Does CEO Equity Ownership Matter for Firm Value?

A Study of the Industrial Sector in the Swedish Market

by

Lennart Lindrud

Andreas Valavanis

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Abstract

The primary objective of this study was to measure the effect of CEO ownership on firm value in the presence of strong external governance. We hypothesized that the concentrated ownership structure in Sweden could make equity incentive programs less relevant. The same hypothesis is tested on a subsample of risky firms as well, categorized as firms that conduct R&D. Using panel data methods and firm-fixed effects to control for endogeneity; we find that the relation between CEO ownership and Tobin's Q is positive but insignificant for low levels of ownership while it is negative and significant for high levels. For the subsample, the relation is positively significant for low levels of ownership and negatively significant for high levels. The results indicate that risky firms are in more need of CEO ownership, so strong external governance is not enough on its own to mitigate agency costs. Furthermore, external governance does not seem to work as a substitute for incentive mechanisms when ownership is large, regardless of whether the firms are risky or not.

Keywords: CEO Ownership, Options, R&D, Agency Theory, Firm Value

Abbreviations and Symbols

Symbol	Meaning
BPG	Breusch-Pagan-Godfrey Test
DW	Durbin Watson Test
D/E	Leverage
EG	External Governance
FE	Fixed Effects
IOC	Institutional Ownership Concentration
JB	Jarque-Bera Test
K	Plant, Property and Equipment
OWN	CEO ownership
Q	Tobin's Q
R&D	Research and Development
ROE	Return on Equity
ROA	Return on Assets
RE	Random Effects
S	Sales
TA	Total Assets
Y	Operating Income

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1 Introduction

1.1 Background

The principal-agent problem between managers and shareholders in firms with diffuse ownership is an issue that has been frequently discussed and researched by academics, with rather ambiguous results. The implications of the separation of ownership and control in modern corporations were first brought up by Berle and Means (1932). They argue that when management and ownership is separate and managers are remunerated mostly for labor, the consequence will be a divergence of interests between the two groups.

The separation is necessary because shareholders in general own very small amounts of a corporation. They enjoy the risk-reducing benefits of diversification but it is too costly to control or monitor the many companies in their portfolio so managers are appointed for this. When incentives are not aligned between shareholders and managers a negative consequence is that managers may act in ways that benefit themselves at the expense of owners, rather than maximizing shareholders equity. The costs arising from these actions are referred to as agency costs of managerial discretion (e.g. Ogden, Jen and O'Connor (2003)), and the systems/mechanisms in which they are mitigated falls under the heading of corporate governance. The principal-agent problem is not limited to managers versus shareholders, though in this study the focus will be on these two.

There are two main ways through which managers incur agency costs (Ogden et.al (2003)).

- Actions that increase their compensation (empire building, excessive perquisites etc)
- Actions that reduce the riskiness of their compensation (excessive diversification, underemployment of debt, management entrenchment etc)

Jensen and Meckling (1976) argue that by establishing the right incentive plans, agency costs can be mitigated, which should result in higher firm value. A common way to try and align incentives is through the use of equity ownership and/or stock options. The idea is to

compensate managers in a way that is linked to performance, so that when the company does well, so does the manager. This should put management in the shoes of the shareholders, but at the same time increases the risk in their personal portfolios, leading to possible non-optimal investment decisions.

A number of studies have explored how managerial ownership affects firm value in order to gauge how efficient this method is in aligning interests. Examples of papers that found there is a significant relation between the two are Morck, Shleifer, and Vishny (1988), McConnell and Servaes (1990), and Kim and Lu (2011). Examples of papers that do not find a significant relation are Demstez and Lehn (1985) and Himmelberg, Hubbard, and Palia (1999). Cho (1998) finds that causality runs the opposite way from what is usually assumed; from firm value to ownership rather than vice versa. These studies are all performed in the United States with different sample sizes and models, which are discussed more in detail later.

The results from previous studies are mixed, to say the least. Comparing results is delicate since different econometric methods are used and in many cases the variables are defined in a variety of ways. Econometric problems are further exacerbated by causality issues. Does ownership cause higher Q or is it the other way around? Managers may see great potential in in their firms and choose to increase their equity ownership for that reason. Core, Guay and Larcker (2003) suggest using vector autoregressions to deal with the issue of causality.

The main paper that sparked our interest is by Kim and Lu (2011). They concentrate on CEO ownership rather than a broader measure of insiders to determine its impact on firm value, arguing that CEOs tend to have the most influence on firms decision making regarding investments and leverage. They observe a hump-shaped relation between ownership and Q, and contend that incentives change with large ownership. At low levels firm value rises since interests are aligned but with too much ownership the CEO becomes risk-averse and entrenched. A significant relation is only observed when external governance (EG) is low, which indicates that EG can be used effectively as a substitute for stock- and option ownership as a means to reduce agency costs. One of the ways they measure EG is through institutional ownership concentration (IOC). They argue that when ownership is concentrated there is less need for mitigating agency costs since these large owners will have incentive to monitor the company.

The idea put forth by Kim and Lu (2011) that EG can be an effective substitute for equity incentives is an interesting one and inspired us to conduct this study on Swedish firms. In the Swedish market, EG should be strong since the ownership structure is quite focused in comparison to the United States where most studies have been undertaken. Consider the following quote from the Swedish Corporate Governance Board:

> *"Ownership structure on the Swedish stock market differs significantly from that in countries such as the United Kingdom or the United States. While the majority of listed companies in those countries have a very diverse ownership structure, ownership in Sweden is often concentrated to single or small numbers of major shareholders, as is the case in many continental European countries. These shareholders often play an active ownership role and take particular responsibility for the company, for example by sitting on the board of directors."*

They also state that "broad ownership can lead to conflicts of interest" for the same reasons that were discussed earlier. The Swedish Corporate Governance Board is positive to focused ownership, and this view is strengthened by studies like Kim and Lu's (2011). With such concentrated ownership in Sweden, there should be little reason to use equity ownership as an incentive. This will be the topic of our study. Are Swedish firms on average in less need of ownership incentives due to concentrated ownership?

A further consideration for our study takes its root in a study by Demsetz and Lehn (1985). They found that firms with higher risk have more concentrated ownership, and that there is more room for management to do damage agency-wise in risky firms. Furthermore, Baber, Janakiraman, and Kang (1996) find there is a strong link between CEO ownership and performance in firms with growth opportunity, which firms conducting R&D should exhibit. If so, CEO ownership should be more relevant, perhaps even in the presence of strong EG. This raises the question: Is EG still a substitute for equity based incentives in risky firms as well?

1.2 Aim and Objectives

The aim of this study is to investigate how CEO equity ownership and options-based incentives affect firm value. This is done with panel data methods. We use CEO stock ownership as the main variable of interest and limit our study to the Industrial sector of the Swedish market between the years 2009 and 2013. Additionally, we investigate whether a regression on a subsample of firms that conduct R&D (which is a risky and discretionary activity) will alter the results. We suspect that it might since there is more room for negative outcomes if the CEO does not act optimally.

To our knowledge, no study has been performed on the industrial sector of the Swedish market that measures the effects of managerial ownership on firm value. The studies we have seen are mostly based on insider versus outsider ownership. With this study we contribute with a new approach on the Swedish market as employed by Kim and Lu (2011), where panel data methods are used and the focus is on CEO ownership in the presence of high EG. We hope to cast some light on the incentive mechanisms in Sweden and provide a deeper understanding of agency theory. The questions we wish to answer are:

- Does high ownership concentration in Sweden make equity ownership incentives less necessary there?
- Does this hold for risky companies as well?

Our null hypotheses are:

1. H_0: There is no significant relationship between ownership and firm value in the Swedish industrial sector due to strong EG.
2. H_0: Risky firms need more incentive alignment, so strong EG will not be enough to replace equity ownership.

1.3 Research Limitations

It would have been optimal to use the whole Swedish market in the sample. However, we limit ourselves to the industrial sector since much of the data had to be collected manually and the limited time frame did not allow for a larger sample. Also, information on stock option programs in the annual reports was limited and sometimes missing so valuing them was not possible. Thus we include them only as a dummy variable.

Another factor to consider is that there are variables we have not considered that may have an impact on the results. Examples of these are CEO outside wealth, acumen, and risk preferences. These may vary over time so using firm fixed effects (FE) will not help. While it would have been optimal to conduct personality tests on each CEO and measure wealth outside the firm, it was not feasible for obvious reasons.

1.4 Outline of the Thesis

This paper is organized as follows. Section 2 covers the relevant literature and previous studies in the different topics relating to agency theory. This is followed by methodology in section 3, which includes a description of the data. Section 4 contains the results of the study and ends with a deeper analysis of findings and comparisons to other studies. Section 5 is a conclusion of the paper. Section 6 discusses limitations and ends with recommendations for possible future studies.

2 Theory and Literature Review

2.1 Theory

We will describe the relevant theory for our study in this section, in order to clarify some of the terms and arguments used later. Most of the material is taken from Ogden et al. (2003) but can be found in a majority of standard corporate finance textbooks. This is a short summary and by no means an attempt to cover all issues in corporate governance and agency theory.

2.1.1 Agency Costs

The separation of ownership and control in modern firms leads to two groups being formed. The first group (Principals) owns the capital but does not have the time to manage it, so a second group (Agents) is hired to manage this capital and have the skills to do so. The result of this separation can lead to agency costs if the interests of the different parties are not aligned. Ogden et al. (2003)

Managers will usually attempt to maximize their own wealth, and this is sometimes done at the expense of shareholders. Examples of how they do this include: excessive consumption of perquisites, manipulating earnings to reach bonus targets, and siphoning off assets. Managers will also sometimes overinvest in order to increase firm size, since there is a high positive correlation between firm size and management salaries. This is called empire building. Ogden et al. (2003)

Another way in which managers increase their compensation is through overly conservative decisions. Managers act this way because their portfolios are likely to be highly dependent on the firm they run, since much of their compensation comes from there. In other words, their portfolios are overexposed to one firm, whereas the owners of the firm are highly diversified and only expect compensation for systematic risk. Ogden et al. (2003) bring up four ways that managers are likely to reduce risk: Excessive diversification, bias towards investments with near-term payoffs, underemployment of debt, and management entrenchment. These are

mostly self-explanatory but the last one, entrenchment, is worth explaining since it is frequently referred to in the studies we mention and in ours as well. Ogden et al. (2003) define entrenchment as a situation where the manager has too much control and becomes hard to replace. This occurs for a number of different reasons. One is that managers naturally make investments in their own areas of interest and expertise, which makes it hard to fire them over time. Another way to become entrenched is to "pack the board", which means filling the board of directors with friends. Yet another way is to control much of the voting rights in the firm, which naturally makes it hard to oust the manager. Ogden et al. (2003)

The last reason is often cited in studies like ours when a negative effect on firm value is observed for large amounts of equity owned. However, it is worth pointing out that managers would likely need a very large portion of the firm for this to be true. The more reasonable conclusion is that entrenchment is caused through a combination of the reasons above, and that voting power alone is not enough to describe the phenomenon of lower firm value.

2.1.2 Monitoring

Monitoring is a way decrease agency costs by keeping track of what the CEO is up to and making sure they do their job. With small ownership stakes for any one shareholder, there is not enough incentive to do this since monitoring is costly. Instead, this duty falls mainly on the board of directors, which is why it is often argued that the members should be independent. Other monitoring agents include financial institutions, rating agencies, analysts, and creditors. When ownership is concentrated however, the large equity owners have enough vested to make monitoring worthwhile. Monitoring, whether it is practiced by equity holders, debt holders or even board of directors, can have significant ramifications on the economic performance of the firm if agency costs are large. Ogden et al. (2003)

2.1.3 Equity Based Incentives

In their paper Jensen and Meckling (1976) mention that if a company is fully owned by its managers, they will work on maximizing its value. But if a fraction of this equity owned by managers is sold to outsiders, the risk borne by them now is lower. This will be one of the main reasons for management to act on maximizing this new percentage owned of the firm rather than maximizing the full dollar amount owned before. Outside shareholders, realizing

this problem, bear the cost of the equity owned, in addition to the monitoring costs over management and the cost of misaligned interests. They suggest that this conflict of interest could be resolved in many ways, like auditing, budget restrictions, control systems, and establishing incentive programs (equity-based), where the last one could help in aligning the interests of management with that of the shareholders.

2.1.4 Option Based Incentives

Smith and Watts (1992) and Gaver (1993) found a significant relationship between stock option compensation and growth opportunities available to firms. Kim and Lu (2011) find the same positive relation using Q as the dependent variable. These are but a few of the papers studying stock options as an incentive aligner. The convexity of the option payoff arguably makes it more effective in making CEOs less risk-averse, since the value of options increase with added volatility. That is usually how the argument goes, but it may not necessarily be true as seen below.

Some studies have shown that with stock options issuance from the company, dividends tend to decrease (Lambert, Lanen, and Larcker (1989) and Bartov, Krinsky, and Lee (1998)). Furthermore, they find that when managers own options, repurchases tend to replace dividends. This is not surprising, since managers can increase earnings by repurchasing shares, and any dividends paid decrease the value of their options. Warren Buffett (2005), in a letter to shareholders gives a very lucid explanation and example of how managers with fixed-price options would act when looking out for themselves. They simply need to withhold earnings and redeploy it at whatever return is available. This does not reflect their skill unless it is earning a higher return than shareholders demand, since redeploying earnings at the cost of capital is no different from a bank account where the interest is reinvested each year. Yet managers are often compensated without adjustment for retained earnings. The idea that they should take more risk with more options is therefore not necessarily true, since they can safely cash in by doing very little. Why risk unemployment by increasing the probability of bankruptcy? Of course, if the reasons are right, i.e. low stock price, then buying back shares is good for shareholders, as is lowering dividends when growth prospects are good.

2.1.5 Leverage as Agency Cost Mitigation Tool

There are both negative and positive effects of leverage on agency costs, but the negative ones pertain mostly to agency costs between creditors and shareholders. The positive ones are more relevant for our purposes, since they pertain to shareholders versus managers. The argument is that debt is a disciplinary mechanism which puts pressure on the CEO to be more efficient. Ogden et al. (2003) mention three reasons managers might decide to use sub-optimal debt.

- More debt means higher probability of bankruptcy, leading to a loss of income for the manager
- Creditors act as monitors and also restrict what managers can do through covenants.
- Fixed interest payments leave less room for wasteful spending and overinvestment since there is less cash flow left over. Reducing cash flow to mitigate the CEOs scope for wasteful spending is first brought up by Jensen (1986)

Ogden et al. (2003) add that constant default threats are not a bad thing for the shareholders, since the managers will be constantly leery of losing their jobs. This should make them more interested in creating value through better investment decisions.

Jensen (1986) indicates that debt and its regular payment dues are the appropriate tool to put management on the edge of its seat and keep investing in order to meet these requirements. This is usually the main argument in agency theory with regards to leverage.

2.2 Literature Review

Although the findings of previous studies on the relation between ownership and firm value are mixed, there is a clear trend over time towards more accurate conclusions due to the development of more sophisticated econometric methods and better computing power. These studies show clear improvements in a chronological order, which makes the history quite interesting to read. Here we will describe some of these studies and the ways in which the authors have improved their models over time.

The setting, as mentioned in the introduction, takes its beginning in agency costs between principals and agents in modern firms, which is brought up first by Berle and Means (1932). Much later, Jensen and Meckling (1976) drew the conclusion that agency costs could be reduced by aligning interests between shareholders and managers. This is called the convergence-of-interest hypothesis, and simply put means that more management ownership leads to higher firm value. However, there are negative aspects of ownership as well, as pointed out by a number of authors like Demsetz (1983) and Fama and Jensen (1983). They argue that managers with large ownership will be harder to fire or control due to the larger number of votes they control and this will negate the convergence-of-interest. This is referred to as the entrenchment hypothesis. These two opposing forces are discussed frequently in subsequent papers.

