EXECUTIVE COMPENSATION AND FIRM LEVERAGE. A POLICY ORIENTED SURVEY

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Abstract

This paper surveys the literature that studies the connection between leverage and executive compensation. First, we discuss the dynamics of pay-for-performance compensation and how to measure it. Then we study the theoretical underpinnings of how firm leverage may be related to the compensation structure of its executives. After reviewing the empirical work on the topic we survey the policy implications. We discuss recent work that shows positive outcomes from regulating executive compensation, but that raises a cautionary note: regulating leverage directly seems more efficient than regulating executive compensation.

1 Introduction

Following the 2008 financial crisis, there has been a lively debate in the academic and policy circles about regulating executive compensation to avoid excessive firms' leverage. Some countries have regulated the structure or the level of compensation, especially for financial firms, while others have adopted say-on-pay regimes that increase shareholder's weight in the design of executive compensation.

For example, the European Union (Directive 2013/36/EU and CRDIV) has established that bonuses at credit institutions and investment firms cannot exceed 100% of fixed salary (200% if the company wins shareholder approval). The U.S. is also discussing new rules to curb executive compensation in financial institutions [Wall Street Journal (2016)]. Correa and Lel (2016) document that eleven countries have passed laws to give shareholders direct influence on executive compensation policies (i.e., say on pay laws). In Spain, the "Ley de Sociedades de Capital" regulates executive compensation.[1] For public companies, the "Código de Buen Gobierno" approved in 2015 by the Spanish Securities and Exchange Commission (CNMV) recommends the use of deferred compensation and clawbacks clauses.

In this article, we discuss the literature that studies the connection between firm leverage and executive compensation. Our survey is selective and guided by two policy questions. First, we study the effects of executive compensation on firm's leverage. We focus on whether the structure of compensation affects the willingness to borrow following a credit stimulus. Governments and central banks often try to stimulate economic activity by promoting credit supply. This is referred to as monetary policy's risk-taking channel. It was especially important during the Great Recession because, once the policy rates hit the zero-lower bound, many Central Banks resorted to unconventional policies to lower banks' borrowing costs and expand credit supply [Correia et al. (2016), Gambacorta and Shin (2016)]. The literature has focused on what types of lenders react more.[2] In this article, we discuss papers that focus on the borrowers, which is a relatively unexplored question. This work can help us understand in what settings the credit expansion policies of Central Banks may have the maximum impact.

Second, we discuss recent work that studies when and how executive compensation should be regulated. The literature suggests that it may be more effective to directly limit leverage rather than trying to affect it indirectly by imposing limitations on executives' compensation.

1 Articles 217-220 and 529.

2 See, for example, Dell'Ariccia, Laeven and Suárez (2017), or Jiménez et al. (2014).

2 Definitions and Basic Facts

In this section, we define how the literature measures pay-for-performance compensation. After that, we discuss the dynamics of the structure of executive compensation. We use CEO and executives as synonyms. The key take-away is that pay-for-performance compensation has increased over time, especially since the mid-1980s.

2.1 DEFINITIONS

In the literature, the executive's exposure to firm performance is called the pay-performance sensitivity. To understand better this concept, we consider a simple one period model inspired in Edmans and Gabaix (2016). The firm has no debt to simplify. Let S be the firm's equity value at the beginning of the period.

Let the CEO's compensation be $c=F+\theta S$, where θ denotes the CEO's equity ownership in the firm. We assume risk-neutrality. In this case, the pay-performance sensitivity is θ, the variation in the executive's wealth when the stock's price changes. This measure is also known as the CEO's percentage stake. Jensen and Murphy (1990) estimate this sensitivity as follows:

$$\theta = \frac{\text{Nr. shares owned by CEO} + \text{Nr. options owned by CEO} \times \Delta}{\text{Nr. shares outstanding}} \quad [1]$$

Δ denotes the stock option's delta. *Delta* measures the degree to which an option is exposed to shifts in the price of the underlying asset. Hall and Liebman (1998) show that the portfolio of unexercised stock options is the largest component in CEO's performance-pay sensitivity. Estimating delta for this portfolio of options can be challenging since firms do not typically report the features of options granted in previous years, like their maturity or their strike price. Shareholders can manage executives' pay-performance sensitivity (the slope θ) by either granting more shares, more stock options or, in the case of options, through their delta. There is a positive relation between stock options' delta and pay-performance sensitivity. The executive's risk exposure increases when the sensitivity increases.

