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A Chicken & an Egg Story:

A model of firm specific risk and executive compensation under uncertainty

Abstract

This thesis focuses on the ambiguity of causation in the relationship between pay and risk. It attempts to make an argument for reverse causality in the classic pay-causing-risk narrative. Using the methodology from Cheng *et al.* 2015, this report applies this model to a data set of financial and non-financial firms to determine if reverse causality holds generally in the data, or if it can be distorted by industry heterogeneity. It can be shown that causality is indeed reversed for financial companies as in Cheng *et al.* 2015 and that the notion of reverse causality can be extended to non-financial companies. Regardless of industry, the relationship between pay and risk is one driven by risk reward fundamentals, where firm risk determines pay, not vice versa.

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I: Introduction

The past decade has been scarred by the events of the 2008/2009 Global Financial Crisis that left economies all over the world in disarray**.** Since the crisis, much of the academic research into financial markets has been dedicated to understanding the causes of the crisis, and the events leading up to it. One contributing factor, and an item that remains a hot topic even in more recent headlines is executive compensation and its relationship with risk taking incentives.

A recent publication for *Forbes* describes executive compensation today as 'out of control' (Karabell, 2018). According to this article, exuberant executive remuneration packages are the leading source of income inequality in America which demoralises the individuals that these executives employ and destroys the organisation's sense of community (Karabell, 2018). The Economic Policy Institute in America also voices their concern on this matter. A report published from this organisation in 2017 states that the average salary of a Chief Executive Officer (CEO) is $15.6 million per year, which is about 271 times the annual salary of any average American person in 2016. This report also describes executive compensation today as excessive (Mishel & Schieder, 2017).

These high levels of executive compensation are a primary concern as it has been well established, that under a poor governance structure, CEO compensation, which is designed to maximise shareholder value for a levered firm incentivises this individual to take on excessive risk. The reason for this is that the value of the compensation behaves like a call option and increases in value as the volatility (risk) increases (Bolton *et al.,* 2015). It was this relationship that lead to the downfall of many financial firms during the crisis (Cheng *et al.,* 2015).

Although executive compensation does align managerial objectives with the interests of shareholders, due to the short-term nature of remuneration structures, most managers tend to be focused on maximising only short term profits (Hamza & Lourini, 2014). This further encourages the CEO to induce volatility in the stock price in the short term, contributing to undue risk in the firm and the market in the long run (Cheng *et al.,* 2015).

Poor governance structures encouraging CEOs to be unscrupulous occur in both financial and non-financial firms (Bolton *et al.,* 2015). For example, in their analysis of oil and gas producers, Rajgopal & Shevlin (2002) find evidence that managerial stock options have a positive relationship with firm risk. In their model, options give these managers incentives to take on projects that have high exploration risk, but a positive net present value in an attempt to increase the value of the firm in the short-run.

In this way, this pay causing risk narrative could be applied to spectacular failures of companies in the non-financial industry as well. For example, the Deep Water oil spill that begun in 2010 on the Gulf of Mexico. This was British Petroleum (BP) operated project which due to poor project risk management and corporate governance structures resulted in the largest marine oil spill to date (Wieczorek–Kosmala, 2019). The oil spill caused irreversible damage to the ecosystem and wildlife as well as incredible damage to the domestic economy. BP also incurred huge losses to its profit margins as a result of the enormous and ongoing clean-up costs (Wieczorek–Kosmala, 2019).

Shifting our focus back to the global economy in 2009, regardless of industry, the same song was being sung by the firms who fell into the spotlight as a result of their poor corporate structures. It was a story of management entrenchment and pay, misaligned with long-term shareholder values that caused the levels of excessive risk that lead to the demise of the entire company (Cheng *et al.,* 2015). Indeed Ho *et al.,* (2016) find that overconfident CEOs are more likely to reduce prudent lending standards and increase leverage than not-so-confident CEOs at other banks. This made those banks more susceptible to failure during the crisis (Ho *et al.,* 2016).

To further this notion of overconfident CEOs inducing firm risk is research by Malmendier and Tate (2005) in which they describe the typical CEO has being afflicted by firm specific optimism. As a result, they are too generous in valuing their company. This thesis will not address the psychological reasons as to why overconfident individuals apply for and are more successful in management roles, but accepts that there is an observable relationship between these two. Being a successful manager involves sticking to your convictions and this confidence can often translate into overconfidence and if left unchecked can cause these personalities to take on more risk (Malmendier & Tate, 2005).

If we entertain this idea for a moment, looking at the events of the 2009 crisis, this version of events seems entirely possible. Management entrenchment distorts the classic principal agent relationship. Jensen and Meckling (1976) define this framework as a contractual relationship between two entities, one of which is the principal who contracts the agent to perform services and administrative decisions on their behalf. In a corporate environment, the firm is defined as the principal and the CEO as the agent. Disrupting this relationship, and giving obscene power to the agent so that he is able to behave like a principal allows him to exert explicit control over an efficient market (Cheng *et al.,* 2015).

This is further supported by research by Chen *et al.,* (2006) who find a positive relationship between overall firm risk and the value of managerial compensation at banks. However, what is interesting to note from this research and much of the existing literature, is that they do not provide directional evidence to this relationship. Simply by following standard pay-performance literature, they pose this high risk outcome as driven by opportunistic CEOs, which again, is essentially the accepted relationship throughout much of the literature.

To question this directional argument and elaborated in further sections, is a model that shows that the optimal contract for a CEO comprises both a fixed remuneration component, tied to utility, and also a variable component tied to output. This variable component normally is some feature of stock and option based compensation (Malmendier & Tate, 2005). Having this variable component ensures the alignment of values between the CEO and the firm mentioned earlier. However if we look at this contract from the CEO's perspective, this variable component also introduces a huge amount of idiosyncratic, or firm specific risk.

Arguments that focus on this as an incentive for the CEO to increase the stock volatility, by increasing the company's risk and, therefore its value, also intuitively makes the argument that CEOs are risk seeking instead of rational risk averse agents (Hirshleifer *et al.,* 2015). Now conceivably this isn't all that hard to envision. We all know people who perhaps enjoy the thrill a little more than others. However, in order to claim this systematic behavioural trend, it would have to be stated that on average, any randomly selected CEO is risk-seeking. This assumption especially, in the context of the CEO's own portfolio, is a bit of a difficult pill to swallow.

The CEO could of course diversify some of this risk he has in his portfolio by investing in other firms. However, literature shows that more often than not, they don't. This could be again attributed to overconfidence, however other reasons such as procrastination or tax reasons are also reasonable explanations for this stylised effect that we see in the market (Malmendier & Tate, 2005). What this evidence suggests is that if the CEO is happy to take on this quantity of risk, it is because he is being fairly compensated for doing so.

In other words, while a CEO can be overconfident in his ability to process or deal with large amounts of risk, all else being equal, this CEO would still prefer less risk. Pay and risk are correlated not because of misaligned compensation structures, but rather as a result of risk and reward fundamentals. Risky firms have to pay management more because classical theory defines agents as risk averse and to encourage individuals to maximise firm value, the principal must offer adequate remuneration or ownership (Cheng *et al.,* 2015). In other words, since the

CEO dislikes risk, the CEO would prefer to manage a less risky firm, unless of course he was being sufficiently compensated for introducing this additional aspect of risk into his life. This is why the remuneration packages are larger at riskier firms (Cheng *et al.,* 2015).

For the firm, the optimal contract is therefore more expensive and so, it too must critically consider how much risk is in its operations. All else being equal the firm would of course prefer to be a less risky firm, and devote less to executive remuneration packages, however it is compensated by higher profits by taking on more risk (Cheng *et al.,* 2015).

Based on these notions, this thesis hypothesises that while the scenario that a risky CEO is the root cause of unreasonable firm risk is entirely possible, it is unlikely. To apply this narrative to the crisis, this version of the story places the blame on a relatively small group of individuals for the drastic value destruction that started in the USA and spread to the rest of the world, which again, seems dubious.

The pay relationship between the CEO and firm is albeit a complicated one, however this thesis will focus on this causation ambiguity. It will describe this relationship as a kind of a chicken and an egg story; who came first? The risky CEO or the risky firm?

Despite the evidence presented in previous research that it was the risky CEO who came first, the central idea presented in the following text is one of reverse causation: risky firms breed risky CEOs, not vice versa. To extend the existing research, primarily provided by Cheng *et al.,* (2015) this thesis will also study this causation ambiguity theme applied not only to financial firms, but to non-financial firms as well. It is well known and established that compensation structures drastically differ in terms of value and assembly between industries, especially between the finance industry and other industries (Houston & James, 1995). Although executive compensation may differ between industries, it is still driven by the same reward-risk fundamentals, and all else being equal, to hire a CEO at a risky firm, you must pay this person appropriately.

There is little research that has been conducted into the fundamental causes of the differences in executive compensation structures at financial firms compared to non-financial firms. This thesis recognises that perhaps the reason for that is that in many scenarios financial firms and non-financial firms are not so comparable. These industries are worlds apart in terms of the presence of regulatory intermediaries and regulation compliances. For example, the Basel Accords that apply to systematically important financial firms require that these firms meet stringent capital and liquidity requirements (Hull, 2018). These do not apply to non-financial companies regardless of their systematic importance (Wieczorek–Kosmala, 2019).

Despite the substantial heterogeneity between financial and non-financial firms, this thesis will look at the central drivers of the relationship between risk and pay. This thesis hypothesises, while financial and non-financial firms are largely incomparable in almost every way regarding corporate risk and governance, they are comparable in terms of the direction of causality between pay and firms because people and firms are driven by the same fundamentals at their core.

