STOCKHOLM SCHOOL OF ECONOMICS
Master Thesis in Finance

Governing research and development in the pharmaceutical industry - a literature study

Lisa Nielsen-Englyst

Abstract

In the past years there have been a number of media reports of large drug companies having trouble with getting new drugs to the market, and a number of big selling drugs are nearing the end date of the original patent, opening up to competition from generic drug makers. This paper takes a closer look at the incentives to make large investments in pharmaceutical development from the perspective of corporate governance.

The author concludes that business characteristics such as the size of investment, lead time to marketable product and the inherent risk level of pharmaceutical research and development will impact agency conflicts. The author finds little evidence indicating that the pharmaceutical firm's response to corporate governance mechanisms would be strongly contrary to that of any other industry. However, the effects on incentives will be coloured by the particular conditions of the industry.

Tutor: Mike Burkart
Presentation: 11:30 – 13:00, June 4, 2008-05-23
Venue: Room Ragnar, Stockholm School of Economics
Author contact: lisa.englyst@gmail.com

Acknoledgements: I would like to thank my tutor Mike Burkart and Eva Eklund for their support, and Markus Andersson for the cup.

Contents

1. Introduction

In any pharmaceutical firm, innovation is the most important determinant of growth, value creation and future prospects. The core of operations of a pharmaceutical firm is research and development, something that is fraught with risk as well as the possibility of great success. Any strategic decision-making in R&D will be made in a setting of high complexity, and managers need a high level of autonomy in order to make these decisions. However, high autonomy bears with it the risk of suboptimal actions taken by the manager that are detrimental to the interests of shareholders – the classic problem of corporate governance.

In the case of the pharmaceutical industry, the time lag between investment and a commercial product is on average 12 years, meaning that a manager must be able to commit to long-term strategies in order to provide viable future opportunities for the firm, even though the manager might not be in place to watch the investments decided take fruit in earnings. (Economist, 18/6/2005; Bátiz-Lazo, Holland, 2001)

Current research has suggested that the rate of innovation in the pharmaceutical industry is lower than ever before, and concerned voices are being raised that the firms are focusing on the wrong things, while losing future competitiveness. In America, drug firms are facing criticism for focusing on "me-too" drugs, which are said to have little additional clinical benefit over the medicines already existing in the market, as they use mechanisms and chemicals too similar to ones that are already in use. (Economist, 19/3/2005) 31 new drugs were launched on the American market during 2004, compared with 52 per year on average a decade earlier, according to the Centre for Medicines Research, an industry think-tank. (Economist, 13/7/2005) In 1996, only 37 were launched in the US, which was then the lowest number for several decades. (Matraves, 1999) Between 2000-2002, Pfizer and GSK, two of the "Big Pharma" companies, have produced between them three new drugs, while roughly three a year for each company has been estimated to be necessary in order to maintain their profit growth. (Economist, 13/7/2005)

Due to separation of ownership and control, all corporations face agency conflicts since managers do not have the same incentive structure as do owners, something that might lead to decisions by management that are inefficient or outright harmful to owner interests. It is therefore necessary to implement control structures to monitor the actions of management. (Fama, Jensen, 1998)

However, the way that these controls are structured will influence a number of actions by the management. Therefore, it is essential to be aware of how the different types of monitoring and structuring of incentives will affect management.

As the debate on corporate governance has been developed through focusing on the principal-agent problem, the existing literature has on occasion delved into the interaction between specific areas of corporate governance and innovation, since the structure deciding distribution of returns and who, what and why in investment decisions is bound to affect the innovation drivers within the company. (Lacetera, 2001)

As we will find, there are a number of business conditions that exacerbate principal-agent issues when looking at the long-term process of innovation for a pharmaceutical firm. The question of the paper is 'are there variations in the behaviour of classical corporate governance mechanisms when applied to the pharmaceutical industry?'.

2. Method

This paper will be a study of a selection of existing research, as I cannot claim to have found and studied all potentially relevant material. I will analyze this material from the perspective of the conditions for the pharmaceutical industry. The issue is whether there is anything special about the pharmaceutical industry as regards corporate governance, anything that investors and managers should know, shaped by the peculiarities of this industry but rooted in the general, well studied problems of corporate governance.

Studies about the connection between corporate governance and innovation are often limited to case studies, and research about the differing time-horizons of owners and management rarely delves into such long time-spans as are the reality in the pharmaceutical industry. Also, any qualitative study into corporate governance will run into one major difficulty – how do you get a manager to tell you why he does not rob the owners, or make suboptimal decisions, or in the worst case: why he does make those decisions?

This being a literature study it is a matter of contention whether anything can be solidly proven, but I will place my work at the service of future empiricists and treat this problem openly when it arises. To achieve its goal, this paper will be structured around five classical mechanisms in corporate governance, prevalent in most corporate governance textbooks:

- Takeovers
- Debt and creditor monitoring
- Concentrated ownership
- Executive compensation
- Board structure

These will be presented with a brief run-through of the basic theories, followed by such further previous research as can be found relating specifically to the pharmaceutical industry, followed by chapters of analysis.