One of the first studies performed on the efficiency of equity incentives was by Demsetz and Lehn (1985), using ownership concentration as the main variable of interest and accounting profit rates as the dependent variable. They find no significance and conclude that Berle and Means (1932) may not be correct in their theory that diffuse ownership causes agency costs. In the study they report that in their sample the mean ownership of the top three owners is 24% and for the top 20 it is 37%. We come back to this when reporting our ownership numbers, which are much larger. The main weakness in this study is that it did not allow for a non-linear relation, which means it does not take into account the entrenchment hypothesis.

Rather than assuming a linear relation as Demsetz et.al did, Morck, Shleifer, and Vishny (1988) use piecewise linear regressions to "capture the possible presence of both the convergence-of-interest and entrenchment effects". This is done on 371 Fortune 500 firms in 1980, with directors' ownership and Q as independent and dependent variables, respectively.

Their results indicate a positive effect on Q for ownership up to 5%, but from there falls until ownership reaches 25%, and then it rises again slowly after that. Their results support entrenchment theory since firm value falls after 5%. However, they voice concerns about the convergence-theory due to the rather large effect of ownership on Q between 0 and 5%, stating that successful firms probably have managers that end up with more stock over time so large ownership may be a result of firm performance rather than incentive mechanisms. Also, they use only large firms in their study, which makes it vulnerable to size bias.

McConnell and Servaes (1990) perform a similar study on much larger samples, using two separate cross sectional regressions (for the years 1976 and 1986) in USA. They use a squared ownership variable in order to allow for a possible non-linear relation between Q and insider ownership. Their findings are similar to Morck et al (1988), but the slope turned negative at 40% to 50% ownership rather than at the 5% level. This also supports the convergence-theory for small ownership and entrenchment for large ownership.

Both of these studies have treated the ownership variable as exogenous, which is criticized and explored by Cho (1998). His argument is that the ownership variable is endogenous, which means it is either determined within the equation or in a system of equations. After running simultaneous regressions on 326 Fortune 500 companies he finds that firm value affects ownership structure, but not vice versa. This casts some doubt on the direction of causality assumed not only in previous studies, but also in future studies. This would be an interesting study to conduct today, with further improvements to the model that are discussed below.

In response to the previous studies that find a significant relation between management ownership and firm value, Himmelberg, Hubbard, and Palia (1999) replicate Demsetz and Lehns (1985) study but use panel data rather than a cross-section, arguing that previous studies are spurious due to endogeneity of the ownership variable . Their criticism is different from Cho (1998) in that they believe there are many unobserved firm characteristics that also influence the ownership variation. To account for these, they use firm FE while also controlling for observed effects with control variables. A number of these control variables are new. Interestingly, they observe no significant relation when using this model, which supports their theory that previous findings are spurious.

Himmelberg, et al. (1999) are criticized by Zhou (2001) who notes that when FE are used one has to rely on within-variation, and he shows there is little variation from year to year in ownership so the model by construct will tend not to find any significant relation.

One issue not brought up by any of these studies is the measure of ownership. Most of them use an aggregated measure, such as management ownership, insider ownership, directors, or a combination. If the number of say managers, in a company varies over time then variation in equity owned is likely to change due to changes in the number of managers, making conclusions unreliable. Kim and Lu (2011) make this point and disaggregate the ownership variable to include just the CEO, and then run the same regression using the top five owners as well. Replicating Himmelberg et al. (1999) but with extra control variables, they find there is in fact a significant effect on firm value, and that the relation is hump-shaped, despite Zhou's (2001) FE argument. Furthermore, they classify companies by industry and sort them based on whether the industry on average displays highly concentrated ownership or not. In theory there should be less agency costs in focused industries since large owners have the right incentives to monitor the firm. This is used as a measure of EG, and their results indicate that in highly concentrated industries, CEO ownership does not significantly affect firm value. This holds for the entrenchment theory as well, since they find no significance in the squared variable either when the industry had high EG.

However, we would posit that there is a weakness in the argument about institutions and their assumed monitoring incentives. Although they may own a big portion of a specific firm, that portion may only be a small fraction of their total portfolio, making monitoring less likely even though they have enough influence to make a difference. Another issue we think should be considered which pertains to the model used by Kim and Lu (2011) as well as Himmelberg et al. is that no consideration is taken for the turnover in their ownership variable. It is likely that in their time frame some of the firms employed a new CEO and that the ownership changed dramatically that year. Their models do not differentiate between different CEOs in the same firm. Even when using a fixed number (like top five owners) there is still an issue if the composition changes over the time frame used. Needles to say, this is only an issue in panel data models.

A more general objection we have with ownership variables is that they do not account for differences in owners either. It would make a large difference to most investors if Warren Buffett was a large stakeholder of a firm as opposed to some unknown mutual fund. While

this would be hard to model, it definitely plays a role and speaks to the difficulty of modeling these types of studies.

To sum up, early studies were conducted on a cross-section of firms and with disaggregated ownership variables, as well as likely erroneous assumptions about the exogeneity of both the dependent and independent variables. Furthermore, the majority of studies up until Himmelberg et al. (1999) did not account for unobserved firm characteristics, though most used control variables for observed firm characteristics. The very early studies also did not account for a non-linear relation. Despite some of these flaws, many of the early studies did find that the relation is curvilinear which later studies often observe as well. When correcting for all the issues mentioned, Kim and Lu (1999) observed a strong, curvilinear relation but only for industries where EG is not strong. As for the direction of causality, there is still concern that it runs the other way as Cho (1998) suspected, but that study has yet to be replicated using unobserved effects.

2.3 Considerations for This Study

When it comes to agency costs, we believe there is a point to be made about the competency of managers which is not brought up in most studies. In the long run, firm value is determined by cash flow, which in turn is determined by how competent the CEO is at making investment decisions. A competent CEO may increase firm value while also consuming perquisites. The opposite could also be true. Would you rather have a competent but wasteful manager, or an incompetent but honest manager? There is no clear answer to that question, but while it is true that excessive perquisite spending is detrimental, the problem is best thought of as a tradeoff between value they create and value they destroy through other motives. Needless to say, this will depend on the type of agency cost. Empire building is likely to be more detrimental to firm value than perquisite spending.

There is an implicit assumption in extant literature that managers are driven more by pecuniary motives than obligations or ethics, so that when given a choice they will do whatever makes them wealthier. In theory this is all well and good, but in real life they most likely have a moral standard that sets a limit to such behavior. Do we assume anywhere else that employees on average will neglect their duties or be dishonest to make some extra money

at the expense of their employers? The only reason we can think of that makes CEOs any different would be the extra temptation they are exposed to since they make all the decisions and are not likely to be questioned. Furthermore, extreme wastefulness will cause the firm to lose value and put the CEO at risk of losing his job, so there is some limit to the damage done.

The pecuniary motive is partly expressed through the notion that managers (and everyone else) attempt to maximize expected utility, given their personal utility functions. These functions are assumed to be concave, which simply put means that the person in question is risk-averse. They would prefer to pay some amount of money to receive money in-the-hand right now rather than participate in a gamble or lottery with expected value higher than that received in the hand. This was first modeled mathematically by John Von Neumann and Oskar Morgenstern (1944) and is based on a number of axioms or assumptions that have to be fulfilled.

Research indicates that the majority of agents/people are risk-averse as opposed to risk-neutral or risk-seeking (e.g. Holt and Laury (2002)). This has implications for equity incentives, since there is an assumed trade-off between higher ownership and the higher risk imposed on a manager's portfolio. If the manager is risk-neutral or risk-seeking, there would be no trade-off since more risk will not deter them from doing their job. Individual risk preferences are hard to measure, but it is reasonable to make the assumption that CEOs are risk-averse on average. Note however that CEOs may also be insensitive to firm risk if they are already wealthy outside the firm, even if their utility functions are concave.

3 Methodology

3.1 Panel Data

Panel Data can be defined as having both a time- and cross sectional dimension, where data is collected on the same entities over time. For example, in this study we look at the data for a cross-section of industrial companies (N) going back five years (T). Panel data is useful in that there is more information than single cross-section or time-series data yields, but comes with added complexity with regards to model specification. Some advantages and disadvantages of panel data are listed below, these are taken from Brooks (2003).

Advantages

- More complex problems can be tackled than with just time-series or cross-sectional data alone.
- Rich data structure, more observations so there are more degrees of freedom and this makes it more useful to study the relationship between variables over time.
- More generalizable since data includes two dimensions. Multicollinearity may be mitigated due to the extra variation.
- Certain types of omitted variables bias can be removed if the model is structured correctly. Omitted variables are one of the causes of endogeneity, which is a major issue when it comes to corporate finance econometrics (Roberts-Whited (2012)).

Disadvantages

- More complex so more choices to be made regarding specification. Questions to be answered are: Use FE or RE or neither, transform the data, use cross-section effects or period effects etc?
- Results will vary to a great extent depending on the model specification. Therefore it is vital to get it right.

Many early studies have used cross-sectional regressions to study the effect of ownership on firm value, like for example Demsetz and Lehn (1985), Morck et al (1988), and McConnel and Servaes (1990). Himmelberg et al. (1999) criticized these studies, stating that cross-sectional studies do not account for unobserved heterogeneity, i.e. differences between firms. They argue that it is the contractual environment that causes ownership to differ across firms, and that the ownership variable is endogenous. Endogeneity is a major issue in financial studies, ours included, so we devote some time here to define and explain the underlying causes of it.

Endogeneity is present in a regression when there is correlation between the explanatory variables and the error term. This violates one of the formal assumptions for OLS and causes the coefficient estimates to be biased and inconsistent, meaning they are not accurate and they do not converge as samples get larger (Brooks (2003)).

There are three causes of endogeneity.

1. Simultaneity

   When the equation we wish to estimate is part of a system of simultaneous equations where a variable occurs more than once, then that variable will be determined simultaneously and is likely to be endogenous (Brooks (2003)).

2. Omitted variables

   Any omitted variable will be reflected in the error term, so if the omitted variables are correlated with the explanatory ones, the error will be also, violating the OLS assumption of no correlation. In corporate finance the omitted variables problem is common due to many unobservable variables, but with the help of panel data it is sometimes possible to model the omitted variables effect in the intercept via FE, which mitigates this problem (See Appendix C for an explanation of fixed and random effects (RE)).

3. Measurement errors

   Often, the variable of interest is unobservable and a proxy is used instead. Since these proxies likely are not perfect, they will differ from the true value of the parameter we wish to estimate. The difference is absorbed by the error term. If that error term in turn is correlated to some of the explanatory variables then there is an endogeneity

problem. The measurement error can be in the independent variables or the dependent variable (Roberts-Whited (2012)).

The most common cause of endogeneity is omitted variables. We have described how this source of endogeneity can be mitigated through the use of FE (Appendix C), but they are not an automatic fix and should be used with care. As Roberts-Whited (2012) pointed out, if the aim of a study is to understand the variation cross-sectionally, then using FE will defeat the purpose, since the parameters are based mostly on variation within the firm.

In this study the variable of interest is ownership in the regression of Q. Himmelberg et al (1999) find that when endogeneity is controlled for via FE there is no significant relationship between ownership and value. However, Zhou (2001) points out that with most of the variation in ownership occurring across firms, the structure of their model makes it hard to find such a relation. On the other hand, Kim and Lu (2011) replicate Himmelberg's study and find high significance when the definition for ownership is changed to reflect only the top five executives.

Clearly, a choice has to be made as to what is more important; dealing with endogeneity through FE where variation over time may be too small to observe, or running a badly specified cross-sectional model which is biased. Since Kim and Lu (2011) did find a significant relation it would seem that the variation in ownership levels was large enough to merit the use of FE. Note however that if omitted variables vary over time and are correlated to explanatory variables, we are still left with endogeneity problems.

3.2 Research Design

The design used in this study is similar to the one employed by Kim and Lu (2011), which we believe is an improved model of much previous research since they focus on CEO ownership and use FE to deal with endogeneity. They also added some new control variables to Himmelberg et al. (1999) study in order to guard against omitted variable bias.

We use panel data methods, while controlling for variables that might be related to Q and ownership. Firm- and period FE are used in order to deal with endogeneity. Rather than just using theory to specify the model, we ran tests to verify that using FE really was a good

specification. This process is described in the results. In order to save degrees of freedom the variables are all demeaned (within-transformation), which means that 73 less parameters are estimated (one for each firm intercept). Finally, Q is logged to pull in outliers and to make the observations more normal. We discuss this further in the descriptive stats.

The main variable of interest is CEO ownership. Two regressions are run, one with all industrial firms included in the sample and the other with a subset of these, as stated earlier. The first examines firm value as a function of CEO ownership; the second examines if the presence of risky, discretionary activities in the form of R&D makes ownership more relevant. Both regressions use Q as the independent variable, which is logged due to its inherent positive skew. We limit ourselves to a subset of the explanatory variables in Himmelberg et al. (1999) and Kim and Lu (2011). See Appendix A, table 1 for the definitions of all the variables used. The main variables of interest are described in further detail below.

The equation for both regressions is:

$$\boldsymbol{ln(Q_{it}) = u_i + \lambda_t + \beta_0 + \beta_1 OWN_{it} + \beta_2 OWN\_2_{it} + \beta_3 Options_{it} + \beta_4 Z_{it} + \varepsilon_{it}}$$

Q is Tobins Q, u_i and λ_t capture firm- and year FE, β_0 is the intercept, OWN_{it} is the stock ownership owned by the CEO, Options is a dummy for when options are used, and Z_{it} represents the other control variables that may be related to Q and OWN. In addition, OWN^2 denoted (OWN_2) is included to allow for a possible non-linear relation, like McConnel and Servaes (1990). In accordance with previous studies, we expect the coefficient for OWN_2 to be negative in line with entrenchment theory, while the OWN and Options coefficient is expected to be positive, in line with the convergence-of-interest hypothesis. The expected signs for all the variables can be found in Table 1 below.

Variable	Expected sign	Comment
OWN	+	Lower agency costs should lead to higher Q
OWN_2	-	Too much leads to entrenchment
Options	+/-	May create more risk-taking which could be both good and bad
Leverage	+/-	Acts as a disciplinary mechanism, which is positive from an agency perspective. However high Q means high growth opportunity so leverage is not optimal there
Age_of_firm	+	Should be survival value, stability of earnings.
CEO_Age	+/-	Experience vs risk aversion
Cash_TA	+/-	More opportunity (Dittmar and Mahrt-Smith, 2007) but also higher scope for perks.
I_K	+	Proxy for growth opportunity
K_S	-	Related to moral hazard since fixed assets are easier to monitor. Also may affect value negatively, since high ratio indicates low sales from existing assets (Kim & Lu (2011))
K_S_2	-	Allows for non-linear relation
LNS	+	Large firms have higher Q
LNS_2	+	Allows for non-linear relation
ROA	+	Higher return should lead to higher Q
Y_S	+	Higher margins should lead to higher Q
CEO_Tenure	+	More experience should be positive but entrenchment might be a problem

Table 1: Independent variables and their expected signs

Q (logged) is used as a proxy for firm value, defined here as the market value of equity plus the book value of debt, divided by the book value of total assets. It is a common proxy in these kinds of studies and is similar to the price-to-book ratio (P/B). The benefit to using Q is the ease of computation and comparisons to other studies. The downside to this measure is that there are many other variables that also determine Q. Any measure of performance or firm value will suffer from this weakness but some variables (like return on assets) are perhaps less dependent on so many other factors. In auxiliary regressions, ROA is used in place of Q in order to gauge the robustness of the model (see section 3.6).