The main research question that will be addressed is: does firm specific risk increase the remuneration packages of executives at both financial and non-financial firms? To answer this question, the following text is organised as follows: Section II will state the hypotheses and their development. Section III will define the data and variables as well as present the summary statistics. Section IV will report the results and state the findings and Section V will conclude.

II: Hypothesis development

In defining the pay relationship, the first complication is one of moral hazard which commonly arises in situations such as this which involve a delegation of decision making duties. That is the distribution of responsibilities from the principal, the firm, to the CEO, the agent. The reason for this is that the principal and the agent engage in risk sharing activities that determine the probability distribution of the outcome that affects both these parties (Holmstrom, 1979). There is therefore an incentive for one party to withhold information so that the outcome tips in their favour, creating this issue of moral hazard.

It is because of this issue that casting the correct compensation or determining the optimal contract for a CEO can be quite convoluted. For the principal, the profit function is determined by rough linear aggregates such as revenues, costs and profits. The optimal contract of the agent is also a linear function, however may vary more arbitrarily with information and outcomes (Holmstrom, 1979). Therefore, assuming general risk aversion, the output of the agent will depend on all available information about said agent. In this analysis, this is assumed to be primarily, the agent's effort denoted as, a (Cheng *et al.*, 2015).

Following the intuition of Holmstrom and Milgrom (1987) first, consider a firm whose output $\bar{x}$ is defined by a linear function of a. The noise function follows a Gaussian distribution so that $\bar{\varepsilon} \sim N(0, \sigma^2)$:

$$\bar{x} = ha + \bar{\varepsilon} \tag{1}$$

It follows that, $\partial\bar{x}/\partial a = h$, so that h reflects the agent's marginal productivity of agent effort. It is assumed this is an upwards sloping function so that $h > 0$ and increases in effort are met with increases in output. This obviously meets a maximum point in which the CEO is physically unable to contribute further effort, however for simplicity this function is considered to approach infinity. The restriction $a > 0$ is also set as it is assumed that the CEO must contribute some positive effort to increase output, otherwise he would not contribute to the firm, and his contract would be terminated. In a world of over 7 billion people, qualified individuals for the role are considered to approach infinity and the terminated CEO would be immediately replaced.

Other characteristics tied to CEO effort such as age, education, experience, tenure and skill could be considered in the above equation, however this analysis again makes a simplifying assumption. That is, all individuals accepted as a CEO have adequate and analogous levels of the mentioned characteristics otherwise they would not be accepted into a management position. Because CEOs are similar in these characteristics, they are still comparable without including these items in the above function.

The CEO in this analysis cares only about aggregate compensation, net of a positive convex cost of supplying earlier defined effort, $c(a)$. This function passes through the origin so that $c(0) = 0$ and that no effort is rewarded with no pay (Cheng *et al.,* 2015). Since this thesis is focused primarily on society's wealthiest individuals, CEOs, no welfare payments are assumed.

This cost of supplying effort is also characterised as having exponential utility with constant absolute risk aversion, γ (Cheng *et al.,* 2015). This means that risk aversion is persistent, regardless of how much wealth is at stake. The implication of this here is that CEOs of differing pay grades are comparable. This is an important assumption because this thesis will compare executives across industry groups and there can be substantial disparity in wages compared to, and within these groups.

To relate back to our initial moral hazard problem, let us set the sharing of outcomes to be defined by the linear function $s(\bar{x}) = \alpha + \beta\bar{x}$ (Cheng *et al.*, 2015). This implies that the agent maximises his effort by:

$$\max_{a}\left\{\alpha + \beta ha - c(a) - \frac{\gamma}{2}\beta^2\sigma^2\right\} \tag{2}$$

In this function, β is the agent's incentive slope and also represents their ownership stake in the firm. Ownership is examined here as several studies have found a link between firm performance and managerial ownership (Cheng *et al.,* 2015). Essentially, as mentioned in the introduction, it can help align the interests of the principal and the agent and reduce the moral hazard problem (Zhou, 2001). For this reason, it is included as another proxy for reward alongside compensation. Optimal effort is therefore determined by this ownership concept and is therefore given by:

$$c'(a) = \beta h \tag{3}$$

Taking a step back for a moment, participation in the contract by the agent requires that the agent can obtain at a minimum his reservation utility, $\bar{u}$. Assuming that this constraint binds, Cheng *et al.,* (2015) find that total pay is given by:

$$T \equiv E[s(\tilde{x})] = \alpha + \beta ha = \bar{u} + c(a) + \frac{\gamma}{2}\beta^2\sigma^2 \tag{4}$$

From this function, the principal maximises output by the agent (net of payments) subject to the above mentioned constraints, which leads to the equilibrium agent ownership stake as:

$$\beta^* = \frac{1}{1 + \gamma\sigma^2 c''(a^*)/h^2} \tag{5}$$

Where, σ^2 is the risk of the firm. Taking the first derivative of equation 5 with respect to σ^2 and setting this to zero, $\partial\beta^*/\partial\,\sigma^2 = 0$, gives rise to a scenario where the total pay, T of the agent must rise with the overall firm risk, σ^2. This scenario can be applied to many varying levels of effort, $c(a)$, where effort is assumed to be an increasing function (Cheng *et al.,* 2015). This gives rise to the first hypothesis:

$H_{1:}$ Across industry groups, firms with higher lagged or origin risk have higher executive compensation and ownership.

Next, if we consider a realistic example of uncertainty, so that if, $\sigma^2 > 0$, the agent accepts a fixed amount plus a share of β of the output $\bar{x}$. In equation 5 where β^* is defined, notice that this amount is a decreasing function of risk aversion γ and approaches zero as γ becomes infinite. In this scenario, a contract which relies solely on this variable component would not be accepted by a risk-averse agent as it would not representative of effort exerted under the optimal effort function. Thus, the optimal contract that should be casted to a CEO is a compromise between a fixed component for agent insurance related to $\bar{u}$ and a and the provision of incentives related to β, γ and σ^2(Kraft & Niedeprum, 1999).

A further implication of this is that the remuneration packages at risky firms compared to those that are not-so-risky, only differentiate by the variable component that is tied to output in the above total pay function. This is because $\bar{u}$ and willingness to supply a are the same for each individual CEO, regardless of which firm he is employed by. This strengthens the findings of Cheng *et al.,* (2015) in which pay increases with firm specific risk.

Referring to the earlier assumptions mentioned above, effort exerted by the CEO must be positive otherwise it is presumed that he would be terminated and replaced. This implies that $a > 0$. A broad productivity assumption is made so that, increases in output are only achieved by increases in effort and that $h > 0$. This assumption is supported by anecdotal evidence that executives, especially those in the finance industry work extremely hard and endure tough working conditions (Oyer, 2008).

It is also assumed that there is at least some aspect of uncertainty which is consistent with a real-world analysis of the optimal contract so that $\sigma^2 > 0$. The outcome of these restrictions again results in the same conclusions of Cheng *et al.,* (2015) in that there is a positive relationship between total pay T and firm risk, σ^2. This holds for all levels of effort since $a > 0$ in this analysis.

The reasons for this are twofold. First, the participation constraint where the agent must receive at least his reservation utility $\bar{u}$ in the total pay function means that the principal must pay a risk-averse agent more to take on more risk. Second, the optimal effort constraint means that to extract this optimal effort so the agent works as hard as he can, the principal must pay the agent more. This is in line with the economic intuition that high-risk firms are also high-productivity firms (Cheng *et al.,* 2015). It is also the intuition that forms the basis of the second hypothesis.

H_2: Across industry groups, risk and productivity are positively associated.

Finally, the third hypothesis deals with the relative power of the principal and the agent. As mentioned above, the moral hazard problem incentivises each party to adjust the available list of outcomes so that they tip in their favour (Holmstrom, 1979). This of course becomes easier to do the more powerful the agent is (Cheng *et al.,* 2015).

As a result of this, executive entrenchment is a primary concern as obscene CEO power will make the productivity assumptions which are essential in the above optimal contract model void. Without these constraints, the CEO could increase their salary without increasing effort which in equation 4 would cause overall firm risk, σ^2, to increase. This would mean that pay does indeed cause risk and management entrenchment is the omitted variable in the above model that determines causality (Cheng *et al.,* 2015).

Motivated by this concern, the final hypothesis will search for signs of entrenchment in the data as well as any other possible omitted variables to determine causation. Hypothesis three is as follows:

H_3: The pay and risk relationship is not driven by management entrenchment.

Based on these developments, the main goal of this thesis is to, after controlling for size and industry heterogeneity, show in a cross-section, how firm-specific risk contributes to executive compensation and determine the direction of causality. Using the Cheng *et al.,* (2015) methodology, this thesis will attempt to replicate the findings of this paper of firms in the finance industry, and extend these findings to firms in the non-financial industry.

III: Data & Variables

The sample of companies examined is made up of those available in the amalgamation of the CRSP, ExecuComp and Compustat databases from 1992 to 2018. Companies available are sorted into industry groups, generally determined by the SIC code. Firms in the Finance group are comprised of those with a SIC code between 6000 - 6999 while firms in the Non-Financial group are those in the manufacturing, transportation and services industries with SIC codes between 2000 - 3999, 4000 - 4999, and 7000 – 8999 respectively.

The key variables of interest to answer the proposed research question are compensation, size and risk. The variable for total executive compensation comes from ExecuComp, and is an average of the compensation salaried to the top 5 executives for each firm in each year.

Insider ownership is measured as the average number of shares and options owned by the top 5 executives, divided by the total number of shares outstanding. However, following Core and Guay (1999), the number of options is multiplied by a delta of 0.75 to obtain a value of delta weighted options. Core and Guay (1999) describe this as a more accurate value of these options in terms of equity incentives in the optimal contract.