Important to note is that I will not be taking into account the alternative strategy of large pharmaceutical companies of purchasing already semi-developed product lines from smaller biochemical companies, thought the results might be interesting to contrast to such a strategy for furthur research. This thesis will focus on a generic pharmaceutical company characterized by:

- Ownership of the entire value chain, from initiating base level research on compound/molecule/substance to the production, marketing and distribution of the finalized product
- Separation of role of CEO and owner (CEO does not own 100% of the firm)
- Located in a developed market economy (no market capital constraints or uncommon problems with enforcement of ownership rights, etc)
- Financed by less than 100 % equity

3.The pharmaceutical company

Before the Second World War, prior to the introduction of early sulpha drugs around 1937, the pharmaceutical industry was largely characterized by established firms producing generic and standardized products. However, with the introduction of products like penicillin, the industry changed and started to develop the pattern we see today, with competition focusing on product differentiation and monopolization of therapeutic markets through constant innovation and patenting of drugs and compounds. The change meant that profits after the Second World War II depended primarily on the individual firm's position in the innovative race, as opposed to position in relative price level. (Comanor, 1964)

Since that time, the pharmaceutical industry has been one of high R&D spending, with firms dependent on their product innovation as determinant of growth. (Bátiz-Lazo, Holland, 2001) Such industries are characterized by high degrees of uncertainty, and decisions concerning growth by managers will inevitably be subjective, based on ex ante predictions that might be very different from the outcomes realized ex post. High business risk firms such as these are usually subject to greater agency-conflicts, and will therefore need more intensive monitoring. (Bathala, Rao, 1995)

3.1. Innovation

Innovation can create value, but it does not come without costs. Any R&D investment strategy is characterized by three main traits:

1. The great variability of success/failure is naturally inherent in every innovative project, and much of the risk is independent of the effort-level of managers. This creates a great employment risk for agents, something that cannot be diversified away by the management.
2. Secondly, investment in R&D is a long-term commitment, and the decision to pursue any R&D project might influence the short-term performance negatively.
3. Thirdly, innovation is often assumed to take place in complex environments, and this implies that managers need a high degree of autonomy, since any type of strategic choice will be hard to standardize or predict given the complexity of the context. This level of discretionary power will mean that management has the choice to pursue strategies that have inherently lower risk than the optimal strategic R&D expenditure.

These factors can aggravate the risk of opportunistic behaviour by management, increasing the agency costs as the required discretionary power makes it easier to hide actions detrimental to shareholders. (Berrone, Surroca, Tribó, 2005)

The success of any pharmaceutical company is dependent on its rate of innovation, but the large investment of time and capital in the research process creates a number of specific issues for the pharmaceutical firms, which can be found further down.

It takes an average of 12 years to develop a drug from start to finish – though there are great differences due to the complexity of the molecule and the disease it tackles. (Economist, 18/6/2005;

Bátiz-Lazo, Holland, 2001) The likelihood that any given investment in a promising molecule will be profitable is small. For every 10 000 molecules screened, 250 go into pre-clinical testing, 10 go through clinical testing, and statistically only one will eventually be approved by the regulator and end up on the shelf of a drugstore. The drugs that are launched today will reflect the research performed a decade ago. An often used estimate for the cost of a commercial drug, from start to finish, calculated by Joseph DiMasi, an economist at the Tufts Centre for the Study of Drug Development, sets the cost at 802 million dollars. Of this, just over 400 million dollars was directly out-of-pocket, and the rest calculated as the discounted opportunity cost of capital. However, this cost was derived from data from 1983 through 2000, whereas some estimates place today's figure at around 1.5 billion dollars or more. (Economist, 18/6/2005) Also, investors are prone to discount products that have not yet reached late-stage clinical development, as the alternative is seen as too risky, according to Stewart Adkins, an analyst at Lehman Brothers. (Economist, 19/3/2005) He also believes that fewer and fewer drugs make it through the research-pipeline, not due to them not working, but because the firms do not believe that they will earn blockbuster revenues of more than one billion dollars in peak annual sales. (Economist, 13/7/2005)

The low valuation of products that are not in the end-stage of development can be one of the reasons as to why companies, according to Steven Paul, head of science and technology at Eli Lilly, are putting compounds into the late stages of clinical development in order to gain a higher profile with investors. (Economist, 18/6/2005) Focusing too much on the search for blockbuster drugs can then result in much higher levels of risk. (Bátiz-Lazo, Holland, 2001)

Such high investment costs together with the decade long lag in investment to output will have great influence on the agency conflicts between management and shareholders, as well as bring into question the optimal mix of dispersed private ownership and concentrated institutional ownership.

This presents a structural strategy decision fraught with problems if inappropriate corporate governance is applied to the firms in question, but also can pose questions on the rational behaviour of owners.

3.2. Short-term versus long-term horizons

One of the problems put forth by business leaders is that shareholders pressure firms to meet short-term goals, which undermines the company's ability to compete in the long run. The preoccupation with quarterly results impairs investments in innovation and technology with distant payoffs. However, many academics argue that investor horizons should have very little impact on investment decisions. The basic theoretic model that values a company takes into account all future cash flows, discounted to a greater extent the further away in time the cash flow is estimated. Within that framework it is possible to incorporate both short- and long-term payoffs. Arguments about investor horizons and short-sightedness are then based on a belief that the market fails to incorporate the distant payoffs into the value of the firm. One explanation of this could be that shareholders rely on

quarterly earnings as a signal for the future prospects of the firm instead of doing a full analysis. With the growth of large institutional investors, for instance, it is hard to keep track of the events of hundreds or thousands of companies. This means that it is inevitable that the market will use proxies such as quarterly earnings. If other communication channels are not efficient or reliable, these proxies will override other signals sent to the market. The following is an example of rational behaviour that sends myopic signals. (Jacobs, 1991)