OWN is defined as the stock percentage ownership of the CEO, calculated by taking total shares owned divided by shares outstanding. Many studies include the value of options in the ownership variable or calculate it separately, and since options are an important part of compensation plans this would be the optimal way to gauge CEO incentives (Zhou (2001)).

Due to scarcity of information on options in annual reports it is not possible to value them accurately, and so instead we use a dummy that takes on the value of one for when options are part of the compensation. We recognize the weakness of such a measure, in that it does not consider the magnitude of option ownership. Our thoughts on options and the difficulty in measuring their value even when information is complete are discussed further in analysis.

The reason for using CEO ownership alone as opposed to a measure that includes the board of directors or other executives can be motivated by our previous discussion of the Himmelberg et al. (1999) study earlier, where the variation in number of executives over time becomes a larger explanatory factor than the actual ownership, as explained and tested by Kim and Lu (2011). They also found that their results were robust to using the top five executives which led them to conclude that the number of executives should be held constant. Also, we expect the CEO to have the final say in decisions and therefore have the most influence in agency cost effects.

The control variables used in this study that are inspired by the Himmelberg et al. (1999) study are: size (LNS), capital intensity (K/S), cash flow (Y/S), Leverage, and gross investment rates (I/K). These are combined with three added control variables by Kim and Lu (2011): Firm age, return on assets (ROA), and CEO age. Finally, we included a variable of our own, CEO_tenure, which really is a proxy for experience, with the expectation that it would affect firm value positively. CEO_tenure is used as an instrumental variable in other studies, first by Palia (2001) and then by Kim and Lu (2011) in robustness tests but not as an explanatory variable.

3.3 Data Collection

The data is collected on all industrial firms in the Nasdaq OMX sector, Sweden. Besides industry, we restrict the sample to years 2009 -2013. In total the original sample included 77 firms. Three of the companies in the sample were omitted since they had just gone public and did not have retrievable data before then. We excluded an investment company as well, since this company consists of firms already included in the sample. Also, they conduct no business of their own. With these four firms removed the total sample drops to 73 firms.

The following variables were retrieved manually from annual reports: CEO stock ownership, dummy for when Options are used, dummy for firms that conduct R&D, CEO age, CEO tenure, and firm age. These were not available in any other way. All other data was retrieved from SIS Ägarservice. The firms that do not conduct R&D are excluded from the second regression. The number of omitted firms due to this was 30, so the second regression is run on 43 firms.

It would have been possible to use random sampling, but in order to reduce idiosyncratic effects we chose only one sector. The industrial sector was selected because it has many manufacturing firms that spend money on R&D, which is a variable we are interested in for the subsample. Also, the industrial sector has enough firms that the sample is large enough to allow for accurate inferences. The downside of studying just one sector is that the conclusions are less generalizable. What holds in this sector may not hold for other sectors or for the total market due to possible industry specific characteristics.

Two factors played a role in the choice of time frame. First, it needed to be long enough that sample size is adequate and that relations over time can be discerned. However, in order to reduce the effect of CEO turnover it is preferable that the time frame is not too long. Five years should be ample to allow for the first criterion, while limiting turnover somewhat. Also, manually perusing 77 annual reports for each added year limited the use of a longer time frame.

3.4 Data Analysis

3.4.1 Descriptive Statistics for Full Sample

Table 2 below shows summary statistics for the variables used in the regressions. An assumption of OLS is that the errors, and therefore also the dependent variable are normally distributed. With 357 observations (cross-section multiplied by period, minus any missing data) it is not necessary that the normality assumption holds, according to the central limit theorem. The general rule-of-thumb is that for samples larger than 30 the normality assumption can be taken lightly. However, we log Q since it cannot take on negative values and is therefore positively skewed. Logging also helps with some outliers in Q. The remaining variables are kept in original data form. The table shows unlogged values however.

Q has a mean value of 1.4 while the average ownership of CEOs in the industrial sector is 2.8%. The minimum and maximum values for Q are 0.2 and 8.8. Ownership lies between 0 and 47.9%. Incidentally, Kim and Lu (2011) also have a mean of 2.8% ownership in their sample, while the mean for their Q is 2. Their minimum and maximum ownership is 0% and 76%. The values we obtained look reasonable as compared to their sample, but it is interesting to see that Swedish firms own as much equity as American firms. One might be inclined to think that incentive mechanisms are equal but that would only be true if the average market cap of the American firms in their sample is equal to the Swedish average. A quick comparison of LNS indicates that this is not likely; our sample has a mean LNS of 6.4 while theirs is 7.1.

The correlation matrix shown in Table 2, Appendix A is simple way to check for possible multicollinearity problems. The variables that stick out are the squared ones; OWN_2, K_S_2 and LNS_2. These are highly correlated to their non-squared counterparts for obvious reasons. A common way to deal with squared variables is to subtract the mean from each value before squaring them. In this way the correlation will be low but will not change the outcome. We did this with the variables mentioned above and as can be seen the correlations drop to reasonable values.

The correlation matrix only displays pair-wise correlations and not correlation between more than two variables. As such there may be multicollinearity problems present that we cannot observe in the matrix (Brooks (2003)). There are ways of detecting these as well, by running regressions of each explanatory variable on the others but this would be cumbersome since we have 13 explanatory variables. A good reason not to do this is that we have no reason to believe multicollinearity is a problem. Omitting insignificant variables did not result in much of a change in the results for the final model used, which leads us to believe the model is not sensitive to specification, as it likely would be if multicollinearity were a problem.

3.4.2 Descriptive Statistics for Subsample

Table 3 below shows the descriptive statistics for the subsample, which is comprised of 43 firms but unbalanced as before so total number of observations ends up being 206. As with the main regression, Q does not pass the normality test but this OLS assumption is disregarded for reasons already stated.

Average Q is 1.7 and average OWN is 1.9% which is similar to the full sample.

The correlation matrix is shown in table 3, Appendix A. As can be seen, the only variables exhibiting high correlation are between tenure and ownership, at 0.78. The rule of thumb for when collinearity is a problem is when correlation is over 0.8 so there may be an issue here. To test this, tenure was omitted in an auxiliary regression. We found that it did not make a difference in the results so it was kept in the main regression. See Panel 3, Appendix A for these results. Squared variables are dealt with in the same way as before.

1. Table 2: Descriptive Stats (Full Sample):

	TOBINS_Q	OWN	OWN_2	OPTIONS	LEVERAGE	AGE_OF_FIR...	CEO_AGE	CASH_TA	I_K	K_S	K_S_2	LNS	LNS_2	ROA	Y_S	CEO_TENUR...
Mean	1.407850	0.027826	0.000494	0.512605	0.461607	16.37815	51.07003	0.113408	0.231996	0.219799	0.006484	6.422973	0.009141	0.024741	0.045364	7.221289
Median	1.150382	0.001440	5.55E-08	1.000000	0.242424	15.00000	51.00000	0.077243	0.172772	0.113703	0.000113	6.379142	0.002305	0.049043	0.064828	6.000000
Maximum	8.839435	0.479833	0.060663	1.000000	33.19658	49.00000	67.00000	0.794794	2.573095	6.447413	1.106677	8.491876	0.394185	0.264423	1.409790	46.00000
Minimum	0.271590	0.000000	0.000000	0.000000	-0.972942	1.000000	36.00000	0.000000	-0.761398	-0.044407	1.12E-10	4.011824	2.55E-08	-0.966960	-1.718574	0.000000
Std. Dev.	1.103691	0.082699	0.003831	0.500543	1.787415	8.339016	6.471469	0.121185	0.229179	0.701592	0.062521	0.861589	0.027451	0.116019	0.197888	6.979810
Skewness	3.199718	4.226440	13.10822	-0.050436	17.28665	0.783839	0.157994	2.821227	3.771654	7.612064	15.83503	-0.035489	9.608035	-3.322977	-3.651694	2.765884
Kurtosis	16.93520	20.95745	190.7692	1.002544	316.9079	4.229617	2.423202	12.57748	34.67319	62.59341	272.5657	2.971734	121.1984	21.65790	44.37375	13.50885
Jarque-Bera	3497.744	5859.576	534675.5	59.50010	1483535.	59.04744	6.434110	1838.035	15768.88	56274.34	1095822.	0.086824	213309.4	5835.252	26256.26	2097.917
Probability	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.040073	0.000000	0.000000	0.000000	0.000000	0.957517	0.000000	0.000000	0.000000	0.000000
Sum	502.6025	9.933804	0.176393	183.0000	164.7939	5847.000	18232.00	40.48659	82.82258	78.46835	2.314888	2293.001	3.263270	8.832497	16.19511	2578.000
Sum Sq. Dev.	433.6557	2.434724	0.005224	89.19328	1137.367	24755.95	14909.25	5.228122	18.69813	175.2342	1.391560	264.2713	0.268265	4.791886	13.94085	17343.52
Observations	357	357	357	357	357	357	357	357	357	357	357	357	357	357	357	357

2. Table 3: Descriptive Statistic (Subsample) :

	TOBINS_Q	OWN	OWN_2	OPTIONS	LEVERAGE	AGE_OF_FIR...	CEO_AGE	CASH_TA	I_K__GROW...	K_S	K_S_2	LNS	LNS_2	ROA	Y_S	CEO_TENUR...
Mean	1.704080	0.019608	0.000207	0.616505	0.327603	16.36893	51.56311	0.133318	0.248152	0.137580	0.001322	6.452199	0.012012	0.019602	0.040154	7.373786
Median	1.367250	0.000858	1.57E-08	1.000000	0.222588	14.00000	51.00000	0.083647	0.172193	0.134243	0.000168	6.515258	0.002903	0.053707	0.087504	6.000000
Maximum	8.839435	0.423130	0.035256	1.000000	2.428571	49.00000	65.00000	0.794794	2.573095	0.467302	0.114159	8.491876	0.394185	0.264423	1.409790	46.00000
Minimum	0.271590	0.000000	0.000000	0.000000	-0.972942	1.000000	36.00000	0.008712	0.000000	0.000720	2.22E-08	4.011824	2.55E-08	-0.966960	-1.718574	1.000000
Std. Dev.	1.330225	0.068164	0.002467	0.487422	0.380815	9.270978	5.598205	0.147327	0.255347	0.094568	0.008080	1.023717	0.034565	0.137521	0.248911	7.211853
Skewness	2.567524	5.252036	14.02814	-0.479210	1.491174	0.985829	0.152062	2.356829	4.570394	0.652494	13.34655	-0.211939	8.010110	-3.198852	-3.245281	3.226648
Kurtosis	11.32456	30.67777	199.6543	1.229642	8.127538	4.260827	2.483554	8.572143	36.14404	3.253857	186.4428	2.363640	80.93523	18.19474	30.27834	16.78448
Jarque-Bera	821.1419	7522.387	338698.9	34.78598	302.0136	47.01192	3.083203	457.2115	10146.20	15.17049	294955.7	5.018044	54337.20	2333.043	6748.521	1988.388
Probability	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.214038	0.000000	0.000000	0.000508	0.000000	0.081348	0.000000	0.000000	0.000000	0.000000
Sum	351.0405	4.039237	0.042584	127.0000	67.48631	3372.000	10622.00	27.46347	51.11923	28.34158	0.272286	1329.153	2.474385	4.037948	8.271689	1519.000
Sum Sq. Dev.	362.7470	0.952494	0.001248	48.70388	29.72919	17619.96	6424.680	4.449547	13.36645	1.833346	0.013385	214.8392	0.244921	3.876966	12.70108	10662.22
Observations	206	206	206	206	206	206	206	206	206	206	206	206	206	206	206	206

3.5 Validity and Reliability

Reliability

Much of the data for this study has been collected manually, which naturally causes some concern as to the reliability of the study. While manual collection is prone to mistakes, we tried to minimize these by working slowly and meticulously. Additionally, we took a random sample of ten firms and double checked the values and found that they were all correct. Besides these, the outliers were checked as well as stated above which is likely where mistakes would lie if they were made. To the best of our knowledge, the data is accurate and a replication of it would yield the same results.

Validity

We attempt to deal with unobserved omitted variables by using FE. To the extent that these are time-invariant this works well, but when they are not the results will be biased. It is important to keep this in mind when viewing the model and results. Another consideration is the measures used for dependent and explanatory variables. Since many of these are proxies it is possible that the error in measurement causes bias, which is explained in the theory section. For comparisons to other studies this is not a problem since the same variables are used, but the true values could be off their mark.

3.6 Robustness Tests

Robustness tests are performed by running regressions with a different measure for the dependent variable, and omitting variables to test the sensitivity of the model specification. The model is not robust to the use of ROA as an alternative to Q in the full sample, whereas it is robust in the subsample. For the main sample, using ROA led to both coefficients of ownership being positive which is not what we expect theoretically. Also, OWN_2 was not significant in this regression.

After collecting data, we plotted the variables in individual graphs and found there were some substantial outliers (Graph 1, Appendix A). For each of these extreme outliers we re-checked the data by looking at the relevant annual reports to determine the cause. One of these outliers was omitted (ROA data point) due to the fact that the company had sold off a large portion of its business and reported it in their income statement, causing a large one-off value in the ROA which did not reflect the true ROA for the operations of that business. The others were legitimate but often caused by rare occurrences like the financial crisis where for example D/E became very large when market cap dropped, while debt stayed constant.

Since each data point is valuable, our preference is to keep them in the sample. To check whether these outliers would change our results, the variables were plotted using Box and Whisker plots. After examining each variable individually, far outliers (any values outside the outer fences) were excluded and then the regressions were run in order to determine if results would change. As seen in Panel 6 and 7 of Appendix A, the result was only slightly altered and did not change any conclusions so the final regression includes them.

Variable	Number of Far Outliers Omitted from Main Regression Variables	Number of Far Outliers Omitted from Subsample Variables
OWN	0	0
OWN_2	0	0
Options	0	0
Leverage	5	2
Age_of_firm	0	0
CEO_Age	0	0
Cash_TA	5	3
I_K	1	1
K_S	10	0
K_S_2	10	2
LNS	0	0
LNS_2	2	2
ROA	1	1
Y_S	0	0
CEO_Tenure	5	5

Table 4: Number of Extreme Outliers that have been omitted for each variable

4 Results and Discussion

4.1 Full Sample

First a pooled regression was run in order to see how the variables behaved, and to subsequently test if this was a good specification. Panel 1 in Appendix A shows the pooled regression. Notice that DW is low which could mean there is a serial correlation problem (or that the model is not specified correctly). Also, the OWN variable is significant but has a negative sign, which is not what we would expect according to the convergence-of-interest theory. Note also that the options dummy variable is significant, as are a number of control variables.

A pooled regression assumes the firms are homogenous, and that there is no dependency over time for the firm which is unlikely to be true. The simplest way to test whether that assumption holds is to run a regression with FE in both dimensions. Testing whether the extra dummy parameters are significantly different from each other will tell us if they are needed or not. This is called a Redundant FE Test and is included in Eviews. As seen in table 1, appendix B the F-tests for cross-section FE and period FE are highly significant so we reject the null that they are equal. Thus endogeneity is present across firms and over time, meaning FE or RE should be applied.

We then turned to the specification of random vs. fixed effects. To do this we first ran a regression using RE for cross-section and period separately, and then ran a Hausman specification test on each to see if the model was well specified. The Hausman test results are shown in table 2 and 3 in appendix B.