Size is primarily measured by market capitalisation. This is calculated for each firm by averaging the number of shares outstanding over the calendar year, as well as the average share price listed on CRSP, and then multiplying these two values. Differences in size between the industries is also illustrated through total assets, which is simply the total book assets of each firm.

Risk is measured by the annual stock price beta and volatility. The annual beta for each firm was downloaded from the WRDS database, while the stock price volatility was calculated using CRSP monthly stock returns including dividends.

In order to be considered in the final data set, each firm needed to have at least five years of consecutive data for each of the mentioned variables. Missing values were simply removed, and each variable was winsorised at the sub-industry level to remove outliers.

The summary statistics are shown below in panels A – D of Table I.

Table I: Summary Statistics

Panel A: Financal Panel Statistics	Mean	Std.	Min	Median	Max	N
Compensation and Size						
Executive Compensation ($M)	3.57	3.68	0.36	2.28	19.89	1,287
Total Insider Ownership	0.01	0.01	-	-	0.15	1,287
Market Capitalisation ($M)	12.00	27.00	0.19	3.40	170.00	1,287
Total Assets ($M)	70.49	220.00	0.19	10.62	1,600.00	1,287
Risk Variables						
Beta	1.12	0.48	0.18	1.03	2.92	1,287
Volatility	0.09	0.07	0.02	0.07	0.70	1,287
Leverage	7.45	5.50	1.34	5.53	30.05	1,287
Productivity Variables						
Return on Assets	0.04	0.05	-0.05	0.02	0.26	1,287
Asset Turnover	0.47	0.65	0.03	0.21	2.99	1,287
Pay Components						
Salary	0.26	0.18	0.01	0.21	1.00	1,287
Bonus	0.16	0.18	-	0.09	0.88	1,287
Total Insider Ownership, shares	0.81	0.23	-	0.90	1.00	1,287
Total Insider Ownership, options	0.19	0.23	-	0.10	1.00	1,287

Panel B: Financal Origin Risk Statistics	Mean	Std.	Min	Median	Max	N
Origin Beta	1.16	0.59	0.18	0.98	2.92	101
Origin Volatility	0.10	0.06	0.03	0.08	0.30	101
Origin year	1999	5.89	1992	1998	2011	101

Panel C: Non-Financal Panel Statistics	Mean	Std.	Min	Median	Max	N
Compensation and Size						
Executive Compensation ($M)	2.12	1.76	0.17	1.70	15.44	2,497
Total Insider Ownership	0.01	0.03	-	-	0.58	2,497
Market Capitalisation ($M)	3.70	3.40	0.13	2.60	16.00	2,497
Total Assets ($M)	4.87	5.55	0.09	2.98	39.21	2,497
Risk Variables						
Beta	0.92	0.49	-0.05	0.87	2.70	2,497
Volatility	0.09	0.06	0.01	0.07	0.59	2,497
Leverage	3.06	1.73	1.13	2.72	19.71	2,497
Productivity Variables						
Return on Assets	0.09	0.06	-0.19	0.08	0.32	2,497
Asset Turnover	0.85	0.55	0.16	0.73	3.61	2,497
Pay Components						
Salary	0.31	0.19	0.02	0.25	1.00	2,497
Bonus	0.11	0.13	-	0.07	0.76	2,497
Total Insider Ownership, shares	0.77	0.26	-	0.86	1.00	2,497
Total Insider Ownership, options	0.23	0.26	-	0.14	1.00	2,497

Panel D: Non-Financial Origin Risk Statistics	Mean	Std.	Min	Median	Max	N
Origin Beta	0.87	0.52	-0.03	0.77	2.70	200
Origin Volatility	0.10	0.06	0.02	0.08	0.33	200
Origin year	1997	6.66	1992	1994	2013	200

Following Cheng *et al.,* (2015), leverage is used as an additional risk measure to ensure that risk in this model comes from financial markets, not risk incurred from the firm's assets. This is a primary concern moving forward as the assets of financial non-financial firms are inherently different. Leverage is measured as the book assets-to-equity ratio, where book equity is the stockholder equity downloaded from Compustat.

Table I also shows the productivity variables for financial and non-financial firms. Again, following Cheng *et al.,* (2015), return on assets is calculated as income before extraordinary items plus depreciation, all divided by the total book assets. Asset turnover is simply total revenue divided by total assets. The last section of panels A and B is dedicated to illustrating the differences in pay components between financial and non-financial companies.

Finally, panels C and D report the origin statistics. Albeit, rather arbitrarily, the first year that each firm appears in the data is assumed to be the year of its inception. This is quite a general assumption, however the purpose of this analysis is to see how compensation, size and risk are related over extended periods of time. Making this assumption serves this purpose without embarking on the daunting task of obtaining the above variables for each firm's IPO year.

These summary statistics highlight some important differences between financial and non-financial companies. For one, salaries of executives at financial companies are much larger than those at non-financial companies. That is an average of 3.57 million for financial firms compared to an average of 2.12 million for non-financial firms. However, this difference seems rather intuitive when relative measures of size are considered. It seems that pay scales with size as financial firms are far larger than their counterparts in this analysis.

At least initially high pay seems to translate into high risk. The mean values for the risk measures, stock beta and volatility, are higher for financial firms. However, when comparing the origin risk measures, the values between the two categories do not seem to vary drastically despite non-financial companies having a much larger range.

It is also interesting to note, that despite the high salaries, financial firms are less productive in terms of their return on assets and asset turnover. This lower productivity for financial firms in this sample could reflect the drastic destruction of the value of the assets of these institutions during the crisis (Shah *et al.,*2017). Extreme values during this period could be responsible for reducing the mean for the whole 1992 – 2018 period.

IV: Results

Table II summarises the results obtained from the following regression:

$$LogExecutiveCompensation_i = \alpha_i + \delta_0 LogSize_i + \gamma_0 Financial_i + \delta_1(LogSize * Financial_i) + \varepsilon_i \quad (6)$$

Where the firm's market capitalisation is used as a proxy for its size and $Financial_i$ is simply a dummy indicator, taking a value of 1 if the firm is a financial company and 0 if not.

The motive for running the above equation is twofold. Firstly, the primary variable of interest for the remaining sections of this thesis, residual compensation, is obtained from this regression. This is important as it allows a comparison of compensation despite dramatic heterogeneity in firm size. Secondly, this equation also allows for a separate linear slope for financial companies which contributes an additional control for the fixed differences between industries in this analysis.

A. Residual Compensation

Columns 1 to 5 of Table II Panel A report OLS estimates for annual cross-sections chosen arbitrarily at 5 year intervals. Only a selection of annual cross-sections has been shown to illustrate how this relationship holds over time, however in the calculation of the residuals, consecutive annual cross sections are used. This analysis confirms what was suspected in the summary statistics: pay scales with size.

Focusing on the finance specific slope indicated by *LogMarketCapitalisation*Finance,* it can be see that the coefficients are all significant with the exception of 2007. Although these values are not significant, after controlling for size it seems that executives at financial companies do earn more than those at non-financial firms.

Column 6 reports the coefficients of a pooled regression covering the whole 1992 – 2018 time period. Consistent with the results shown in columns 1 to 5, size is again positively associated with compensation with a coefficient of 0.428. In this last column, standard errors are clustered at the firm level for 301 firms and the pooled R^2 is 0.56. The fit here remains relatively high and so it can be reasonably assumed that size and industry effects on executive compensation heterogeneity have been eliminated. Therefore, the residuals from these annual cross sections will now be used as the primary compensation variable.

Table II: Residual Compensation

Panel A reports the residuals from the cross-sectional regressions where Log Executive Compensation is the dependent variable. The independent variables are listed on the left-hand side. Columns 1 to 5 show the results from the regressions of annual cross-sections, arbitrarily chosen at 5 year intervals. Column 6 reports the results from a pooled regression with year effects. T-statistics are reported in brackets. Standard errors are clustered at the firm level in column 6. These are marked *, **, *** for statistical significance at 10%, 5% and 1% levels respectively. Panel B reports the residual correlations of the listed variables by substituting the listed variable into the dependent variable of the regression used to formulate panel A.

Panel A: Executive Compensation and Size						
	1997	2002	2007	2012	2017	Pooled
Log Executive Compensation	1	2	3	4	5	6
Log Market Capitalisation	0.380	0.488	0.495	0.534	0.240	0.428
	[6.67]***	[8.19]***	[9.33]***	[6.56]***	[3.03]***	[13.59]***
Financal	-0.85	-0.52	0.90	-0.16	-0.90	0.003
	[-0.67]	[-0.48]	[0.77]	[-0.16]	[-0.68]	[0.01]
Log Market Capitalisation * Financal	0.083	0.036	-0.05	0.016	0.060	0.010
	[0.96]	[0.48]	[-0.71]	[0.25]	[0.76]	[0.27]
Constant	1.483	0.282	0.160	2.500	4.304	0.471
	[1.79]*	[0.33]	[0.20]	[3.06]***	[3.92]***	[1.02]
Year effects	N/A	N/A	N/A	N/A	N/A	Y
N	165	145	161	153	104	301
R^2	0.39	0.54	0.51	0.48	0.34	0.56
Firms	165	145	161	153	104	301

Panel B: Residual Correlations								
	Comp., t	Comp., t-1	Beta, t	Vol., t	Beta, t-1	Vol. t-1	O. Beta, t	O.Vol, t
Commpensation, t	1.000							
Compensation, t - 1	0.686	1.000						
Beta, t	0.282	0.279	1.000					
Volatility, t	0.210	0.222	0.391	1.000				
Beta, t-1	0.291	0.308	0.582	0.311	1.000			
Volatility, t - 1	0.210	0.205	0.335	0.241	0.399	1.000		
Origin Beta	0.279	0.286	0.396	0.245	0.463	0.264	1.000	
Origin Volatility	0.122	0.120	0.198	0.152	0.224	0.220	0.326	1.000

Following the same motivation for calculating residual compensation, residual risk measures are also calculated by substituting the risk measure (including those at origin) into the left-hand side into equation one as follows:

$$Risk_i = \alpha_i + \delta_0 LogSize_i + \gamma_0 Financial_i + \delta_1(LogSize * Financial_i) + \varepsilon_i \tag{7}$$

The correlations between these residual compensation and risk measures from equation 7 are shown in Table II panel B. Residual compensation today is strongly correlated to residual compensation in the previous period, taking a value of 0.686. In addition, residual risk measures of beta and volatility in this period are still correlated to those in the last period with values 0.582 and 0.241 respectively. This even remains the case when we look at origin risk measures which are at a minimum 5 years ago. Beta and volatility today are correlated to their origin measures which have a value of 0.396 and 0.152 respectively.