> "Suppose a company's board approves a $100-million expenditure that it believes will produce $300-milion in added revenues, leaving $200 million as profit. (For simplicity, ignore the time value of money in this example.) If management is able to communicate the strategic and economic merits of the project to the market – and the shareholders listen – then when the project is announced the value of the company's stock should rise by $200 million. This is the paradigm of market behaviour that academics and investors generally espouse. However, if management fails to communicate the benefits of the capital investment to the marketplace – because it does not want to publicly disclose its competitive strategy, because shareholders ignore the press release, or because investors have lost faith in management's projections – then the market will not incorporate the full value of the project into the stock price.
>
> In the early stages of the project, the shareholders note a decrease of $100 million in the company's cash flow. Not knowing otherwise, they construe this as a decline in the company's business prospects and adjust their valuation of the stock downward. Not until the profits from the capital investment show up in reported earnings would the market fully incorporate the merits of the capital expenditure into the value of the stock. The market is behaving rationally, given available information, but from the perspective of corporate managers, investors are behaving myopically."
> (Jacobs, 1991, 35f)

3.3. Risk of the final product

The makeup of the "Big Pharma" group of companies has not changed much over time. The relative ranking among those within the group does however change substantially. Most of the firms derive the bulk of their revenues of pharmaceuticals from a small group of products. Around 1992 for example, 21% of pharmaceutical revenues of the 25 top firms came from the respective sales of one single product. This means that the emergence of one or two new products can have significant effects on the market shares of the world-leading firms. (Balance et al, 1992) As the Economist reported in September 2006, Bristol-Myers Squibb lost 75% of the market for the drug Plavix to a generic rival in only a few short weeks that summer. (The Economist, 14/10/2006) The introduction of the new product can act both as a signal of profitability to other firms and as well as an important piece of information in another firm's research. (Dao, 1984) This structure of markets implies that even when the uncertainty of research is resolved, there are significant risks connected to the final product.

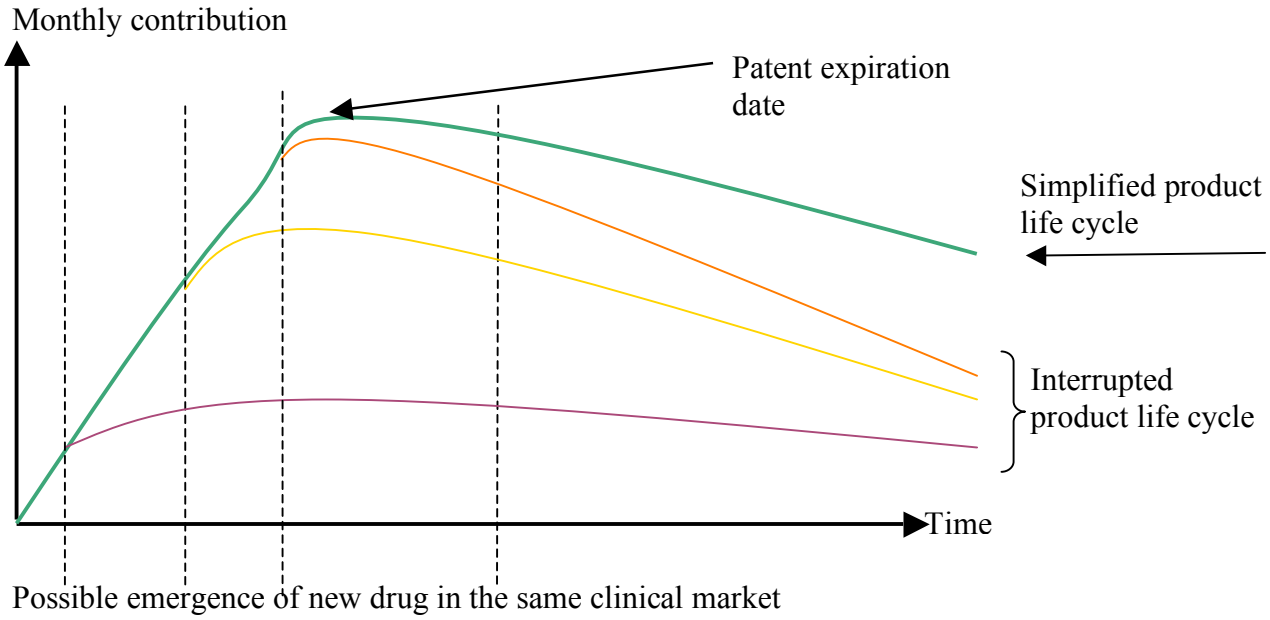

Figure 1. Model showing potential loss in contribution level of a drug due to external business risk.

3.4. Resulting issues in pharmaceutical companies

The different inherent qualities in a pharmaceutical company may lead to diametrically different issues, such as over- and under-investment, and risk-averse behaviour as well as too risky investments. I will try to highlight the main structures of these difficulties, such as attitudes towards risky investments and the implications of the time lag between investment and payoff. These four areas of concern will be revisited in the conclusions.

- Managers may inflate short-term profit due to the long lag between research expenditures and output, to the detriment of optimal long-term performance, in order to
    - cash out on inappropriately structured incentive pay
    - lower employment risk
    - accommodate market pressure for short-term results
- Low valuation of products in the research-pipeline may induce managers to reduce R&D spending to long-term inefficient levels. Even if the market would price these investments according to standard discounted cash flow theory, the discount rate for an investment that has a chance of 1 in 10 000 of succeeding to the market would be so high as to make the present value of any one project quite small indeed.
- Managers may under-invest in positive NPV-projects in order to fund expenditure on research on potential blockbuster compounds, leading to low investment in less risky projects and high investment in high-risk projects. This means that an already inherent risky business becomes even

more risky, especially when taking into account the impact of new competing compounds on the same clinical market discussed above.

