How incentive payments encourage innovation? A meta-analysis study

Zahra Lotfi

Friedrich Schiller University Jena, Graduate College “The Economics of Innovative Change”

Abstract:

The literature offers contradictory findings about the relation between incentive pay and innovation. On the one hand there are studies that represent the positive relation and suggest that incentive compensation is a proper motivational tool to promote innovation. On the other hand, some scholars point to the existence of a negative relation. In order to clarify the diversity of existing finding, we apply meta-analysis in this study. Meta-analysis of 43 studies enables us to find a positive and significant association between incentive compensation and innovation. Moreover we investigate the moderating role of study characteristics on the direction and scope of the interested relation. Results indicate that the different measures of innovation and the target group for compensation have a moderating effect on the incentive-innovation association.

Introduction:

Studies show that firm-level innovation can lead to economic growth (e.g. Aghion and Howitt, 2006) and this relation is intensified in technology sectors (Leary, 2002). Innovation is a pivotal factor for firms' and nation's competition and the firms investing in research and development (R&D) can get technological advantages over their rivals. People have been considered as a key resource in innovative organization and successful innovative organizations should know how to generate motivation and reward people (Gupta and Singhal, 1993). One of the effective human resource strategies that can affect innovation is reward system (Gupta and Singhal, 1993). Reward system can generate motivation in employees to achieve different organizational goals namely, innovation. Innovation is associated with uncertainty and employees in order to improve innovation in firms should think about firms' long-term success. High amount of intrinsic motivation, autonomy and freedom are critical factors in promoting innovation (Amabile and Gryskiewicz, 1987). Therefore reward system can be effective in fostering innovation as long as it provides employees long-term perspective, autonomy and motivation to take risks. The aim of this study is to review whether variable rewards provide such motivation and improve innovation in firms.

Variable payment is widely used in firms, particularly stock options are a prevalent pay scheme in new economy firms (Anderson et al., 2000; Ittner et al., 2003). Some school of thought believes that applying variable payments might not be a proper stimulant for innovation activity since incentive payments basically motivate executives to focus extremely on short term (Walker, 2010). This can lead to the fact that individuals usually do not have incentives to focus on long-term measurements of performance like innovation. Some researchers indicate that extrinsic compensation by reducing intrinsic motivation, autonomy and freedom are likely to weaken employees' innovation behavior (Amabile et al., 1986; Cooper et al., 1999). Despite the evidences indicating negative effect of incentive payment on innovation, some recent studies find that incentive payments specifically in the form of stock option work well for innovation (Bereskin and Hsu, 2011; Francis et al., 2010; Lerner and Wulf, 2007). These studies argue that long-term payments like stock option can create long term commitment in executives, therefore encouraging them to foster innovation. By reviewing previous literature, mixed results have been found relating to the effect of incentive payment on innovation. In this study through meta-analysis we make a systematic overview of studies that examine the relation between variable payments and innovation.

Meta-analysis is a statistical technique that have been widely applied in economics (Stanley, 2001). Meta-analysis summarizes and integrates the results of many empirical studies. The advantage of this method is that it eliminates confounding effect and enhances statistical power (Cohn and Becker, 2003; Stanley, 2001). Basically, authors and journals prefer to publish significant results and results which are more in accord with theories (Card and Krueger, 1995). Therefore many published empirical results might suffer from publication bias. Meta-regression analysis (MRA) helps us to detect the publication bias and identify the precision effect regardless of bias (Stanley, 2008). In this study we analyze the results of 43 empirical studies by applying MRA in order to find genuine effect between incentive pay and innovation.

Theoretical Framework:

The question if compensation practices can provide incentives to innovate has been addressed by various studies. But there is no solid empirical evidence on this subject. The current study deals with one commonly used compensation scheme which is variable compensation. By reviewing prior studies, we could find two perspectives regarding the impact of variable compensation on encouraging innovation. In the following section, we extend these two arguments.

Positive impact of variable compensation on innovation:

Based on some studies, variable monetary rewards can be considered as effective motivational tool for improving innovation (e.g. Balkin et al., 2000; Francis et al., 2010; Honig-Haftel and Martin, 1993; Laursen and Foss, 2003; Lerner and Wulf, 2007). These studies apply the agency theory in order to support their arguments. Agency theory expresses that shareholders, in order to encourage managers to perform according to shareholders' interest, link their payment to firm performance (Jensen and Meckling, 1976). Therefore, performance-based pay can motivate managers to exert more effort and increase firm performance in order to get higher rewards. Regarding innovation activities, based on Balkin et al. (2000), the payment of agents should be linked to innovation activity of firms rather than to firms' financial performance. Also in high-technology firms, mostly the payment of engineers and scientists is related to meeting innovation goals (Balkin and Bannister, 1993). Linking executives or scientists pay to innovation activity stimulate them to allocate more resources to innovation and bear more risk (Balkin et al., 2000).

Among different types of performance-based payments, the effect of long-term payments such as stock options and equity compensation have been highlighted as stimulant of innovation activity (Chang et al., 2015; Francis et al., 2010; Lerner and Wulf, 2007; Yanadori and Marler, 2006). Specifically high-tech firms are more likely to apply this type of incentive compensation (Balkin and Gomez-Mejia, 1985). Lerner and Wulf (2007) state that over 1990s the uses of long-term incentives have increased dramatically among corporate R&D heads. Innovation activities are associated with long term perspective, since the benefits of R&D spending are realized after some years (Balkin et al., 2000). Employees who are associated with innovation like R&D employees should also have the long-term perspective in order to implement innovation strategy successfully. The recent study by Chang et al (2015) posits that non-executive employees stock option have a positive effect on innovation output. Designing employees' compensation in the form of long-term pay can incentivize them to focus on the firm's long-term success and take more risk in innovation activity. Given the long-term characteristic of innovation projects (Holmstrom, 1989), employees engaging in these projects require to stay long-time in firms. Long vesting period of stock option is a factor that can retain employees in their firms until their options become exercisable (Rajan and Zingales, 2000). Moreover Francis et al. (2010) believe that long-term payment decreases the fear of failure in executives. Innovation activity is characterized by high uncertainty and risk, so it's more likely that agents fail in their decision and investment in the short-run. They are not penalized for their early failure when they receive long-term payments like stock option, since the long-term performance of agents are considered in this compensation (Francis et al., 2010).

There are also some studies that focus on long-term compensation on the CEO or top management level (e.g. Certo et al., 2003; Sanders and Hambrick, 2007). These studies point out the positive effect of the long-term incentive, stock option, on risk taking behavior. Sanders and Hambrick (2007) in their study highlight three main effects of CEO's stock option reward. First, stock option can overcome the problem of CEO shirking by aligning their interests to shareholders interests. Second, stock option can prevent myopic decisions of CEOs. When CEOs are paid stock option, after some years they can exercise the options so the long-term performance of the firms affect their payment and this can induce them to have long-term investments. Third, one of the important roles of stock option is that it can encourage CEOs to take risky decisions. Stock option allows CEOs to partake in firm's gains, the limited downside risk of stock option to managerial wealth provides motivation in CEOs to undertake risky projects in order to earn the potential profit of their investment and increase share price (Sanders, 2001; Wright et al., 2007). When executives invest largely on uncertain projects, it is more likely that the company's share price is affected and the firm has bigger return (Core et al., 2003). Also top managers will not exercise their option when the firm's stock price goes down, so the chance of loss will decrease in this type of compensation.

