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Equity, Options, and Bank Strategies

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We build on existing literature to develop a stylized model of a bank in which managers can receive variable pay through stocks or options. The model shows both modalities aligning managers' and shareholders' interests. However, options allow determining a performance contingent optimal. This options' feature is desirable in mitigating perverse implications for depositors emerging from the alignment of managers' and shareholders' interests through equity. Exercises against the model's simulated and real data corroborate the model's findings. Our findings can be useful for banks in setting variable pay modes and regulators and supervisors in addressing the implications of different pay modes.

Key Words: Financial incentives; Managerial compensation; Banking sector; Equity-based pay; Stock options.

JEL Classification Numbers: D82, G20, L10, M20.

1. INTRODUCTION

Payment packages involved in employment contracts generally consist of a fixed salary and a list of incentives, of which stock, options, and bonuses are the most prominent. Among these, executive stock options became an important component that increasingly fueled the controversy of managerial pay. Indeed, the options-based incentives continue to centralize the ongoing discussions on the crisis in corporate governance and unexpected failures in industrial and some banking firms (Ju et al., 2014). Notwith-

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standing, such incentives enclose merits that are worthwhile to evaluate and explore.

Equity-based pay is a significant topic of discussion when assessing managerial compensation. Equity-based pay includes any payment to employees, directors, or independent contractors based on the value of specific stock (Jucá et al., 2012). The positive relationship between firm performance, as measured by the return-on-equity (ROE), and equity-based pay has been thoroughly demonstrated (see, e.g., Baglioni and Colombo, 2009). However, some reservations remain about this type of payment in cases involving stock options, notably since the financial scandals attributed to the exercise of options (Earle, 2009; Collin et al., 2014).

Notwithstanding, the options establish a link between the manager's salary and the stock performance in that the value of a call option is a function of the stock price; options theoretically exert a double but inverted effect on manager behavior. In general, given their intrinsic volatility, options encourage managers to make potentially and excessively risky investments; however, options can help mitigate agency problems by providing a better alignment of incentives, which can increase the total payment level to resolve the free cash flow problem and achieve a better leverage ratio (Berger et al., 1997).

It has been shown that option-based contracts can function at least as well as direct stock-based contracts, in a general environment with no restrictions on preferences or technologies (Choe and Yin, 2006). In addition to other advantages that options offer, they are important support for aligning the interests of the parties, in an agency problem that involves a tripartite "depositor and bondholders $\longrightarrow$ shareholders $\longrightarrow$ managers" chain, in situations where shareholders and managers may agree to decisions that involve taking excessively high risks, to the detriment of first-line principals, who are depositors and bondholders.

This is precisely the path followed in the current study, in which options play the primary role compared to stocks in equity-based payments. Specifically, we carry out a comparative study of stock and options based on the models of John, Saunders, and Senbet (2000) (JSS henceforth) and Stoughton and Wong (2009), to comparatively evaluate these two forms of equity-based pay.

Because stock options challenge the manager's strategic planning and intrapreneurship abilities, with potential benefits for the company (including banks), the study focuses on management compensation in the banks, specifically, the deposit-lending banks, and sophisticates the JSS model by directly comparing the pros and cons of engaging in option-based incentive payments against the more traditional approach of direct stock compensation within a simple analytical framework. Conditions under which the

options choice is preferable from the bank's performance perspective are derived, and the results are duly illustrated with a brief numerical example.

The study results confirm the former study conclusions by Choe and Yin (2006). In addition, they extend the JSS (2000) model contribution by bringing a new approach that suggests an unexpected usefulness of options in banks as an additional pay mode and the portfolio diversification, and also the lifting of the relaxation of some conditions, as a path for potential development of the study. The main contributions of this study, relative to the JSS benchmark, are summarized in Table 1.

TABLE 1.

Contributions of the model concerning the JSS framework

JSS (2000) model	Contribution of this model
1. Bank regulation concentrated on capital ratios is potentially inefficient in controlling risk-taking.	1. Incentive features of top-management pay may be done **in two different pay modes (stock-based and option-based pay)**, without discarding insurance premium schemes, to obtain the same effective risk control.
2. **New approach:** insurance premium schemes and incentive features of top management pay lead to effective risk control.	2. **Options** are a valid and useful reference variable for the banks.
	3. The portfolio of **diversified investment forms** provides a more effective risk control.

While the JSS (2000) model contribution to the literature suggests a more direct mechanism to influence banks' risk-taking incentives, this model brings a new approach by suggesting an unexpected utility of options in banks as an additional pay mode and the portfolio diversification as a path for potential development of the study. While the JSS (2000) model contributes to the literature, suggesting a more direct mechanism to influence risk-taking incentives in banks, this model brings a new approach, suggesting an unexpected utility of options in banks as an additional payment and the diversification of portfolio as a path to the potential development of the study. Source: Authors.

The remaining sections of this paper are in the following sequence. Section 2 is devoted to a short and systematic literature review. Section 3 presents the model. Issues on managerial pay are approached in section 4. Section 5 is devoted to the analytical evaluation of the options' pay modality. In section 6, the comparative advantage of using options against stock is assessed. Section 7 explores an illustrative numerical example, with simulated data. Section 8 extends the numerical analysis, in this case

through an exercise that resorts to real-world data from Australian and British banks. Section 9 highlights the extension this model produces on the JSS model, and section 10 concludes.

2. LITERATURE REVIEW

Payment packages involved in employment contracts generally consist of a fixed salary and a list of incentives, of which the equity-based ones, namely, stock and options are the most prominent. Stock is the main variable of equity-based pay. In fact, managers' equity-based pay is the most widely used scheme to alleviate the agency problem in publicly traded companies, because it positively influences the corporatism and stimulates the manager's intrapreneurship.

Some of the main worries about the options modality are as follows: (i) in general, it is not easy to account for, and in particular, it is not easy to deal with their expenses; (ii) the options opportunity cost may turn higher than the option's value to undiversified executives at any time, and this is not comfortable for the granting banks; (iii) executives may feel more emboldened to distort accounting information for their own benefit; (iv) executives may be over-rewarded when the market is booming; (v) There is always the risk of failure to penalize poor performance in the bear market by resetting the option price; and (vi) the potential stimulus executives have to take excessively risky decisions, thus harming the shareholders' interests (Choe and Yin, 2006).

Despite the aforementioned caveats, stock options became an increasingly important component of managerial pay. Options emerge as an essential variable in managerial optimization problems, because of the trade-off of the goals of raising the equity and the dilution effect of the options. Options link a manager's pay to stock performance because they positively influence corporatism, stimulate the manager's intrapreneurship, and because the call option's value reflects the stock price. Although option usage has generally declined in recent years, notably since the financial scandals attributed to the exercise of options, it remains substantial. The options are undeniably useful; not only do they confer compensatory advantages on investments, but they also help manage operational risks.