- Low valuation of products in the research-pipeline may induce managers to prematurely force expensive clinical development investments, as investors will gauge such projects as having higher value.

As we can see, the high level of risk and the long-term time-horizon of the operations within a pharmaceutical firm can lead to both under- and over-investment in R&D, with different risk strategies, meaning that a measure of R&D expenditure would not give us all the information about what kind of problem could be present in the firm. However, due to the difficulties in separating the "right" kind of investments from the "wrong" kind, together with the secretive nature of R&D, it would be very hard to study this at an aggregate level, outside of a single firm case study. In most cases in this paper, I will therefore be forced to rely on research where increases and decreases of R&D expenditure are the signals available for the studies.

4.Takeovers

We will now focus on the first of the five classical areas of corporate governance, the takeover. After a short general introduction to the concept, I will introduce those areas of research within the field that I have found to be relevant to the paper, and analyse the findings using the issues presented earlier.

4.1. Takeovers in a nutshell

One of the most radical mechanisms in corporate governance disciplining management is the threat of hostile takeovers. However, its functioning is less than optimal – hostile takeovers are disruptive and costly, and in reality they are rare occurrences. It is also common for public firms to adapt a variety of anti-takeover measures, such as poison pills etc., which reduces the ex-ante gain for a presumptive acquirer. (Stein, 1988)

There are two important functions that the mechanisms of takeovers fill, according to proponents of raiders. First, acquiring firms can use economies of scale/scope, apply superior skill or technology, or take advantage of value creating synergies in creating higher value for shareholders. Secondly, the very threat of takeover is thought to discipline entrenched managers to adopt value-maximizing behaviour in order to avoid being ousted by a raider. However, one the other side of the fence there are those who claim that the constant threat of takeover feeds an inefficient fear in managers of being bought out at an undervalued price, and force them to focus heavily on short-term profits. This leads to resources being spent on avoiding being undervalued in the short term, both by sacrificing long-term investment in favour of short-term investment, and by costly signalling to the market. (Stein, 1988)

4.2. Applied to pharmaceutical R&D

So what do we find if we look at takeovers in the perspective of innovation and investment in R&D? The three points of interest would seem to the issue of costly signalling, the use of takeover defences, and the effects of a takeover actually occurring.

4.1.1. The cost of signalling

The use of short-term signalling to the market does not necessarily mean that the manager does not act rationally and in the interests of shareholders. Signalling can be rational when there is a chance that the firm might be targeted during a temporary mispricing of the stock. In such cases, managers may boost earnings in an attempt to correct the market price and secure a fair price for shareholders. The risk of such behaviour is dependent on the type of shareholders currently in possession of the firms stocks. If shareholders are characterized by patience, low current earnings will not deflate stock price and make the firm vulnerable to takeover. In the opposite case, managers will be more inclined to focus on short-term earnings. It is an issue of informational asymmetry – managers may act in suboptimal ways to communicate the true value of the firm to the market, and thereby reduce the potential value of the firm in the long run. (Stein, 1988) This type of signalling is called *resolution*

timing. (Chordia, Hirshleifer, Lim, 2001) The problem of signalling, while not actually fooling the market, may however be a lesser problem in companies where the success of R&D efforts are a critical determinant of business success. (Stein, 1989)

Against this reasoning stands the fact that the market often responds positively to information about new investments in general, which would imply that the myopic reasoning as defence against takeovers is erroneous. However, if it is true that managers are reluctant to deflate current earnings in order to invest in future earnings, the more reluctant the manager, the higher the value of those investments that actually pass the needle's eye. Therefore it is natural for the market to value those investments highly. (Stein, 1988)

Other forms of signalling affect the investment behaviour of management. Signal enhancement is one form of signalling where the manager secretly underinvests in order to strengthen current cash flow when investment choices are not very visible to the market. If investment choices are visible, however, the manager may then mimic the actions appropriate for a firm with high value projects and overinvest in R&D. The working paper by Chordia, Hirshleifer and Lim indicate that if investment choices are visible, R&D efforts can therefore actually be reduced if market pressures are lessened. This means that insulation from takeover threats may reduce innovative activities, not the other way around. In their model, the threat of takovers may even lead to excessive innovative activities. (Chordia, Hirshleifer, Lim, 2001) The question that follows is then how visible investment decisions by management are.

4.1.2. Takeover defences

Mentioned earlier were the various methods of shielding a company from the threat of takeovers. During and after the 1980s many firms immunized themselves from that particular threat. For instance, forty state legislatures in the US have enacted statues of protection as a direct result of requests by firms with headquarters or chartered in that state. Here are a few examples of takeover defences:

"Shareholder rights plan" (poison pill)

If this is triggered during a hostile bid, the current shareholders can double their holdings at a low price, diluting the equity and voting power of the bidder so that it would be ill-advised to continue with the takeover.

Classified board

The directors are split into three separate groups, which have three-year terms that overlap, meaning that it would take even a majority owner two years to gain control of the company.

Shareholders prohibited from calling a meeting

Only the board can call a meeting of shareholders, regardless of any shareholder majority wishing to replace the board, consider an offer or discuss some other topic.

No shareholder action by written consent

Shareholders cannot take action outside of a shareholder meeting.