For risk-averse CEOs we cannot ignore the effect of firm volatility on the executive's incentives. Instead of talking of the CEO's dollar pay we should talk about her certainty equivalent wealth, CE. Guay (1999) decomposes the executive's certainty equivalent wealth into two components:

$$\text{CE} = \text{E(wealth)-risk premium} \quad [2]$$

When the executive is risk neutral, the second element vanishes and we converge to the previous analysis. Differentiating equation [2] with respect to firm risk (σ) we obtain the following expression:

$$\frac{\partial \text{CE}}{\partial \sigma} = \frac{\partial \text{E(wealth)}}{\partial \sigma} - \frac{\partial \text{(risk premium)}}{\partial \sigma} \quad [3]$$

Guay (1999) calls the first element in equation [3], $\frac{\partial \text{E(wealth)}}{\partial \sigma}$, the wealth effect. This effect operates through the non-linearity of the executive's compensation cash flows. Three examples: 1) for stock options, this effect corresponds to *vega*, the option's sensitivity with respect to the volatility of the underlying stock. Vega is positive because of the convexity of the option payoffs with respect to the stock price; 2) bonuses that include a compensation

for outperforming certain benchmark and no (or limited) penalty in the case of underperformance also exhibit an option-like behaviour with respect to the volatility of firm cash flows; 3) in leveraged firm, common stock can be interpreted as a call option on the firm's cash flows with debt's face value as the strike price [Black and Scholes (1973) and Jensen and Meckling (1976)].

The second element in equation [3], $\frac{\partial(\text{risk premium})}{\partial\sigma}$, is called the risk-aversion effect. When shareholders increase pay-performance sensitivity (θ in equation [1]), risk averse executives will demand a premium for bearing more firm-specific, non-diversifiable risk. Equation [3] says that the size of this premium varies with the executive's sensitivity with respect to firm risk. This sensitivity is higher for non-diversified executives (i.e., when the CEO's compensation is a larger fraction of her total wealth) and for more risk averse executives.

In the case of options, Carpenter (2000) and Ross (2004) show theoretically that, due to the risk-aversion effect, higher stock volatility may actually decrease the value of options when options are deep enough in the money (i.e., when the price-to-strike price is large enough). This theoretical argument can be extended to any convex, option-like compensation structure, like common stock from a levered firm.

Moreover, there are several other features of executive compensation that could affect firms' risk taking. Like trading, option or maturity restrictions, market vs. stock performance or severance packages. For instance, severance packages, combined with stock options can increase the vega of the executive compensation.

2.2 MEASURING PAY-FOR-PERFORMANCE

The literature typically considers two measures of pay-performance sensitivity. The first measure is the *percentage stake* or Jensen-Murphy measure. It corresponds to θ in equation [1]. This measure captures the dollar variation of the CEO's wealth for a given dollar variation in firm's value. In a seminal paper, Jensen and Murphy (1990) study the compensation of CEOs in large publicly traded U.S. firms for the 1974-1986 period. They estimate that CEOs percentage stake is very low. On average, executive compensation increases only $3.25 for every $1,000 increase in firm's value, which denotes very low levels of management ownership. They conclude: "Corporate America pays its CEOs like bureaucrats".

The second measure is the *dollar equity at stake*, which measures the variation in the CEO's dollar pay relative to the percentage variation in firm's value. Hall and Liebman (1998) calculate the dollar equity at stake among the CEOs of the largest US companies from 1980 to 1994. The sensitivity of the median CEO direct compensation (salary, plus bonuses, plus new grants of restricted stock, plus stock options) is about 0.3, meaning that a 10% stock return leads to 3% increase in CEO dollar compensation. However, they also show that the results are different when there is re-pricing of the holdings of stock and, especially, the stock options. Taking them into account, the sensitivity increases to about 3.9. In other words, a 10% stock return is associated (median value) with a 39% increase in the CEO's dollar pay. This is not the pay-performance sensitivity of a bureaucrat!

2.3 STYLIZED FACTS

The structure of CEO compensation is very heterogeneous across countries. Table 1, which comes from Fernandes et al. (2013), highlights several stark differences. For example, equity-based compensation has a significantly larger weight in the U.S. (39%), Canada (32%), and the U.K. (30%) than in the rest of the countries in the sample.