Notwithstanding, options can influence the manager's behavior in a dual, but reversed manner. First, they encourage managers to undertake overly risky investments; second, they align the manager's and owners' risk aversion and interests (Ju et al., 2014). In other words, options are expected to stimulate the manager's intrapreneurship and strategic planning, thus benefiting the firm (Razul et al., 2024). In this sense, in an environment without restrictions on preferences or technologies, in general, option-based

contracts can succeed at least as good as direct stock-based contracts (Choe and Yin, 2006).

By assuming that stock options can indeed mitigate agency problems, as ample studies suggest, the scholars presume that stock options affect corporate payout policy in one of two ways: (i) Better incentive alignment can increase the total payout level to resolve the free cash-flow problem and attain a better leverage ratio (Berger et al., 1997); and (ii) Stock options change the composition of the payout, specifically, companies will favor repurchases over dividends (Muurling and Lehnert, 2004).

When the stock value drops below the option's strike price, and, therefore, the option value declines, leaving the option underwater, employees may leave. To prevent this, companies re-price options by lowering their exercise price. Re-pricing enhances employee retention when underwater options are present. Payment consultants have estimated that employee replacement costs (turnover, termination, underlying loss of productivity, new hires, and training) represent about 150% of an employee's annual salary (Carter and Lynch, 2004). Additionally, research has shown that revaluing stock options typically promotes poor company performance.

Thus, structuring manager incentives to maximize shareholders' value in a levered firm tends to encourage excessive risk-taking. The stock value is like the call option's one and increases the volatility (riskiness) of the assets held by the firm (Duarte et al., 2020). So, although it may be in shareholders' interests to encourage a manager to take less risk to lower the cost of debt if the manager's actions are unobservable, he/she might undertake excessive risk due to risk shifting (Bolton et al., 2010). The inspection of managers' actions therefore comes in response to this constraint.

On this issue, risk management is influenced by the payment package due to the decision-making role exercised by managers. According to Feltham and Wu (2001), empirically, the stock will be more prevalent in incentive plans used by firms in which the manager's actions have a limited effect on the firm's operating risk. In contrast, options will be more prevalent if the manager's actions significantly affect that risk. A substantial argument against this is that the downside risk potentially associated with stock options seldom affects managers and that the payment of stock options is not very transparent to shareholders (Benz et al., 2001). Thus, this issue calls for further debate.

3. THE MODEL

Following the JSS model, assume a representative depository institution under moral hazard and incomplete contracting. The institution is run by a manager hired by the shareholders through an incentive package that aims to align the manager's and shareholders' objectives. This incentive

package consists of a fixed wage and an incentive payment that depends on the bank's stock price. In this context, the notion of manager may refer to a small team of managers, and not necessarily to a single one.

Consider a three-period setting: $t = 0, 1, 2$. At the initial date, $t = 0$, the institution accumulates deposits and carries out residual financing through equity, subject to existing regulatory requirements. The manager chooses both debt issuance and the underlying riskiness of the bank's investments.

Deposits are insured by a government agency (the FDIC), the minimum capital requirements are in place, and the bank pays the relevant insurance premium, P. All associated contracts are written and priced at $t = 0$, given the available information and admissible contracting opportunities.

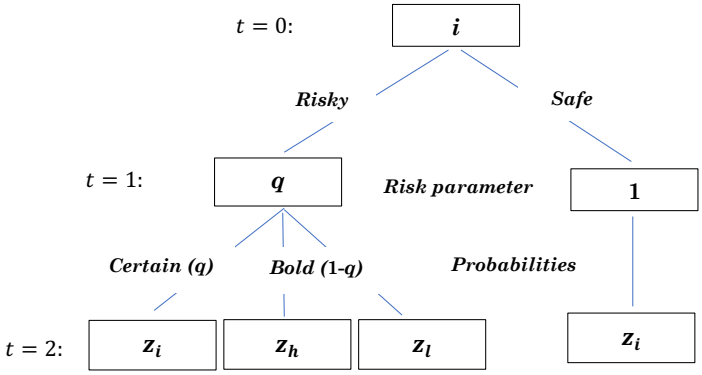
At an interim date, $t = 1$, investment opportunities emerge. These opportunities represent the possible loans (asset choices) that the bank can make. The manager chooses both debt issuance and the underlying riskiness of the bank's investments. The insiders observe a risk measure q to better choose between riskless loans and risky loans, but the outsiders (depositors and regulators) are not likely to know, due to the cost of observing that risk measure, although this cost is shared among the bank and the outsiders. However, all the relevant parties know that q is distributed uniformly over the interval $[0, 1]$.

For simplicity, assume that the investment opportunities are of two types: (i) Safe investments (i.e., loan opportunities), to which the bank has monopoly access, with zero risk and nonnegative call value. The safe investment has a null associated gain, but an assured recovery value of z_i. Because of the null associated gain, this investment opportunity type is not attractive, thus we will not consider it. (ii) Choice from a menu of possible risky investments, which are indexed by the parameter q. The returns from the risky loan-backed projects are high or low (z_h or z_l, respectively), with $z_h > z_i > z_l$. In this setting, q is interpreted as the probability of a certain outcome, z_i, and $1 - q$, the probability of the uncertain outcome, z_h and z_l (see Fig.1).

At $t = 2$, loans mature, and the proceeds are collected. Let tcf denote the terminal cash flow, which is equal to z_i for a riskless investment taken at $t = 1$, or equal to z_h or z_l depending on the result of the risky investment, in the case where this is the investment strategy that is followed (also at $t = 1$). The bank pays the depositors $\min(f, tcf)$ and the deposit insurance agency (FDIC) honors its guarantee by paying the depositors $\max(0, f - tcf)$, with f as the depositors promised return. Depositors are thus paid off if their deposits are fully insured for failure.

Assuming that all deposits are insured, this model's investment schedule can be set as follows:

FIG. 1. The decision moments



This diagram represents the decision moments of the JSS model and the expected respective outcomes.

(i) At $t = 0$, incumbent equity holders hire a manager under a linear incentive contract $C = C(b, \alpha)$, where $b > 0$ is base salary, and $\alpha \in [0, 1)$ is the share of the equity increment.

(ii) At $t = 1$, investment opportunities are disclosed. The manager's choice regarding the bank's risk q occurs after observing this parameter value. The bank raises investment funds, i, from depositors and/or bondholders to fund the asset, with a promised return of $(1 + r)i$.

(iii) At $t = 2$, the returns, tcf, on the asset, are realized with all taxes and the fixed salary for the manager deducted. Depositors and bondholders are paid first. If there are remaining returns, the equity holders get the residual value.

For most of the analysis, one assumes that i remains exogenously fixed, the bank has sufficient funds at stage (ii), the depositors are insured and the minimum capital requirements are in place. Unlike the assumption in the JSS model and following the Basel III for vital banking parameters (capital, leverage, funding, and liquidity), short-term incentive packages, like bonuses, are ignored, and the study solely focuses on long-term packages.