Negative impact of variable compensation on innovation:

There are some arguments that prove the existence of a negative relation between variable compensations and innovation. Amabile (1997) highlights the role of intrinsic motivation in creativity. Intrinsic motivation encourages people to engage in tasks since these tasks are challenging, interesting and involving. People are more likely to create since the interest, challenge, satisfaction and enjoyment of the work make them feel motivated (Amabile, 1997; Amabile, 1998). In addition to creativity, intrinsic motivation is also considered as a component of innovation in organizations (Amabile, 1988). Innovation activities are associated with long time horizon and high uncertainty, so employees are likely to engage in these activities when they are intrinsically motivated. Some studies in psychology and psychological economics argue that monetary compensation such as pay-for-performance can undermine intrinsic motivation of people in interesting tasks (e.g. Amabile, 1998; Fehr and Gächter, 2001; Frey and Oberholzer-Gee, 1997; Lepper et al., 1973). When intrinsically motivated people are paid stock options or bonus for doing interesting tasks like innovation, they might lose their interests in what they are doing and only focus on the reward, therefore their attention might be directed from innovation to monetary compensation. Emphasizing strongly on money cause employees to carry out less precise work and only follow 'tried-and tested rout' (Frey and Osterloh, 2002). It should be mentioned that the detrimental effects of extrinsic motivation is more likely when the monetary rewards are perceived as controlling relative to informative (Ryan et al., 1983) . When monetary rewards are perceived as controlling, people are under pressure to achieve specific goals and their intrinsic motivations get reduced in interesting tasks.

The negative impact of variable compensation on innovation can also be supported based on the multitasking problem. According to this problem, when people are paid based on their performance they mostly pay attention to the tasks whose outcomes can easily be measured. Hence, other tasks that are less quantifiable, are neglected (Holmström and Milgrom, 1991). For instance when a salesperson is paid based on the numbers of goods sold, he only maximizes the short-term sale in order to earn more money but the other activities like customer satisfaction or recognizing customer desires are ignored by him. Therefore this motivational distortion has detrimental effect on long-term performance and growth of the firm (Frey and Osterloh, 2002). When individuals are paid based on their performance for innovation activity, they focus on the tasks that increase firm's share price and value in short run in order to increase their payment, so it's unlikely that they invest in innovation activity. The reason is that it takes some years that R&D investment yield its return, which leads to lower firm's short-term benefit (Gibbs, 2012). The multi-tasking problem can occur in different groups who are associated with innovation activities. For instance, top managers basically invest in short–term projects in order to increase firm's value and show their ability to boards (Laux, 2012). When their compensation is tied to financial and stock price performance, they prefer to focus on tasks that enhance the firm's profit in the shortest way (Jensen et al., 2004). Also this type of compensation directs mangers attention to predictable and easily measurable short-term activities, so top managers don't allocate resources to innovation activities since they know these activities affect the firm value in the long-run (Hitt et al., 1996). Moreover, multi-tasking problem might lead R&D employees, who are closely involved in innovation, issue low quality patents. Incentive pay might distort their incentive in a way that they only increase the number of patents in order to enhance their payment without considering the quality of the innovation.

Remuneration of employees can be also in the form of stock option. Stock option because of its long term horizon is assumed to be effective in encouraging employees to invest in long-term projects (Murphy, 1999). However when R&D projects take longer than vesting period of option, the stock option lose its impact in inducing long-term horizon (Honoré et al., 2015).

While reviewing two arguments regarding the impact of incentive pay on innovation, the inconsistency in empirical results can be realized. Given the importance of incentive pay in firms and research and its critical role in innovation, we conduct a meta-analysis to examine the true relationship between incentive pay and innovation. In the next section of the paper we introduce the applied methodology to find the real relationship.

Method:

Empirical results are diverse across studies since they apply different data sources, model specifications, and various measurements of variables. Deriving clear inferences using qualitative reviews might be difficult despite of these differences. In this situation using an effective technique which systematically review empirical finding on specific subject might be helpful. Meta-regression analysis, by reviewing all existing empirical studies comprehensively and aggregating the results of various studies, can provide more authentic estimates than the individual study (Stanley and Doucouliagos, 2012). In this study we have searched in the literature to find the empirical studies that have explored the relation between variable pay and innovation. In the following section we explain the criteria we have used to collect the sample of studies.

In order to select our sample we have searched Google scholar, Elsevier, Business Source Premier and Jstor databases for the combination of the keywords “pay for performance”, “incentive pay”, “executive compensation”, “CEO compensation”, “employee compensation”, “innovation”, “R&D” and “R&D intensity”. In order to find further studies we also used the references cited in these surveys. Data collection is limited until September 2014, so any paper published after this date has not been included in the sample.

We adopted some criteria to include studies in the sample. First, studies that consider variable payment of managers, employees and R&D heads are included. Relating the measurements of compensation and innovation, both long-term and short-term compensation and patent, R&D intensity and innovation performance have been considered. Second, in addition to published studies we also included working papers in order to reduce publication bias. Third, the studies should provide enough statistical information to be able to calculate the effect size. Therefore we excluded studies that do not include information like t- values and sample size which are necessary for determining the effect size. Fourth, studies that are published in English are taken into account. The extensive review of the literature enabled us to find 43 studies that report 301 estimation of compensation-innovation relationship. Each study by applying different measurements of variables or different models might report more than one estimation of compensation-innovation association. Therefore we have 301 estimations for 43 studies.

Measurements:

Effect size: Our dependent variable is effect size that measures the strength and direction of compensation-innovation link. The reported coefficients within studies cannot be considered as a dependent variable since using different approaches in studies make them incomparable. Instead, we can use effect size that encodes relationship of interest in to a common index. The effect size that we use in this study is partial correlation. It measures the correlation between compensation and innovation. We calculate partial correlation as follows:

$$r = \frac{t}{\sqrt{t^2 + Df}}$$

Where *t* reports the t-statistics of the regression coefficient and *Df* denotes the degree of freedom of t-statistics.

Moderator variables:

One of the principal applications of meta-regression analysis is to identify the effect of different study characteristics on estimated compensation-innovation association. Each of 43 studies used different dataset, different specification, different time periods, different control variables and different industry. Applying meta-regression analysis enables us to detect quantitatively the impact of these differences in study characteristics on estimated compensation-innovation link. In the following we consider set of moderator variables to control for the effect of different study characteristics.

Theoretical aspect:

We collected the data about the underlying theory at the study level. The studies develop different theories in order to discuss the relationship between compensation and innovation. We divided these theories into three categories namely agency theory, crowding-out theory and other theories. The agency theory category relates to the group of studies that discusses agent-principal theory. The crowding out theory category includes all studies that discuss crowding out theory, behavioral or psychological economics theory. The studies that develop other theories than the first two groups are placed in the third group. We constructed dummy variables for each group; 1 if each study discusses specific theory in the categories considered, and 0 otherwise.

Publication outlet:

We controlled whether the study is published in a journal or is still a working paper. Moreover we considered the type of journal in which the study has been published. We have three categories for the type of journal: Economics, Management/Business and Finance and each category has been indicated by dummy variables. We also collected data about the impact factor of each journal. Impact factor illustrates the average number of citation that an article receives in the first two years after publication from other articles. Basically each journal provides its impact factor so information regarding this variable can be found in the website of journals. We considered the impact factor of zero for working papers. We also controlled for the time that each study was published.