This positive correlation suggests is that pay and risk are largely permanent effects and the fact that compensation this year is still correlated to the risk measures in the previous period, and even at origin, strengthens this argument. The results in Table II indicate that executive compensation today is largely determined by the pay salaried last year. As such, it is likely to be controlled by a fixed corporate structure, rather than the person in that executive role at that point in time. This persistence will be used as the primary motivation of this thesis that pay does not directly cause risk and in fact, this relationship may run the other way.

The results presented in Table III test this persistence concept. The following section discusses the premise that there are fixed differences in firm risk and this is the case starting at the firms inception and carries through to the present year, by showing that there is substantial tenacity in residual compensation and residual risk measures. These values do not jump widely between years but instead follow a smooth pattern.

Table III: Persistence in compensation & risk

Panel A displays the results from pooled OLS regressions where residual compensation is the dependent variable and is related to the independent variables listed on the left. Panel B also shows the results of a pooled OLS regression however now residual beta and volatility are the dependent variables. Lagged and origin residual risk measures are the independent variables and are listed on the left. Standard errors are clustered at the firm level in panels A and B. These are marked *, **, *** for statistical significance at 10%, 5% and 1% levels respectively.

Panel A: Compensation Persistence							
	Levels			Changes		Absolute Changes	
Residual Conpensation, t	1	2	3	4	5	6	7
Residual Compensation, t-1	0.671	0.670	0.670				
	[33.49]***	[33.34]***	[33.31]***				
CEO Turnover, t-1		0.010		0.012		0.014	
		[0.71]		[0.87]		[1.01]	
Excess Returns, t-1		0.065	0.055	-0.771	-0.783	-0.132	-0.147
		[0.16]	[0.13]	[-1.55]	[-1.59]	[-0.60]	[-0.65]
Constant	-0.004	-0.010	-0.004	-0.002	0.005	0.298	0.307
	[-0.40]	[-0.70]	[-0.42]	[-0.20]	[0.95]	[23.94]***	[33.35]***
N	3,483	3,483	3,483	3,483	3,483	3,483	3,483
R^2	0.471	0.471	0.417	0.002	0.002	0.001	0.000
Firms	301	301	301	301	301	301	301

Panel B: Risk Persistence				
	Beta Residual, t		Volatility Residual, t	
Dependent Variable, t	1	2	3	4
Beta Residual, t-1	0.581			
	[31.50]***			
Volatility Residual, t-1			0.242	
			[8.46]***	
Origin Beta Residual		0.386		
		[13.42]***		
Origin Volatility Residual				0.193
				[7.74]***
Constant	-0.007	0.000	0.000	0.000
	[-0.83]	[-0.02]	[-0.21]	[0.02]
N	3,483	3,784	3,483	3,784
R^2	0.339	0.203	0.06	0.04
Firms	301	301	301	301

B. Persistence

The baseline regression in column 1, panel A of Table III has a coefficient that is very similar to the correlation between residual compensation in this period and residual compensation in the last period shown in Table 1, panel B. These values are 0.686 and 0.671, respectively. This suggests is that residual compensation is similar across subsections, despite industry heterogeneity.

Columns 2 and 3 is to show the relationship between residual compensation, CEO turnover and excess returns in the last period. CEO turnover is a dummy variable indicating whether there was a change in management. This was calculated using employee identification numbers for each company obtained from ExecuComp. Excess returns were calculated using the annual stock price return from CRSP and subtracting the annualised T-bill rate which has been as a proxy for the risk-free rate and has been downloaded from Kenneth French's website to determine the excess return over the market. In general, although CEO turnover and excess returns may have some influence on compensation, this effect is insignificant here.

Columns 4 and 5 look at the interaction between changes in residual compensation and CEO turnover and excess returns. Column 5 and 6 show this same interaction except the absolute change in residual compensation is used as the dependent variable. As before, these interactions are insignificant although it should be noted that these values have a higher significance in changes in residual compensation relative to absolute changes suggesting that these factors are perhaps more important with decreases in residual compensation.

To conclude these findings, while stock performance and CEO turnover may have some influence on residual compensation, residual compensation today is largely determined by residual compensation in the previous period. As such, the coefficient measure of the baseline regression, 0.671 can be characterised as being a largely permanent effect.

Moving on to panel B of Table III, the positive and highly significant coefficients strongly suggests that risk this year is positively associated with risk in the previous year, as well as risk as far back as its origin. And so, as with compensation, risk measures are clearly persistent effects. This applies for all firms in this analysis, despite the substantial cross-sectional heterogeneity.

Split sample regressions comparing the coefficients of financial companies to non-financial companies is detailed in Table I of the Appendix of this report. Both groups reflect similar coefficients in terms of direction and magnitude as those presented in Table III, further confirming compensation persistence despite industry heterogeneity.

C. Compensation & Risk

Now that the foundations of this thesis have been established, this next section is dedicated to testing the first hypothesis: in both financial and non-financial industries, firms with higher lagged and origin risk have higher executive compensation.

Table IV exhibits the affiliation between residual compensation, ownership and risk in full sample pooled OLS regressions using the following specification

$$\begin{aligned} LogComp_i = \alpha_i + \beta Risk_{i,t-1} + \delta_0 LogSize_i + \gamma_0 Non - Financial_i \\ + \delta_1 (LogSize * Non - Financial_i) + \varepsilon_i \end{aligned} \tag{8}$$

Where $Risk_{i,t-1}$ is either stock beta, volatility, origin beta or origin volatility. $Non - Financial_i$ is a dummy indicating whether a firm falls in the non-financial group or not. The purpose of using equation 8 is to obtain values for the coefficient of interest, β, which measures the interaction between compensation, ownership and risk in the previous year, net of annual size and industry effects.

A convenient shortcut that has been executed in panels A and B of Table IV is to simply use the residual compensation measure obtained from equation 6 in Section III and regress this on the residual risk measure as the right-hand side variable. This is equivalent the above equation to obtain β (Cheng *et al.,* 2015).

Additional interaction coefficients have been included for specifically the non-financial group for easy comparison. In columns 5 to 8, this process has been repeated but with residual ownership as the dependent variable.

Table IV: Compensation, Ownership & Risk

Panel A reports the lagged risk regression analysis for pooled OLS regressions with either residual compensation or ownership as the dependent variable. The independent variables are lagged risk measures with an additional interaction coefficient reported specifically for non-financial firms. Regressions include year, industry and sub-industry effects. T-statistics are written in brackets. Standard errors are clustered at the firm level in panels A and B. These are marked *, **, *** for statistical significance at 10%, 5% and 1% levels respectively

Panel A: Lagged Risk Regression Analysis								
Dependent variable, t	Compensation				Ownership			
	1	2	3	4	5	6	7	8
Beta, t-1	0.271	0.326			0.212	0.094		
	[6.75]***	[4.32]***			[1.76]*	[0.59]		
Beta, t-1 * Non-Financial		-0.087				0.185		
		[-0.98]				[0.81]		
Volatility, t-1			1.356	1.100			1.106	0.406
			[5.26]***	[3.46]***			[1.45]	[0.53]
Volatility, t-1 * Non-Financial				0.449				1.189
				[0.90]				[0.85]
Non-Financial	0.050	0.052	0.067	0.066	0.038	0.033	0.051	0.048
	[0.88]	[0.93]	[1.13]	[1.12]	[0.18]	[0.16]	[0.25]	[0.24]
Constant	-0.175	-0.187	-0.248	-0.244	-0.554	-0.529	-0.610	-0.599
	[-0.73]	[-0.79]	[-1.07]	[-1.05]	[-1.57]	[-1.48]	[-1.72]	[-1.69]*
Year, industry & sub-industry effects	Y	Y	Y	Y	Y	Y	Y	Y
N	3,483	3,483	3,483	3,483	3,483	3,483	3,483	3,483
R^2	0.179	0.180	0.153	0.153	0.161	0.161	0.158	0.158
Firms	301	301	301	301	301	301	301	301

Table IV: Compensation, Ownership & Risk

Panel B reports the lagged risk regression analysis for pooled OLS regressions with either residual compensation or ownership as the dependent variable. The independent variables are origin risk measures with an additional interaction coefficient reported specifically for non-financial firms. Regressions include year, industry and sub-industry effects. T-statistics are written in brackets. Standard errors are clustered at the firm level in panels A and B. These are marked *, **, *** for statistical significance at 10%, 5% and 1% levels respectively