3.1. Investment Characteristics

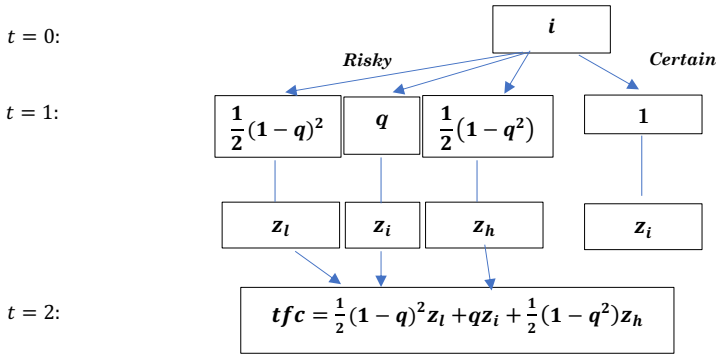
The bank raises funds through deposits and subordinated debt and for a total amount d of deposits and subordinated debt, it promises a return of $f = (1 + r)d$, where r is the premium rate. Assume that all the bank's lenders have an outside option of investing their money in an alternative that yields a safe return of $f_s = (1 + r_s)d$, with $r_s < r$. For now, and for

simplicity, assume that all agents are risk-neutral and set the discount rate to zero.

The bank applies the investment, i, in risky assets according to an observed risk parameter q, i.e., the bank adheres to an investment technology with the following characteristics: by investing an amount i, the bank can obtain a gross return tfc, where tfc can have three possible values: (i) a certain result, z_i, with probability q; (ii) a high return, z_h, with probability $\frac{1}{2}(1-q^2)$; and (iii) a low return, z_l, with probability $\frac{1}{2}(1-q)^2$.[1]

If the risky investment produces just a certain outcome, which can happen for $q \approx 1$, this can reflect no activity, meaning that no investment technology was set up and therefore no risk was run (see Fig.2).

FIG. 2. The investment schedule



Source: Authors

In this scheme, the manager has two decision moments: (1) at $t = 0$ he / she chooses at least two investment alternatives: a safe and a risky investment and decides how much to apply in each alternative, depending on the amount of funds being collected. (2) For the risky investment, at $t = 1$, he/she decides whether to apply the available resources in a risky opportunity, or just to keep the money safe in a secure investment. For the risky opportunity, he/she has two expectations: certainty (bearing the expectation of recovering the investment) and risky (returns may be low or high with their respective probabilities).

Relating the parameters q and i, a decrease in q thus reduces the probability of recovering i, while also increasing the riskiness and the returns z_h and z_l, thus creating a risk-return trade-off (see Table 2 and Fig.3).

[1]Under this formulation, in which the return on the risky asset is a function of q, the objective function of the bank is implicitly risk neutral. One could sophisticate the analysis by assuming risk aversion, e.g., by taking a constant absolute risk aversion utility function. Although the analysis with this type of function is beyond the scope of this study, one may speculate that risk aversion does not compromise the alignment of interests between managers and equity owners. On the contrary, it should reinforce it.

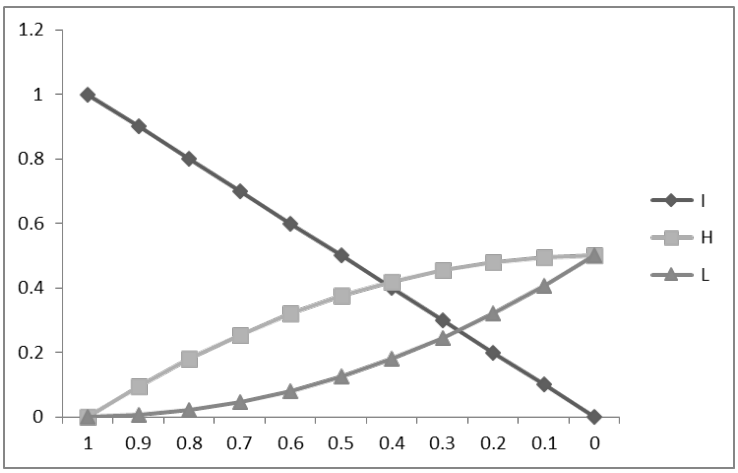
TABLE 2.

Variation of the probabilities for the returns z_i, z_h and z_l

	q	1	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1	0
z_i	q	1	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1	0
z_h	$0.5(1-q^2)$	0	0.095	0.18	0.255	0.32	0.375	0.42	0.455	0.48	0.495	0.5
z_l	$0.5(1-q)^2$	0	0.005	0.02	0.045	0.08	0.125	0.18	0.245	0.32	0.405	0.5

This table shows the behavior of the probabilities for the normal (z_i), high (z_h), and low (z_l) expectations, when q varies from 1 to 0, according to the JSS model Lemma 1. Source: Authors

FIG. 3. Return probabilities in the JSS model



Return probabilities in the JSS model. This graph shows the probabilities distribution for normal (I), high (H), and low (L) expectations, when q varies from 1 to 0, according to the JSS model Lemma 1.

3.2. Best outcome

The return on the risky investment is a function of probability q; write this as:

$$v(q) = tfc = qz_i + \frac{1}{2}(1-q)^2 z_l + \frac{1}{2}(1-q^2)z_h. \tag{1}$$

The maximization of (1) yields the following optimal investment policy:

$$\hat{q} = \frac{z_i - z_l}{z_h - z_l} \tag{2}$$

and the corresponding best (optimal) return is:

$$v(\hat{q}) = tcf^* = \frac{z_h^2 + z_i^2 - 2z_i z_l}{2(z_h - z_l)}. \tag{3}$$

With these equations, when q is changed from 1 to 0, the terminal cash flow value increases from i to $v(\hat{q})$ and then decreases towards $(z_h + z_l)/2$. Value $v(\hat{q})$ is the highest value achievable in a full information scenario with complete contracting. Furthermore, it is easily noticeable that the values in the curve $v(q)$ are constant for $i = (z_h + z_l)/2$, with $\hat{q} = 0.5$; they are declining for $i > (z_h + z_l)/2$, with $\hat{q} > 0.5$, and they are increasing for $i < (z_h + z_l)/2$, with $\hat{q} < 0.5$.

Concerning the leverage, sometimes the level of equity capitalization and the corresponding level of deposit claims of promised payment f may be high. When this is the case and f is high enough, risk-shifting is induced, which incentivizes managers to implement an investment policy riskier than $\hat{q}$, with lower value, $v(q) < v(\hat{q})$, according to the JSS model Proposition 1, as follows:

$$q(f) = \begin{cases} \hat{q} & \text{if } z_l \geq f \\ \frac{z_i - f}{z_h - f} & \text{if } z_l < f < z_i \\ 0 & \text{if } f \geq z_i \end{cases} \tag{4}$$

Considering the incentive effects of a bank's financial structure on its investment, the JSS model has shown the conditions under which the managers are more or fully aligned with the equity holders or with depositors to influence the choice of their most adequate investment policy, denoted qm. However, since this study is only concerned with the long-term incentive packages and therefore the bonus variable λ is set to null, the q^m of the JSS model becomes $q(f)$. This aligns the manager's interests with those of the equity holders only by replacing q with $q(f)$ in equation (1) to produce $v(q^m)$. The minimal investment policy that is suitable for this equation is precisely the optimal one. Other lower investment policies are riskier and produce lower incomes, which can fall to 0 if $z_l \geq f$.