Sample characteristics:

The sample of each study has particular characteristics. We controlled for some of these characteristics in sub-effect level. First we gathered the data regarding the nationality of the firms existing in the sample. More than 50% of studies considered US firms therefore we constructed a dummy indicating whether the study is US-based or non-US based. The type of industries is another factor that we controlled. Three categories of Manufacturing, service and high technology industry are constructed and dummy variables are considered for each category. Concerning the compensation, we consider the group of people whose compensation is selected. Basically the studies in the meta-analysis took into account the compensation of different groups that we summarized to three categories: Managers, R&D heads and employees.

Methodological aspect:

We documented the method of analysis that estimates the compensation-innovation association. NonOLS is a binary variable taking the value of 1 if the study applies estimators other than OLS. This study also considered whether studies included industry fixed effect, time period fixed effect and time-lag effects in the estimation. Time-lag effect relates to the lag of main explanatory variable, i.e. compensation variable. There might be less methodological problems in studies that control for industry and year fixed effects since they remove some confounding factor of the compensation-innovation link.

Data:

The studies used different databases in order to answer their research questions. Some of the studies also conducted survey to collect data. So we control whether the studies applied secondary databases or they did survey to gather data. Types of the data that are used are also documented as panel and cross-section data. Furthermore we controlled for the time period of data and defined four time intervals to cover the whole time periods: 1980-89, 1990-99, 2000-09, and 2010-14.

Control variables:

In order to measure innovation and compensation, different specifications have been applied. We try to summarize these methods of measurements to particular categories. In the case of innovation, the most common measurement was patent and patent citation. Other frequent measures in selected studies are R&D intensity (defined as ratio of R&D spending to sales) and spending on R&D. Innovation performance (defined as a scale or dummy variable) is also reflected in some studies as measure of innovation. In the sample of studies selected, the compensation measurements comprise cash payment, bonus, stock and stock option. Furthermore we control for the time period analyzed by each study and defined four time intervals to cover the whole time periods: 1980-89, 1990-99, 2000-09, and 2010-14.

The selected studies in their models control for factors that affect compensation and innovation with different control variables. By reviewing all the control variables, they can be divided into two groups; CEO characteristics and firm characteristics. Firm characteristics include firm size, firm age, firm performance and firm growth and CEO characteristics comprise CEO age, tenure, background and ownership. So we include these two groups in the moderator variables in order to document the control variables of studies since these variables might affect the size of estimated compensation-innovation effect.

Table A1 summarizes all the moderator variables. Table A1 illustrates that 98 percent of studies focus on manufacturing industry, 77 percent of studies used US firms data, 49 percent of studies used patent and patent citation as measurement of innovation, and 70 percent of studies used stock option as proxy of variable compensation.

Reporting bias analysis:

Reporting bias, which is the propensity in reporting statistically significant results, has been a serious concern in social science and medical research. The bias can be considered as a threat to empirical inference and validity of policy implication that are drawn from empirical results (Doucouliagos and Stanley, 2013; Stanley and Doucouliagos, 2014). Reporting bias is also a widespread problem in economics and as De Long and Lang (1992) found, it is present in top economic journals. Moreover Doucouliagos and Stanley (2013) in their recent study documented 'substantial' and 'severe' publication bias among 87 separate areas of economics that comprises more than three and half thousands empirical economic research. Reporting bias can be distinguished by two tests: funnel plot test and FAT test (Egger et al., 1997; Stanley and Doucouliagos, 2010).

Visual examination of funnel plot is usually used in order to detect publication selection (Stanley and Doucouliagos, 2010). Funnel plot is a scatter diagram that can be drawn with effect size on the horizontal axis and its estimated precision (precision is inverse of estimates' standard error, 1/SE) on the vertical axis. Asymmetric or skewed funnel plot can indicate the presence of publication bias, since as a consequence of publication or reporting selection, the estimates are biased and the true empirical effects are exaggerated. In contrast, symmetric funnel plot around the mean of effect size can show that there is no reporting bias in the literature.

In addition to funnel plot, FAT (funnel asymmetry testing) can be applied to identify reporting bias more precisely (Egger et al., 1997; Stanley, 2005). In this test, meta-regression analysis is used to examine the presence of reporting bias and also detect the genuine effect between two variables of interest. When the reporting bias is absent, all the results have equal chance to be accepted for publication therefore estimated effect size and its standard error have no relationship. However, in the presence of reporting bias, there is significant relationship between effect size and its standard error since the lower precision estimation (higher standard error) should report larger effect size in order to get statistically significant result and be published. Therefore:

$$r_i = \beta_0 + \beta_1 SE_i + v_i \tag{1}$$

where r_i is partial correlation, SE_i is its standard error and v_i is error term. Study characteristics such as data sources, time period, specifications can also be considered as explanatory variables in this equation. Testing H_0: $\beta_1 = 0$ that is the test of the funnel graph's asymmetry (FAT) can illustrate whether there is reporting bias (Stanley, 2005) and by testing H_0: $\beta_0 = 0$ the genuine effect between compensation and innovation adjusted for reporting bias can be found out. The latter test is called precision effect test (PET) by Stanley (2005). For estimating this meta-regression model, ordinary least squared (OLS) cannot be applied since this model has heteroskedasticity and SE_i and v_i vary from one study to the next. Each study might apply different specification, different sample size or different data base, so the SE_i and v_i may not be equal. Therefore weighted least square (WLS) can be used in order to estimate the model. Stanley and Jarrell (1989) suggest that in order to correct for heteroskedasticity both sides of the equation can be divided by SE_i then:

$$t_i = \beta_1 + \beta_0 (1/SE_i) + e_i \tag{2}$$

where t_i is the t-statistics of each estimated empirical effect, and $1/SE_i$ is precision. In this equation the slope of precision, β_0, indicates the genuine effect between compensation and innovation and the intercept, β_1 tests the reporting bias. In this study meta-regression model (2) has been used in order to do FAT and PET tests.

Meta-regression Analysis:

In this study as explained in previous section, weighted least square (WLS) has been applied to estimate meta-regression model. In order to estimate meta-regression model, fixed-effects and random-effects models can be applied. The assumption of fixed-effect model is that all studies are sampled from the same population and they estimate one true effect size. In this case the one source of sampling error is within studies differences. In fixed effect model, the weight assigned to each study is inverse of effect size variance (within-studies variance). In contrast, random-effect model assume that studies sampled from several population and estimate various effect size. Random–effect model weigh each study by inverse of effect size variance but in this model the variance contains two components, within-studies variance and between-studies variance (Borenstein et al., 2007).

Results:

Reporting Bias Test:

Funnel Plot. Visual inspection of funnel plot is one way to detect reporting bias. Figure 1 presents the distribution of the estimates with partial correlation of compensation and innovation on horizontal axis and its inverse standard error (precision) on vertical axis. As can be seen in the figure, the plot is relatively symmetric, numbers of studies that reported positive results on compensation-innovation link are roughly equal to studies that reported negative results. So according to the plot, we can conclude that reporting bias in the selected compensation-innovation literature is absent.

Insert Figure 1 about here

FAT test. Based on equation (2) we can do the FAT test in order to examine the presence of reporting bias. First we run this model without control variables. Table 1 presents the results of this test. This meta-regression model can be estimated by WLS and it is weighted by precision of a study. The first column relates the results of fixed effects and the third column reports the results of random-effects model. We also cluster meta-regression by study; the results are comparable to the sub-effects model. As we can see in the results in both cases the intercepts are insignificant so there is no evidence of reporting bias in the sample of studies selected. This statistical result confirms our visual impression from funnel graph (Figure 1). We found symmetric funnel graph that is in line with finding insignificant intercept in equation (2).

