(0.0241)		
log(Firm age)	0.320***	0.278***	-0.0587***	-0.0527***	-0.00690**	-0.00482
	(0.0267)	(0.0465)	(0.00450)	(0.00702)	(0.00305)	(0.00467)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	6,833	6,833	7,996	7,996	6,836	6,836

Business segments is the number of business segments in the firm, the Herfindahl index is the Herfindahl index of sales across segments, and leverage is total debt divided by assets. All regressors are lagged one year. All regressions are instrumental variable two-stage least squares. The vega regressors are instrumented using our section 162(m) indicator, which takes values of 1 if salary is at least $1 million in 1994 or later and 0 otherwise. Standard errors presented are robust. Significance at 10%, 5% and 1% is denoted by *, ** and *** respectively.

	(A)	(B)	(C)	(D)
	Stock volatility		Idiosyncratic risk	
Vega ($000) [inst]	0.136***		0.0225***	
	(0.0242)		(0.00421)	
log(1 + Vega) [inst]		0.132***		0.0225***
		(0.0285)		(0.00493)
Delta ($000)	-0.000216**		-4.95e-05***	
	(0.000102)		(1.75e-05)	
log(1 + Delta)		-0.0351***		-0.00631***
		(0.00526)		(0.000896)
log(Total compensation)	-0.00804**	-0.104***	-0.00201***	-0.0183***
	(0.00312)	(0.0242)	(0.000496)	(0.00417)
log(Sales)	-0.0534***	-0.0567***	-0.00988***	-0.0104***
	(0.00202)	(0.00409)	(0.000321)	(0.000693)
Sales growth rate	0.00520**	0.00722*	0.000982**	0.00134*
	(0.00223)	(0.00435)	(0.000435)	(0.000814)
Market-book equity ratio	-2.96e-05	0.0120***	-0.000839***	0.00130***
	(0.00157)	(0.00262)	(0.000244)	(0.000431)
Free cash flow / Assets	0.00331	0.00752	0.000994	0.00179
	(0.0285)	(0.0338)	(0.00415)	(0.00517)
Total stock return	-0.00430***	-0.00215**	-0.000716***	-0.000336**
	(0.000477)	(0.000860)	(8.04e-05)	(0.000146)
Leverage	0.0826***	0.0257	0.0153***	0.00555*
	(0.0128)	(0.0203)	(0.00202)	(0.00336)
log(Firm age)	-0.0380***	-0.0559***	-0.00728***	-0.0104***
	(0.00245)	(0.00505)	(0.000416)	(0.000867)
Industry FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	7,529	7,529	7,529	7,529

Stock volatility is the annualized standard deviation of daily stock returns for each firm in each year. Idiosyncratic risk is estimated as the square root of the mean squared error from the regression for each year of the firm's daily stock returns on the daily returns on the S&P 500. All regressors are lagged one year. All regressions are instrumental variable two-stage least squares. The vega regressors are instrumented using our section 162(m) indicator, which takes values of 1 if salary is at least $1 million in 1994 or later and 0 otherwise. Standard errors presented are robust. Significance at 10%, 5% and 1% is denoted by *, ** and *** respectively.

Conclusion

- We find that in general an increase in vega leads to an increase in riskier investments by firms, and an increase in stock return volatility. However, unlike these earlier papers, we do not find an increase in leverage, business segments and the Herfindahl index as a result of an increase in vega. Some of these differences are a consequence of our methodology, and in particular, our instrument, which is different from that applied in these earlier papers.