4. MANAGERIAL PAY

The linear incentive payment contract, $C = C(b, \alpha)$, is applied as follows. The manager receives a fixed salary $b > 0$, and an equity increase fraction α of the bank. Therefore, the total reward for shareholders is the increase in equity, calculated as $\max\{0, y\}$, with $y = tcf - i$. The fraction α assigned to the manager affects this equity increase. Thus, one establishes $C = b + \alpha y$.

For simplification purposes, we will assume that the fixed component of the salary is paid from the bank's operating cash flow, to make the

terminal cash flow $tcf = \{z_i, z_h, z_l\}$ residual to the fixed payments, b, at the manager. With this feature, the incentive pay can easily be calculated as follows:

$$\Delta C_\alpha = \alpha y. \tag{5}$$

Since the stock fraction α turns the manager into a shareholder, $\Delta C\alpha$ is subject to the rules that regulate equity. From equation (5), it follows that the total payment to the equity holders is obtained from the equity increase through the following equation:

$$\Delta e = (1 - \alpha)y. \tag{6}$$

Thus, the linearity of the α-based payment of incentive fixes no critical point for parameter α, which means that the manager could benefit from almost all dividends if α is set near its ceiling ($\alpha \approx 1$). However, this lack of reference results in shareholders randomly defining incentive parameters to design payment contracts, which increases subjectivity. Thus, there is no Pareto-optimal reference in the model, relegating the parameter setting to the shareholders' discretion. Some other variables are required to help set an optimum reference that can objectively assist in setting the manager's incentive payment contracts. Stock options appear as one of these variables.

5. OPTION-BASED PAY

Stoughton and Wong (2009) have developed a model that simultaneously considers the two alternatives equity-based pay systems for professional staff: stock-based and option-based (see the diagram in Fig.4).

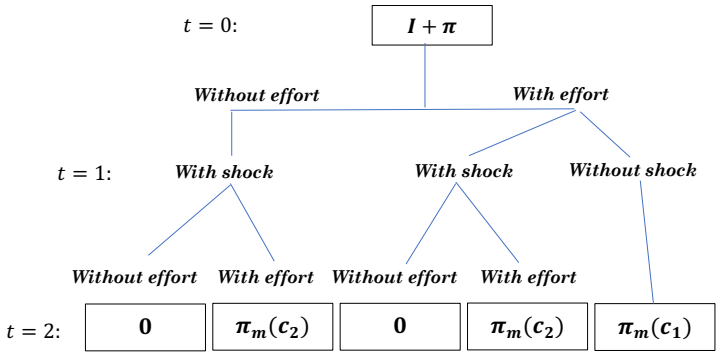
The Stoughton-Wong model showed that option-based pay and stock-based pay are equivalent, at least in a monopolistic market, except when the following condition is met:

$$p_1\pi_m(c_2) > qp_2\pi_m(c_1). \tag{7}$$

In inequation (7), π_m represents market value, c_1 and c_2 are the costs associated with innovation, and p_1 and p_2 are the personal costs before and after a shock, respectively. Under these conditions, the use of option-based pay strictly dominates the use of stock-based pay. Relation (7) holds when the effort cost p_1 of the first period is larger when compared to the second-period effort cost p_2, if the shock probability, q, is small, or even if there is relatively little difference between the profits in the respective states, i.e., $\pi_m(c_1) - \pi_m(c_2) \approx 0$.

However, options continue to fuel debate among researchers (see Dittmann et al., 2006), thus opening up the possibility for a deeper discussion on the

FIG. 4. The Stoughton-Wong model



This diagram was extracted from Stoughton and Wong (2009) and represents the evolution of the information and distribution of terminal cash flow.

subject. For instance, assuming a competitive environment, options can create risks that stock does not have. As Collin et al. (2014) stated, options are not exactly an incentive instrument, aligning the manager's interests with those of absentee owners, but more of a recruitment and retention instrument and an indicator of the manager's strength. In cases where competitors may attract managers, options can serve as a strategy to retain managers, especially at the start-up stage of a firm's organizational life cycle. Since options have an additional contract parameter, they can often provide the same incentives at a lower cost (Stoughton and Wong, 2009).

This discussion could go on indefinitely in that many other factors influence the advantages of options over the straight stock, while some other factors have the opposite influence. One of the factors in favor of options is the development stage in the company's organizational life cycle. As stated by Milkovich and Rabin (1991), cited by Wang and Singh (2014, p. 149), "Firms at the start-up stage of organizational life cycle development tend to pay their managers lower cash and larger stock options than those at the maturity stage". Moreover, "growing firms grant more stock options to their managers than do stagnant firms, while the manager pay-performance sensitivity for growing firms is higher than for stagnant firms".

Each organization faces a particular set of contingencies in its context. Hence, the optimal payment strategy does not have to be the same for every company. In this tangle of arguments, this study does not take sides but rather contributes to the search for the critical point at which the choice between stock-based or option-based incentive pay becomes indifferent.

Now we develop the simplest basic version of our model in a single banking firm setting. The model is based on that of Stoughton and Wong (2009). As in their paper, let us assume that both the firm and its workers are risk-neutral. At $t = 0$, instead of a fraction α of stock, the bank grants the staff a portion β of call options on firm value with a strike price x. Of course, the stock price at maturity ($t = 2$) is influenced by the gains resulting from decisions made at $t = 1$. Since the manager will be interested in improving his / her benefits to the maximum, the options use will incentivize him/her to make more daring decisions (Rajgopal and Shevlin, 2002). Thus, at $t = 0$ the firm solves a principal-agent problem that leads to the same shareholders' equilibrium payoff as for the stock compensation in equation (1):

$$T = V(q^m) = q^m z_i + \frac{1}{2}(1 - q^m)^2 z_l + \frac{1}{2}[1 - (q^m)^2] z_h. \tag{8}$$

Although setting variables q and β depends on expectations from the investment to undertake, these variables are not correlated. Their effect occurs at different and sequential moments and uses various criteria. The former is observable, and its use is induced by the investment opportunities that may emerge, while the latter is fixed based on the expectations for the equity increase.

Since stock produces a linear payment proportional to the volume of granted stock, comparing the optimum of stock-based versus option-based pay, consider first that n options corresponding to β were granted to the manager as an incentive. The options' strike price, x, can be set as a stock unit value function s, such that $x = \rho s$, where $\rho \in (0, 1]$ is a constant. Thus, letting k be the stock volume and e the equity before hiring the manager, the following equality holds: $k = \frac{e}{s} = \frac{\rho e}{x}$.