SAMPLE SIZE AND LEVEL AND STRUCTURE OF CEO PAY BY COUNTRY TABLE 1

Country	Number of CEOs in Sample and Data Source			% of Market Cap	CEO Total Pay ($ million)		Mean Composition of CEO Pay (%)			
	BoardEx & Exec	Corp. Filings	Total		Mean	Median	Salary	Other	Bonuses	Stock & Options
Australia	8	129	137	82	$2.4	$1.7	46	10	26	18
Belgium	37	2	39	73	1.6	0.9	58	5	27	10
Canada	7	166	173	79	3.1	2.2	33	10	26	32
France	192	0	192	88	2.4	0.9	61	2	22	15
Germany	106	0	106	78	3.6	2.4	39	10	41	10
Ireland	32	1	33	98	2.4	1.7	44	8	25	22
Italy	71	2	73	80	5.2	2.7	56	4	29	12
Netherlands	80	1	81	92	2.4	1.4	44	12	23	22
Norway	47	2	49	90	1.7	1.0	56	3	25	15
S. Africa	6	50	56	80	1.7	1.3	43	7	36	14
Sweden	83	1	84	90	1.7	1.1	62	18	19	2
Switzerland	21	10	31	55	6.1	2.3	50	4	21	25
United Kingdom	561	0	561	91	2.9	1.7	42	9	19	30
Non-U.S.	1,251	364	1,615	83	$2.8	$1.6	46	8	24	22
U.S.	1,648	0	1,648	90	$5.5	$3.3	28	6	27	39
All 14 countries	2,899	364	3,263	87	$4.2	$2.3	37	7	25	31

SOURCE: Fernandes et al. (2013).
NOTE: 2006 fiscal year CEO pay data extracted from S&P's ExecuComp database (U.S.), BoardEx (non-U.S.) (collectively "BoardEx & Exec" in the table), or hand-collected from corporate filings. "% of Market Cap" is computed for each country as the market capitalization of firms with CEO pay data divided by the total market capitalization of firms in Worldscope. We exclude CEOs in their first years to compute the CEO pay statistics. CEO Total Pay is defined as the sum of salaries, bonuses (including all nonequity incentives), benefits, and grant-date values for stock options, restricted stock, and performance shares.

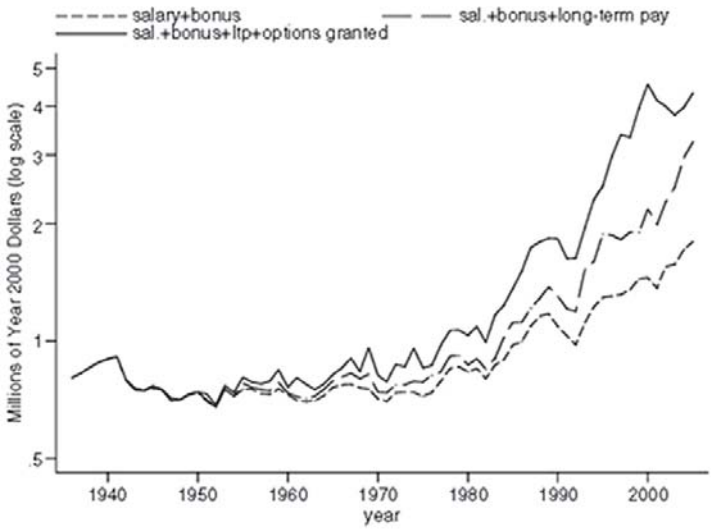
Table 1 shows the four key components of executive compensation: 1) Salary is fixed, non-contingent compensation; 2) Other components may include pension plans, insurance benefits and perquisites (like a club membership, for instance); 3) Bonuses are non-equity incentive plans based either on the board discretion or on the achievement of certain objectives. These objectives can be expressed in terms of accounting performance (like a target for earnings-per-share), market performance, or the relative ranking of the firm with respect to its peers; 4) The equity-based component includes stock option grants (at their Black-Scholes value) and stock grants (at their market value).

The compensation of CEOs and board members in Spain is regulated by the Governance Code of Listed Companies from 2015.[3] This Code follows the principle of "comply or explain." It limits the use of stock and stock options to executive board members (recommendation #57) and specifies that variable pay in general, and stock and stock options in particular, must be subject to vesting period of at least three years and that the redemption of stock and stock options is limited to twice the value of their fixed remuneration (recommendation #62).