PET test. In order to find the genuine empirical effect regardless of reporting bias, we employ meta-regression analysis. In this test we try to estimate the coefficient of precision in equation (2), therefore this test called precision-effect test (PET) (Stanley, 2005) . The results of the test can be found in Table 1. As can be seen in the results, the coefficient on precision is +0.07 and significantly positive presenting that when all studies are considered, variable compensation is positively correlated with innovation. By controlling for study diversity (Table 3), the positive corrected effect hold.

Insert Table 1 about here

Firms in different countries are likely to be different regarding the compensation and innovation strategy. For instance the innovation pattern of German firms is different from US and UK firms (Soskice, 1997). Regarding the compensation schemes, US executives own more shares than other countries like Japan (Kaplan, 1994). Two surveys in US and Europe which provide information on individual incentive pay during 2000 to 2006 also report striking difference in the diffusion of employees' incentive pay across countries (Bryson et al., 2012). Thus in order to consider country-specific effect of compensation on innovation, we attempt to separately estimate the compensation-innovation link in US and non-US firms. The results of this analysis are shown in Table 2. We apply WLS and fixed effect model to estimate the relation. According to the findings in both US and non-US firms the coefficient on precision is positive and significant which suggest variable compensation has a positive effect on innovation in United States as well as in non-US countries. However the compensation- innovation effect is slightly larger in United States which is expectable since US in compare with other countries apply more incentive payment schemes for individuals (Bryson et al., 2012).

Insert Table 2 about here

In the next stage we run the equation (2) including study characteristics in order to investigate the mediating effect of different study specifications on compensation-innovation relation. For example this equation can be used to identify whether differences between short-term and long-term incentive pay and differences between input or output-based measures of innovation activity affect estimated size of compensation–innovation effect. Differences in study characteristics can be considered as a source of potential differences in estimates of compensation-innovation effect. Initially, we include all moderator variables in the base regression model. The results are presented in column 2 of Table 3. As can be seen in the results, many of the moderator variables are insignificant in this model. In the next model the general-to-specific modeling strategy has been applied (see Hendry, 1995). According to this strategy the insignificant variables are sequentially eliminated until all the remaining variables are statistically significant at 10 percent level of significance. By adopting this strategy the redundant and insignificant variables are removed and clarity can be improved. The final model is displayed in column 3. The meta-regression results presented in column 4 and 5 relate to only studies that used R&D intensity and patent activity as the measure of innovation, respectively. This allows the investigation of the effect of different incentives on estimated compensation-R&D intensity and compensation-patent effects. Previous studies find different effect of incentive schemes on input and output-based measure of innovation. For instance while short-term incentives have been found to have a negative effect on input-based measure of innovation (e.g. Xue, 2007), they do not have effect or have positive effect on output-based measure of innovation (e.g. Burhop and Lübbers, 2010; Lerner and Wulf, 2007). So the incentive variables (stock option, stock and bonus) are the key variables of interests in these analyses.

Results presented in both general and specific models indicate that the positive effect between compensation and innovation hold even after controlling for main differences between studies. Regarding the theories developed by studies, the coefficient on crowding-out theory is positive and significant which suggest that studies discuss crowding-out theory, behavioral or psychological economics theories report larger compensation-innovation effect. According to the results, types of journal in which the studies publish affect compensation-innovation association. A smaller compensation-innovation effect emerges when studies publish in finance Journals compared with studies that publish in management and business journals as a base group. Also studies publish as a working paper report lower link rather than studies publish in a journal and this highlights the difference between findings of working and published papers. This difference might be due to the fact that working papers usually have not been peer reviewed. The coefficient on variable Year 2010-2014, capturing the time period of data used (with the year 1990-1999 as the base), is positive and significant in 10 percent level. This finding can show that the interested association might be larger in recent years compared with prior decades.

The target group of compensation does make a difference. Considering the incentive scheme of employees rather than managers (CEO and managers are base group) results in lower positive compensation-innovation effect. This finding suggests that incentive pay persuades managers more to invest in innovation activities, relative to employees. So by comparing managers and employees, variable compensation can be considered as a more effective motivational tool in risk taking for managers. In line with this finding, Bova et al. (2012) point out to the setting that when executives are motivated to take more risk, incentive scheme (stock holding in their study) might mitigate non-executive employees risk-taking.

Moreover the measure of innovation activity and variable compensation exert a moderating effect on compensation-innovation relation. As can be seen in the results, negative and significant coefficient on innovation performance reveals that studies that use innovation performance as measurement of innovation reported lower compensation-innovation link, rather than studies that applied numbers of patent and patent citation as proxies of innovation (Patent and citation is base group). The variable innovation performance relates to study that conducted the survey to collect data and they measure innovation with dummy or scale variables. Regarding measurement of variable compensation, compensation-innovation link is larger when stock ownership has been used as a measure of variable compensation.

Relating type of data in studies we could find that using cross-section data result in higher link rather than panel data (Panel data is a base group).

The inclusion of Firm and CEO characteristics as control variables does not affect the reported compensation-innovation effects. After controlling for other study characteristics, there is no difference in compensation-innovation effect between studies that use secondary database and did survey. Similarly, considering industry, year dummy and time lag effect produce the same compensation-innovation effect, once other study differences are controlled for.

In column 3 of Table 3 we restrict our sample to studies that measure innovation with R&D spending and R&D intensity. In this column we can see how different measurements of variable compensation affect compensation-R&Dintensity association. Among incentive variables, only Bonus variable is statistically significant. Measuring compensation with short-term incentive tend to decrease the reported compensation-R&Dintensity effect. This is in line with finding of study by Xue (2007) which states that accounting-based compensation like cash bonus cannot provide risk taking incentives in managers to pursue innovation through internal R&D. Moreover, to explore the effect of short and long term incentives on compensation–patent association we consider only studies that measure innovation by patent and patent citation and the results can be found in column 4. In both columns of 3 and 4 some of the variables are excluded because of multicollinearity. When variable compensation is measured in terms of stock option, the compensation–patent effect is lower whereas measuring compensation with stock ownership increases the magnitude of reported compensation-patent correlation. Thus stock ownership and stock option, as long-term incentives, have different effect on compensation–patent association. This is consistent with the argument by Sanders (2001) states that stock option and stock ownership have different effect with regard to risk taking.

We could not find significant effect for many control variables which indicate the insensitivity of compensation-innovation association to these variables. However this does not imply that these variables should not be considered in empirical investigation. Based on the results we could also find significant effect for some variables which can explain the variation in reported compensation-innovation estimates.

Insert Table 3 about here

Conclusion:

The compensation-innovation association is of great importance. Many empirical studies attempt to find the type of compensation that can stimulate innovation. Narrative review of the relation between compensation and innovation in prior empirical research, reveals how diversified the results are and drawing general conclusion is difficult based on these results. Therefore the inconsistencies in the previous empirical results provide incentive to apply a method that integrates the previous findings to draw general conclusion regarding the compensation-innovation association. Meta-analysis is a method that through a systematic approach is able to estimate the magnitude of the relationship between interested variables. In this study, by using meta-analysis, the association between incentive pay and innovation has been examined. Furthermore, by this approach a better estimate of the strength of the relationship between compensation and innovation can be achieved. Moreover in this study we identify the sample characteristics that act as mediating factors in the interested association.