As incentive pay represents an additional reward for an increase in equity, the manager receives:

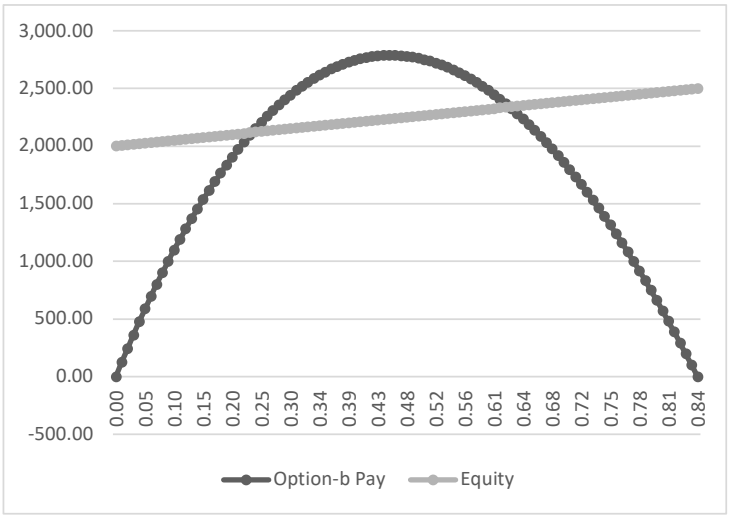
$$\Delta C_\beta = \frac{ny}{k + n}, \tag{9}$$

where $y = tcf - i$, after the deduction of all taxes, and $\frac{y}{k+n}$ represents the additional stock unit value in the case such that $y > 0$. If $y \leq 0$ then the options are underwater and $\Delta C_\beta = 0$. The income, y, may be lowered if other incentives, such as bonuses, are used, if the discount rate for the risk aversion is set up, or Basel restrictions are applied.

Due to the decreasing effect of options on the unit value of shares — the dilution effect — when combined with the increasing effect their exercising has on the equity, the benefit to the manager starts increasing with the number of options, then decreases to 0 after reaching a maximum at a certain level of the number of the options. The 0 level is reached when

the corresponding stock unit price increase becomes null. (see Fig.5 and Fig.6).

FIG. 5. Options effect on the equity.



Source: Authors

This graph shows the behavior of options-based and stock-based pay, showing the linearity of stock-based and the concavity of the options-based pay.

Because ΔC_β depends on the income y, and y depends on n, one infers, from equation (9), that the optimum ΔC_β^* can be expressed under the form

$$\Delta C_\beta^* = y + \frac{kx}{\rho} - 2\sqrt{\frac{ykx}{\rho}} \tag{10}$$

or

$$\Delta C_\beta^* = \frac{n^2 x}{\rho k}, \tag{11}$$

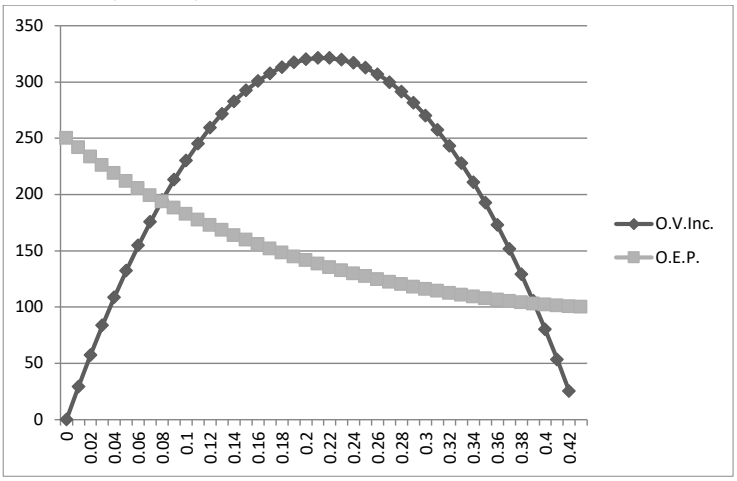
results that are obtained respectively when

$$n^* = \sqrt{\frac{y\rho k}{x}} - k, \text{ for } y > kx = \rho e \tag{12}$$

or

$$y^* = \frac{x(k+n)^2}{\rho k}, \quad \text{when instead of } y, n \text{ is known.} \tag{13}$$

FIG. 6. Options dilution effect on the stock unit price (O.E.P.) vs options volume for the incentive (O.V.Inc).



Source: Authors

Fig.5 and Fig.6 depict the increasing effect on the equity volume and the dilution effect of options on the stock unit price, respectively, when exercised. Thus, an options number increase results in an equity volume increase, while reducing the stock unit price. However, its effect on the incentive volume is convex, with a maximum (optimal) reference according to equation (10). Source: Author

The previous expressions convey information about the possibility that the manager has to estimate the expected optimal income y^*, when the n granted options are known; and that the shareholders can estimate the optimum options number n^*, when the expected optimum income y^* is known.

This optimum represents the level at which the manager is fully aligned with the owners. Thus, when the manager fails to reach the optimum expectations, he/she also comes to harm. This result is a goal that the manager should pursue to be able to optimize his/her incentives. However, one can easily see that if the value is too high, y may become unfeasible, and if $n = 0$, there is no increase in equity volume, which makes the incentive useless even when the shares are highly valued. In this last situation, there is no exercising of options and, consequently, this will bring no changes in shareholders' dividends proportion.

6. OPTION-BASED VERSUS STOCK-BASED PAY

As pure stocks and options are both long-term equity-based incentives, they are similarly granted. They differ only in that stocks are a direct incentive, while options depend on stock appreciation to be exercised and to turn a manager into a potential shareholder. Both types are related to manager performance, although the required level of performance is slightly different.

A comparison of stock-based and option-based payouts leads to the following assertions: (i) stocks and options have a similar impact on equity, but they differ in impact on ownership structure. Thus, unlike stock, options have a strong potential to change shareholder structure. (ii) Although both depend on the manager's performance, stocks are safer for the manager against market fluctuations. Options, in turn, are sensitive to market fluctuations. This can make the bank's stock appreciation difficult. This may be one of the reasons banks are less likely to use options. (iii) Unlike stocks, options allow an optimal level to be set that can help estimate the best level for the stock parameter α through its relationship to β. Contributions on this issue have been provided by Feltham and Wu (2001), Choe and Yin (2006).

According to Feltham and Wu (2001, p. 7), "... the main characteristic of shares is that the manager's pay has a linear variation depending on the firm's stock value, while the main characteristic of options is that the salary of the manager varies with the company's stock value only to the extent that the price exceeds what is often called the strike price. Options shield the manager from the downside risk to which stock exposes the manager". The options volume required to induce a given level of effort increases as the exercise price rises, and that increase is sufficient to result in a higher cost-of-risk imposed on the manager for a given level of effort, and thereby to make options more costly to equity holders than stock.