Panel B: Origin Risk Regression Analysis								
Dependent variable, t	Compensation				Ownership			
	1	2	3	4	5	6	7	8
Origin Beta	0.213	0.19			0.200	-0.023		
	[4.01]***	[2.08]**			[1.59]	[-0.13]		
Origin Beta * Non-Financial		0.041				0.394		
		[0.37]				[1.59]		
Origin Volatility			0.154	0.976			1.070	-0.345
			[0.37]	[1.63]			[0.80]	[-0.22]
Origin Volatility * Non-Financial				-1.435				2.472
				[-1.78]*				[0.99]
Non-Financial	0.068	0.065	0.098	0.106	0.078	0.053	0.010	0.086
	[1.13]	[1.07]	[1.64]	[1.80]	[0.40]	[0.27]	[0.51]	[0.46]
Constant	0.091	0.09	0.108	0.111	0.223	0.208	0.231	0.225
	[1.18]	[1.17]	[1.36]	[1.40]	[1.19]	[1.14]	[1.24]	[1.22]
Year, industry & sub-industry effects	Y	Y	Y	Y	Y	Y	Y	Y
N	3,784	3,784	3,784	3,784	3,784	3,784	3,784	3,784
R^2	0.171	0.172	0.138	0.143	0.165	0.170	0.162	0.164
Firms	301	301	301	301	301	301	301	301

Panel A reports the lagged risk measure while panel B reports the interaction with the origin risk measure. Standard errors are clustered for all 301 firms in the full sample.

Panels A and B of Table IV demonstrate a strong positive relationship can be seen between risk and compensation. Baseline regressions 1 and 3 of both panel's report a strong relationship between compensation and lagged and origin risk with these coefficients largely significant at the 1% level. The difference between risk and compensation is not significantly different between financial and non-financial firms with the exception of the interaction between origin volatility and compensation which is statistically significantly lower for non-financial firms.

In ownership, not such a significant conclusion can be reached however this relationship between ownership and risk is still largely positive for both financial and non-financial firms across both panel A and B.

To conclude this section, it is clear that Table IV reports evidence towards accepting the first hypothesis. That is, in both the financial and non-financial industries, firms with higher lagged and origin risk have higher executive compensation. What this means is that managers at more risky firms experience more stock price risk and therefore require more pay to offset this positive and significant risk they bear for working at a riskier firm. In this way, the risk that managers at these companies endure determines their salary, not the other way around.

D. Robustness: Controlling for leverage

The conclusion reached in Table IV is an important one for the premise presented in this text and so this subsequent section is devoted to providing an accompanying robustness check to establish validity.

In Table V, leverage is added as an additional independent variable alongside the risk measures to determine if there is a relationship to either compensation or ownership. There is a possibility that the results achieved in Table IV is not a measure of compensation and its association to financial risk, but instead, these positive and significant coefficients are driven by the risk associated with the firm's assets (Cheng *et al.,* 2015).

Columns 1 to 4 report regressions with residual compensation as the dependent variable and residual lagged risk measures and residual lagged leverage as the right hand side variables. The risk measures are positively associated with compensation and ownership, while leverage remains inconsequential at all levels of significance.

Table V: Robustness

Panel A reports the results for a robustness check which includes lagged residual leverage as an independent variable along with lagged residual risk measures with an additional interaction coefficient reported specifically for non-financial firms. The dependent variables are residual compensation in columns 1 to 4 and residual ownership in the remaining columns. Regressions include year, industry and sub-industry effects. T-statistics are written in brackets. Standard errors are clustered at the firm level. These are marked *, **, *** for statistical significance at 10%, 5% and 1% levels respectively.

Panel A: Controlling for Leverage								
Dependent Variable, t	Compensation				Ownership			
	1	2	3	4	5	6	7	8
Beta, t -1	0.264	0.325			0.234	0.092		
	[6.71]***	[4.49]***			[1.91]*	[0.54]		
Beta, t-1 * Non-Financial		-0.091				0.206		
		[-1.05]				[0.88]		
Volatility, t-1			1.357	1.100			1.106	0.406
			[5.32]***	[3.58]***			[1.45]	[0.53]
Volatility, t-1 * Non-Financial				0.434				1.198
				[0.90]				[0.87]
Leverage, t -1	0.005	0.000	0.011	0.009	-0.015	0.001	-0.010	0.003
	[0.65]	[0.05]	[1.37]	[0.88]	[-0.90]	[0.03]	[-0.57]	[0.16]
Leverage, t-1 * Non-Financial		0.022		0.017		-0.082		-0.079
		[1.30]		[1.00]		[-2.02]**		[-1.92]*
Non-Financial	0.051	0.057	0.069	0.071	0.034	0.015	0.050	0.033
	[0.91]	1.03]	[1.12]	[1.21]	[0.16]	[0.07]	[0.24]	[0.16]
Constant	-0.178	-0.188	-0.247	-0.243	-0.547	-0.525	-0.611	-0.602
	[-0.75]	[-0.81]	[-1.08]	[-1.07]	[-1.56]	[-1.53]	[-1.73]*	[-1.76]
Year, industry & sub-industry effects	Y	Y	Y	Y	Y	Y	Y	Y
N	3,483	3,483	3,483	3,483	3,483	3,483	3,483	3,483
R^2	0.18	0.182	0.157	0.159	0.162	0.168	0.158	0.164
Firms	301	301	301	301	301	301	301	301

This association is not significantly different for non-financial companies. Compensation is positively associated with leverage however it is insignificant and not significantly different for the non-financial group.

Columns 5 to 8 follow the same regression process as columns 1 to 4 however in these instances, residual ownership is the dependent variable. Here, leverage is negatively associated with ownership as reported in the baseline regressions 5 and 7. Although directionally, this association as reversed, just as for compensation, this relationship remains insignificant.

It is interesting to note that this relationship between leverage and ownership becomes significantly more negative for non-financial firms in columns 6 and 8 at 10% and 5% levels respectively. This could be a reflection of the higher variable pay component for financial executives which translates into a higher interaction between ownership and leverage for the full sample, compared to just non-financial firms.

To summarise the findings presented in Table V, it seems as though the conclusion reached in Section IV is further corroborated here. As shown in columns 1 to 4, for both financial firms and non-financial firms, leverage may have some positive influence compensation. However, due to the strength of the risk coefficients presented in Tables IV and V, it is concluded that financial risk is the driving force behind the association between pay and risk.

The conclusion of Table V in terms of residual executive ownership is slightly more ambiguous. It seems although in this sample, neither risk nor leverage is overwhelmingly imperative in determining ownership. The only points of significance in columns 5 to 8 lie in the slope specific coefficients for non-financial firms. This indicates that although the relationship between ownership and lagged leverage is negative, this is significantly more so for firms in this group. In general, it is concluded that leverage has little to no effect on ownership.

Combing the evidence produced in Tables VI and V, it is now safe to accept the first hypothesis and conclude that despite industry heterogeneity, firms with higher lagged and origin risk do indeed have higher levels of executive compensation.

E. Risk & Productivity

This section of the text will now move on to test the second hypothesis. That is, for both financial & non-financial firms, risk and productivity are positively related.

The relationship between productivity and risk intuitively could take one of two directions: it could be either positive or negative. If the coefficients of this regression are negative, this would indicate that risk residualised for productivity is simply noise (Cheng *et al.,* 2015). That is, the agent is not able to relate the effort that he/she dispenses on their work to risk and reward. Essentially, the optimal contract carefully outlined in the hypothesis development would fall apart. A negative coefficient would mean that effort (productivity), risk and reward do not go hand in hand and would be in direct opposition of the findings thus far (Cheng *et al.,* 2015).

A positive coefficient on the other hand, would provide evidence for the notion of reverse causality presented in this thesis. In order to conclude that compensation and ownership are driven by fundamentals and not manager discretion, or firm specific noise, effort and risk must be positively associated (Cheng *et al.,* 2015).

Panel A of Table VI relates residual return on assets to the residual risk measures, both lagged and at origin. These residual productivity measures have been calculated by equation 6, using the productivity measures as left hand side variables. The results indicate that while volatility is positively associated with residual return on assets, residual beta both lagged and at origin is negatively associated.

Panel B is similar to panel A however now residual asset turnover is used as the dependent variable. It has been calculated in the same manner as residual asset turnover mentioned above. As before, lagged and origin measures of volatility are positively associated with residual asset turnover. Residual beta at origin is positively related to residual asset turnover however it is insignificant. As in panel A, lagged residual beta remains negatively associated with residual asset turnover, however the significance of the base line regression coefficient in column 1 does diminish.

Across panel's A and B the difference between non-financial firms and the full sample is largely insignificant, excluding the interaction between lagged residual beta and residual asset turnover in column 2, panel B. The positive and highly significant coefficient here suggests that this interaction may be positive for non-financial firms, despite it being negative for the full sample in column 1, panel B.

The results presented in panels A and B alone are not able to confirm the second hypothesis. It seems that, depending on how you choose to measure risk, high risk firms could be either more or less profitable. The purpose of panels C and D is to help untangle this relationship by controlling for productivity in the relationship between pay and risk. A positive coefficient here would strengthen any positive association in panels A and B and contribute evidence to causation reversal in the pay-causing-risk relationship.

Panels C and D of Table VI relate the residual return on assets and residual asset turnover to either compensation or ownership. Panel C of Table VI reports the coefficients relating residual risk and productivity to residual compensation. Across columns 1 to 8 it can be seen that, as before, risk is strongly positively associated to compensation at the 1% level. In terms of beta this relationship for non-financial firms is lower than for financial firms, however when risk is measured by volatility, the slope for non-financial firms is now slightly higher. Despite this reversal, this magnitude is insignificant and so, non-financial companies are determined to be indifferent to the full sample on this component.