Important to note is that not only do measures such as these protect management and board from takeovers, but they also seriously hamper other shareholder action against those two groups. (Jacobs, 1991)

Malekzadeh, McWilliams and Sen looked at 256 different companies that between 1980 and 1990 proposed one of three forms of antitakeover amendments: fair price, staggered board or supermajority vote amendments. They found that implementation of such measures lead managers to focus more on the longer term and riskier things such as R&D. (Malekzadeh, McWilliams, Sen, 1998)

So what happens when a takeover actually occurs? With a LBO, the company must become lean and mean to be able to cover the principal and interest payments. This means that monitoring the cash flow becomes very important, and in cases where the deal is highly leveraged or the repayment is aggressively tight it is not unlikely that too much focus will be on short-term revenues vital to covering the debt incurred. (Jacobs, 1991)

4.3. Takeover analysis

The issue of signalling may seem to be severe in a firm where investment in R&D takes very long to be recognized as potential for future earnings and therefore will result in, at least in the view of the manger, a lower than fair share price. However, it is possible that signalling in the form of public announcements of investment in a research project may take the role of the less optimal signalling discussed above. The success of this resolution would then depend on how visible the manager can make the investment without revealing important and confidential research information. It is also possible that visible investment may be used as a "warning signal" to competitors of their presence in the research field – competitor investment in the same area may be called off because of the signalling firm's "head start" and apparent commitment. Malekzadeh, McWilliams and Sen did in their study indicate that antitakeover amendments made managers focus on the longer term and more risky projects.

Such signalling is contrary to signal enhancement, and it is difficult to draw any conclusions of what type of behaviour would be more likely within a pharmaceutical firm. In the absence of takeover defences, the manager may have to choose between the two in a situation where a hostile takeover is a clear and present threat. It is conceivable that the manager in a firm *with* takeover defences may use investment signalling in an effort to avoid the criticism that may follow when takeover defences are used (or threatened to be used), though this argument, being inferred in several steps, is less convincing. Where takeover defences are present, the use of signal enhancement as protection against takeovers does not seem very logical, even though non-optimal investment behaviour may surface for other reasons.

The paper by Chordia, Hirshleifer does indicate that insulation from takeover threats may reduce innovative activities, in the case of visible R&D efforts, though this is contradicted by

Malekzadeh, McWilliams and Sen. In order to get closer to the answer the issue of the degree of visibility seems an important aspect, but to explore it further is beyond the scope of this thesis.

A pharmaceutical firm after an LBO will need to generate enough cash flow to cover the principal as well as interest payments, meaning that short-term earnings and cash flow will be critical to its survival. In such an environment, it may be that maintaining an investment program in risky and long-term projects such as pharmaceuticals is pushed down on the list of priorities if the value of the projects, i.e. the intangible assets that might be lost in reducing such a program, is considered low. After the LBO, the issue of visibility of investments is limited, since the new ownership usually have full insider information about the company and is setting the new direction of the company.

On a more speculative note – if the value of the research pipeline is dependent on keeping up set investment program, a highly leveraged buyout which requires large cash flow to service the debt may be clearly detrimental to the long-term value of the firm. On the other hand, a firm with a limited research pipeline but with assets in block buster drugs may be more appealing to consider for a LBO. Following this reasoning, a higher valuation of the research pipeline due to premature investment in later stage clinical trials may be a tool against takeovers.

5. Debt and Creditor Monitoring

5.1 Debt and Creditor monitoring in a nutshell

Theoretically, borrowing (and distributing borrowed capital to owners or using other means to make the borrowed amount not available to management) will reduce the amount of discretionary funds that managers have access to, since it creates need for annual cash flow in order to make good on amortization and interest payments. The argument is that this will in turn reduce incentives to use the firm's capital in a suboptimal way – an investment in a corporate jet will seldom lead to future payoffs needed to amortize debt. The monitoring role of creditors is one of the main tools of corporate governance. (Gray, 1997)

If firms need to go to the capital market in order to find funds for investment needs, they will be subject to significant demands for information disclosure, analysis and scrutiny by investment bankers in particular and the capital market in general. This may act as a deterrent to opportunistic behaviour. (Bathala, Rao, 1995) However, what effect would this have on managerial propensity to make long-term investments?

5.2 Applied to pharmaceutical R&D

5.2.1 Leverage in innovative firms

In her study of innovation financing, B. Hall reports on a study by Opler and Titman in 1994, showing that high intensity R&D-firms that were leveraged during the LBO-wave in the 80's suffered more than other types of firms when faced with difficult economic times, likely because they were unable to sustain their R&D programs in the face of reduced cash flows. (B. Hall, 2005)

The asset created by an investment in pharmaceutical R&D is intangible, in part embedded in human capital (e.g. research personnel) and may be difficult to transfer to a new firm without loss of information or value, and it is hard to capitalize on the asset before it has matured – the alternative use of the asset is limited. Debt holders are usually seen as preferring more physical assets to secure loans, where the sunk cost is generally lower than with R&D investments, such as plant and equipment. Hall further lists a number of studies all pointing to the conclusion that debt is a disfavoured source of financing for R&D investment. (B. Hall, 2005) It is generally assumed that R&D-intensive firms have, on average, lower levels of debt than other firms. (Davidson, Brooks, 2004)

A similar overview of case studies by Frédérique Savignac in 2006 pointed to that the effect of financial constraints on a firm's decision to undertake innovative activities may be dependent on the home country of the studied firm; e.g. the cash flow-constraining effects on innovation decisions were more severe in US firms than French, and German evidence was inconclusive. Taking the difficulties of measuring financial constraints into consideration, Savignac does conclude that financial constraints affect R&D expenditure. His case study, using data from a French survey about the

financing of innovation by firms, shows a significant reduction of the likelihood that the firm will engage in innovative activities, amounting to 22,3 %, everything else being equal. (Savignac, 2006)

5.2.2 Renegotiation and cooperative relationships

The increased securitization of loans has eased the tension between the short-term liabilities of banks and the long-term debt that they issue. However, securitized loans are not very flexible. A firm with high leverage and not sufficient cash flow has a need to restructure the debt, but the lower flexibility makes this less likely to be possible. (Jacobs, 1991)