However, options are often touted because they shield a risk-averse manager from downside risk and thereby induce him to be willing to take riskier actions in an attempt to raise the stock unit value. Thus, in addition to other advantages that equity-based pay provides, it helps to improve the manager's performance.

Notwithstanding, if the contract terms, such as the grant amount, expiration time, and strike price, are set optimally, an options-based contract can dissuade the tendency toward excessive risk-taking. This is why options cannot be considered in isolation from broader governance issues. This confirms the former study conclusions by Choe and Yin (2006).

7. APPLICATION EXAMPLE

This example uses simulated data in a simplified context (values are expressed in thousands of dollars). Observing all rules about the minimum requirements, suppose that at $t = 1$ a bank applies $i = 1000$ (equity: $E = 200 +$ liabilities: $d = 800$), in a risky investment. The investment proportion in each type may differ according to firm or investment specificities. Another investment share could be taken; the adopted values allow for an equity share of 20 percent of the investment to adjust to banks' propensity for high liquidity.

Concerning the risky investment, and setting the highest benchmark, suppose that the market is characterized by a higher return rate of 0.4. The highest income this investment can produce in $t = 2$ is $z_h = 1.4 \times 1000 = 1400$. Because of the shareholders' risk neutrality, one has $f = d = 800$.

The risky investment needs a tempting incentive $\alpha > 0$. So let $\alpha = 0.1$. Then consider three cases: (a) $z_l \geq f$, (b) $z_l < f < x_i$, and (c) $f \geq z_i$. The three different cases are illustrated in Table 3.

TABLE 3.

Example of investment outcomes

Investment outcome	Safe	Risky	
	z_i	z_h	z_l
Scenario 1	1000	1400	900
Scenario 2	1000	1400	600
Scenario 3	1000	1400	1200

Source: Authors

The respective investment policies can be set as follows.

(a) Scenario 1 illustrates the case $z_l \geq f$. Suppose that the expected income is higher than d, say 900. Under these conditions, the optimum venture procedure can be quantified as follows:

$$q^m = \hat{q} = \frac{z_i - z_l}{z_h - z_l} = \frac{1000 - 900}{1400 - 900} = 0.2$$

with

$$tcf^* = 0.2 \times 1000 + 0.5 \times 900 \times (1 - 0.2)^2 + 0.5 \times 1400 \times [1 - (0.2)^2] = 1,160.00$$

Given that $z_l = 900 \geq f = 800$, from equation (4) it follows that the manager's result, $y^* = 160$, will be following all shareholders' expectations.

(b) Scenario 2 is associated with case $z_l < f < z_i$. Suppose that the expected income falls below d, say to 600. Under these conditions, the

optimum venture procedure is such that:

$$q^* = \frac{z_i - z_l}{z_h - z_l} = \frac{1000 - 600}{1400 - 600} = 0.5$$

and

$$q^m = \frac{z_i - f}{z_h - f} = \frac{1000 - 800}{1400 - 800} \approx 0.33$$

with

$$tcf^* \approx 0.5 \times 1000 + 0.5 \times 600 \times (1 - 0.5)^2 + 0.5 \times 1400 \times [1 - (0.5)^2] = 1,100.00$$

and

$$tcf^m \approx 0.33 \times 1000 + 0.5 \times 600 \times (1 - 0.33)^2 + 0.5 \times 1400 \times [1 - (0.33)^2] = 1,088,44$$

Given that $z_l = 600 < f = 800 < z_i = 1000$, from equation (4) it follows that the manager's most adequate investment policy is that which produces the income $y^m = 108,84$, which is slightly below the optimal, $y^* = 110.00$.

(c) Scenario 3 illustrates case $f \geq z_i$. Now suppose that d is higher than the projected investment z_i, say 1200. Under these conditions and from equation (4), the investment policy is the riskiest. The expected terminal cash flow with this investment policy is

$$tcf^m \approx 0.5 \times (1400 + 1200) = 1300, \text{ with } y^m = 300.$$

However, this is an unrealistic situation. Listing the results backward, the result for this last case gives: $tcf_3 = 1,300.00$. The second case result is $tcf_2 = 1,088.44$, and $tcf_1 = 1,160.00$.

Assuming that s was diluted in the operating cash flow, α will only affect the expected incomes to produce the results summarized in Table 4.

TABLE 4.

Profits under three different scenarios

	Chosen q	Profit (a)	Equity increase $(b = a)$	Incentive payment $\alpha = 0.1 \times (b)$	Profit after dividends $s_h = 0.9 \times (b)$
$z_l < f < z_i$	0.2	160.000	160.000	16.00	144.00
$z_l \geq f$	0.33	110.885	110.885	11.08	99.805
$f \geq z_i$	0	300.000	300.000	30.00	270.00

Source: Authors

These results allow for the simulation of the simplified balance sheet and income statement of the financial institution, following Dermine (2003);

the balance sheet and the income statement of the second case, with the optimum venture procedure, are displayed in Table 5. All taxes and dividends have been assumed as nonexistent, and the considered profits are the lowest profits resulting from the chosen investment policies.

TABLE 5.

Bank and P&L statement (Case 2)

BALANCE SHEET	
$T = 1000$	Liability = 800
	Equity = 200
Total Assets = 1.000	**Total** = 1.000

INCOME STATEMENT	
Profit (z_i)	88.44
Total Profit	110.00
Variable Costs	11.00
Gross Profit	99.00
Fixed Costs	0
Profit before tax	99.00
Income tax	0
Net income	99.00
Dividends	0
Profit after Dividends	99.00

Source: Authors

Turning to the option-based incentives, and under the same assumptions on the minimum requirements and market characteristics, aiming for the highest benchmark, suppose again that at $t = 1$ a bank applies $i = 1000$ (Equity: $E = 200 +$ liabilities: $d = 800$) in a risky investment.

Considering the highest income expectations level $y = 0.4 \times 1000 = 400$, the exercise price, $x = 2$, with $e = 200$, one has $k = 100$ and this allows the granting of $n = \sqrt{\frac{yk}{x}} - k = \sqrt{400 \times 50} - 100 \approx 41$ stock options for $\rho = 1$, aligning the manager's interests with those of the shareholders.

With this result, the equity is expected to rise 82, i.e. from 200 to 282, the exercise of the options will raise the stock volume from 100 to 141, and the stock unit price $\frac{y}{k+n} = \frac{400}{141} \approx 2.83$, from 2 to 4.83, giving the manager a yield of $2.83 \times 41 \approx 116$ by exercising his / her options. This provides a share of about 82 from 282, corresponding to $\alpha = \beta \approx 0.29$ of the new (total) stock volume.

These results permit the simulation of the corresponding simplified ledger and bank statement according to Dermine (2003), as follows in Table 6, in which the model's assumptions were relaxed by considering all taxes and dividends as nonexistent.