In this study we apply MRA to 43 empirical studies that report 301 estimation of compensation-innovation relationship. No evidence of publication bias can be found among the selected studies. According to MRA results when all studies are considered, there is a positive and significant relationship between incentive pay and innovation[1]. However this association is weak. Therefore the finding of this study is consistent with those theories that emphasize incentive pay as an important factor in encouraging innovation. We also check whether there is country-specific association between variable compensation and

[1] The results of this study cannot be generalized to service sector since this sector only comprises 2% of the whole sample. So the results basically relates to manufacturing sector.

innovation. The positive association appears for both United States and non-United States and this relation is slightly stronger in the United States context.

The other conclusion that can be drawn from analysis is that the variation in published compensation-innovation effects across studies can be due to differences in data, sample characteristics, type of journal and measures used. The results reveal that the target groups for compensation is important in the relation being studied and it seems incentive payments are more effective for managers rather than employees. Thus the results indicate that incentive payments do not have similar effect on managers and employee with regard to innovation activity. Moreover, different measurements of innovation and compensation give rise to different compensation-innovation correlation, which means that the way innovation and compensation are measured, affect the results.

With reviewing the compensation-innovation effects literature, some weaknesses in this literature have been found out. First, the majority of studies examine this relation in United States so little is known of the effect in European countries. So further studies that analyzing this association in European countries are needed. Second, further investigation is required to identify the relation between variable compensation and innovation in service sector since approximately 98% of studies in the sample focus on manufacturing industry. Third, according to studies in the sample little is known of the effect with regard to R&D employees therefore one possibility for further research is to examine the relation for R&D employees.

References:

Aghion, P., Howitt, P., 2006. Appropriate Growth Policy: A Unifying Framework. 4, 269-314.
Amabile, T.M., 1988. A model of creativity and innovation in organizations.In B. M. Staw & L. L. Cummings (Eds.). Research in organizational behavior 10, 123-167.
Amabile, T.M., 1997. Motivating Creativity in Organizations: on doing what you love and loving what you do. California Management Review 40, 39-58.
Amabile, T.M., 1998. How to kill creativity. Cambridge, MA: Harvard Business School Publishing.
Amabile, T.M., Gryskiewicz, S.S., 1987. Creativity in the R&D laboratory. Technical report no.30, Center for Creative Leadership, Greensboro, NC.
Amabile, T.M., Hennessey, B.A., Grossman, B.S., 1986. Social influences on creativity: the effects of contracted-for reward. Journal of personality and Social Psychology 50, 14-23.
Anderson, M.C., Banker, R.D., Ravindran, S., 2000. Executive Compensation in the Information Technology Industry. Management Science 46, 530-547.
Balkin, D.B., Bannister, B.D., 1993. Explaining pay forms for strategic employee groups in organizations: A resource dependence perspective. Journal of Occupational and Organizational Psychology 66, 139-151.
Balkin, D.B., Gomez-Mejia, L.R., 1985. Compensation practices in high-technology industries. Personnel Administrator 30, 111-123.
Balkin, D.B., Markman, G.D., Gomez-Mejia, L.R., 2000. Is CEO Pay in High-Technology Forms Related to Innovation? The Academy of Management Journal 43, 1118-1129.
Bereskin, F.L., Hsu, P., 2011. New dogs new tricks: CEO turnover, CEO-related factors, and innovation performance. Social Science Research Network.
Borenstein, M., Hedges, L., Rothstein, H., 2007. Meta-analysis: fixed effect vs. random effects. www.Meta-Analysis.com.
Bova, F., Kolev, K., Thomas, J., Zhang, F., 2012. Non-executive employee ownership and corporate risk-taking. Working Paper, University of Toronto.
Bryson, A., Freeman, R., Lucifora, C., Pellizzari, M., Perotin, V., 2012. Paying for performance: incentive pay schemes and employees' financial participation. Centre for Economic Performance, LSE.
Burhop, C., Lübbers, T., 2010. Incentives and innovation? R&D management in Germany's chemical and electrical engineering industries around 1900. Explorations in Economic History 47, 100-111.
Card, D., Krueger, A.B., 1995. Time-series minimum-wage studies: a meta-analysis. The American economic review, 238-243.
Certo, S.T., Daily, C.M., Cannella, A.A., Dalton, D.R., 2003. Giving money to get money: How CEO stock options and CEO equity enhance IPO valuations. Academy of Management Journal 46, 643-653.
Chang, X., Fu, K., Low, A., Zhang, W., 2015. Non-Executive Employee Stock Options and Corporate Innovation. Journal of Financial Economics 115, 168-188.
Cohn, L.D., Becker, B.J., 2003. How meta-analysis increases statistical power. Psychological methods 8, 243.
Cooper, B.L., Clasen, P., Silva-Jalonen, D.E., Butler, M.C., 1999. Creative performance on anin-basket exercise: Effects of inoculation againstextrinsic reward. Journal of Managerial Psychology 14, 39-57.
Core, J.E., Guay, W.R., Larcker, D.F., 2003. Executive equity compensation and incentives: A survey. Economic policy review 9.
De Long, J.B., Lang, K., 1992. Are all economic hypotheses false? Journal of political economy 100, 1257-1272.
Doucouliagos, C., Stanley, T., 2013. Are all economic facts greatly exaggerated? Theory competition and selectivity. Journal of Economic Surveys 27, 316-339.
Egger, M., Smith, G.D., Schneider, M., Minder, C., 1997. Bias in meta-analysis detected by a simple, graphical test. Bmj 315, 629-634.