The Hausman test clearly rejects the RE model as a good specification in the cross-section while the period dimension is not rejected. Unfortunately Eviews is not able to mix different effects which really would have been the correct way to run this test, since heterogeneity is present in both dimensions.

When the RE specification test is not rejected this means that either FE or RE could be used and that the results of these two converge as samples get bigger (Woolridge (2012)). Although RE are more efficient, we preferred FE for a number of reasons. First, one of the main reasons for using FE is to deal with omitted variable bias. The main assumption of RE is that the error is not correlated to any of the explanatory variables, which is a rather strong assumption and one that we theoretically have already dismissed as implausible. Second, it is hard in practice to mix both fixed and random effects for unbalanced data, and Eviews is not capable of handling this. Third, RE are generally used when the method of sampling is random. Our sample was not randomly sampled so the intercepts most likely do not follow a random distribution. Given the decent sample size in our model and our focus on endogeneity issues it would seem more prudent to use FE, since both methods are valid for large samples. This leads to a model where FE is used in both dimensions (Panel 2 Appendix A).

In order to save degrees of freedom while using FE, the variables were de-meaned over time within each firm, also referred to as within-transformation. The mean is subtracted from each observation within the firm, which eliminates any variable that is constant over time. Thus the FE disappear since they are assumed to be fixed over time. The final model used has de-meaned variables in the cross-section (which is equivalent to firm specific FE) and FE in the period dimension. By de-meaning we end up with 73 less parameters to estimate. Table 5 (in text) shows the regression results, with dummy variables in the period dimension and a demeaned cross-section.

The difference between demeaned and two-way dummy variable FE is mostly seen in the adjusted R-squared which drops from 0.87 to 0.39, which is expected since there are fewer explanatory variables. Also, standard errors are somewhat lower due to more degrees of freedom.

As for the pooled model, it is clear that the current one is better. DW is closer to two, and the OWN variables have the expected signs but only OWN_2 is significant, indicating that low ownership does not affect value significantly, while large ownership has a negative significant effect. Options is not significant, while Leverage is. Other control variables that are significant are LNS (size) and LNS_2 with positive signs for both which we also would expect, and ROA. CASH_TA is significant at the 10% level.

While DW indicates that autocorrelation likely is not a problem, we have not examined whether the error variance is heteroscedastic. A first step to deal with this is to plot the residuals (See Diagram 2 Appendix B).

The graph does reveal some variability in variance but it is hard to discern if it is large enough to cause problems. The scatter of the residuals (Scatterplot 1 in Appendix B) is promising in that it indicates that there is no pattern in the errors which means there is likely no dependence between them.

Eviews does not have automatic tests for heteroscedasticity in panel data, so we run a BPG test manually by saving the residuals from the regression above and then running a new one with the squared residuals as dependent variable against the original regressors. The F-test for joint significance determines whether there is heteroscedasticity or not (Panel 1 in Appendix B). The F-stat is not significant so the null of homoscedasticity (in the regressors) cannot be rejected. Thus no remedial action is necessary. Following Kim and Lu (2011) we ran the regression with period clustered standard errors to guard against serial correlation, and found that the effect was negligible and did not change any conclusions.

4.2 Subsample

This regression includes only the companies that conduct R&D. The sample consists of 43 firms. As stated earlier, R&D can be seen as a way for the CEO to affect firm value and is risky. Ownership may therefore be more relevant from an agency perspective, with greater benefits from aligning interests.

The pooled regression (Panel 4, appendix A) does not show any significance for any of the variables of interest and DW is quite low, indicating an incorrect specification and/or autocorrelation. Furthermore, the signs are not what we predicted for the ownership variables, according to theory. As seen in panel 5 Appendix A, running the FE model in both dimensions yields a better model with DW at 1.9 and expected signs. Adjusted R-squared is higher but this is due to the 43(firms) + 5(periods) = 48 extra dummies included.

The test for redundant FE shows that there is endogeneity present in both dimensions, indicating that fixed- or random effects need to be used. The RE Hausman test yields the

same results as the main regression earlier, rejecting RE in the cross section but accepting them in the period dimension. The tests are all displayed in Appendix B, tables 4, 5 and 6 respectively. For reasons already stated, we apply FE in both dimensions rather than use RE in the period dimension.

Table 5 below shows the final model with FE in both dimensions, but with demeaned variables in the cross-section for the same reasons given earlier.

Interestingly, here both ownership variables are significant and exhibit a hump-shaped relation, despite strong EG. Ownership is positive but turns negative in the squared variable, supporting entrenchment theory. Options are not significant, while amongst the control variables I_K, ROA, K_S_2 and both LNS variables show significance. DW seems to be ok at 1.9 and the adjusted R-squared is 0.52.

The scatterplot of the residuals (Scatter Plot 2, Appendix B), shows no pattern while the graph of the residuals reveals a somewhat uneven variance (Diagram 3, Appendix B), similar to the full sample earlier. A BPG test is run for heteroscedasticity which like the first regression shows no significance as seen in Panel 2, Appendix B. As with the full sample regression, the results did not change when a regression using period clustered errors was used (Panel 6, Appendix B).

4.3 Control Variables

Leverage

From an agency perspective, finding a positive coefficient is not surprising since debt acts as a disciplinary tool for management, decreasing agency costs Jensen (1986). However, leverage is only significant in the full sample. This most likely is due to the effects of a multitude of different factors, too many to discuss here. For the subsample we do not find a significant relation. According to theory, firms with growth opportunities (or that are inherently risky) should use less debt since negative outcomes in the future could limit their ability to invest when the opportunity arises. Also, less debt means less chance of bankruptcy. The relation between leverage and firm value is complex, and is not the focus of this study. Trade-off theory suggests that there is some kind of optimal level and that the relation is

hump-shaped but there is no clear indication as to where it lies since each firm and industry is unique.

Cash_TA

We expected this variable to be positively significant in both samples since more cash means greater flexibility in regards to future investments. Surprisingly, it was found to be significant in the full sample but not in the subsample which is a bit of a conundrum. One would think that for firms where R&D is vital to stay competitive, more cash would affect firm value positively. We surmise that the market sees increasing cash as an indication of neglecting R&D, or as a sign of low growth opportunities in which case the cash should be disbursed to shareholders. The latter should be true for the full sample as well however.

From an agency perspective, large cash flow should be negative if the cash is not disbursed since it makes wasteful spending more probable. This would indicate a need for larger amounts of ownership to align interests (Jensen (1986)).

I_K

This variable used as a proxy for growth is positive and significant in the subsample only, which is reasonable since growth is likely to be more important for R&D intensive firms.

K_S and K_S_2

From an agency perspective, tangible assets are easier to monitor which reduces agency costs. However, high ratios in this variable indicate low capital efficiency since sales are low in comparison to assets. The impact of low capital efficiency is larger, making this variable have a negative sign.

LNS and LNS_2

As expected, larger firms are traded at a premium, and it seems this relation becomes stronger the larger the firm gets, since the squared term is significant as well, in both regressions.

ROA

As expected, coefficients are positively significant in both samples. Higher profitability leads to higher firm value.

Y_S

This is a proxy for cash flow, and should be positive. It is not clear why this is negative in the full sample but in both cases it is insignificant.

CEO_Tenure

Tenure is positive, but not significant. The sign is expected since time should arguably make the CEO more experienced but the effect is not large enough to be significant.

4.4 Table 5: Full sample and Subsample Results

	Main Regression	**R&D Subsample**
Dependent Variable (demeaned):	LN(Q)	LN(Q)
Independent Variables (all demeaned except options)		
c (intercept)	-0.0058 (0.013)***	0.004 (0.021)***
OWN	0.933 (0.782)	8.822** (3.822)
OWN_2	-22.49*** (7.143)	-93.72*** (26.95)
Options	0.0096 (0.019)	-0.005 (0.028)
Leverage	0.038*** (0.0124)	0.0025 (0.788)
Age_of_firm	0.0133 (0.0413)	0.012 (0.055)
CEO_Age	0.0034 (0.0031)	0.0064 (0.0062)
Cash_TA	0.377* (0.210)	0.136 (0.248)
I/K (growth)	0.109 (0.0713)	0.26** (0.1127)
K_S	-0.115 (0.1744)	1.06 (0.711)
K_S_2	-0.225 (0.284)	-17.92*** (6.475)
LNS	0.746*** (0.128)	0.603*** (0.181)
LNS_2	3.577*** (0.578)	5.47*** (0.915)
ROA	0.7307*** (0.173)	0.985*** (0.2605)
Y/S	-0.072 (0.089)	0.015 (0.123)
CEO_Tenure	-0.0015 (0.005)	0.0006 (0.0077)
Adjusted R-squared Durbin Watson	0.39 1.81	0.52 1.9
*** 1% significance **5% significance * 10% significance Standard Errors are in parentheses ()	Obs. #357	Obs. #206

4.5 Analysis

Ownership

As expected, the sign for OWN is positive in both regressions, but only significant in the subsample. The insignificance in the full sample is what we expected since Swedish firms on average have highly focused ownership structures. In the full sample the top three owners owned 37% of shares and 44% of votes (Table 7, Appendix B). This gives owners enough reason to monitor the managers closely so there should theoretically be less reason to use equity as a way to reduce agency costs. This is the argument used by Kim and Lu (2011). However, one might also argue that even if institutions own a large chunk of a firm it may only represent a small fraction of their own portfolio. A large number of Swedish firms are family owned however, and have greater incentive to monitor than institutions would, leading us to believe there is strong EG pressure.

For the subsample, we would argue that the significance of ownership is due to the more risky nature of these firms, since they conduct R&D. This result occurs despite large concentrated ownership in the group. For this sample, on average the top three owners owned 33% of shares and 40% of the votes (Table 7, Appendix B). Thus we deduce that strong EG is not enough on its own to mitigate agency costs for R&D intensive firms, which is interesting because it indicates that future studies should give more thought to the nature of risk in a sample of firms than classifying them broadly by industry. Given that R&D is sometimes used as a proxy for risk taking, it is not implausible that this result holds for other types of discretionary risk taking as well, like advertising expenses and leverage. The results of the subsample discussed here are not comparable to other studies, since we know of none that have categorized firms in this way. However, it implies that the industry classification used in previous studies is not enough to draw strong conclusions, since firms show large differences even within industries.

The connection between risky firms and ownership concentration is not new. Demsetz and Lehn (1985) found that firms with higher risk have more concentrated ownership. They measured risk as stock price volatility. It is worth pointing out that large CEO ownership and concentrated ownership is not the same thing, and that both are not necessarily present at the

same time. However, their argument that there is more room for management to do damage agency-wise in risky firms is reinforced by our findings.

We mentioned earlier that there are a number of ways that CEOs can incur costs, like increasing their compensation through excessive perquisites or taking less risk than optimal in order to reduce bankruptcy risk. Conducting less R&D leaves more cash laying around which increases the risk of perquisite spending, and decreases the likelihood of bankruptcy, so the CEO is more likely to keep his job. These are the ways in which we believe R&D makes a difference in the above regression. At the same time, a poorly performing CEO is likely to be fired rather quickly unless they are entrenched, which acts as a counterbalance to the risk-aversion argument.

Ownership squared

The squared ownership variable turns out to be negative and significant in both cases.
The negative sign is expected; and supports the entrenchment theory. Other factors also make increased ownership less effective. There is a tradeoff between the benefit of ownership and extra risk to the CEOs personal portfolio. At some point, the CEO will start to decrease the risk of his/her own portfolio rather than maximize shareholders equity. The most likely way to do this is to under-invest or undertake less R&D. Our results support previous findings of a hump-shaped relation. However, we had not expected it to be significant, since EG is strong in Sweden. This runs counter to the results by Kim and Lu (2011) where the squared variable is not significant in industries where EG is strong. Apparently, either EG is not strong enough to counter the entrenchment effect of CEOs in Sweden, or EG is not the only deciding factor (or both).

To sum up the ownership variable results, for the group of companies that undertake R&D it is worthwhile implementing equity ownership in order to reduce agency costs and thereby increase firm value, but only up to a point. This is true even in the presence of strong EG. For the full sample, there is no significant benefit.

Options

Options are not significant in either regression, but this is a dummy variable that admittedly does not capture the full effect of their use. It does not take into consideration the magnitude

of potential payoffs. We could not value these since there was not enough information in the annual reports but it is reasonable to believe that they do play a significant role. Other studies, such as Smith and Watts (1992) and Gaver (1993), have found there is a relation between stock option ownership and Q. The difficulty in calculating the value of these casts some doubt on the validity of their results however, as is discussed by Core and Guay (2003). They argue that even if options are valued with the commonly used Black Scholes Pricing Model, the CEO likely does not agree with that valuation since their portfolios are focused. Lambert, Larcker and Verrecchia (1991) show that when the utility function of a CEO is a power function (which is typical of a risk averse agent) *"…the manager's risk aversion and degree of diversification can reduce the managers valuation of a stock option to substantially less than the present value of the options payout from the perspective of shareholders"*. In other words, market prices may not be the best way to approach option valuations. Thus, it is less clear what their effect is even in studies that measure actual value.

Furthermore, it is doubtful whether options increase risk-taking as is often argued. This was discussed earlier in the theory section of this paper; where we brought up some ways the CEO may act that actually decrease risk. We do not argue that incentive effects are low for stock option incentive programs, only that it is hard to measure their value which makes results hard to interpret, perhaps even misleading.

For a discussion on whether the results are economically significant or not, see Appendix C.

5 Conclusion

This paper examines the efficacy of CEO equity ownership as a way to align interests between shareholders and the CEO. This is done in the industrial sector of the Swedish stock market, which is characterized by highly focused ownership. As such, CEOs in Sweden should theoretically be scrutinized more closely than firms in other markets with diffuse ownership, making incentive alignment tools unnecessary. Additionally, we examine if firms that conduct R&D are in more need of CEO ownership due to the more risky nature of their businesses. The scope of damage they can inflict with sub-optimal incentives is larger than that of non-R&D firms.

We find that CEO ownership is effective as a value booster for firms that perform R&D but not for the full industrial sector. Thus our hypothesis that CEO ownership is less useful in Sweden than markets with less focused ownership is verified, except in the case when the firms conduct R&D. For these, EG is not strong enough alone to mitigate agency costs.

Interestingly, we find that the squared ownership variable is negative and significant in both cases, leading us to conclude that strong EG is not enough to mitigate entrenchment effects caused by large ownership fractions.

The relation between CEO stock ownership and Q is hump-shaped regardless of what sample is used, but in the full sample there is no significant relation for small amounts of ownership. We conclude that the usefulness of this incentive tool depends on the business risk of the firm as well as the ownership structure. It would seem that classifying firms by industry is not the optimal way to undertake these kinds of studies. Instead, categorizing firms by business risk should yield more accurate results. The measure of risk used should be something that the CEO has influence over, like R&D.

Regarding stock options, they were not found to have a significant effect on Q in any of the samples. However, we recognize that our measure, using dummies, is not good enough to make accurate inferences.

6 Limitations and Recommendations

It should be clear from this study and other studies that gauging the effect of ownership on firm value is hard, and that results are highly sensitive to the measures and econometrical methods used. In this study, we use FE which will sometimes cause insignificance if there is too little variation within the firms. Although we do not believe this to be the case, (since there is enough variation to see a significant effect in the subsample) it is nonetheless worth considering when interpreting results. Another concern that may have affected our results is the time frame used. It starts after the financial crisis and runs for five years until 2013. These years have been very good on the stock market and therefore may not represent the typical situation, making results hard to generalize over time. We cannot draw conclusions about other industries either but as stated earlier, the industry is less likely to be a determining factor for our results than risk-related characteristics are.