Equity ownership by banks encourages a different type of long-term strategy since the banks take part in the upside rewards of risk. The regulatory environment in the US, prohibiting banks from owning significant company equity and exposing them to legal liabilities from other creditors and shareholders, creates barriers to cooperative relationships between banks and debtors. Banks in Germany and Japan are more willing to renegotiate debt, which means that significant debt does not impair their long-term strategies in the same way as in the US. (Jacobs, 1991)

5.2.3 Signalling with debt

Taking on long-term debt may also act as a signal of confidence in having high future earnings. The highly public and well-understood punishment of managers in both reputation and future earnings of managers in case of default then acts as a deterrent against behaviour that might lead to default. In order for the manager to honour the debt when it is due, it forces behaviour that is optimal for long-term performance. Therefore, it should act as a credible sign of management commitment to optimal strategies. However, if it is possible for the manager to borrow from future earnings in order to repay the debt, the credibility of that signal and the effectiveness of the debt on the manager are severely weakened. Even if such borrowing does not occur and the manager acts in an optimal and long-term way, the firm may still not be able to service the loan when it is due, and may therefore engage in short-term behaviour, such as fire sales. (Nolan, 1998)

5.3 Debt and creditor monitoring analysis

The reduced amount of discretionary funds and incentive not to "waste" corporate funds will likely have a negative correlation with the propensity to invest in pharmaceutical R&D, as well as the ability to continue to follow a defined investment plan which upholds the potential value of a current R&D project. In addition, such a control mechanism, reducing managerial autonomy and increasing scrutiny from commonly risk-averse groups as banks (as will be discussed next under "Banks and financial institutions as block holders") may indeed act as a deterrent to long-term investment, increasing short-term managerial myopia – increasing propensity to invest in existing drugs and develop the market for available products. Adopting debt as the main control mechanism of the firm means that one of the most critical stakeholders in the firm is more interested in the downside of sunk capital in pharmaceutical investments than in the upside of the project.

The very public failure of defaulting or appearing to be at risk of defaulting on debt will also have a high impact on the previously mentioned "employment risk" – the career risk of the management. The possibility of bias towards high-risk projects with high potential payoff in situations with high default risk is limited, since the lead time for pharmaceutical projects is comparatively long, and the option is likely to be attractive only to those projects in the very last stages of development.

Any one pharmaceutical R&D project payoff is likely to be too distant and have too high a risk to be used for the strict amortization and interest payment schedule. This makes the potential of signalling interesting: since the R&D project is very risky it would be hard to borrow on future earnings related to the project, increasing the credibility of the signal to the market. Since the alternative use for the intangible asset invested in is limited, the risk of fire sales should be limited. In a case of high default risk, it may prove attractive as a way of increasing payoff in an attempt to raise equity capital to avoid default. However, the restrictions on borrowing on future earnings and the restraints of limited amounts of tangible assets to liquidate for servicing a debt may be dependent on a "one project firm" – a mature pharmaceutical firm will have several projects, not only in the research pipeline, but also as existing products with often valuable patents. One may therefore speculate that the signalling potential for any one firm may be lessened with product stage diversity (having a balanced mix of early stage developing projects in the pipeline as well as mature, cash generating marketed drugs) and size.

For a firm debating investment in R&D, a securitized loan will be harder to restructure in order to increase value for the company. Therefore, the more standardized and non-negotiable a loan, the higher will be the risk that it leads to sub-optimal long-term behaviour by the firm, depending on the national and institutional setting of the firm.

As mentioned earlier, high principal and interest payments do invoke a "knee-jerk" conclusion that it would lead to greater focusing on short and medium-term projects, a category in which pharmaceutical R&D does not fit.

6. Concentrated ownership

Concentrated ownership may have a positive effect on firm performance, likely partly due to a significant stake in a firm increasing incentives to monitor management. However, it might also lead to collusive behavior between management and the large shareholder, at the expense of minor shareholders. (Maury, Pajuste, 2004) In this section, we investigate the relationship between block holding and R&D in a pharmaceutical firm.

6.1 Concentrated ownership in a nutshell

Traditionally, ownership concentration is assumed to stimulate long-term investments, as in the absence of effective control by shareholders, managers have incentives to maximize short run profits and sacrifice long-term profits. Adopting the wider view of Lacetera, a "stable" long-term owner could signal to management that even poor short-term performance may be viewed by shareholders as optimal, if it is an effect of management pursuing long-term strategies. Thus, as large investors tend to keep participation long-term, ownership concentration can help increase the financial commitment of shareholders. Also, the longer participation of a large owner, the better is the owner's knowledge of firm's activities, which can improve monitoring capabilities. (Lacetera, 2001)

6.2 Applied to pharmaceutical R&D

In the US the average ownership percentage of principal shareholders in drug companies is higher than the average level at NYSE, and the study done by Lacetera showed that ownership concentration had a significant, positive effect on research intensity. (Lacetera, 2001) However, it is important to note that the literature concerning the effect of ownership concentration on R&D expenditure shows mixed results, and to date there is little consensus on the actual effect. (Berrone, Surroca, Tribó, 2005).

We will look a little bit further into a working paper by Berrone, Surroca and Tribó (2005), which differentiates the types of block holders into three categories: banks, non-financial companies, and individuals, in order to make the discussion more nuanced. After this, I will look into other research specifically on institutional shareholders, both as block holders and non block holders, as there has been mounting discussion both in academic, political and business circles that such owners have significant impact on management myopia.