Fehr, E., Gächter, S., 2001. Do incentive contracts undermine voluntary cooperation? (10.2139/ssrn.229047), SSRN eLibrary. SSRN.
Francis, B., Hasan, I., Sharma, Z., 2010. Incentive and Innovation: Evidence from CEO compensation contract. Working paper, Rensselaer Polytechnic Institute, Troy, NY.
Frey, B.S., Oberholzer-Gee, F., 1997. The cost of price incentives: An empirical analysis of motivation crowding-out. The American economic review 87, 746-755.
Frey, B.S., Osterloh, M., 2002. Successful Management by Motivation. Balancing Intrinsic and Extrinsic Incentives. Springer, Berlin/Heidelberg/New York.
Gibbs, M., 2012. Design and Implementation of Pay for Performance. IZA Discussion Paper No. 6322.
Gupta, A.K., Singhal, A., 1993. Managing human resources for innovation and creativity. Research-Technology Management 36, 41.
Hendry, D.F., 1995. Dynamic econometrics. Oxford University Press.
Hitt, M.A., Hoskisson, R.E., Johnson, R.A., Moesel, D.D., 1996. The market for corporate control and firm innovation. Academy of Management Journal 39, 1084-1119.
Holmstrom, B., 1989. Agency costs and innovation. Journal of Economic Behavior & Organization 12, 305-327.
Holmström, B., Milgrom, P., 1991. Multitask Principal-Agent Analyses: Incentive Contracts, Asset Ownership, and Job Design. Journal of Law, Economics and Organization 7, 24-52.
Honig-Haftel, S., Martin, L.R., 1993. The effectiveness of reward systems on innovative output: An empirical analysis. Small Business Economics 5, 261-269.
Honoré, F., Munari, F., de La Potterie, B.v.P., 2015. Corporate governance practices and companies' R&D intensity: Evidence from European countries. Research Policy 44, 533-543.
Ittner, C.D., Lambert, R.A., Larcker, D.F., 2003. The structure and performance consequences of equity grants to employees of new economy firms. Journal of Accounting and Economics 34, 89-127.
Jensen, M.C., Meckling, W.H., 1976. Theory of the firm: Managerial Behaviour, Agency Costs, and Ownership Structure. Journal of Financial Economics 3, 305-360.
Jensen, M.C., Murphy, K.J., Wruck, E.G., 2004. Remuneration: Where We've Been, How We Got to Here, What are the Problems, and How to Fix Them, Negotiation, Organizations and Markets. Harvard Business School NOM Research Paper No. 04-28.
Kaplan, S.N., 1994. Top executive rewards and firm performance: A comparison of Japan and the US. National Bureau of Economic Research.
Laursen, K., Foss, N.J., 2003. New human resource management practices, complementarities and the impact on innovation performance. Cambridge Journal of economics 27, 243-263.
Laux, V., 2012. Stock option vesting conditions, CEO turnover, and myopic investment. Journal of Financial Economics 106, 513-526.
Leary, W.E., 2002. Secrets of 200 years of inventions in the most innovative country. New York Times Online 6.
Lepper, M.R., Greene, D., Nisbett, R.E., 1973. Understanding children's intrinsic interest with extrinsic reward: A test of the 'overjustification' hypothesis. Journal of personality and Social Psychology 28, 129-137.
Lerner, J., Wulf, J., 2007. Innovation and Incentives: Evidence from corporate R&D. The Review of Economics and Statistics 89, 634-644.
Murphy, K.J., 1999. Executive compensation. Handbook of labor economics 3, 2485-2563.
Rajan, R.G., Zingales, L., 2000. The governance of the new enterprise. NBER working paper no. 7958.
Ryan, R.M., Mims, V., Koestner, R., 1983. Relation of reward contingency and interpersonal context to intrinsic motivation: A review and test using cognitive evaluation theory. Journal of personality and Social Psychology 45, 736.
Sanders, W.G., 2001. Behavioral responses of CEOs to stock ownership and stock option pay. Academy of Management Journal 44, 477-492.
Sanders, W.G., Hambrick, D.C., 2007. Swinging for the fences: The effects of CEO stock options on company risk taking and performance. Academy of Management Journal 50, 1055-1078.
Soskice, D., 1997. German technology policy, innovation, and national institutional frameworks. Industry and Innovation 4, 75-96.

Stanley, T., 2008. Meta-Regression Methods for Publication Selection Bias: Simulations and Heckman Regression. Bulletin of Economic and Meta-Analysis.
Stanley, T., Doucouliagos, H., 2010. Picture this: a simple graph that reveals much ado about research. Journal of Economic Surveys 24, 170-191.
Stanley, T., Doucouliagos, H., 2014. Meta-regression approximations to reduce publication selection bias. Research Synthesis Methods 5, 60-78.
Stanley, T.D., 2001. Wheat from chaff: Meta-analysis as quantitative literature review. Journal of Economic Perspectives, 131-150.
Stanley, T.D., 2005. Beyond publication bias. Journal of Economic Surveys 19, 309-345.
Stanley, T.D., Doucouliagos, H., 2012. Meta-regression analysis in economics and business. Routledge.
Stanley, T.D., Jarrell, S.B., 1989. Meta-Regression analysis: A quantitative method of literature surveys. Journal of Economic Surveys 3, 161-170.
Walker, D.I., 2010. The Challenge of Improving the Long-Term Focus of Executive Pay. Boston College Law Review 51, 435-472.
Wright, P., Kroll, M., Krug, J.A., Pettus, M., 2007. Influences of top management team incentives on firm risk taking. Strategic Management Journal 28, 81-89.
Xue, Y., 2007. Make or buy new technology: The role of CEO compensation contract in a firm's route to innovation. Review of Accounting Studies 12, 659-690.
Yanadori, Y., Marler, J.H., 2006. Compensation strategy: does business strategy influence compensation in high-technology firms? Strategic Management Journal 27, 559-570.

Appendix:

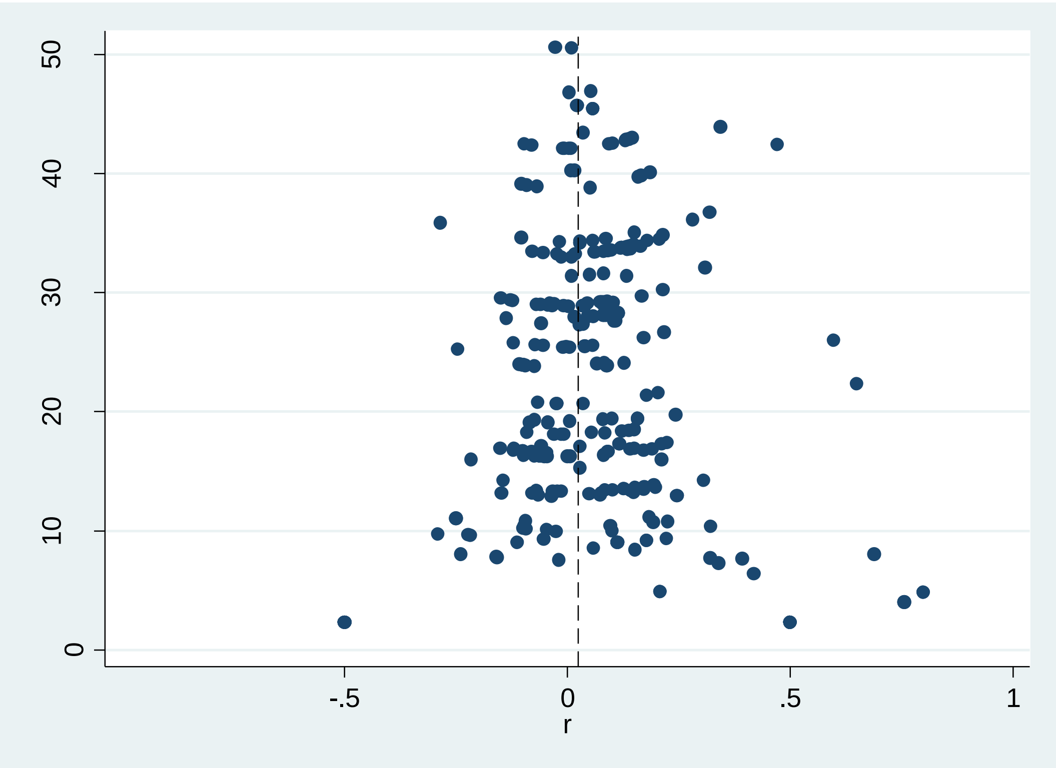

Figure 1- Funnel Plot

Table 1. FAT-PET-MAR Test

Dependent variable: t-statistics	(1) Sub-effect, fixed effect	(2) Study-effect	(3) Sub-effect, random-effect
Percision	0.072***	0.072*	0.07***
	(3.41)	(2.10)	(4.97)
Constant (Reporting bias)	-0.46	-0.45	-0.410
	(-0.64)	(-0.45)	(-1.14)
Number of observation	301	301	301
R-squared	0.037	0.037	0.073