In the proposed example, pure stock-based and stock option-based incentives produce the same results, if they are equally valued. However, the benefit of the options is that while β is calculated, α can be exogenously set. Thus, relation $\alpha = \varphi(\beta) = \mu\beta$, where μ is a constant, should help manage the α variation and set its level optimally.

TABLE 6.

Bank and P&L statement (option-based pay)

BALANCE SHEET	
$T = 1000$	Liability = 800
	Equity = 200
Total Assets = 1.000	**Total** = 1.000

INCOME STATEMENT	
Profit (z_i)	400.00
Total Profit	400.00
Variable Costs	116.00
Gross Profit	284.00
Fixed Costs	0
Profit before tax	284.00
Income tax	0
Net income	284.00
Dividends	0
Profit after Dividends	284.00

Source: Authors

8. EMPIRICAL DATA

In the previous section, the application example employed simulated data to illustrate the arguments provided in the study. This additional section simulates the model directly with empirical data, to get further insights. This simulation confirms the thesis underlying the developed theoretical framework.

The collected data relates to fiscal years 2005 and 2015, thus enclosing the time interval in which the global financial crisis took place. This period is considered a natural experiment for the banks' study and bank performance (Abreu et al., 2019). The data were gathered from the management reports analysis of the one hundred largest banks in the world in 2017, referring to their financial years 2005 and 2015. Information on the incentives' use was collected from these reports. Only one fraction of the banks released the use of incentives as indicated in Table 7.

The small difference between the 32 banks that granted incentives and the 31 banks that did so in 2005 suggests that the banks under consideration that granted these incentives in 2015 are practically the same that did it in 2005. Likewise, all 28 banks that granted options did so in 2005, but in 2015 the number fell to 11. In 2005 the number of banks granting options exceeded 90% of the sample, while only about 52% granted stocks. This proportion practically reversed in 2015 when about 61% granted options against about 78% that granted stocks. Notwithstanding, the number of banks using stock decreased slightly from 16 (94.12%) to 14 (82.35%) in this period from 2005 to 2015, while the number opting for options fell from 28 (100%) to 11 (39.29%), confirming, on the one side, the greater options' sensitivity to market instability, and suggesting, on the other side that all banks that were selected based on the criteria for granting options

TABLE 7.

A sample from the 100 world's largest banks in early 2017 with cross-data.

FY-Report	(1) # Banks	(2) Stock	%	(3) Options	%
TOTAL	32	17	53.13	28	87.50
%	100.00	100.00		100.00	
2005	31	16	51.61	28	90.32
%	96.88	94.12		100.00	
2015	18	14	77.78	11	61.11
%	56.25	82.35		39.29	

From a total of 32 banks that granted either equity or options, 31 did it in 2005, and 18 in 2015; 17 have granted stock, and 28 have awarded options. From the total of the 31 banks that granted either equity or options in 2005, 16 have granted stock, and 28 have awarded options. From the total of the 18 banks that granted either equity or options in 2015, 14 granted stock, and 11 granted options. From the total of the 17 banks that granted equity, 16 did it in 2005 and 14 in 2015. And from the total of the 28 banks that granted options, all of them did it in 2005, and only 11 did it in 2015.

did it in 2005. This trend was reflected in the banks' number that granted incentives in general, which fell from 31 (96.88%) to 18 (56.25%).

Tables 8 (8.1 and 8.2) depict relevant financial data for seven banks composing a sample of large banks that have disclosed the use of incentives pay. These data are from three Australian and four United Kingdom banks. When compared to this study period, all banks have improved their current position, except for the Royal Bank of Scotland Group (henceforth RBSG) and the Australia & New Zealand Banking Group, which fell out of the world's top 100 banks. The Barclay PLC rose from 18th to 5th place, the Lloyds Banking Group from 24th to 15th place, the Commonwealth Bank of Australia from 43rd to 27th place, the Standard Chartered Plc from 48th to 24th place, and the National Australia Bank (henceforth NAB) from 53rd to 32nd place.

The Data from Tables 8.1 and 8.2 show that in 2015 all of the seven selected banks granted stocks, and four granted both incentives type. In 2005 (3) only two banks, namely, the Australia & New Zealand Banking Group, and the RBSG granted more options than equity, and in 2015 only the NAB did it. However, comparing the two FYs, in 2015, in general, there was a remarkable decrease in the options use while increasing the stock use, except for Barclay PLC and Commonwealth Bank of Australia, which reduced the use of both incentives, especially the options that dropped respectively from 2,060,000 and 250,000 to zero. Similarly, Standard Chartered Plc. dropped the options' use from 154,479 to zero, but, in compensation, it increased notably the stocks' use from 938,780 to 3,155,635. Notwithstanding, the options' use was not fully abandoned, the

Table 8.1 — Data from the 7 most standardized banks in FY2005. All of the 7 banks granted stock as well as options.

Bank	Country	Total asset ($\times 10^6$ €)	Total equity ($\times 10^6$ €)	Investment ($\times 10^6$ €)	Granted equity	Granted options
Australia & NZBG	Australia	196,433.95	13,056.96	4,650.47	377,261	530,004
CBA	Australia	220,453.45	11,532.04	6,917.08	2,356,025	250,000
NAB	Australia	281,123.96	17,460.20	38,837.22	5,149,812	900,000
Barclay PLC	UK	1,016,792.70	26,873.00	93,721.00	27,169,953	2,060,000
Lloyds Banking Group	UK	340,729.40	11,693.00	32,120.00	4,215,545	521,876
RBSG	UK	854,509.70	41,298.40	22,936.10	184,585	1,037,603
Standard Chartered Plc	UK	236,605.60	13,566.30	33,343.56	938,780	154,479

Table 8.2 — Data from the 7 most standardized banks in FY2015. All seven banks granted stock in 2015, but three failed to do so with options.

Bank	Country	Total asset ($\times 10^6$ €)	Total equity ($\times 10^6$ €)	Investment ($\times 10^6$ €)	Granted equity	Granted options
Australia & NZBG	Australia	596,233.00	38,426.51	26,974.20	4,039,566	290,419
CBA	Australia	585,208.82	36,123.05	51,805.07	1,545,391	
NAB	Australia	639,884.84	35,505.31	59,864.50	192,218	208,432
Barclay PLC	UK	1,232,013.20	72,450.40	169,595.80	18,130,823	
Lloyds Banking Group	UK	887,356.80	51,678.00	58,124.00	43,451,697	37,151
RBSG	UK	896,948.80	59,561.70	90,306.70	1,280,711	417,486
Standard Chartered Plc	UK	704,531.30	53,363.20	10,803.24	3,155,635	

other four banks kept its use, although on a lower scale. Once the 2008 financial crisis occurred in between these two fiscal years, these changes certainly reflected these banks' reaction to the crisis, implementing management measures and policies, including adjusting the level of incentives used to reduce the crisis's harmful effects to a minimum.