For future studies, we recommend categorizing firms by risk. It would also be interesting to study a larger sample on the Swedish market, and include a more sophisticated measure for the value of options. Dealing with CEO turnover may also improve the model. Finally, the direction of causality between ownership and Q would be interesting to investigate.

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8 Appendix A

1. Table 1: Variables Description:

Variable	Description	Reason for using the variable
Tobin's Q	Market cap plus book value of total liabilities divided by book value of total assets.	Measure of firm value
OWN	Percentage of shares CEO owns as a fraction of total shares outstanding.	Main variables of interest
OWN_2	Ownership squared	To capture the non-linearity
Options	Dummy for the inclusion of option based compensation. Takes on the value 1 if options are used and zero otherwise.	To measure the effectiveness of CEO option based compensation on firm value creation
Leverage	Long term debt over book value of equity.	Agency cost measure (Himmelberg et al. (1999))
Age_of_firm	Number of years since IPO.	New firms should have more growth opportunity (Kim and Lu (2011))
CEO_Age	The age of the CEO in office	Younger CEO may have higher risk preferences (Kim and Lu (2011))
I_K	Capex to PP&E	Proxy to growth (Kim and Lu (2011))
Cash_TA	Total cash divided by total assets.	To reflect ability to take risk, and also may affect Q (Kim and Lu (2011))
K_S	Ratio of PP&E to sales.	Tangible assets are easier to monitor so ownership should be lower, measures moral hazard. (Himmelberg et al. (1999))
K_S_2	Ratio of PP&E to sales squared	Squared to capture non-linearity (Himmelberg et al. (1999))
LNS	Log of sales in Swedish kronor.	This is a measure of size, since larger firms have higher Q values (Himmelberg et al. (1999))
LNS_2	Log of sales in Swedish kronor squared	Squared log sales to capture possible non-linearity (Demsetz and Lehn (1985))
ROA	Net income divided by total assets, in percentage.	Indicator of firm's profitability (Kim and Lu (2011))
Y_S	Operating income divided by sales.	Proxy for cash flow available for operations. (Kim and Lu (2011))
CEO_Tenure	Number of years CEO has been in office from IPO	To reflect the CEO's effect of staying longer in office

2. Table 2: Correlation Matrix (Full Sample):

Correlation	TOBINS_Q	OWN	OWN_2	OPTIONS	LEVERAGE	AGE_OF_FIR...	CEO_AGE	CASH_TA	I_K_GROW...	K_S	K_S_2	LNS	LNS_2	ROA	Y_S	CEO_TENUR...
TOBINS_Q	1.000000															
OWN	-0.019743	1.000000														
OWN_2	-0.075731	0.484860	1.000000													
OPTIONS	0.264984	-0.017374	-0.049683	1.000000												
LEVERAGE	-0.218071	-0.163833	-0.210673	-0.194227	1.000000											
AGE_OF_FIRM	-0.127796	-0.247388	-0.264898	-0.223597	0.268636	1.000000										
CEO_AGE	0.035331	0.075993	-0.161527	-0.126423	0.131116	0.049963	1.000000									
CASH_TA	0.198288	-0.107196	0.000334	0.115662	-0.321363	-0.083962	0.036070	1.000000								
I_K_GROWTH	0.221251	-0.039842	0.003699	0.173357	-0.257170	-0.074318	-0.067865	0.191509	1.000000							
K_S	-0.186486	-0.220489	-0.300848	-0.195979	0.472744	0.287651	0.135949	-0.213522	-0.427220	1.000000						
K_S_2	-0.172710	0.008425	-0.007010	-0.134858	0.215236	0.228666	-0.045670	-0.063301	-0.259369	0.563223	1.000000					
LNS	-0.039435	-0.402757	-0.342006	0.010495	0.442598	0.324423	0.110352	-0.183163	-0.030313	0.213805	-0.173387	1.000000				
LNS_2	0.219178	0.271143	0.326887	0.083416	-0.194431	-0.127488	-0.127191	0.032212	0.041953	-0.134105	0.178882	-0.295043	1.000000			
ROA	0.449404	-0.096184	-0.185395	0.115336	-0.123542	0.019667	0.134323	0.057992	0.153964	-0.079744	-0.259727	0.336973	-0.176543	1.000000		
Y_S	0.285484	-0.210164	-0.298041	0.127625	0.099864	0.093264	0.147994	0.050887	-0.085860	0.353515	0.102344	0.239564	-0.061452	0.439059	1.000000	
CEO_TENURE	0.216440	0.492575	-0.037283	-0.012494	0.086997	-0.010725	0.361549	-0.052642	-0.097126	0.057635	-0.005503	-0.012310	0.057294	0.213479	0.176675	1.000000

3. Table 3: Correlation Matrix (Subsample) :

Correlation	TOBINS_Q	OWN	OWN_2	OPTIONS	LEVERAGE	AGE_OF_FIR...	CEO_AGE	CASH_TA	I_K_GROW...	K_S	K_S_2	LNS	LNS_2	ROA	Y_S	CEO_TENUR...
TOBINS_Q	1.000000															
OWN	0.001852	1.000000														
OWN_2	-0.064152	0.228706	1.000000													
OPTIONS	0.137964	0.051005	-0.096185	1.000000												
LEVERAGE	-0.208701	-0.055915	-0.026271	-0.199363	1.000000											
AGE_OF_FIRM	-0.049965	-0.271386	-0.031848	-0.171481	0.150473	1.000000										
CEO_AGE	-0.079271	0.353847	0.048312	-0.081366	0.142053	-0.068968	1.000000									
CASH_TA	0.651386	-0.110952	-0.048184	0.152175	-0.278531	-0.059985	-0.163257	1.000000								
I_K_GROWTH	0.443610	-0.022159	0.071349	0.089184	-0.188839	-0.057527	-0.093086	0.438664	1.000000							
K_S	-0.258803	0.092217	-0.100096	-0.242803	0.275941	0.210100	0.062387	-0.323289	-0.153097	1.000000						
K_S_2	0.186039	0.017673	-0.008027	0.051872	-0.074734	-0.017699	-0.043270	0.225738	0.638808	0.269429	1.000000					
LNS	-0.426784	-0.071433	-0.122892	-0.140852	0.389675	0.418563	0.219261	-0.447028	-0.413549	0.370357	-0.207205	1.000000				
LNS_2	0.363039	0.047754	-0.011673	0.072550	-0.106971	-0.131713	-0.088850	0.326781	0.564486	0.097285	0.798520	-0.352903	1.000000			
ROA	-0.035891	0.016394	-0.192429	0.026954	-0.071116	0.113059	0.155493	-0.225643	-0.246574	0.118829	-0.215029	0.466509	-0.282281	1.000000		
Y_S	-0.106385	0.019950	-0.073979	-0.005418	0.118756	0.096695	0.127966	-0.212627	0.042001	0.325479	0.354767	0.345046	0.189562	0.564164	1.000000	
CEO_TENURE	0.085310	0.782771	-0.060174	0.013224	0.108356	-0.165718	0.436853	-0.137178	-0.098668	0.119020	-0.045581	0.004426	-0.002853	0.186463	0.089151	1.000000

4. Panel 1: Pooled Regression (Full Sample):

Dependent Variable: LOG_Q
Method: Panel Least Squares
Date: 05/14/15 Time: 11:39
Sample: 2009 2013
Periods included: 5
Cross-sections included: 73
Total panel (unbalanced) observations: 357

Variable	Coefficient	Std. Error	t-Statistic	Prob.
OWN	-1.782708	0.537932	-3.314006	0.0010
OWN_2	-4.421342	12.29870	-0.359497	0.7194
OPTIONS	0.139494	0.052314	2.666471	0.0080
LEVERAGE	0.039225	0.024832	1.579608	0.1151
AGE_OF_FIRM	0.002359	0.003372	0.699561	0.4847
CEO_AGE	0.000813	0.004409	0.184466	0.8538
CASH_TA	1.553544	0.243546	6.378863	0.0000
I_K__GROWTH_	0.415436	0.129327	3.212301	0.0014
K_S	-0.032858	0.045646	-0.719850	0.4721
K_S_2	-0.080182	0.473963	-0.169174	0.8658
LNS	-0.068865	0.039609	-1.738632	0.0830
LNS_2	3.241051	1.145700	2.828883	0.0049
ROA	1.545029	0.294855	5.239964	0.0000
Y_S	-0.525721	0.168932	-3.112026	0.0020
CEO_TENURE	0.028857	0.006299	4.581371	0.0000
C	-0.042968	0.301946	-0.142305	0.8869

R-squared	0.399211	Mean dependent var	0.149919
Adjusted R-squared	0.372783	S.D. dependent var	0.582268
S.E. of regression	0.461139	Akaike info criterion	1.333548
Sum squared resid	72.51336	Schwarz criterion	1.507340
Log likelihood	-222.0383	Hannan-Quinn criter.	1.402673
F-statistic	15.10578	Durbin-Watson stat	0.855754
Prob(F-statistic)	0.000000		

5. Panel 2: Fixed Effects Both Dimension (Full Sample):

Dependent Variable: LOG_Q
Method: Panel Least Squares
Date: 05/14/15 Time: 11:40
Sample: 2009 2013
Periods included: 5
Cross-sections included: 73
Total panel (unbalanced) observations: 357

Variable	Coefficient	Std. Error	t-Statistic	Prob.
OWN	1.015154	0.888440	1.142626	0.2542
OWN_2	-22.89920	8.060046	-2.841075	0.0048
OPTIONS	0.052562	0.057811	0.909200	0.3641
LEVERAGE	0.038103	0.014062	2.709714	0.0072
AGE_OF_FIRM	0.013834	0.059722	0.231644	0.8170
CEO_AGE	0.003975	0.003571	1.113226	0.2666
CASH_TA	0.372411	0.236917	1.571906	0.1172
I_K__GROWTH_	0.110308	0.080658	1.367604	0.1726
K_S	-0.108741	0.197086	-0.551742	0.5816
K_S_2	-0.216048	0.320819	-0.673424	0.5013
LNS	0.750368	0.146179	5.133223	0.0000
LNS_2	3.515729	0.657459	5.347447	0.0000
ROA	0.721645	0.196517	3.672168	0.0003
Y_S	-0.061281	0.102073	-0.600364	0.5488
CEO_TENURE	-0.002477	0.006210	-0.398903	0.6903
C	-5.232588	1.390712	-3.762525	0.0002

Effects Specification

Cross-section fixed (dummy variables)
Period fixed (dummy variables)

R-squared	0.906219	Mean dependent var	0.149919
Adjusted R-squared	0.874015	S.D. dependent var	0.582268
S.E. of regression	0.206672	Akaike info criterion	-0.097966
Sum squared resid	11.31905	Schwarz criterion	0.901339
Log likelihood	109.4869	Hannan-Quinn criter.	0.299501
F-statistic	28.13997	Durbin-Watson stat	1.828383
Prob(F-statistic)	0.000000		

6. Panel 3: Subsample Regression Excluding Tenure (FE Both Dimensions):

Dependent Variable: LOG_Q
Method: Panel Least Squares
Date: 05/21/15 Time: 13:56
Sample: 2009 2013
Periods included: 5
Cross-sections included: 43
Total panel (unbalanced) observations: 206

Variable	Coefficient	Std. Error	t-Statistic	Prob.
OWN	9.012529	4.344958	2.074250	0.0398
OWN_2	-95.49279	30.78404	-3.102023	0.0023
OPTIONS	-0.031203	0.081883	-0.381070	0.7037
LEVERAGE	0.006201	0.089449	0.069325	0.9448
AGE_OF_FIRM	0.053624	0.259178	0.206900	0.8364
CEO_AGE	0.006863	0.006539	1.049564	0.2957
CASH_TA	0.135688	0.281356	0.482264	0.6303
I_K__GROWTH_	0.258672	0.128587	2.011649	0.0461
K_S	0.976435	0.828892	1.178000	0.2407
K_S_2	-17.75160	7.630068	-2.326532	0.0214
LNS	0.591545	0.210489	2.810335	0.0056
LNS_2	5.554689	1.045443	5.313241	0.0000
ROA	1.013031	0.299013	3.387912	0.0009
Y_S	0.007457	0.144049	0.051770	0.9588
C	-5.146724	4.376554	-1.175976	0.2415

Effects Specification

Cross-section fixed (dummy variables)
Period fixed (dummy variables)

R-squared	0.914915	Mean dependent var	0.321468
Adjusted R-squared	0.879708	S.D. dependent var	0.625668
S.E. of regression	0.217001	Akaike info criterion	0.023264
Sum squared resid	6.827992	Schwarz criterion	1.008704
Log likelihood	58.60376	Hannan-Quinn criter.	0.421809
F-statistic	25.98644	Durbin-Watson stat	1.907160
Prob(F-statistic)	0.000000		

7. Panel 4: Pooled Regression (Subsample) :

Dependent Variable: LOG_Q
Method: Panel Least Squares
Date: 05/14/15 Time: 11:47
Sample: 2009 2013
Periods included: 5
Cross-sections included: 43
Total panel (unbalanced) observations: 206

Variable	Coefficient	Std. Error	t-Statistic	Prob.
OWN	-1.575354	0.975906	-1.614247	0.1081
OWN_2	0.252860	15.91691	0.015886	0.9873
OPTIONS	0.121508	0.073570	1.651582	0.1003
LEVERAGE	0.213482	0.112638	1.895296	0.0596
AGE_OF_FIRM	0.006205	0.004342	1.429130	0.1546
CEO_AGE	-0.001901	0.007004	-0.271418	0.7864
CASH_TA	1.377891	0.285615	4.824299	0.0000
I_K__GROWTH_	0.535560	0.201868	2.653023	0.0087
K_S	-0.374940	0.471251	-0.795626	0.4272
K_S_2	-9.351803	9.376254	-0.997392	0.3198
LNS	-0.110805	0.053841	-2.057991	0.0410
LNS_2	4.983172	1.733423	2.874758	0.0045
ROA	1.874014	0.416764	4.496583	0.0000
Y_S	-0.567778	0.219348	-2.588480	0.0104
CEO_TENURE	0.027556	0.009395	2.932972	0.0038
C	0.389222	0.445172	0.874318	0.3830

R-squared	0.460829	Mean dependent var	0.321468
Adjusted R-squared	0.418263	S.D. dependent var	0.625668
S.E. of regression	0.477208	Akaike info criterion	1.432757
Sum squared resid	43.26815	Schwarz criterion	1.691233
Log likelihood	-131.5740	Hannan-Quinn criter.	1.537294
F-statistic	10.82621	Durbin-Watson stat	0.916327
Prob(F-statistic)	0.000000		

8. Panel 5: Fixed Effects Both Dimensions (Subsample):

Dependent Variable: LOG_Q
Method: Panel Least Squares
Date: 05/14/15 Time: 11:49
Sample: 2009 2013
Periods included: 5
Cross-sections included: 43
Total panel (unbalanced) observations: 206