***p < 0.001, **p < 0.01, *p< 0.05
t-statistics are reported in parentheses

Table 2. FAT-PET-MAR Test

Dependent variable: t-statistics	(1) US studies, fixed effect	(2) Non US studies, fixed effect
Percision	0.08**	0.054*
	(3.01)	(2.02)
Constant (Reporting bias)	-0.7	0.41
	(-0.80)	(0.48)
Number of observation	233	68
R-squared	0.03	0.05

***p < 0.001, **p < 0.01, *p< 0.05
t-statistics are reported in parentheses

Table 3. FAT-PET-MAR Test with moderator variables

Dependent variable: t-statistics	**(1) General model**	**(2) Specific model**	**(3) Input-based measure of innovation (R&D)**	**(4) Output-based measure of innovation (Patent and citation)**
percision	0.2***(5.05)	0.122***(5.14)	0.391***(4.25)	-----
Theretical aspect:				
Agency Theory	0.007(0.01)	-----	-0.0701(-0.02)	1.356(0.47)
Crowding-out Theory	3.67**(3.27)	2.64***(4.49)	2.612(0.57)	4.62(1.60)
Publication time & outlet:				
Publication year	0.052 (0.45)	-----	-0.126(-0.41)	0.251(1.32)
Economics	1.925 (1.37)	-----	-5.057(-1.62)	-----
Finance	-4.13**(-2.92)	-2.6***(-3.51)	-4.505(-1.72)	1.66(0.99)
Working paper	-3.087†(-1.74)	-2.46***(-3.56)	-2.3(-0.54)	-----
Impact Journal	-0.23 (-0.46)	-----	0.4(0.44)	1.622**(3.07)
Sample characteristics:				
non_US firms	0.214(0.11)	-----	-----	-----
service	1.173(1.00)	-----	-3.08(-0.34)	0.95(0.34)
High technology	1.59†(1.93)	-----	1.93(0.98)	0.772(1.29)
Employees	-4.458*(-2.29)	-2.24*(-2.48)	6.151(0.45)	1.075(0.27)
R&D heads	-2.171(-0.75)	-----	-----	-----
Data and time:				
Survey	1.08(0.54)	-----	-----	-----
Cross section	2.454†(1.88)	1.639**(2.69)	-----	-----
Year 00_09	-2.47(-1.57)	-----	0.072(0.02)	-----
Year 10_14	7.022†(1.93)	-----	4.533(0.96)	-----
Measures:				
R&D intensity	-0.6(-1.04)	-----	-----	-----
Innovation performance	-4.728**(-3.11)	-3.246**(-3.14)	-----	-----
Stock options	-1.015(-0.99)	-----	-2.683(-1.35)	-2.844***(-5.13)
Stocks	1.945**(2.64)	-----	-0.87(-0.58)	4.525***(8.12)
Bonus	0.117(0.13)	-----	-3.338*(-2.15)	-----
Controls & Methodological aspect:				
Firm charecteristics	0.085(0.07)	-----	6.063(1.15)	0.472(0.23)
CEO characteristics	0.391(0.26)	-----	-----	3.426(0.82)
Industry dummy	-0.46(-0.46)	-----	-----	-3.194***(-3.46)
Year dummy	1.084(0.73)	-----	-3.83(-1.02)	0.291(0.09)
Time lag effect	-0.436(-0.43)	-----	-2.521(-1.02)	3.452***(3.46)
non_OLS	0.747(0.90)	-----	0.102(0.06)	2.181(1.44)
_cons	-106.5(-0.46)	-0.233(-0.33)	246.3(0.39)	-509.8(-1.34)
N	273	273	113	128

***p < 0.001, ***p < 0.01, **p< 0.05,†p< 0.1
t-statistics are reported in parentheses

Table A1. Moderator variables for meta-regression analysis

Moderator Variables	Definition	Mean (standard deviation)
Agency Theory	=1, if a study argues agency theory	0.425 (0.5)
Crowding out theory	=1, if a study argues crowding out theory	0.142 (0.350)
Other	=1, if a study argues other theory	0.68 (0.460)
Workingpaper	=1, if a study publishes as a working paper	0.305 (0.461)
Journal	=1, if a study publishes in a journal	0.7 (0.461)
Economics	=1, if a study publishes in an economic journal	0.3 (0.457)
Management/Business	=1, if a study publishes in a management/business journal	0.312 (0.464)
Finance	=1, if a study publishes in a finance journal	0.241 (0.43)
Impact Joural	Impact factor of journal	1.311 (1.5)
Publication year	Year that the studies publish	2008.369 (5.147)
USfirms	=1, if estimate relates to US firms	0.774 (0.42)
non_USfirms	=1, if estimate relates to non US firms	0.212 (0.41)
Manufacturing	=1, if estimate are for manufacturing sector	0.98 (0.152)
service	=1, if estimate are for service sector	0.093 (0.3)
High technology	=1, if estimate are for high technology sector	0.2 (0.4)
Managers	=1, if estimate relates to managers	0.255 (0.437)
R&D heads	=1, if estimate relates to R&D heads	0.066 (0.25)
Employees	=1, if estimate relates to employees	0.146 (0.353)
OLS	=1, if OLS model is used	0.435 (0.5)
Non OLS	=1, if other models except OLS are used	0.564 (0.5)
Industry dummy	=1, if industry specific fixed effects are used	0.521 (0.5)
Year dummy	=1, if year specific fixed effects are used	0.52 (0.5)
Time lag effect	=1, if a model includes lagged compensation	0.501 (0.5)
Secondary	=1, if a study uses secondary database	0.88 (0.325)
Survey	=1, if a study conducts a survey	0.19 (0.4)
Panel	=1, if estimate relates to panel data	0.8 (0.402)
Crosssection	=1, if estimate relates to cross-sectional data	0.2 (0.4)
Cash	=1, if estimates relates to cash payment	0.308 (0.462)
Bonus	=1, if estimates relates to bonus payment	0.524 (0.5)
Stocks	=1, if estimates relates to stock payment	0.232 (0.423)
Stockoptions	=1, if estimates relates to stock option payment	0.707 (0.455)
Patent/citation	=1, if estimates relates to patent/patent citation	0.491 (0.5)
innovation performance	=1, if estimates relates to innovation performance	0.132 (0.34)
R&D intensity/spending	=1, if estimates relates to R&D intensity/spending	0.401 (0.491)
year 80_89	=1, if estimates relates to year 80_89	0.09 (0.286)
year 90_99	=1, if estimates relates to year 90_99	0.737 (0.44)
year 00_09	=1, if estimates relates to year 00_09	0.654 (0.476)
year 10_14	=1, if estimates relates to year 10_14	0.013 (0.114)
Firm charachteristic	=1, if a model includes firm characteristics variables	0.823 (0.381)
CEO characteristic	=1, if a model includes CEO characteristics variables	0.6 (0.5)

Studies included in the Meta-analysis:

1. Alessandri, T. M., & Pattit, J. M. (2014). Drivers of R&D investment: The interaction of behavioral theory and managerial incentives. *Journal of Business Research, 67(2),* 151-158.
2. Baranchuk, N., Kieschnick, R., & Moussawi, R. (2014). Motivating innovation in newly public firms. *Journal of Financial Economics*, *111*(3), 578-588.
3. Barker III, V. L., & Mueller, G. C. (2002). CEO characteristics and firm R&D spending. *Management Science, 48(6),* 782-801.
4. Barros, H. M., & Lazzarini, S. G. (2012). Do organizational incentives spur innovation?. *BAR-Brazilian Administration Review*, *9*(3), 308-328.
5. Bereskin, F. L., & Hsu, P. H. (2014). Bringing in changes: the effect of new CEOs on innovation. *Available at SSRN 1684329*.
6. Beugelsdijk, S. (2008). Strategic human resource practices and product innovation. *Organization Studies, 29(6),* 821-847.
7. Bulan, L., & Sanyal, P. (2011). Incentivizing managers to build innovative firms. *Annals of Finance, 7(2),* 267-283.
8. Burhop, C., & Lübbers, T. (2010). Incentives and innovation? R&D management in Germany's chemical and electrical engineering industries around 1900. *Explorations in Economic History, 47(1),* 100-111.
9. Cazier, R. A. (2011). Measuring R&D curtailment among short-horizon CEOs. *Journal of Corporate Finance, 17(3),* 584-594.
10. Chen, M. Y. C., Lin, C. Y. Y., Lin, H. E., & McDonough III, E. F. (2012). Does transformational leadership facilitate technological innovation? The moderating roles of innovative culture and incentive compensation. *Asia Pacific Journal of Management*, *29*(2), 239-264.
11. Coles, J. L., Daniel, N. D., & Naveen, L. (2006). Managerial incentives and risk-taking. *Journal of Financial Economics, 79(2),* 431-468.
12. Curran, B., & Walsworth, S. (2014). Can you pay employees to innovate? Evidence from the Canadian private sector. *Human Resource Management Journal, 24(3),* 290-306.
13. Currim, I. S., Lim, J., & Kim, J. W. (2012). You get what you pay for: the effect of top executives' compensation on advertising and R&D spending decisions and stock market return. *Journal of Marketing*, *76*(5), 33-48.
14. Eng, L. L., & Shackell, M. (2001). The implications of long-term performance plans and institutional ownership for firms' research and development (R&D) investments. *Journal of Accounting, Auditing & Finance, 16(2),* 117-139.
15. Faleye, O., Hoitash, R., & Hoitash, U. (2011). The costs of intense board monitoring. *Journal of Financial Economics, 101(1),* 160-181.
16. Francis, B. B., Hasan, I., & Sharma, Z. (2011). Incentives and innovation: Evidence from CEO compensation contracts. *Bank of Finland Research Discussion Paper*, (17).
17. Galbraith, C. S., & Merrill, G. B. (1991). The effect of compensation program and structure on sbu competitive strategy: A study of technology-intensive firms. *Strategic Management Journal, 12(5),* 353-370.
18. Hirshleifer, D., Low, A., & Teoh, S. H. (2012). Are overconfident CEOs better innovators?. *The Journal of Finance, 67(4)*, 1457-1498.
19. Holthausen, R. W., Larcker, D. F., & Sloan, R. G. (1995). Business unit innovation and the structure of executive compensation. *Journal of Accounting and Economics*, *19*(2), 279-313.
20. Honig-Haftel, S., & Martin, L. R. (1993). The effectiveness of reward systems on innovative output: An empirical analysis. *Small Business Economics, 5(4),* 261-269.

21. Huang, Y. T., Wu, M. C., & Liao, S. L. (2013). The Relationship Between Equity-Based Compensation and Managerial Risk Taking: Evidence from China. *Emerging Markets Finance and Trade*, *49*, 107-125.
22. Lau, C. M., & Ngo, H. Y. (2004). The HR system, organizational culture, and product innovation. *International business review, 13(6),* 685-703.
23. Laursen, K., & Foss, N. J. (2003). New human resource management practices, complementarities and the impact on innovation performance. *Cambridge Journal of economics*, *27*(2), 243-263.
24. Lerner, J., & Wulf, J. (2007). Innovation and incentives: Evidence from corporate R&D. *The Review of Economics and Statistics*, *89*(4), 634-644.
25. Li, Y., Zhao, Y., & Liu, Y. (2006). The relationship between HRM, technology innovation and performance in China. *International journal of manpower*, *27(7)*, 679-697.
26. Lin, C., Lin, P., Song, F. M., & Li, C. (2011). Managerial incentives, CEO characteristics and corporate innovation in China's private sector. *Journal of Comparative Economics*, *39*(2), 176-190.
27. Ling, T. C., & Nasurdin, A. M. (2010). Human resource management practices and organizational innovation: An empirical study in Malaysia. *Journal of Applied Business Research (JABR)*, *26*(4).
28. Lorenz, E., Michie, J., & Wilkinson, F. (2004, May). HRM complementarities and innovative performance in French and British industry. *In PIE-conference (Product Innovation Interactive Learning Economic Performance of Danish SME) (Vol. 24).*
29. Mazzanti, M., Pini, P., & Tortia, E. (2006). Organizational innovations, human resources and firm performance: The Emilia-Romagna food sector. *The Journal of Socio-Economics, 35(1),* 123-141.
30. Nam, J., Ottoo, R. E., & Thornton Jr, J. H. (2003). The effect of managerial incentives to bear risk on corporate capital structure and R&D investment. *Financial Review, 38(1)*, 77-101.
31. O'Connor M., Rafferty M., & Sheikh A. (2013).Equity compensation and the sensitivity of research and development to financial market frictions. *Journal of Banking & Finance* 37 (7), 2510–2519
32. Onishi, K. (2013). The effects of compensation plans for employee inventions on R&D productivity: new evidence from Japanese panel data. Research Policy, 42(2), 367-378.
33. Ryan Jr, H. E., & Wiggins III, R. A. (2002). The interactions between R&D investment decisions and compensation policy. *Financial Management*, 5-29.
34. Sanders, W. G., & Hambrick, D. C. (2007). Swinging for the fences: The effects of CEO stock options on company risk taking and performance. *Academy of Management Journal, 50(5),* 1055-1078.
35. Shen, C. H. H., & Zhang, H. (2013). CEO risk incentives and firm performance following R&D increases. *Journal of Banking & Finance*, *37*(4), 1176-1194.
36. Shipton, H., West, M. A., Dawson, J., Birdi, K., & Patterson, M. (2006). HRM as a predictor of innovation. *Human Resource Management Journal, 16(1),* 3-27.
37. Souitaris, V. (2002). Firm–specific competencies determining technological innovation: A survey in Greece. *R&D Management*, *32*(1), 61-77.
38. Tien, C., & Chen, C. N. (2012). Myth or reality? Assessing the moderating role of CEO compensation on the momentum of innovation in R&D. *The International Journal of Human Resource Management*, *23*(13), 2763-2784
39. Un, C. A. (2010). An empirical multi-level analysis for achieving balance between incremental and radical innovations. *Journal of Engineering and Technology Management, 27(1),* 1-19.
40. Walsworth, S., & Verma, A. (2007). Globalization, human resource practices and innovation: Recent evidence from the Canadian workplace and employee survey. *Industrial Relations: A Journal of Economy and Society, 46(2),* 222-240
41. Wu, J., & Tu, R. (2007). CEO stock option pay and R&D spending: a behavioral agency explanation. *Journal of Business Research*, *60*(5), 482-492.

42. Xue, Y. (2007). Make or buy new technology: The role of CEO compensation contract in a firm’s route to innovation. *Review of Accounting Studies*, *12*(4), 659-690.
43. Zhou, Y., Zhang, Y., & Montoro-Sánchez, Á. (2011). Utilitarianism or romanticism: the effect of rewards on employees' innovative behaviour. *International Journal of Manpower*, *32*(1), 81-98.