According to the 2015 Annual Report on the Remuneration of Firm Officers, the mean total pay for CEOs among the 35 largest firms in the IBEX-35 was 3.05 million euros.[4] Of that amount, 46% corresponds to salary, the equity-based compensation (including shares granted and the profit from exercised stock options) amounts to 38% of the total compensation.

3 *Código de Buen Gobierno de las Sociedades Cotizadas,* CNMV (2015).
4 *Informe Anual de las Remuneraciones de los Consejeros de las Sociedades Cotizadas,* CNMV (2015).

MEDIAN TOTAL COMPENSATION AND ITS COMPONENTS, 1936-2005 CHART 1

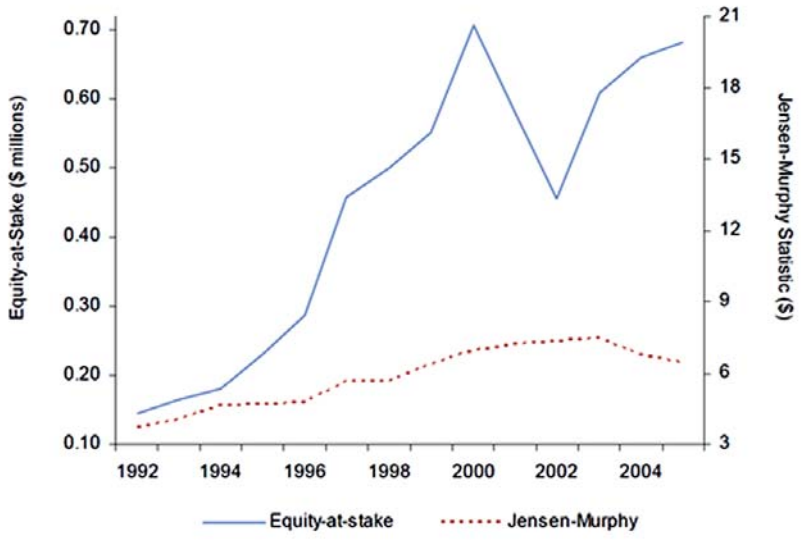


SOURCE: Frydman and Saks (2010).
Each line shows the median value of compensation defined as an increasing number of types: salary and current bonuses (paid out in stock or in cash); salary, current bonuses, and long-term incentive payments (paid out in stock or in cash); and salary, current and long-term bonuses, and the Black-Scholes value of stock options granted. Based on the three highest-paid officers in the largest fifty firms in 1940, 1960, and 1990 (a total of 101 firms).

Chart 1 from Frydman and Saks (2010) shows that the large weight of equity based compensation in the U.S. is a recent fact. Until the 1960s, equity-based compensation was rare among U.S. companies. Executive compensation consisted basically of fixed salary and cash bonuses. Since the 1960s, stock grants started to become usual in long-term incentive plans. The big "revolution" in CEO compensation came when a tax reform taxed stock options as capital gains at a much lower tax rate than labour income. As Chart 1 shows, stock options increased dramatically since the 1980s.

Chart 2 from Frydman and Jenter (2010) compares the two measures of pay-for-performance for S&P 500 firms. The right axis is the Jensen-Murphy, or percentage stake measure, that computes the dollar change in pay per $1,000 increase in firm's value. The

EQUITY AT STAKE AND JENSEN-MURPHY PROXY OF PAY-FOR-PERFORMANCE CHART 2



SOURCE: Frydman and Jenter (2010).

left axis is the change in dollar pay per 1% change in firm's value (dollar equity at stake). The two lines differ because of the growth in firms' values over time. Executives tend to own smaller stakes in larger firms. As a result, firm's growth leads to higher equity-at-stake incentives. Both measures show an increase in pay-for-performance pay over time.

3 Compensation and Firm's Leverage. Theory

In this section we survey the theoretical literature studying the theoretical underpinnings of how a firm's leverage is related to the compensation structure of its executives. For a given level of compensation, when the variable share is larger we say that compensation is more convex, or has a higher pay-for-performance sensitivity.

We should mention that the literature we are reviewing in this section assumes the existence of an *arms-length* relationship between the CEO (the agent) and the compensation committee (representing the board and, ultimately, the shareholders). We could term this approach as the contractual approach. This is not the only view. Pioneered by the work of Bebchuck and Fried (2004), a strand of the literature challenges the arms-length assumption and argues that the observed contracts are not justified by firm performance or firm characteristics. This literature stresses rent extraction by CEOs interested in their own agendas.