Moving on, now let's apply the above data to the proposed model. This example uses the 2005 RBSG's report data and the 2015 NAB's report data, in a very simplified way. The choice of these banks was due to their relatively large investment in options during the years of study (they granted more options than shares in these years).

With the provided data (investment and equity), using the same weight (0.2) of the equity in the simulated example and the average variation of the equity in each bank during 10 years, one can estimate the market higher return of about 0.44 for the RBSG and 0.62 for the NAB. This enables the estimation of the highest expectation as €37,156,482,000.00 and €86,204,880,000.00, and the investment policies as 0.77 and 0.82 respectively.

Assuming the risk-neutrality of the shareholders and that the least expectation for both the RBSG and the NAB was fixed at €1,000,000,000.00, this yields the optimal $q^* = 0.61$ and $tcf^* =$ €25,732,545,520.14 for the RBSG and the optimal $q^* = 0.69$ and $tcf^* =$ €64,165,049,344.00 for the NAB. However, the manager's most adequate investment policies and results are $q^m = 0.2439$, and $tcf^m =$ €23,353,063,665.08 for the RBSG, and $q^m = 0.3125$ and $tcf^* =$ €57,837,201,718.75 for the NAB, with €5,004,183,665.08 and €9,945,601,718.75 as the total reward for shareholders, for which the banks used €4,587,220,000.00 and €11,972,900,000.00 of their equity respectively. This would represent an increase of about 15.32% of the used equity and about 1.7% of the total equity from the RBSG. Meanwhile, the NAB would record a decrease of 16.93% of the used equity and 5.71% of the total equity. An increase of these variables in this bank would be possible only for the least expectation of about €10,000,000,000.00.

Like this, the RBSG's equity would rise from €702,805,425.94 to €42,001,205,425.94 corresponding to $k = 51,684,084,227$ shares (€0.8126526 per share). Being certain that the investment was successful, this would convert the 184,585 granted equity into €150,003.48 and the exercise of the 1,037,603 granted options would yield €843,210.78, increasing the equity in €993,214.26. Using the same reasoning, the National Australia Bank's equity would fall to €33,478,011,718.75, corresponding to $k = 49,967,181,670$ (€0.67 per share). Although the investment was not successful, this would convert the 192,218 granted equity into €128,786.06 and the exercise of the 208,432 options would yield €139,649.44, increasing the equity in €268,435.50.

Turning to the option-based incentives, since the number of granted options is known, and $x = \rho s$, for $\rho = 0.1$, one can estimate the expected return for the RBSG as €4,200,289,186.42 and for $\rho = 0.3$ one can estimate the expected return for the National Australia Bank as €10,043,487,305.51, somewhat close to the total reward of €5,004,183,665.08 for the RBSG, where the simulation records profits; and the total reward of €9,945,601,718.75 for the NAB, where the simulation records losses.

Although we used real data from these two banks, the relaxation of the context corresponds to a results' validity only in the simulation context yet, to show the usefulness of both forms of equity-based incentives (stocks and options). This occurs because not all values of the variables are available for more precise calculations. Two of these variables are x and ρ. However,

the ease with which the values of these variables can be manipulated to adapt their effect to different circumstances is an additional advantage of options.

9. EXTENSIONS

The JSS (2000) model contribution to the literature suggests a more direct mechanism to influence banks' risk-taking incentives. In extension, this model brings a new approach, by suggesting an unexpected usefulness of options in banking as an additional payment mode, and portfolio diversification as a path to the potential development of the study, plus serving as support for more complex and reflexive studies of situational reality, which may result from lifting the relaxation of some assumptions.

10. CONCLUSION

This study assesses option-based incentive pay in the banks, based on the JSS and the Stoughton-Wong models, in search of an optimum reference for the bank managers' incentive pay, which aligns the managers' and owners' interests, in a more simplified context, to enable an easier understanding of the influence of the variables.

Technically, the results mirror the linearity of the effect of α in the payment contract, which does not allow establishing an optimal limit for the stock parameter, in its range $[0, 1)$, which means that the manager could benefit from almost all returns (if $\alpha \approx 1$); Nevertheless, this lack of reference gives shareholders the freedom to randomly define incentive parameters when setting payment contracts, although this reduces the level of objectivity in decision-making. Therefore, as this can benefit shareholders and possibly managers as well, the mentioned parameter does not help in optimizing stock-based incentive pay. Other variables are required to help set an optimum reference for the objective design of managers' payment contracts. This brings us to options.

Interestingly, this doesn't seem to impress banks since options are not often used, although they are a necessary variable to optimize incentive payments. This suggests that either other mechanisms exist to optimize incentive compensation in banks or that shareholders are not interested in an optimal managers' compensation contract that could be more expensive. Another reason may be the long-term incentive nature of options that do not fit into the short-term management that liquidity (deposits) imposes.

Another reason may be the option-based incentive long-term feature that does not fit into the short-term management that liquidity (deposits) imposes.

In this study, we assume that depositors and regulators can observe q through public information about the bank's activity. However, a potential avenue for further study development (beyond the issue of risk aversion and even within this) is its extension to more sophisticated settings, i.e., assuming the outsiders' incentive to exert an π-amount of effort to observe q with Φ-accuracy, although this monitoring has costs for both the bank and the outsiders, and eliminating the assumption of risk neutrality, since risk aversion for all actors is more common. The results are related only to banks, following the restrictions mentioned in the introduction section.

In an attempt to address concerns regarding the comparison between stock-based and options-based pay, the model results show that, depending on the factors influencing the business environment, pure stocks may prove to be better than options only in some cases, but the options are more advantageous in most cases. However, in addition to the advantages already identified in the literature, options provide a reference that allows managers to set their goals, when the number of granted options or the parameter β value are known. Options allow for the computation of an optimal outcome, a feature that pure stock alone does not have.

Thus, in this study the main findings can be summarized in the following points: (i) although previous studies have shown that the options are more adapted to the reality of industrial companies, banks can perfectly use them; (ii) being options more useful for hiring and retaining managers, this use can also be done in banks; (iii) since there continues to be an adverse tendency towards depositors when the alignment of managers' and shareholders' interests tends to encourage the making of concordant but very risky decisions, which is more influenced by stocks than by options, as a reason for the preference of stocks by banks instead of options, these last appear to be a solution for this constraint in that they allow the determination of a performance contingent optimal. In this way, options appear mainly as a way of mitigating the agency problem (managers' and shareholders' moral hazard vs. depositors and bondholders), establishing an alignment between the parties through the possibility of determining optimal contracts that options confer.

The main results confirm the findings of a previous study by Choe and Yin (2006). In addition, they extend the JSS (2000) model contribution by bringing a new approach that suggests an unexpected usefulness of options in banks as an additional pay mode and the portfolio diversification, and the lifting of the relaxation of some conditions, as a path for potential development of the study.

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