6.2.1 Banks and financial institutions as block holders

Banks and financial institutions often have relationships with the company in which they invest that go beyond share ownership, usually in the role of creditors. This means that they may be averse to R&D projects due to the double channels of uncertainty they are exposed through; credits and stakes. Also, any bank with these double ties to a company will be attracted to a strategy of information monopoly, devoting resources to collect information of management quality, firm strategy and firm operations. For the firm this information monopoly can be an impasse to access to resources elsewhere – the hold-up problem. As the firm is reluctant to increase dependency on any one financial institution, it may

become reluctant to borrow more from that particular source, impeding the investment in potential high-value R&D projects. However, for the outside financial markets, this hold-up problem can act as a signal that the bank with in-depth information about the firm is unwilling to lend further resources to the firm in question, making it hard to convince additional lenders of the viability of further investment. Additionally, some research suggests that as large-scale banks require high-quality information to evaluate the prospects of any debtor, they tend to avoid investing in complex and risky R&D. (Berrone, Surroca, Tribó, 2005)

The working paper by Berrone, Surroca and Tribó uses data from companies in Spain, and even though the results are likely influenced by the different structures of financial institutions in the markets of different countries, it is tempting to draw some conclusions of the effect of bank block holders on R&D in general. They do find that block ownership by banks has a significant, negative impact on R&D investment, and that such financial institutions can be seen to avoid investing in high-growth firms. This suggests that banks have a conservative investment strategy, shying away from investment in risky long-term projects that do not promise any return in the short-term. However, one should keep in mind that stringent monitoring by conservative block holders that lower the investment in R&D might not per definition lead to lower financial performance. Monitoring in itself is essential in addressing the agency problem, and may instead lead to better selection of projects and thus increased efficiency of R&D expenditures. Interestingly enough though, for firms with higher than industry mean R&D investments, the scrutiny by banks does not seem to cause ROA improvements, suggesting that monitoring by financial institutions does not increase the efficiency of R&D investments, though one should note that since the investment are assumed to be long-term, increased efficiency would not have an immediate impact on ROA. (Berrone, Surroca, Tribó, 2005)

6.2.2 Non-financial institutions as block holders

Non-financial corporate shareholders are less likely to have credit relationships with the controlled firm when compared to banks. The existence of potential synergies between the firms, reciprocal business relationships and spillover effects between firms should favour R&D investment in the pharmaceutical firm. They are more likely to have long-term perspectives with clear incentives to monitor management, motivating them to allow managers to take long-term views of the investment strategy of their firm. Berrone, Surroca and Tribó thus claim that non-financial corporations are more likely to recognize the importance of R&D expenditures as essential for future earnings and market success than banks. The lack of a credit relationship with the company in which the non-financial company has a stake lead to non-financial corporate investors being more inclined to offer incentives in order to invest in R&D. In the study, Berrone, Surroca and Tribó find a clear positive relationship between concentrated ownership by non-financial corporations and investment in R&D. (Berrone, Surroca, Tribó, 2005)

6.2.3 Individuals as block holders

Due to the heterogeneity of individual investors, Berrone, Surroca and Tribó do not believe that it is possible to find any systematic relationship between R&D investment and ownership concentration of individual investors. Any one shareholder with a large stake in a firm is highly exposed to the specific firm risk of that company, and would therefore often prefer management to pursue low-risk strategies. At the same time, there are large diversified individual shareholders as well as venture capitalists that would argue the in opposite direction. Also, even though one large shareholder would in theory mean greater monitoring of management, and therefore lesser agency problems, the evidence is less clear cut when dealing with multiple large individual shareholders. The different individual sets of preferences can make reaching a consensus on firm strategy more difficult, incurring larger costs of monitoring – the bargaining effect. Also, with every new large individual shareholder, the incentives of any one shareholder to monitor will be weakened – a problem of free-riding. In accordance with their predictions, the authors did not find any significant relationship between large individual shareholders and investment in R&D in the empirical data from Spain used in their study. (Berrone, Surroca, Tribó, 2005)

6.2.4 Institutional shareholders

There is concern among some scholars that institutional investors could be a cause for myopia. The premise for the argument is that institutional investment managers are somewhat dominant in setting stock prices and that these managers are highly focused on short-term earnings, in essence with their finger on the button at the first indication of weakened earnings as they are evaluated on the short-term performance of their portfolio. Corporate managers are also assumed to be very sensitive to changes in stock prices and wish to avoid the impression of sagging short-term earnings. Since investments in R&D have such effects in accounting measures, the argument goes that the pressure from institutional investors will lead to corporate managers avoiding long-term investment. (Wahal, McConnell, 2000; Hansen, Hill, 1991)

A contrasting view is that institutional investors function as a buffer between corporate managers and impatient individual shareholders who focus too much on short-term earnings. This argument is based on an assumption that institutional investors might have informational advantages over individual investors and therefore be less inclined to pass judgment based on short-term measures. (Wahal, McConnell, 2000) It is also possible that institutional investors, being more likely to take substantial stakes in a firm, may become locked into long-term relationships with the firm due to high costs of exit. This might lead them to focus their influence on encouraging long-term investments. (Hansen, Hill, 1991; Parthiban, Hitt, Gimeno, 2001) It would be erroneous to assume that ownership is the same as power however; there are many regulations that impede activism by institutional investors. Activism does on the other hand necessarily mean formal activities such as shareholder proposals, direct negotiations with managers or proxy contests. Public criticism by a

prominent shareholders or group of shareholders can have fundamental effects on management and board actions. One way to react would be to send a clear signal of having a long-term strategic focus, such as increased R&D investments. (Parthiban, Hitt, Gimeno, 2001)