The productivity variables highlight some interesting differences between financial and non-financial companies. Lagged residual return on assets is negatively associated with residual compensation in the base line regressions 1 and 5 despite the fact that this relationship is insignificant. In comparing financial and non-financial firms, this is significantly more negative in the group specific slope as shown in columns 2 and 6.

Conversely, the pooled baseline regressions 3 and 7 report a positive and significant coefficient for lagged residual asset turnover. This indicates that for the full sample of 301 firms, reverse causality generally still holds across sub-industries as effort, risk and compensation are positively associated.

Table VI: Risk & Productivity

Panel A relates risk and productivity in a pooled OLS regression with year, industry and sub-industry effects. The dependent variable is residual return on assets and the independent variables are lagged and origin residual risk measures with an additional interaction coefficient reported specifically for non-financial firms. T-statistics are written in brackets. Standard errors are clustered at the firm level. These are marked *, **, *** for statistical significance at 10%, 5% and 1% levels respectively.

	Panel A: Productivity & Risk							
Dependent variable, t	ROA							
	1	2	3	4	5	6	7	8
Beta, t-1	-0.012	-0.011						
	[-3.10]***	[-2.10]**						
Beta, t-1 * Non-Financial		-0.001						
		[-0.19]						
Volatility, t-1			0.024	0.037				
			[0.99]	[0.98]				
Volatility, t-1 * Non-Financial				-0.021				
				[-0.43]				
Origin Beta					-0.003	-0.007		
					[-0.50]	[-0.74]		
Origin Beta * Non-Financial						0.008		
						[0.67]		
Origin Volatility							0.055	0.040
							[1.08]	[0.57]
Origin Volatility * Non-Financial								0.026
								[0.26]
Non-Financial	0.015	0.015	0.014	0.014	0.014	0.013	0.013	0.013
	[1.91]*	[1.92]**	[1.69]*	[1.70]*	[1.80]*	[1.68]*	[1.69]*	[1.70]*
Constant	-0.018	-0.018	-0.013	-0.013	0.005	0.005	0.004	0.004
	[-0.82]	[-0.83]	[-0.61]	[-0.62]	[0.79]	[0.75]	[0.70]	[0.69]
Year, industry & sub-industry effects	Y	Y	Y	Y	Y	Y	Y	Y
N	3,483	3,483	3,483	3,483	3,483	3,784	3,784	3,784
R^2	0.072	0.072	0.064	0.064	0.06	0.06	0.06	0.07
Firms	301	301	301	301	301	301	301	301

Table VI: Risk & Productivity

Panel B relates risk and productivity in a pooled OLS regression with year, industry and sub-industry effects. The dependent variable is residual asset turnover and the independent variables are lagged and origin residual risk measures with an additional interaction coefficient reported specifically for non-financial firms. T-statistics are written in brackets. Standard errors are clustered at the firm level. These are marked *, **, *** for statistical significance at 10%, 5% and 1% levels respectively.

	Panel B: Productivity & Risk							
Dependent variable, t	Asset Turnover							
	1	2	3	4	5	6	7	8
Beta, t-1	-0.038	-0.167						
	[-0.71]	[-2.37]***						
Beta, t-1 * Non-Financial		0.206						
		[2.04]**						
Volatility, t-1			0.843	1.316				
			[2.81]***	[3.00]***				
Volatility, t-1 * Non-Financial				-0.803				
				[-1.35]				
Origin Beta					0.002	0.049		
					[0.03]	[0.37]		
Origin Beta * Non-Financial						-0.083		
						[-0.52]		
Origin Volatility							1.328	2.745
							[1.63]	[1.78]**
Origin Volatility * Non-Financial								-2.476
								[-1.45]
Non-Financial	0.235	0.229	0.224	0.226	0.236	0.242	0.226	0.239
	[2.81]***	[2.69]***	[2.63]***	[2.69]***	[2.78]***	[2.88]***	[2.63]***	[3.03]
Constant	-0.546	-0.219	-0.211	-0.218	0.103	0.106	0.092	0.097
	[-1.42]	[-1.23]	[-1.13]	[-1.19]	[1.36]	[1.38]	[1.31]	[1.38]
Year, industry & sub-industry effects	Y	Y	Y	Y	Y	Y	Y	Y
N	3,483	3,483	3,483	3,483	3,784	3,784	3,784	3,784
R^2	0.141	0.146	0.146	0.147	0.140	0.141	0.157	0.171
Firms	301	301	301	301	301	301	301	301

Table VI: Risk & Productivity

Panel C relates compensation, risk and productivity in a pooled OLS regression with year, industry and sub-industry effects. The dependent variable is residual compensation and the independent variables are lagged residual risk and productivity measures with an additional interaction coefficient reported specifically for non-financial firms. T-statistics are written in brackets. Standard errors are clustered at the firm level. These are marked *, **, *** for statistical significance at 10%, 5% and 1% levels respectively.

	Panel C: Compensation, Risk & Productivity							
Risk Measure	Beta				Volatility			
	1	2	3	4	5	6	7	8
Risk, t-1	0.267	0.333	0.273	0.358	1.363	1.069	1.299	0.884
	[6.60]***	[4.37]***	[6.83]***	[4.84]***	[5.34]***	[3.29]***	[5.02]***	[2.86]***
Risk, t-1 * Non-Financial		-0.107		-0.117		0.464		0.671
		[-1.19]		[-1.35]		[0.95]		[1.40]
ROA, t-1	-0.437	1.177			-0.619	0.971		
	[-1.01]	[1.71]*			[-1.39]	[1.28]		
ROA, t-1 * Non-Financial		-2.278				-2.226		
		[-2.79]***				[-2.55]**		
Asset Turnover, t-1			0.077	0.195			0.061	0.158
			[2.19]***	[4.84]***			[1.77]*	[3.91]***
Asset Turnover, t-1 * Non-Financial				-0.220				-0.186
				[-3.60]***				[-2.91]***
Non-Financial	0.057	0.068	0.031	0.06	0.076	0.082	0.053	0.074
	[1.00]	[1.26]	[0.56]	[1.08]	[1.30]	[1.48]	[0.91]	[1.25]
Constant	-0.149	-0.120	-0.184	-0.185	-0.209	-0.163	-0.257	-0.242
	[-0.67]	[-0.59]	[-0.81]	[0.77]	[-0.99]	[-0.83]	[-1.16]	[-1.02]
Year, industry & sub-industry effects	Y	Y	Y	Y	Y	Y	Y	Y
N	3,483	3,483	3,483	3,483	3,483	3,483	3,483	3,483
R^2	0.180	0.191	0.184	0.197	0.156	0.165	0.156	0.164
Firms	301	301	301	301	301	301	301	301

Table VI: Risk & Productivity

Panel D relates ownership, risk and productivity in a pooled OLS regression with year, industry and sub-industry effects. The dependent variable is residual ownership and the independent variables are lagged residual risk and productivity measures with an additional interaction coefficient reported specifically for non-financial firms. T-statistics are written in brackets. Standard errors are clustered at the firm level. These are marked *, **, *** for statistical significance at 10%, 5% and 1% levels respectively.

	Panel D: Ownership, Risk & Productivity							
Risk Measure	Beta				Volatility			
	1	2	3	4	5	6	7	8
Risk, t-1	0.239	0.105	0.218	0.111	1.078	0.349	0.938	0.279
	[2.02]**	[0.64]	[1.80]	[0.68]	[1.41]	[0.45]	[1.24]	[0.36]
Risk, t-1 * Non-Financial		0.21		0.156		1.254		1.146
		[0.92]		[0.67]		[0.90]		[0.82]
ROA, t-1	2.732	1.937			2.57	1.87		
	[2.26]**	[0.70]			[2.09]**	[0.68]		
ROA, t-1 * Non-Financial		1.143				0.996		
		[0.38]				[0.33]		
Asset Turnover, t-1			0.190	0.105			0.177	0.093
			[1.49]	[0.73]			[1.41]	[0.66]
Asset Turnover, t-1 * Non-Financial				0.155				0.166
				[0.61]				[0.67]
Non-Financial	-0.004	-0.014	-0.008	-0.03	0.014	0.008	0.01	-0.014
	[-0.02]	[-0.07]	[-0.04]	[-0.14]	[0.07]	[0.04]	[0.05]	[-0.07]
Constant	-0.717	-0.712	-0.575	-0.563	-0.774	-0.782	-0.636	-0.633
	[-2.28]**	[-2.22]**	[-1.51]	[-1.42]	[-2.43]**	[-2.45]**	[-1.66]*	[-1.60]
Year, industry & sub-industry effects	Y	Y	Y	Y	Y	Y	Y	Y
N	3,483	3,483	3,483	3,483	3,483	3,483	3,483	3,483
R^2	0.172	0.174	0.167	0.168	0.168	0.169	0.163	0.165
Firms	301	301	301	301	301	301	301	301

Columns 4 and 8 detail the group specific slopes for this interaction. As with lagged residual return on assets, lagged residual asset turnover reports a negative and highly significant coefficient. However since the baseline regressions 3 and 7 still are positive, the interaction between asset turnover, risk and compensation for non-financial firms is still positive, it is simply lower than that of financial companies.

The lower slope for non-financial compared to financial firms is likely a reflection of the fixed differences in the nature of the industries that these two groups operate in. For financial institutions such as banks, a large part of its assets is made up of the loan obligations from their clients (Wagner, 2007). The highly competitive nature of this industry means that these institutions inherently have a high asset turnover, after being scaled for size and risk (Sanyal & Shankar, 2011). This translates into financial firms having a higher slope estimate in this regression.