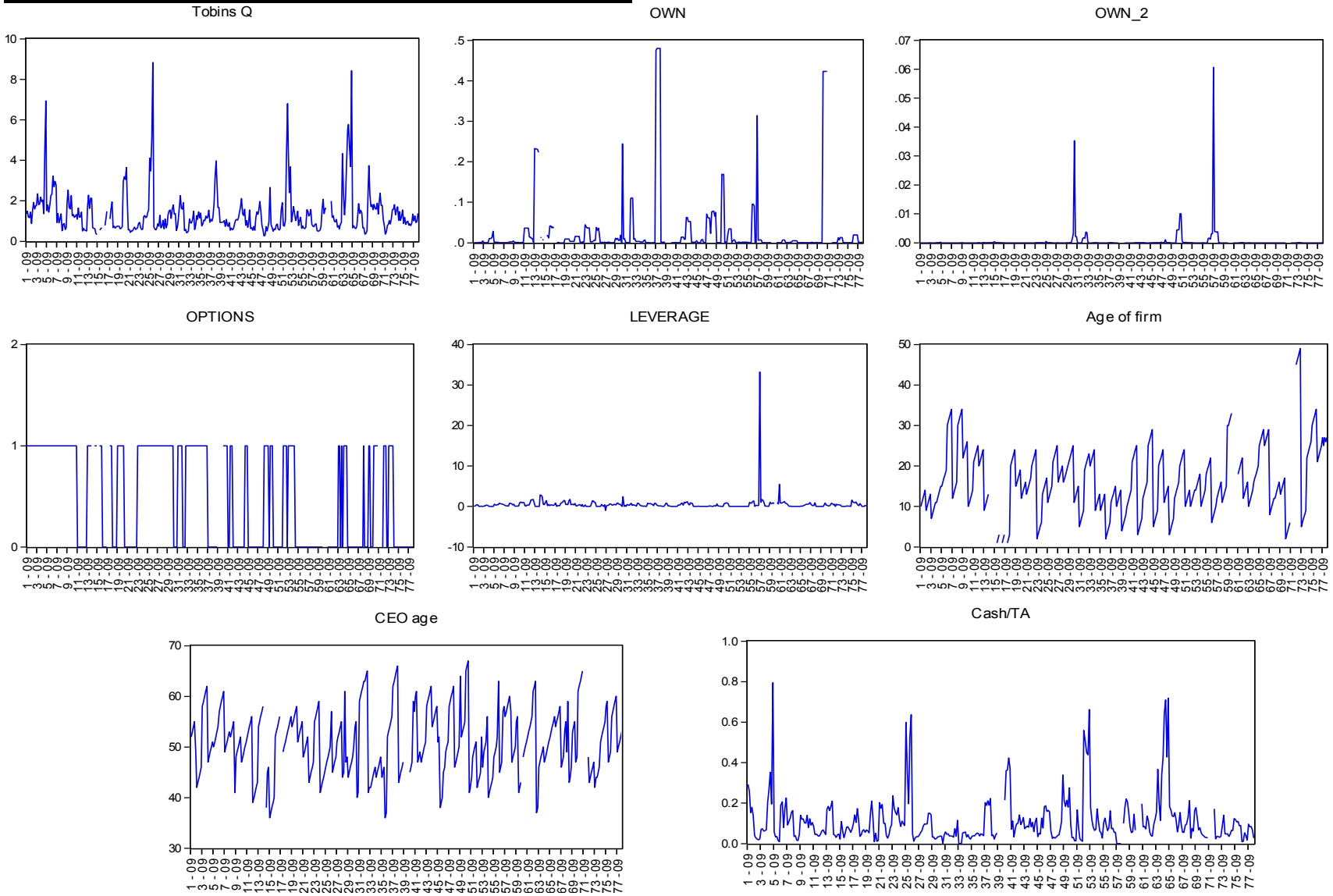
Variable	Coefficient	Std. Error	t-Statistic	Prob.
OWN	9.055364	4.378084	2.068339	0.0404
OWN_2	-95.81756	31.03744	-3.087160	0.0024
OPTIONS	-0.033903	0.085930	-0.394542	0.6938
LEVERAGE	0.006429	0.089780	0.071607	0.9430
AGE_OF_FIRM	0.053906	0.260079	0.207269	0.8361
CEO_AGE	0.006464	0.007539	0.857469	0.3926
CASH_TA	0.134381	0.282583	0.475544	0.6351
I_K__GROWTH_	0.258252	0.129087	2.000597	0.0473
K_S	0.958186	0.848943	1.128681	0.2609
K_S_2	-17.65958	7.704096	-2.292232	0.0233
LNS	0.588415	0.213214	2.759739	0.0065
LNS_2	5.546852	1.051564	5.274859	0.0000
ROA	1.014619	0.300403	3.377531	0.0009
Y_S	0.006762	0.144687	0.046734	0.9628
CEO_TENURE	0.000992	0.009241	0.107298	0.9147
C	-5.114351	4.401901	-1.161850	0.2472

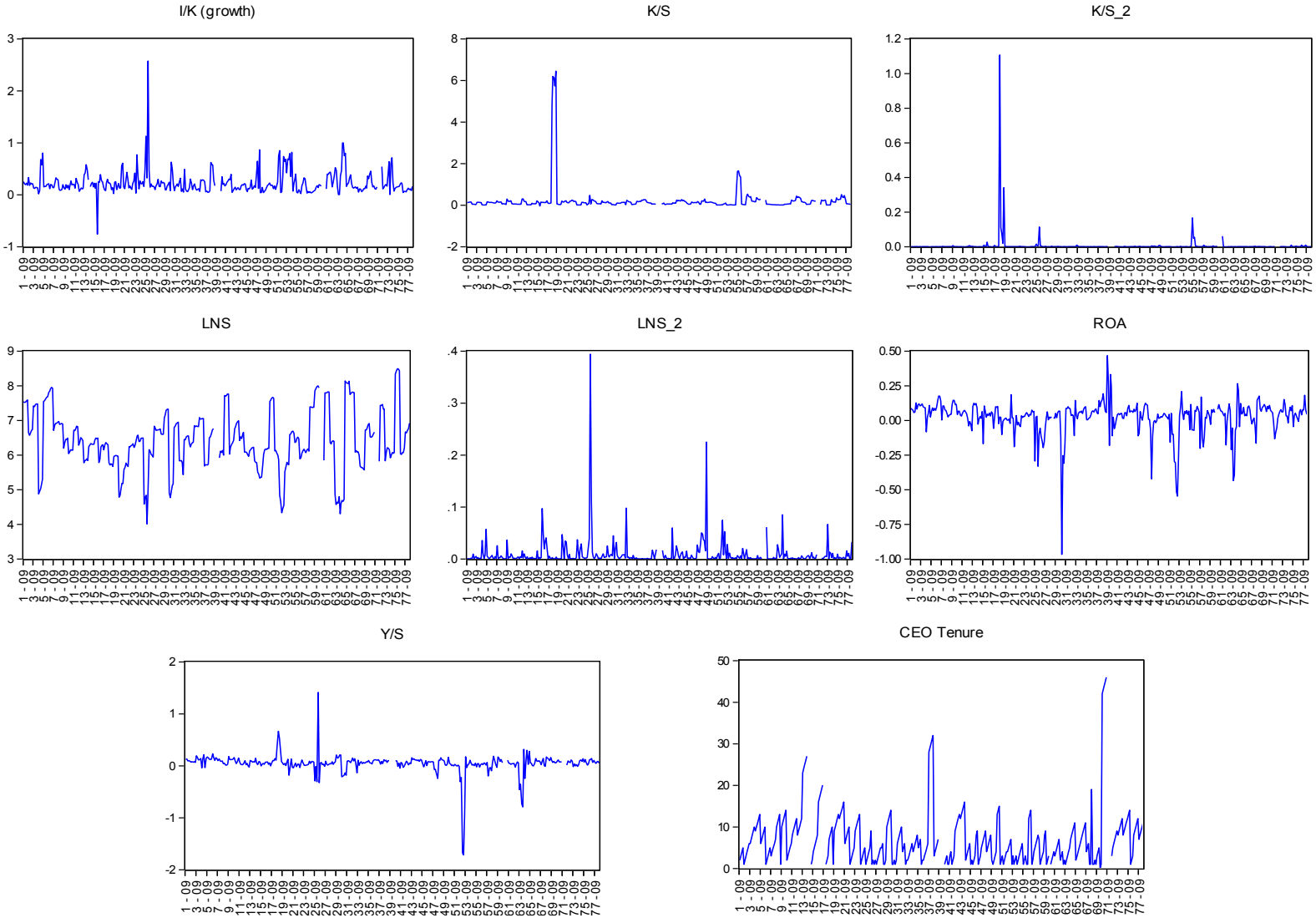
Effects Specification

Cross-section fixed (dummy variables)
Period fixed (dummy variables)

R-squared	0.914922	Mean dependent var	0.321468
Adjusted R-squared	0.878882	S.D. dependent var	0.625668
S.E. of regression	0.217745	Akaike info criterion	0.032893
Sum squared resid	6.827446	Schwarz criterion	1.034487
Log likelihood	58.61199	Hannan-Quinn criter.	0.437972
F-statistic	25.38638	Durbin-Watson stat	1.906988
Prob(F-statistic)	0.000000		

9. Graph 1: Graphs of Original Variables (Outliers Included)




I/K (growth)
K/S
K/S_2
LNS
LNS_2
ROA
Y/S
CEO Tenure

10. Panel 6: Full Sample Excluding Extreme Values (FE Both Dimensions)

Dependent Variable: LOG_Q
Method: Panel Least Squares
Date: 05/23/15 Time: 16:17
Sample: 2009 2013
Periods included: 5
Cross-sections included: 70
Total panel (unbalanced) observations: 332

Variable	Coefficient	Std. Error	t-Statistic	Prob.
OWN	0.674443	0.877793	0.768340	0.4430
OWN_2	-20.97819	8.052602	-2.605144	0.0098
OPTIONS	0.088857	0.059577	1.491452	0.1371
LEVERAGE	0.120533	0.066721	1.806503	0.0721
AGE_OF_FIRM	0.007344	0.059128	0.124206	0.9013
CEO_AGE	0.004536	0.003661	1.238987	0.2165
CASH_TA	-0.533847	0.348351	-1.532496	0.1267
I_K__GROWTH_	0.191002	0.090289	2.115460	0.0354
K_S	-0.387040	0.512481	-0.755228	0.4508
K_S_2	-2.284000	7.211595	-0.316712	0.7517
LNS	0.382820	0.188846	2.027156	0.0437
LNS_2	1.838042	1.425123	1.289743	0.1984
ROA	1.138052	0.242251	4.697829	0.0000
Y_S	0.121757	0.132716	0.917427	0.3598
CEO_TENURE	-0.002041	0.006390	-0.319443	0.7497
C	-2.776667	1.636674	-1.696530	0.0911

Effects Specification

Cross-section fixed (dummy variables)
Period fixed (dummy variables)

R-squared	0.899047	Mean dependent var	0.124062
Adjusted R-squared	0.862487	S.D. dependent var	0.539652
S.E. of regression	0.200117	Akaike info criterion	-0.155754
Sum squared resid	9.731412	Schwarz criterion	0.864297
Log likelihood	114.8552	Hannan-Quinn criter.	0.251042
F-statistic	24.59151	Durbin-Watson stat	1.873595
Prob(F-statistic)	0.000000		

11. Panel 7: Subsample Regression Excluding Extreme Values (FE Both Dimensions)

Dependent Variable: LOG_Q
Method: Panel Least Squares
Date: 05/23/15 Time: 16:34
Sample: 2009 2013
Periods included: 5
Cross-sections included: 42
Total panel (unbalanced) observations: 193

Variable	Coefficient	Std. Error	t-Statistic	Prob.
OWN	16.89940	5.117873	3.302035	0.0012
OWN_2	-130.3811	34.59576	-3.768701	0.0002
OPTIONS	0.060043	0.086083	0.697507	0.4867
LEVERAGE	-0.018812	0.102902	-0.182817	0.8552
AGE_OF_FIRM	0.118144	0.245292	0.481645	0.6309
CEO_AGE	0.007025	0.007033	0.998777	0.3197
CASH_TA	-0.534201	0.365991	-1.459604	0.1468
I_K__GROWTH_	0.219932	0.148900	1.477043	0.1420
K_S	0.515019	0.882322	0.583709	0.5604
K_S_2	0.747648	19.49985	0.038341	0.9695
LNS	0.548271	0.224838	2.438517	0.0161
LNS_2	7.420724	1.667437	4.450377	0.0000
ROA	2.121225	0.352864	6.011452	0.0000
Y_S	-0.151285	0.148048	-1.021863	0.3087
CEO_TENURE	0.001077	0.008799	0.122423	0.9028
C	-5.962055	4.355724	-1.368786	0.1734

Effects Specification

Cross-section fixed (dummy variables)
Period fixed (dummy variables)

R-squared	0.923291	Mean dependent var	0.282104
Adjusted R-squared	0.888423	S.D. dependent var	0.602368
S.E. of regression	0.201210	Akaike info criterion	-0.116698
Sum squared resid	5.344087	Schwarz criterion	0.914515
Log likelihood	72.26136	Hannan-Quinn criter.	0.300910
F-statistic	26.47971	Durbin-Watson stat	1.947842
Prob(F-statistic)	0.000000		

12. Panel 8: Final Full Sample Regression with Demeaned Variables and Period FE:

Dependent Variable: LOG_QDEMEAN
Method: Panel Least Squares
Date: 05/12/15 Time: 15:50
Sample: 2009 2013
Periods included: 5
Cross-sections included: 73
Total panel (unbalanced) observations: 357

Variable	Coefficient	Std. Error	t-Statistic	Prob.
OWN_DEMEAN	0.933319	0.782263	1.193102	0.2337
OWN_2_DEMEAN	-22.49813	7.143710	-3.149362	0.0018
OPTIONS	0.009611	0.019648	0.489172	0.6250
LEVERAGE_DEMEAN	0.038041	0.012436	3.059088	0.0024
AGE_OF_FIRM_DEMEA...	0.013316	0.041315	0.322298	0.7474
CEO_AGE_DEMEAN	0.003476	0.003123	1.113076	0.2665
CASH_TA_DEMEAN	0.377795	0.210017	1.798882	0.0729
I_K_GROWTH_DEMEA...	0.109536	0.071351	1.535183	0.1257
K_S_DEMEAN	-0.115052	0.174475	-0.659421	0.5101
K_S_2_DEMEAN	-0.225868	0.284429	-0.794111	0.4277
LNSDEMEAN	0.746142	0.128545	5.804523	0.0000
LNS_2DEMEAN	3.577397	0.578913	6.179508	0.0000
ROADEMEAN	0.730770	0.173345	4.215706	0.0000
Y_SDEMEAN	-0.072640	0.089546	-0.811201	0.4178
CEO_TENURE_DEMEA...	-0.001515	0.005430	-0.278924	0.7805
C	-0.005882	0.013990	-0.420436	0.6744

Effects Specification

Period fixed (dummy variables)

R-squared	0.423017	Mean dependent var	0.000517
Adjusted R-squared	0.390487	S.D. dependent var	0.235082
S.E. of regression	0.183532	Akaike info criterion	-0.498465
Sum squared resid	11.35149	Schwarz criterion	-0.281225
Log likelihood	108.9760	Hannan-Quinn criter.	-0.412059
F-statistic	13.00382	Durbin-Watson stat	1.811894
Prob(F-statistic)	0.000000		

13. Panel 9: Final Subsample Regression with Demeaned Variables and Period FE:

Dependent Variable: LOG_Q_DEMEANED
Method: Panel Least Squares
Date: 05/21/15 Time: 14:24
Sample: 2009 2013
Periods included: 5
Cross-sections included: 43
Total panel (unbalanced) observations: 206