Since the work of Jensen and Meckling (1976) and Holmstrom (1979), it is well understood that linking compensation to performance is a powerful instrument to align the interests of executives and shareholders. For example, the investment choices of under-diversified, risk averse executives may conflict with the interest of well-diversified shareholders. The former may decide to avoid risky projects with positive Net Present Value, to focus on conservative investments. Shareholders may encourage risk-taking by increasing the *vega* of their executives compensation. For example, by including stock options in the CEO's compensation package. This is the wealth effect component discussed before in equation [3].

The seminal paper linking compensation structure and leverage is John and John (1993). In this paper, the authors study a model that incorporates a moral hazard conflict between shareholders and executives. Higher delta in the executive's compensation may, as we have seen, align the incentives of both agents. On the other side, higher delta exacerbates the executive's risk appetite resulting into a risk-shifting conflict between shareholders and bondholders. Bondholders will discount this conflict pushing up bond premia. To mitigate the extra cost of debt induced by risk-shifting, the optimal compensation contract will reduce pay-performance sensitivity as firm's leverage increases.

Contrary to the risk-shifting incentives, Lambert, Larcker and Verrecchia (1991) show empirically that options may decrease incentives for risk-taking. Theoretically, the models of Carpenter (2000) and Ross (2004) predict that, for risk averse executives, higher stock volatility entail a negative risk-aversion effect which may dominate the wealth effect.

Confirming the previous prediction, Lewellen (2006) shows that if managers are risk averse and not well diversified, in-the-money options discourage executives risk-taking and leverage for a wide range of parameters. In other words, if the manager's risk-aversion is large enough and she cannot hedge her exposure to the firm's stock volatility, the risk-premium component in [3] encourages executives to reduce firm's leverage as the options' vega increases. Carlson and Lazrak (2010) show that risk-averse managers more exposed to variable pay exhibit lower leverage.

The models proposed in all these papers provide arguments for why the *level* of leverage across different firms should be *negatively* related to the ratio of variable pay to the fixed

component of the total CEO compensation. However, the empirical literature, reports conflicting findings on whether the correlation between pay-for-performance compensation and firm's leverage is positive or negative [Tosun (2015)]. Edmans and Gabaix (2016) discuss that the literature lacks a model in which leverage and compensation are jointly determined in a framework that allows for risk aversion, effort, risk taking and endogenous costs of borrowing.

Gete and Gomez (2017) is a first attempt to endogenize effort and leverage decisions in a model with exogenous cost of borrowing. The authors analyze the interaction between leverage and executive compensation in a model in which the executives' choice of effort is endogenous and affects the likelihood of a crisis. Making CEO's effort endogenous unveils a novel channel for the relation between leverage and compensation. In particular, when the CEO is optimistic about asset prices in states of distress, there is a complementarity between effort and leverage. Optimism encourages higher leverage, and higher leverage entices higher effort to avoid the larger losses if the low state on nature is realized. Simultaneously, as the manager is compensated with equity, the manager has more incentives to supply effort in a more leveraged firm.

Dahiya, Gete and Ge (2017) revisit the existing theory and by making effort, leverage and credit spreads endogenous, expands it with new insights. The authors describe an economy with one firm that is owned by a shareholder who in turn has to hire a CEO to run the firm. The model also has a lender from whom the CEO borrows. The CEO is risk-averse while the shareholder and the lender are risk-neutral. The firm is exposed to productivity shocks whose mean is increasing in CEO's effort. This effort is costly for the CEO and noncontractable. The CEO receives a compensation contract composed of a fixed part and a share of the firm's profits. She decides effort and leverage. The lender prices firm's leverage with an endogenous spread over its costs of funds to be compensated for the risk of default from the firm.

The paper shows that the sign of the cross-sectional correlation between the *level* of leverage and the structure of compensation depends on the interplay of three channels: a) More convex compensation encourages effort by exposing the CEO to the rewards from higher firms' profits (increasing the CEO's pay-for-performance sensitivity); b) Like in Gete and Gómez (2017), there is a complementarity between leverage and effort that encourages leverage. That is, more convex compensation induces higher effort and since this makes bad shocks less likely then leverage increases; c) When the CEO is risk-averse, more convex compensation discourages leverage. The basic trade-off faced by the CEO is the level of variable compensation to accept and how much to borrow. This arises because both of these factors are sources of risk for her. That is, her total compensation has higher variance when either pay-for-performance or leverage are larger.