To summarise the findings presented in panel C, due to the relative reduced strength of the coefficients on lagged residual return on assets, in the full-sample pooled regressions, asset turnover will be considered as the primary productivity variable. This is simply due to the magnitude of these t-statistics being much more significant for asset turnover compared to return on assets. It is therefore concluded that compensation, risk and productivity are positively linked as the association between asset turnover and risk is also generally positive in panel B. In other words, pay risk and effort are positively associated and the second hypothesis is confirmed in the data.

Turning now to panel D which reports the results of the same regressions as in panel C, however this time residual ownership is used as the dependent variable. As in earlier tables, not such a significant conclusion can be reached for risk and ownership. Panel D also shows that this applies to ownership and productivity.

Despite the fact that this is largely insignificant, the relationship between ownership, risk and productivity is consistently positive. This also applies when we look specifically at non-financial companies, which in this panel, are not statistically different from financial companies. This provides further evidence towards accepting the second hypothesis for both non-financial firms and the full sample.

To conclude the interpretations of Table VI, the second hypothesis is loosely accepted as risk and productivity are generally positively associated in the data. There is evidence however of substantial noise and while high risk firms can generally be classified as highly productive firms, the results indicate that this may not always be the case.

In order to be in line with the model presented in Section II, so as to encourage a qualified individual to take a management role at a risky firm, and work as hard as they can, the principal must pay this agent more than a role where the agent does not have to work so hard. All else being equal, the agent would obviously prefer a job where he could expend less effort, unless of course he was being fairly compensated for doing so. Since effort, reward and risk are positively associated, an executive cannot increase his wage without increasing effort and so increases the firm's productivity which in turn increases firm risk as a reflection of the risk associated with growth opportunities (Cheng *et al.,* 2015). Despite the evidence presented that this could well be what the data reflects, additional checks should be completed to check for any omitted variables. This is what will be executed in the next section.

F. Factor portfolios

The results thus far have presented some evidence of reverse causation or at least some ambiguity in the pay-causing-risk relationship. The following section is dedicated to determining causation in terms of the value adding power of the agent described in the model in Section II of this thesis. Namely, this section will search for evidence of executive entrenchment in the data. Here the third hypothesis will be tested: the pay and risk relationship is not driven by management entrenchment. This will be concluded based on if it is possible to achieve positive returns on a strategy devised on an executive entrenchment story.

To help determine causation, the following section will test the relative success of two factor portfolios, each constructed on a separate directional notion of the pay and risk relationship.

Executive entrenchment (EXC) is a portfolio based off CEOs who are value destroying. This factor is founded by the idea that high pay causes undue risk. Under this version of events entrenched managers take advantage of poor governance structures, and due to asymmetric information, they are able to increase the value of their remuneration packages. This is detrimental to the firm and should lead to its demise (Cheng *et al.,* 2015).

Therefore, a long/short strategy constructed by taking a short position in companies who pay their executives a lot and also a long position in companies who do not should deliver positive returns. High paying firms (after controlling for size) should consistently underperform the market and so this strategy should deliver a positive and significant alpha.

On the other hand, executive ownership (ONR) is a portfolio based off a theory of CEO value creation. It is the factor presented by Lilienfeld-Toal and Ruenz (2014), constructed by taking a long position in stocks in companies that can be characterised as having a high degree of executive ownership, alongside a short position in companies that have little to no executive ownership. Positive returns for this strategy would suggest that despite the possibility of being presented with a poor governance structure, the CEO can remedy this and increase the value of the company. Here, CEO discretion and power is a good thing. This is because incentives are correctly aligned and the optimal contract is driven by fundamentals.

The EXC and ONR factor portfolios have been created by using residual executive compensation and residual insider ownership, respectively. For the EXC factor, the data has been split into 3 segments to create a high, medium and low portfolio based on compensation. The EXC factor is the then difference in return between portfolios made of stocks with low compensation and those with high compensation.

Following Lilienfeld-Toal and Ruenz (2014), for the ONR factor the data has been instead divided into just two sections, a high and a low section. The ONR factor is the difference between portfolio returns on stocks that have high levels of ownership and those who have low levels of ownership.

These strategies have be used to construct a portfolio of stocks traded on the NASDAQ, NYSE & AMEX with annual rebalancing from 1992 to 2018. These stocks are from the same firms that have been used in the preceding sections of this thesis. Both of these strategies give a minute annual return which produces an average of approximately zero basis points per year. This is without incorporating trading costs.

The approximately zero basis point return will probably be enough to deter any everyday investor from embarking on this strategy. However, if perhaps these factors interact with other strategies in a way that delivers a positive alpha, these strategies would be of use to a more sophisticated trader, such as a fund manager. For this reason, the relative performance of the EXC and the ONR factor portfolios is tested in Table VII against the more traditional factor portfolios.

The additional factor portfolios that will be tested against the EXC and ONR factors described above will be those used in the Fama and French (1993) 3 factor model and the Carhart (1997) 4 factor model. Each factor has been calculated for the whole sample period 1992 – 2018 and the portfolios have been rebalanced annually. The following paragraphs detail how these were designed.

Following the Fama and French (1993) methodology, the whole sample was divided into three groups based on the book value. These groups were stocks that had a high book value (H), a medium book value (M) and a low book value (L). The book value was obtained for each stock for each year from CRSP. Next, the sample was split again into two groups determined by size. These groups were those with either a small (S) Market Capitalisation or a big (B) Market Capitalisation.

Continuing with the Fama and French (1993) methodology, six value weighted portfolios were constructed based on the intersection of the sample splits mentioned above. These portfolios are S/L, S/M, S/H and B/L, B/M, B/H. The fact that these portfolios have been constructed on a sample of firms that has at least 5 years on consecutive data in the CRSP/Compustat/ExecuComp data bases does introduce an element of survivor bias that may be a concern to the results (Fama & French, 1993). This however will not be addressed in this thesis.

The small minus big (SMB) factor in the Fama and French (1993) 3-factor model is a factor designed to mimic the returns gained by taking a long position in small companies and a short position in large companies to take advantage of the risk/return premia gained by investing in small companies (Fama & French, 1993). It is calculated by taking the simple difference each year between the S/L, S/M, S/H and the B/L, B/M and B/H portfolios.

The high minus low (HML) factor is constructed in a similar fashion. It is designed to capture the returns from the difference in book-to-market ratios and is constructed by taking the simple difference for each year of the high book-to-market stocks, S/H and B/H and the low book-to-market stocks S/L and B/L.

The market factor (MKTRF) is developed much more simply. It is the average annual value weighted return of the six portfolios mentioned above, in excess of the risk-free rate which has been downloaded from Kenneth French's online data library where the T-bill rate has been used a proxy for the risk-free rate (Fama & French, 1993).

The Carhart (1997) 4 factor model is essentially the Fama & French (1993) 3 factor model with an additional factor. This additional factor is designed to capture the one year momentum anomaly revealed by Jegadeesh and Titman (1993). This factor, denoted as UMD in Table VII is constructed by taking the difference between portfolios that buy stocks that have done well in previous period and sell those who have performed poorly. The idea here is that stocks exhibit substantial return predictability. Positive returns now are likely to mean positive returns in the future and this momentum pattern can persist for up to 12 months (Jagadeesh & Titman, 1993).

The interactions of the above mentioned factors are populated in Table VII. Panel A reports the annual return correlations for each of the factors over the period 1992- 2018. Panel B reports the coefficients of a regression with either the EXC factor or the ONR factor as the dependent variable and either the Fama and French (1993) 3 factor model or the Carhart (1997) 4 factor model as independent variables. The purpose of doing so is to first determine the extra benefit to an investor who already trades the right-hand side factors that the EXC or ONR factors will add to their portfolio. This is denoted in panel B by alpha. The advantage of constructing the regression in this manner is that a positive and significant alpha here would mean that a factor model that includes the dependent variable is superior to a model that does not (Barillas & Shanken, 2017).

The alphas reported in columns 1 to 4 of panel B are all insignificantly different from zero. In addition to this, most of the variation in either the EXC or ONR factor can be explained by the HML or the SMB factors as these are significant in the presented regressions. This is not surprising as the SMB, HML, EXC and ONR factors are all related to size in some way.

The fact that the ONR factor delivers some slightly negative alpha, while the EXC factor delivers some small positive alpha could be taken as evidence that CEOs are value destroying. This is however unlikely to be the case as mentioned above, these are largely insignificant.

Table VII: Factor portfolios

Panel A displays the annual return correlations for the listed factor portfolios. Panel B reports the results of a regression analysis where the dependent variable is either the EXC or ONR factor. The remaining factor portfolios are listed on the left-hand side as independent variables under the reported annual alpha. This covers the period 1992 – 2018 inclusive with annual rebalancing. T-statistics are reported in brackets. These are marked *, **, *** for statistical significance at 10%, 5% and 1% levels respectively.