Variable	Coefficient	Std. Error	t-Statistic	Prob.
OWN_DEMEANED	8.822823	3.822267	2.308270	0.0221
OWN_2_DEMEANED	-93.72419	26.95316	-3.477299	0.0006
OPTIONS	-0.005815	0.028314	-0.205377	0.8375
LEVERAGE_DEMEANED	0.002502	0.078815	0.031749	0.9747
AGE_OF_FIRM_DEMEANE...	0.012293	0.055794	0.220325	0.8259
CEO_AGE_DEMEANED	0.006492	0.006241	1.040200	0.2996
CASH_TA_DEMEANED	0.136126	0.248627	0.547510	0.5847
I_K_GROWTH_DEMEANE...	0.260273	0.112713	2.309166	0.0220
K_S_DEMEANED	1.060683	0.711035	1.491744	0.1375
K_S_2_DEMEANED	-17.92999	6.475615	-2.768848	0.0062
LNS_DEMEANED	0.603552	0.181358	3.327967	0.0011
LNS_2_DEMEANED	5.478237	0.915410	5.984462	0.0000
ROA_DEMEANED	0.985400	0.260527	3.782336	0.0002
Y_S_DEMEANED	0.015413	0.123495	0.124804	0.9008
CEO_TENURE_DEMEANE...	0.000612	0.007787	0.078598	0.9374
C	0.004074	0.021970	0.185426	0.8531

Effects Specification

Period fixed (dummy variables)

R-squared	0.565989	Mean dependent var	0.001321
Adjusted R-squared	0.521655	S.D. dependent var	0.277497
S.E. of regression	0.191924	Akaike info criterion	-0.371387
Sum squared resid	6.851290	Schwarz criterion	-0.048293
Log likelihood	58.25290	Hannan-Quinn criter.	-0.240717
F-statistic	12.76636	Durbin-Watson stat	1.913941
Prob(F-statistic)	0.000000		

9 Appendix B

1. Table 1: Redundancy Test (Full Sample):

Redundant Fixed Effects Tests
Equation: Untitled
Test cross-section and period fixed effects

Effects Test	Statistic	d.f.	Prob.
Cross-section F	18.792237	(72,265)	0.0000
Cross-section Chi-square	645.899270	72	0.0000
Period F	19.068000	(4,265)	0.0000
Period Chi-square	90.303147	4	0.0000
Cross-Section/Period F	18.850958	(76,265)	0.0000
Cross-Section/Period Chi-square	663.050324	76	0.0000

2. Table 2: Hausman Test RE Cross-section (Full Sample):

Correlated Random Effects - Hausman Test
Equation: Untitled
Test cross-section random effects

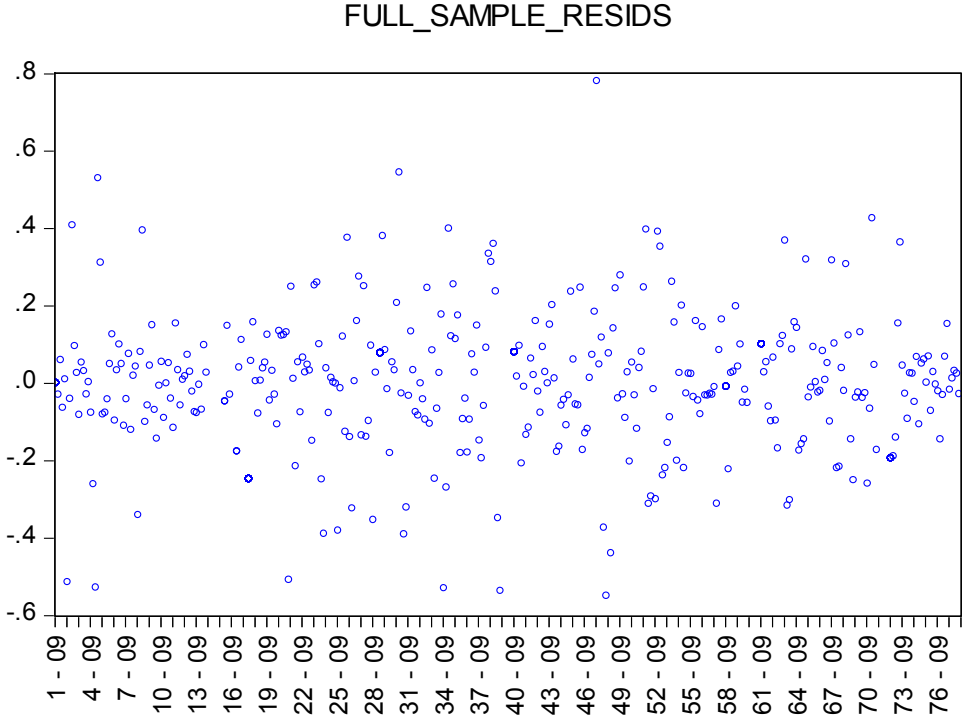
Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	47.114565	15	0.0000

3. Table 3:Hausman Test RE Period (Full Sample):

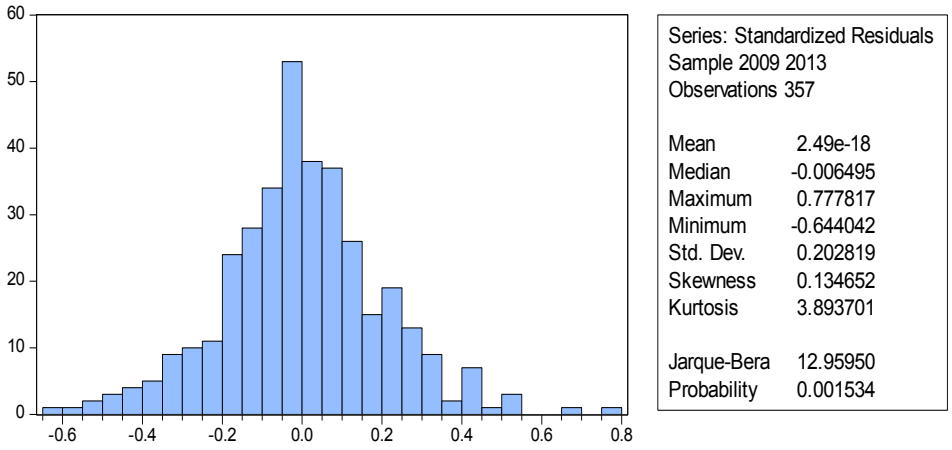
Correlated Random Effects - Hausman Test
Equation: Untitled
Test period random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Period random	2.920664	15	0.9997

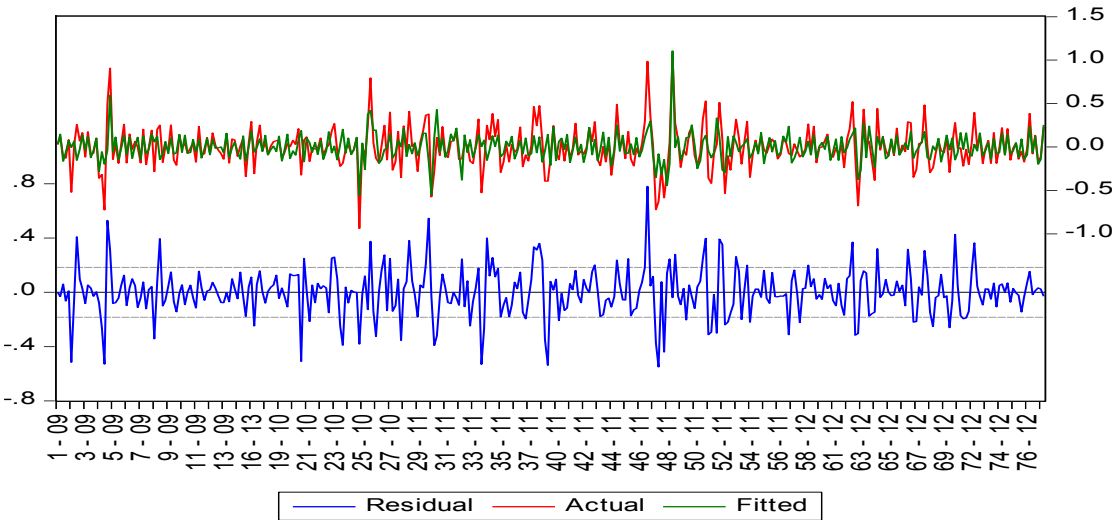
4. Scatter Plot 1: Scatter for the Full Sample Residuals:



5. Diagram 1: Residuals of Full Sample Regression Distribution



6. Diagram 2: Residuals of Full Sample Regression



7. Panel 1:Heteroscedasticity Test of Final Model (Full Sample) :

Dependent Variable: RESIDUALS_2
Method: Panel Least Squares
Date: 05/12/15 Time: 12:42
Sample: 2009 2013
Periods included: 5
Cross-sections included: 73
Total panel (unbalanced) observations: 357

Variable	Coefficient	Std. Error	t-Statistic	Prob.
OWN_DEMEAN	-0.238422	0.265216	-0.898973	0.3693
OWN_2_DEMEAN	-2.500227	2.429402	-1.029153	0.3041
OPTIONS	0.003179	0.006686	0.475481	0.6347
LEVERAGE_DEMEAN	0.005168	0.004218	1.225158	0.2214
AGE_OF_FIRM_DEMEAN	-0.002393	0.002723	-0.878724	0.3802
CEO_AGE_DEMEAN	3.23E-05	0.001058	0.030558	0.9756
CASH_TA_DEMEAN	0.054257	0.069782	0.777518	0.4374
I_K_GROWTH_DEMEAN	-0.014782	0.023550	-0.627653	0.5307
K_S_DEMEAN	0.002748	0.059256	0.046371	0.9630
K_S_2_DEMEAN	-0.001697	0.096288	-0.017624	0.9859
LNSDEMEAN	0.046613	0.042769	1.089870	0.2765
LNS_2DEMEAN	-0.078744	0.194586	-0.404676	0.6860
ROADEMEAN	-0.070331	0.057907	-1.214551	0.2254
Y_SDEMEAN	0.011787	0.030411	0.387593	0.6986
CEO_TENURE_DEMEAN	-0.000293	0.001847	-0.158422	0.8742
C	0.030123	0.004763	6.324500	0.0000

R-squared	0.030335	Mean dependent var	0.031797
Adjusted R-squared	-0.012319	S.D. dependent var	0.062111
S.E. of regression	0.062492	Akaike info criterion	-2.663762
Sum squared resid	1.331706	Schwarz criterion	-2.489970
Log likelihood	491.4815	Hannan-Quinn criter.	-2.594637
F-statistic	0.711188	Durbin-Watson stat	1.608349
Prob(F-statistic)	0.773333		

8. Table 4: Redundancy Test (Subsample) :

Redundant Fixed Effects Tests
Equation: Untitled
Test cross-section and period fixed effects

Effects Test	Statistic	d.f.	Prob.
Cross-section F	17.045908	(42,144)	0.0000
Cross-section Chi-square	368.129319	42	0.0000
Period F	10.253482	(4,144)	0.0000
Period Chi-square	51.627270	4	0.0000
Cross-Section/Period F	16.708333	(46,144)	0.0000
Cross-Section/Period Chi-square	380.372013	46	0.0000

9. Table 5:Hausman Test RE Cross-Section (Subsample) :

Correlated Random Effects - Hausman Test
Equation: Untitled
Test cross-section random effects

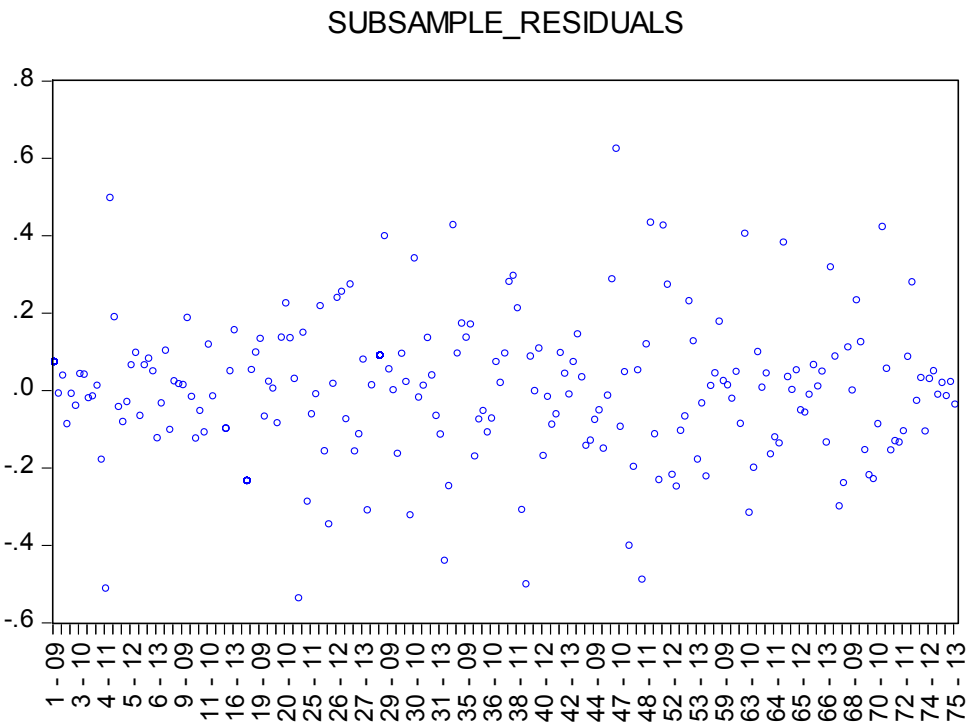
Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	41.423825	15	0.0003

10. Table 6:Hausman Test RE Period (Subsample) :

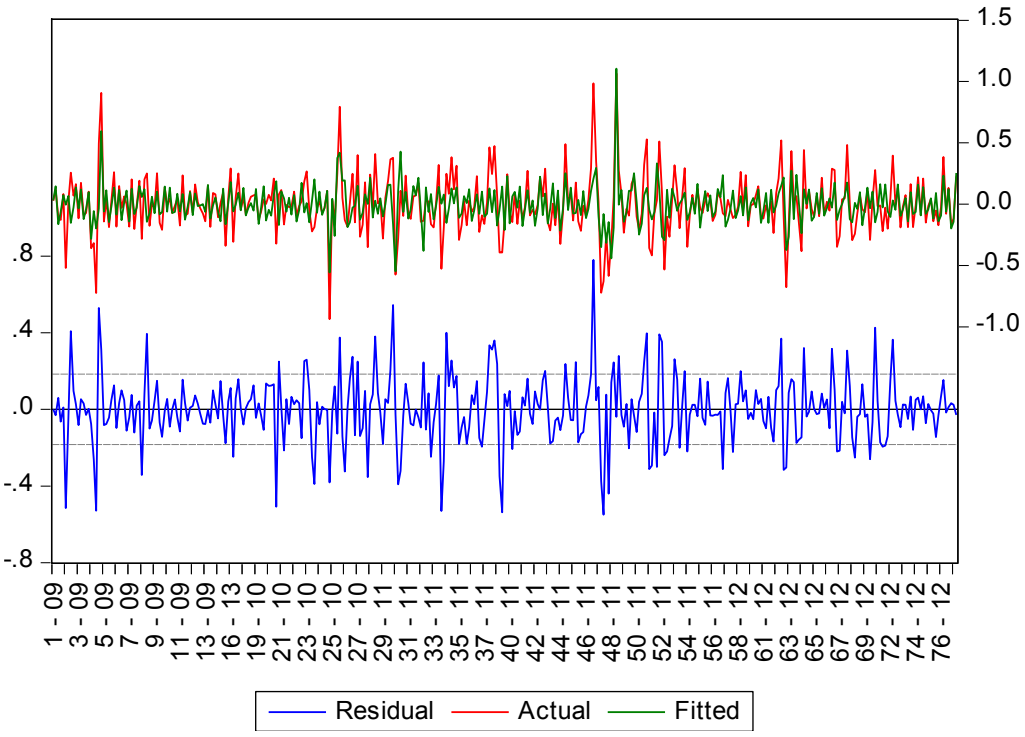
Correlated Random Effects - Hausman Test
Equation: Untitled
Test period random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Period random	3.432272	15	0.9991