Channels a) and b) above generate a *positive* cross-sectional correlation between the level of leverage and the degree of convexity of executive compensation. Channel c) induces a *negative* correlation. For plausible calibrations the authors find that, except when variable compensation or CEO's risk-aversion are small, channel c) dominates and the correlation between the level of leverage and pay-for-performance compensation is negative.

Interestingly, Dahiya, Gete and Ge (2017) predict that the relationship between the *change* in leverage and variable compensation is unambiguously *positive* after an expansive shift in credit supply. This happens because the variable component makes the CEO more exposed to firm's value. Since the credit subsidy generated from the monetary policy shift increases the value of the borrowing firm, its CEO will borrow more if she is promised a larger share of the firm (i.e. higher variable compensation).

Moreover, after expansive credit policies, the shareholder offers contracts with less variable pay. The shareholder understands that after the stimulus the CEO is supplying more effort and choosing higher leverage, which are complements, and sees less need to provide variable compensation to motivate the CEO.

4 Compensation and Firm's Leverage. Empirical Work

Both compensation and firm's risk are endogenous. Thus, there are reverse causality problems. Variable compensation can encourage or discourage leverage for the reasons discussed above. However, it may also be the case that shareholders anticipate the risk conditions that the firm will face and design CEO's compensation to optimize their performance. Moreover, there may exist other reasons (omitted variables) that simultaneously drive compensation and risk-sensitivity. Thus, it is a difficult empirical problem to analyze whether compensation drives firm's risk. We review next how the literature has dealt with this problem.

Palia (2001) uses a system of simultaneous equations on panel data to investigate the relation between managerial pay-performance sensitivity and firm's value, controlling for the CEO's age, education and experience. His results show no relation between the firm's *Q*-value and CEO's pay-performance sensitivity.

Chava and Purnanandam (2010) use the change of the Financial Accounting Standards in the U.S. in 2005. According to this regulation, options had to be accounted for at their fair value and not at their intrinsic value. This regulatory change made options less attractive than restricted stock. The authors find that higher vega leads to more leverage, while higher delta is associated with lower leverage. Hayes, Lemmon, and Qui (2012) examine the relation between option pay and executives' risk-taking exploiting the same change in accounting regulation than Chava and Purnanandam (2010). However, they do not find a strong relation between the decline in option pay and less risky investments.

Shue and Towsend (2017) use a creative instrumental variable to identify causality. They use multi-year option plans as instrument because the expected number of granted options does not change with firm's performance. The authors find that a 10% increase in new options granted leads to a 2.8-4.2% increase in equity volatility. This increase in risk is driven largely by higher leverage. A similar conclusion is obtained by Panousi and Papanikolau (2012). They show that the negative effect of idiosyncratic risk on investment is stronger when risk-averse executives hold a higher fraction of the firm's stock.

Dahiya, Gete and Ge (2017) use data on corporate leverage and compensation from China's 2008 credit stimulus. The goal is to study how the structure of compensation alters firms' incentives to borrow. China is unique as its banking sector is almost completely state owned. This addresses the problems associated with the transmission of monetary and credit policy when risk-averse or poorly capitalized banks refuse to expand credit. This "supply" side problem of credit expansion has been the focus of the bank lending channel literature [see for example Gambacorta and Shin (2016) or Gambacorta and Marques-Ibanez (2011)]. However, this issue is absent in China given the complete control of the banking sector by the government. Deng et al. (2015) state this bluntly: "Beijing ordered state-owned banks to lend and they lent."

Following an unexpected deterioration of the economy in the fourth quarter of 2008, China's government suddenly exhorted banks to lend more and at cheaper rates. Total loan quotas, which are the lending targets that bank officials should meet, were increased from $4.9 trillion CNY in 2008 to almost $10 trillion CNY in 2009 [Cong and Ponticelli (2017)]. At the

same time, the Central Bank dramatically lowered banks' reserve requirements and expanded money supply. The annualized growth rate of real M2 went up from 14.9% in 2008Q4 to 26.2% in 2009Q1, and to 33.9% in 2009Q2. Ouyang and Peng (2015) state that "this was the biggest stimulus program in the world, equal to about the three times size of the U.S. effort." The literature agrees that nobody anticipated this large credit stimulus [Naughton (2009) and Deng et al. (2015)].