Panel A: Annual Return Correlations						
Factor	MKTRF	SMB	HML	UMD	EXC	ONR
MKTRF	1.000					
SMB	-0.142	1.000				
HML	0.184	0.598	1.000			
UMD	-0.376	0.443	0.221	1.000		
EXC	-0.320	0.315	0.428	0.369	1.000	
ONR	0.200	-0.161	-0.444	-0.321	-0.542	1.000

Pannel B: Regression Analysis				
	EXC Factor		ONR Factor	
Explanatory Variables	1	2	3	4
	Annual alpha			
Alpha	0.001	0.000	-0.001	-0.001
	[0.49]	[0.48]	[-0.62]	[-0.57]
	Factor loadings			
MKTRF	-0.206	-0.179	0.173	0.136
	[-1.94]*	[-1.53]	[1.76]*	[1.28]
SMB	-0.116	-0.205	0.449	0.569
	[-0.31]	[-0.64]	[1.77]*	[1.96]**
HML	0.507	0.496	-0.619	-0.604
	[2.38]***	[2.44]***	[4.12]***	[-3.65]***
UMD		0.678		-0.91
		[1.15]		[-1.29]
N	26	26	26	26
R^2	0.351	0.371	0.334	0.373

This is also likely to simply be sample specific since Lilienfeld-Toal and Ruenz (2014) were able to obtain a positive alpha by trading the ONR strategy.

While there may be some evidence of some entrenchment at the individual firm level, it is concluded that the average manager is not characterised as entrenched as it is not possible to make positive returns on a trading strategy devised from this narrative. In this way, the results presented in Table VII provide further evidence for third hypothesis. A trading strategy devised off an entrenchment story would not deliver significant or positive returns.

To enforce this conclusion, the Appendix includes split sample analyses in Table II, panels A and B. Unfortunately, the panel for financial firms was too small to obtain reliable estimates for this regression analysis so only the non-financial firms are presented in this split sample. The results in the Appendix for non-financial firms are unremarkably different from those for the full sample in Table VII however it is interesting to note that it is the EXC factor that has negative returns for non-financial companies.

This could provide some evidence for fixed differences in executive attitude and behaviour between industries, however this could be simply speculation as again, the alphas for both these strategies are not statistically different from zero.

To reiterate, the results presented in Table VII indicate that the acceptance of the third hypothesis is indeed valid. Entrenchment is unlikely to be an omitted factor affecting causality in the model since it is not possible to make positive returns in an investment strategy devised from this narrative. Executives in this data set seem to perform exactly as their contract predicts since the annual alphas for both the EXC and ONR strategies are not statistically different from zero.

V: Conclusion

This thesis attempts to establish causality in the relationship between firm specific risk and executive compensation. It follows the methodology from Cheng *et al*., (2015) on financial firms, then extends this same methodology to non-financial firms. The results show that pay and risk are naturally correlated in the principal agent relationship. This relationship is driven by reward risk fundamentals and shows that in order to employ an executive at a risky firm, you must compensate this individual for taking on this additional element of risk. For the full sample that includes both financial and non-financial companies, this conclusion generally holds in the data. The results show that firm risk and executive compensation are largely permanent effects. The relationship between pay and risk is clearly driven by fundamentals so that risk determines pay and this is same regardless of industry.

It has also been shown that in the full data set that high-risk firms are generally more productive. This assumption is imperative in the model developed in Section II of this thesis as it helps to establish the idea of causality reversal. An executive cannot increase his or her wage without increasing the firm's productivity which in turn increases firm risk as a reflection of the risk associated with growth opportunities (Cheng *et al.,* 2015). Increased pay does not automatically translate into more risk, and in fact, it is the reversal of this relationship that is reflected in the data for both financial and non-financial firms.

This notion of reverse causality is further corroborated in Section IV which shows that executive entrenchment is unlikely to be an omitted variable in the model presented in this thesis since a portfolio constructed on this narrative delivers neither positive nor significant returns. Additionally, the fact that a portfolio constructed on a notion of executive value adding ownership also delivers an insignificant alpha suggests that executives in this sample are not abnormally value destroying, however they are not abnormally value adding either. Executives seem to perform exactly as their contract requires.

With the acceptance of all three hypotheses in this thesis, the conclusion reached is that in the relationship between pay and risk, it is unlikely to be that pay directly causes risk. This thesis confirms the notion that of reverse causality put forward by Cheng *et al.* (2015) and that in the pay-causing-risk-relationship, it is firm risk that is more likely to determine CEO pay. In this chicken and egg story, it was the risky firm that came first.

Appendix

Table I: Split sample persistence in compensation & risk

Panels A and B display the results from pooled OLS regressions as in Table III however the sample is now split to examine financial and non-financial firms individually. Panel A reports the results of financial firms while Panel B reports those of non-financial firms. Just as in Table III residual compensation is the dependent variable and is related to the independent variables listed on the left. Panel B also shows the results of a pooled OLS regression with residual beta and volatility as the dependent variables. Lagged and origin residual risk measures are the independent variables and are listed on the left. T-statistics are reported in brackets. Standard errors are clustered at the firm level in Panels A and B. These are marked for significance using *, **, *** for statistical significance at 10%, 5% and 1% levels respectively.

Panel A: Financial Firms Compensation Persistence							
	Levels			Changes		Absolute Changes	
Residual Conpensation, t	1	2	3	4	5	6	7
Residual Compensation, t-1	0.685	0.686	0.687				
	[18.58]***	[18.14]***	[18.10]***				
CEO Turnover, t-1		0.011		0.003		0.025	
		[0.44]		[0.11]		[1.30]	
Excess Returns, t-1		-0.3	-0.302	0.986	-0.987	0.030	0.022
		[-0.48]	[-0.48]	[-1.38]	[-1.38]	[0.09]	[0.07]
Constant	0.001	-0.003	0.004	0.009	0.011	0.265	0.281
	[0.07]	[-0.12]	[0.27]	[0.50]	[1.22]	[16.61]***	[20.12]***
N	1,186	1,186	1,186	1,186	1,186	1,186	1,186
R^2	0.492	0.492	0.492	0.004	0.004	0.002	0.000
Firms	101	101	101	101	101	101	101

Panel B: Non-Financial Firms Compensation Persistence							
	Levels			Changes		Absolute Changes	
Residual Conpensation, t	1	2	3	4	5	6	7
Residual Compensation, t-1	0.664	0.663	0.663				
	[27.91]***	[28.01]***	[28.05]***				
CEO Turnover, t-1		0.010		0.018		0.007	
		[0.56]		[1.01]		[0.42]	
Excess Returns, t-1		0.254	0.240	-0.655	-0.680	-0.196	-0.206
		[0.47]	[0.45]	[-0.99]	[-1.04]	[-0.67]	[-0.69]
Constant	-0.006	-0.014	-0.008	-0.008	0.003	0.315	0.32
	[-0.52]	[-0.75]	[-0.63]	[-0.55]	[0.38]	[18.94]***	[26.95]***
N	2,297	2,297	2,297	2,297	2,297	2,297	2,297
R^2	0.462	0.462	0.462	0.002	0.001	0.000	0.000
Firms	200	200	200	200	200	200	200

Table I: Split sample persistence in compensation & risk

As in Panel B of Table III Panel C of the Appendix reports the results from regressions where residual beta and volatility are the dependent variables and lagged and origin risk are the independent variables. Columns 1 to 4 of Panel C report the split sample results for financial firms while columns 5 to 8 report the results for non-financial firms. T-statistics are reported in brackets. Standard errors are clustered at the firm level. These are marked for significance using *, **, *** for statistical significance at 10%, 5% and 1% levels respectively.

Panel C: Split Sample Risk Persistance								
	Financial Firms Risk Persistence				Non-Financial Firms Risk Persistence			
	Beta Residual, t		Volatility Residual, t		Beta Residual, t		Volatility Residual, t	
Dependent Variable, t	1	2	3	4	5	6	7	8
Beta Residual, t-1	0.615				0.564			
	[19.83]***				[24.75]***			
Volatility Residual, t-1			0.102				0.331	
			[2.87]***				[10.56]***	
Origin Beta Residual		0.346				0.411		
		[6.63]***				[12.39]***		
Origin Volatility Residual				0.148				0.222
				[5.41]***				[5.98]***
Constant	-0.006	-0.008	0.000	0.000	-0.007	0.003	-0.001	0.000
	[-0.47]	[-0.30]	[0.13]	[-0.05]	[-0.66]	[0.19]	[-0.38]	[0.05]
N	1,186	1,287	1,186	1,287	2,297	2,497	2,297	2,497
R^2	0.377	0.185	0.01	0.026	0.320	0.214	0.111	0.060
Firms	101	101	101	101	200	200	200	200

Table II: Split sample factor portfolios

Panels A displays the split sample annual return correlations for the listed factor portfolios. Panel B displays the split sample regression analysis where the dependent variable is either the EXC or ONR factors. T-statistics are reported in brackets. These are marked for significance using *, **, *** for statistical significance at 10%, 5% and 1% levels respectively.

Panel A: Non-Financial Firm Annual Return Correlations						
Factor	MKTRF	SMB	HML	UMD	EXC	ONR
MKTRF	1.000					
SMB	0.175	1.000				
HML	0.232	0.482	1.000			
UMD	0.257	0.296	0.479	1.000		
EXC	-0.008	0.126	0.401	0.243	1.000	
ONR	0.362	-0.003	-0.455	0.060	-0.541	1.000

Pannel B: Non-Financial Regression Analysis				
	EXC Factor		ONR Factor	
Explanatory Variables	1	2	3	4
	Annual alpha			
Alpha	-0.001	-0.002	0.000	0.000
	[-0.86]	[-0.97]	[0.20]	[-0.16]
	Factor loadings			
MKTRF	-0.059	-0.068	0.247	0.227
	[-0.53]	[-0.62]	[2.99]***	[2.76]***
SMB	-0.117	-0.127	0.32	0.295
	[-0.39]	[-0.43]	[1.29]	[1.40]
HML	0.387	0.354	-0.508	-0.587
	[2.18]**	[1.90]*	[4.89]***	[-3.88]***
UMD		0.157		0.380
		[0.32]		[1.42]
N	26	26	26	26
R^2	0.176	0.183	0.482	0.532

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