11. Scatter Plot 2: Scatter for the SubSample Residuals



12. Diagram 3: Residuals of SubSample Regression



13. Panel 2: Heteroscedasticity Test of Final Model (Subsample) :

Dependent Variable: RESID_DEMEAN_2
Method: Panel Least Squares
Date: 05/12/15 Time: 12:08
Sample: 2009 2013
Periods included: 5
Cross-sections included: 43
Total panel (unbalanced) observations: 206

Variable	Coefficient	Std. Error	t-Statistic	Prob.
OWN_DEMEANED	1.403088	1.199832	1.169403	0.2437
OWN_2_DEMEANED	-12.46132	8.460757	-1.472837	0.1425
OPTIONS	0.001112	0.008888	0.125098	0.9006
LEVERAGE_DEMEANED	0.028156	0.024740	1.138037	0.2566
AGE_OF_FIRM_DEMEANED	0.016252	0.017514	0.927925	0.3546
CEO_AGE_DEMEANED	-0.000787	0.001959	-0.401646	0.6884
CASH_TA_DEMEANED	-0.090438	0.078045	-1.158793	0.2480
I_K_GROWTH_DEMEANED	-0.002206	0.035381	-0.062362	0.9503
K_S_DEMEANED	-0.159137	0.223198	-0.712987	0.4767
K_S_2_DEMEANED	2.728014	2.032734	1.342042	0.1812
LNS_DEMEANED	0.098247	0.056929	1.725775	0.0860
LNS_2_DEMEANED	-0.598015	0.287353	-2.081119	0.0388
ROA_DEMEANED	-0.010715	0.081781	-0.131018	0.8959
Y_S_DEMEANED	0.017422	0.038766	0.449420	0.6537
CEO_TENURE_DEMEANED	-0.001000	0.002444	-0.409180	0.6829
C	0.032130	0.006896	4.658882	0.0000

Effects Specification

Period fixed (dummy variables)

R-squared	0.077829	Mean dependent var	0.033259
Adjusted R-squared	-0.016371	S.D. dependent var	0.059759
S.E. of regression	0.060246	Akaike info criterion	-2.688711
Sum squared resid	0.675105	Schwarz criterion	-2.365616
Log likelihood	296.9372	Hannan-Quinn criter.	-2.558041
F-statistic	0.826213	Durbin-Watson stat	1.739721
Prob(F-statistic)	0.673984		

14. Panel 3:Robustness Test (Full Sample) :

Dependent Variable: ROADEMEAN
Method: Panel Least Squares
Date: 05/17/15 Time: 21:34
Sample: 2009 2013
Periods included: 5
Cross-sections included: 73
Total panel (unbalanced) observations: 357

Variable	Coefficient	Std. Error	t-Statistic	Prob.
OWN_DEMEAN	0.596578	0.243307	2.451952	0.0147
OWN_2_DEMEAN	2.571137	2.237218	1.149256	0.2513
OPTIONS	0.004126	0.006161	0.669595	0.5036
LEVERAGE_DEMEAN	-0.017370	0.003786	-4.587866	0.0000
AGE_OF_FIRM_DEMEA...	-0.003326	0.012963	-0.256581	0.7977
CEO_AGE_DEMEAN	-0.003731	0.000959	-3.890966	0.0001
CASH_TA_DEMEAN	0.120522	0.065573	1.837973	0.0669
I_K_GROWTH_DEMEA...	-0.017312	0.022369	-0.773927	0.4395
K_S_DEMEAN	0.056651	0.054661	1.036415	0.3007
K_S_2_DEMEAN	0.063229	0.089183	0.708985	0.4788
LNSDEMEAN	0.205024	0.038763	5.289158	0.0000
LNS_2DEMEAN	-0.552352	0.179152	-3.083147	0.0022
Y_SDEMEAN	0.107554	0.027482	3.913565	0.0001
CEO_TENURE_DEMEA...	-0.000175	0.001704	-0.102426	0.9185
C	-0.001985	0.004389	-0.452333	0.6513

Effects Specification

Period fixed (dummy variables)

R-squared	0.289690	Mean dependent var	0.000727
Adjusted R-squared	0.251863	S.D. dependent var	0.066581
S.E. of regression	0.057589	Akaike info criterion	-2.819202
Sum squared resid	1.120992	Schwarz criterion	-2.612824
Log likelihood	522.2276	Hannan-Quinn criter.	-2.737117
F-statistic	7.658269	Durbin-Watson stat	2.332846
Prob(F-statistic)	0.000000		

15. Panel 4: Robustness Test (Subsample) :

Dependent Variable: ROA_DEMEANED
Method: Panel Least Squares
Date: 05/17/15 Time: 21:21
Sample: 2009 2013
Periods included: 5
Cross-sections included: 43
Total panel (unbalanced) observations: 206

Variable	Coefficient	Std. Error	t-Statistic	Prob.
OWN_DEMEANED	2.436475	1.057973	2.302965	0.0224
OWN_2_DEMEANED	-15.19943	7.483383	-2.031090	0.0437
OPTIONS	0.007515	0.007928	0.947913	0.3444
LEVERAGE_DEMEANED	-0.136061	0.019759	-6.886125	0.0000
AGE_OF_FIRM_DEMEANE...	-0.002841	0.015659	-0.181426	0.8562
CEO_AGE_DEMEANED	0.000920	0.001750	0.525648	0.5998
CASH_TA_DEMEANED	0.107944	0.069339	1.556749	0.1212
I_K_GROWTH_DEMEANE...	-0.031540	0.031553	-0.999581	0.3188
K_S_DEMEANED	0.297128	0.198394	1.497667	0.1359
K_S_2_DEMEANED	-2.297857	1.809855	-1.269636	0.2058
LNS_DEMEANED	0.200011	0.048759	4.102045	0.0001
LNS_2_DEMEANED	-0.541692	0.253874	-2.133699	0.0342
Y_S_DEMEANED	0.150370	0.032874	4.574209	0.0000
CEO_TENURE_DEMEANE...	-0.000610	0.002185	-0.279021	0.7805
C	-0.004805	0.006157	-0.780374	0.4362

Effects Specification

Period fixed (dummy variables)

R-squared	0.527286	Mean dependent var	0.000702
Adjusted R-squared	0.481784	S.D. dependent var	0.074834
S.E. of regression	0.053871	Akaike info criterion	-2.916744
Sum squared resid	0.542693	Schwarz criterion	-2.609804
Log likelihood	319.4247	Hannan-Quinn criter.	-2.792607
F-statistic	11.58823	Durbin-Watson stat	2.294215
Prob(F-statistic)	0.000000		

16. Panel 5: Full Sample Regression(Demeaned Variable/Period FE & Period SUR):

Dependent Variable: LOG_QDEMEAN
Method: Panel Least Squares
Date: 05/21/15 Time: 12:26
Sample: 2009 2013
Periods included: 5
Cross-sections included: 73
Total panel (unbalanced) observations: 357
Period SUR (PCSE) standard errors & covariance (d.f. corrected)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
OWN_DEMEAN	0.933319	1.117407	0.835254	0.4042
OWN_2_DEMEAN	-22.49813	9.216359	-2.441108	0.0152
OPTIONS	0.009611	0.010941	0.878445	0.3803
LEVERAGE_DEMEAN	0.038041	0.014085	2.700766	0.0073
AGE_OF_FIRM_DEMEA...	0.013316	0.047251	0.281813	0.7783
CEO_AGE_DEMEAN	0.003476	0.004350	0.799222	0.4247
CASH_TA_DEMEAN	0.377795	0.253806	1.488518	0.1375
I_K_GROWTH_DEMEA...	0.109536	0.078803	1.389998	0.1654
K_S_DEMEAN	-0.115052	0.179800	-0.639889	0.5227
K_S_2_DEMEAN	-0.225868	0.276420	-0.817120	0.4144
LNSDEMEAN	0.746142	0.173290	4.305733	0.0000
LNS_2DEMEAN	3.577397	0.696909	5.133235	0.0000
ROADEMEAN	0.730770	0.193261	3.781266	0.0002
Y_SDEMEAN	-0.072640	0.104979	-0.691946	0.4894
CEO_TENURE_DEMEA...	-0.001515	0.007260	-0.208645	0.8349
C	-0.005882	0.005920	-0.993639	0.3211

Effects Specification

Period fixed (dummy variables)

R-squared	0.423017	Mean dependent var	0.000517
Adjusted R-squared	0.390487	S.D. dependent var	0.235082
S.E. of regression	0.183532	Akaike info criterion	-0.498465
Sum squared resid	11.35149	Schwarz criterion	-0.281225
Log likelihood	108.9760	Hannan-Quinn criter.	-0.412059
F-statistic	13.00382	Durbin-Watson stat	1.811894
Prob(F-statistic)	0.000000		

17. Panel 6: Subsample Regression (Demeaned Variable/Period FE & Period SUR):

Dependent Variable: LOG_Q_DEMEANED
Method: Panel Least Squares
Date: 05/21/15 Time: 12:26
Sample: 2009 2013
Periods included: 5
Cross-sections included: 43
Total panel (unbalanced) observations: 206
Period SUR (PCSE) standard errors & covariance (d.f. corrected)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
OWN_DEMEANED	8.822823	4.458116	1.979047	0.0493
OWN_2_DEMEANED	-93.72419	31.52017	-2.973467	0.0033
OPTIONS	-0.005815	0.014654	-0.396822	0.6920
LEVERAGE_DEMEANED	0.002502	0.097807	0.025584	0.9796
AGE_OF_FIRM_DEMEANE...	0.012293	0.050815	0.241914	0.8091
CEO_AGE_DEMEANED	0.006492	0.007722	0.840719	0.4016
CASH_TA_DEMEANED	0.136126	0.284763	0.478031	0.6332
I_K_GROWTH_DEMEANE...	0.260273	0.134181	1.939719	0.0539
K_S_DEMEANED	1.060683	0.860929	1.232021	0.2195
K_S_2_DEMEANED	-17.92999	7.080621	-2.532263	0.0122
LNS_DEMEANED	0.603552	0.230255	2.621230	0.0095
LNS_2_DEMEANED	5.478237	1.021681	5.361985	0.0000
ROA_DEMEANED	0.985400	0.291943	3.375313	0.0009
Y_S_DEMEANED	0.015413	0.147104	0.104774	0.9167
CEO_TENURE_DEMEANE...	0.000612	0.009385	0.065218	0.9481
C	0.004074	0.010212	0.398930	0.6904

Effects Specification

Period fixed (dummy variables)

R-squared	0.565989	Mean dependent var	0.001321
Adjusted R-squared	0.521655	S.D. dependent var	0.277497
S.E. of regression	0.191924	Akaike info criterion	-0.371387
Sum squared resid	6.851290	Schwarz criterion	-0.048293
Log likelihood	58.25290	Hannan-Quinn criter.	-0.240717
F-statistic	12.76636	Durbin-Watson stat	1.913941
Prob(F-statistic)	0.000000		

18. Table 7: Top Ownership and Voting in the Swedish Market:

	Top 3 Ownership	Voting Percentage
Full Sample		
Mean	37%	44%
Median	33%	43.9%
Subsample (R&D firms)		
Mean	33%	39.7%
Median	27.8%	39.2%
Rest of sample (non R&D)		
Mean	43.2%	51.8%
Median	46.5%	51%

(Source: Avanza)

10 Appendix C

1. Fixed effects and Random effects

Two types of estimator approaches in finance are generally used with panel data: fixed effects, and random effects. We will cover only one here, since random effects are not used in the final model.

Fixed effects

With fixed effects, the intercept is allowed to vary across entities while the slope parameters are fixed (Brooks (2003)). The purpose is to allow for differences in each entity. We use the following explanation from Brooks (2003) to illustrate what this model would look like.

Start with the simple panel data equation used earlier:

$$y_{it} = \beta_0 + \beta_1 x_{it} + u_{it}$$

The error term is decomposed into an individual specific effect (fixed effect) and a random part.

$$u_{it} = u_i + v_{it}$$

If there is variation across entities that has not been included in the regression then it will be captured by the fixed part, u_i, while v_{it} captures what is unexplained in the model. The fixed part is assumed to not vary over time. Plugging this in to the first equation yields:

$$y_{it} = \beta_0 + \beta_1 x_{it} + u_i + v_{it}$$

For the fixed effects we can use dummy variables that take on the value of one for the relevant firms' observations and zero otherwise. This is called the least squares dummy variable (LSDV) model.

$$y_{it} = \beta_1 x_{it} + u_1 D1_i + u_2 D2_i + \cdots + u_N DN_i + v_{it}$$

The intercept is dropped in order to avoid the dummy variable trap. From here it is possible to see how to test for heterogeneity via a modified Chow test. It is clear that the dummy variables should be significantly different from each other in order to justify using this model. Using OLS, we can test this with an F-test where the restriction is that the dummy variables are all equal. That would be the null hypothesis, and if rejected, the pooled regression can be used. (Brooks (2003)).

Notice that in a cross-sectional regression all of the heterogeneity is caught in the error term, and it is not possible to estimate the subject-specific parameters since there are more parameters (N+K) than there are observations (N). One of the advantages of panel data is that we now have enough observations so that the subject-specific effects can be separated out and estimated as we showed above (Edward W. Frees (2004)).

It is also possible to have time-fixed effects, in which there is variation in the time dimension rather than the cross-section. The model would then have dummies that explain the time variation, with intercepts that vary over time but not across entities at each given time. The actual modeling is very similar to the one shown above and for those interested we refer to Brooks (2003). An example of when to use this would be if there is a change at a certain time that affects all entities in the same way.

Random effects

Consider again the equation where the error is separated into two parts.

$$y_{it} = \beta_0 + \beta_1 x_{it} + u_i + v_{it}$$

In random effects models, the u_i term is no longer considered a fixed parameter, and is assumed not to be correlated to x_{it} or u_i. In other words, the heterogeneity is random. The assumptions for random-effects are stricter, but results in fewer parameters to estimate as well as better efficiency (Brooks (2003)).

Fixed and random effects can be used in both dimensions, as well as mixed with one in each dimension, but for all these cases the panel data needs to be balanced, which means no data points are missing (Brooks (2003)).

2. Economic Significance

The final equation with estimated parameters for the full sample is given below.

*LOG_QDEMEAN = 0.93*OWN_DEMEAN - 22*OWN_2_DEMEAN + 0.0096*OPTIONS + control variables + error*

Only the variables of interest are included here, to make the equation a little shorter. Q is both logged and demeaned, whereas the other variables are just demeaned. The intuitive interpretation of the effect of OWN on Q is: For each unit change of OWN, relative to the group mean, there is a 153% (exp(0.93) - 1) change in Q, relative to its group mean. Taking the exponential on both sides of the equation is done to get rid of the natural log of Q.

Is this a significant change? Econometrically, it is insignificant. Considering the way OWN is measured, this makes sense. A one unit change represents 1 percentage unit more of a firm which is a very large change. If we consider a hundredth of that to be a normal change in ownership, then Q changes from its mean by 1.53% when OWN changes by 1/10000 of a firm, a much smaller number. That makes Tobin's Q go from its mean of 1.4 to 1.42 for the full sample.

The OWN_2 variable can be interpreted the same way, whereas the option is a dummy so its interpretation is a little more straight forward. If the firm uses stock option incentives, then firm value on average increases by 0.009% (exp(0.0096) – 1), which is insignificant.

The same interpretation can be applied to the subsample but we leave that to the reader.