Dahiya, Gete and Ge (2017) show that the level of leverage and CEO's variable share of compensation are negatively correlated in the cross-section of Chinese firms. This suggests that CEO's risk-aversion is a dominant factor. Second, right after the 2008 credit push, the firms with a higher share of variable compensation increase their leverage faster. Thus, the structure of the executive compensation has a significant influence on which firms reacted more to the credit stimulus. The results are robust across different specifications and controlling for the main alternative drivers of compensation and leverage. They are particularly strong for firms in the real-estate sector. This suggests an interesting interaction between increases in leverage induced by convex compensation, and those caused by higher collateral values [Chaney, Sraer and Thesmar (2012), or Cvijanović (2014)].

5 Executive compensation as a policy tool to control leverage

From what we have reviewed above, there is theoretical and empirical support for the structure of compensation driving leverage dynamics. Following the 2008 financial crisis, there has been a lively debate in the academic and policy circles about regulating executive compensation to avoid excessive firms' leverage. In this section we survey some work on the optimal regulation.

John et al. (2000), Bebchuk and Spamann (2009), Bolton et al. (2011), Raviv and Sisli-Ciamarra (2013), Hakenes and Schnabel (2014), or Thanassoulis (2014) propose arguments for regulation based on risk-shifting problems and externalities from competition in labor markets.

Gete and Gómez (2015) analyzes the impact of remuneration practices on banks' risk-taking, captured by the level of short-term leverage, in a model with fire sales externalities but exogenous effort and exogenous compensation contracts. Fire sales externalities are at the center of the new macroprudential approach to regulation [Kashyap et al. (2011)]. Fire sales occur when financially distressed firms need to sell assets at prices below their value in a best-use scenario. Fire sales can be quite sizeable and lead to high discounts relative to face value. For instance, in March 2012, Spain's Banco Santander sold property-backed loans for EUR 750 million at a 62 percent discount to face value. In June of the same year, the UK's Lloyds sold property-backed loans for EUR 971 million after a discount of 52 percent.

Gete and Gómez (2015) show that when fire sales externalities are not internalized by a bank's shareholders and executives, borrowing is higher than the socially optimal level. Regulating executive compensation can achieve socially superior outcomes because it alters the incentives of bank executives. They analyze four compensation structures proposed by the academic literature:

1 First, plain-vanilla equity fails to internalize fire sales externalities, as it does not "penalize" short-term relative to long-term payoffs.

2) and 3) Deferred equity and long-term bonuses unrelated to short-term profits can restore the efficiency loss induced by the fire sales externality. Long-term bonuses unrelated to short-term profits increase the opportunity cost of fire

sales, thus, reducing fire sales. Deferred compensation works if agents value one dollar less in the future than in the present. If that is the case, then deferred compensation reduces the rewards from short-term debt. Thus, it lowers the incentives to leverage and sell at a discount in the case of a liquidity shock. Deferred compensation would be useless if it is invested in an interest-making account paying the same interest rate as the bank executives' discount rate. In fact, deferred compensation can be thought of as a tax on compensation, where the tax rate is the executives' discount rate.

4) Bail-in bonds reduce incentives to short-term debt by paying equity in cases of bank distress, in which equity has no value. The advantage of bail-in bonds is that they are a "cheaper" way to provide incentives. They increase the opportunity cost of fire sales in periods with liquidity needs while avoiding any remuneration for executives in periods with no liquidity problems.

Compensation schemes in real life are actually more complex than in this model. They may include severance packages (which may increase the compensation's *vega*), trading restrictions (to limit the manager's ability to game the compensation incentives), or vesting periods for stock options. These mechanisms may help to curb CEO's risk appetite. Our numerical exercises, however, show that regulating the level of compensation can have unintended consequences. Setting upper or lower bounds on the number of shares, deferred shares and/or the size of long-term bonuses may lead bank executives to an overcautious choice of debt and, ultimately, fire sales below the socially optimal level.

Based on these insights, Gete and Gómez (2017) show that, when the CEO's choices of leverage and effort are endogenous, letting shareholders vote on the design of compensation schemes (like say-on-pay schemes) fails to prevent socially inefficient firms' overleverage. Regulating the ratio of variable-to-fixed payments (but not the level of compensation) can deliver socially optimal leverage levels.

Gete and Gómez (2017) conclude that, at least for risk-neutral agents, the optimal regulation is not the regulation of executive compensation. A cap on debt is socially more efficient: it can restore the efficient level of debt with a lower distortion in managerial effort. Whether this result holds after introducing managerial risk aversion remains open for future research.

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