It is important to note that the theories discussed by Wahal and McConnell only take into account *relative* myopia – whether or not institutional investors tend to act more or less myopically than individual investors. However, the results of the study performed by Wahal and McConnell using data from 2500 US companies from 1988-1994 do not indicate that institutional ownership induces more myopic behaviour than individual share ownership does. The study does in fact hint that the theory of institutional investors acting as buffers between impatient individual investors and corporate managers may be more accurate. (Wahal, McConnell, 2000)

However, other studies have found negative relationships between institutional ownership and R&D expenditure, though these smaller and less general studies are hard to interpret. The study done by Hansen and Hill analyzed four technology-driven industries, and the result did not support the theory that institutional investors increase myopic behaviour of managers. The data instead suggested that informational advantages from training and benefits of scale in information gathering as well as the lock-in effect mentioned earlier may be a reason for a weak positive relationship between institutional ownership and R&D expenditure, in accordance with the second theory of Wahal and McConnel above. (Hansen, Hill, 1991)

One might imagine that institutional investors such as pension funds, who have long-term liabilities, would be close to ideal long-term shareholders. However, in America for example, these institutional shareholders hold stock for significantly shorter time periods than individual investors. The annual turnover of holdings at the beginning of the 1990s for pension funds in USA was more than 50%. This is perplexing but it is quite possible that the rules and regulations that such institutional investors face create bad incentives. (Jacobs, 1991)

Interestingly, some evidence point to a significant positive relationship between institutional ownership and outside board members, consistent with the view that institutional investors pressure firms to increase the ratio of outside board members in order to look out for shareholder interests. (Bathala, Rao, 1995) Later studies have shown evidence pointing to that the large holdings and the sophistication of institutional investors to monitor and discipline management encouraged long-term R&D investments, and that the nature of this active ownership had a measurable effect on R&D inputs. (Marginson, McAulay, 2007)

A study by Parthiban, Hitt and Gimeno in 2001 found that while institutional *ownership* did not have any effect on R&D inputs, institutional *activism* had a positive association with R&D inputs, though only indirectly with R&D outputs. Neither efficiency nor performance was affected by institutional activism, according to similar studies. (Parthiban, Hitt, Gimeno, 2001)

6.3 Concentrated ownership analysis

As mentioned above, the purpose of concentrated ownership in a corporate governance perspective is to increase probable monitoring of the firm in order to limit non-optimal behaviour. Banks as large block holders will likely perform this task well, but the danger might be that such owners are too conservative for inherently risky pharmaceutical firms. The hold-up problem is one that may clearly be a problem for a bank with substatial equity holdings if it is also a creditor. This is dependent on the bank being conservative in its investment strategy, and that the pharmaceutical firm does not have sufficient cash-flow to finance R&D internally. Non-financial corporate block-holders may then be more likely to value the investments higher, especially when taking into account spillover effects when the two firms have business links as well. The positive relationship found by Berrone, Surroca and Tribó is therefore tempting to extrapolate into a more general conclusion about non-financial block holders. A prudent conclusion would mention that this positive effect on R&D expenditure may be more likely when the business relationship consists of close cooperation between the two firms or when the R&D-project may lead to visible technological gain for the block holder.

A bank holding a large block of shares might be superior to other block holders in preventing shifting of investment funds from low risk positive NPV-projects to high risk investment in potential blockbuster drugs. This is due to increased informational advantage, which is in turn an effect of the double relationship of shareholder and creditor.

Institutional investors and their relationship to managerial myopia have been discussed at length both in academic and political circles. The two perspectives are non-inclusive; (1) institutional investors are highly focused on short-term earnings, since they are evaluated on immediate success over a few months or possibly a few years at a time, (2) institutional investors, taking substantial stakes in firms, act as buffers between impatient individual shareholders and the firm, letting the firm focus on the long-term. The first view can be debated with respect to the theory of perfect markets – if the market values the firm correctly, it should immediately take the value of R&D investments into account, and this should then be reflected in the short-term movements of the share price. It is then conceivable that the previously discussed low valuation of investments in the research pipeline would aggravate the problem of short-sighted investment managers. However, if the second perspective on investment managers is more plausible, the role of buffer would indicate that the firm in question could invest in R&D with few or smaller negative effects. Since studies on institutional investors and short-termism have shown differing results it is difficult to draw firm conclusions, but perhaps the differing results are due to the fact that institutional investors are heterogeneous. It may be that some act as buffers and some are conduits for strong pressure in favour of short-term success, though in this authors view the evidence for the latter does not seem conclusive.

In the case of institutional investors as buffers, the resulting effect on a firm would likely be the same whether or not the firm is in the pharmaceutical business, but this may not be the case for the opposite perspective. If institutional investors are indeed highly focused on the short-term earnings of

the firm, the low valuation of investments into the research-pipeline of pharmaceutical companies would surely aggravate the issue, and make such investments more difficult to motivate for the manager. The danger of management shifting investment from low-risk research to high-risk research in search of blockbusters seems in this setting to be less severe than the problem of prematurely forcing clinical development investments to increase the valuation of investments, since the latter strategy would demand a high industry knowledge to assess by the institutional investor. The sophistication and economies of scale for larger institutional investors in monitoring management in pharmaceutical firms may be pivotal in determining the effect of institutional large ownership on pharmaceutical R&D, though the issue of institutional myopia seems exaggerated.

The heterogeneity of individual investors makes generalized analysis of the issue difficult. Classical corporate governance teaches that each new large individual shareholder weakens the incentives of any one shareholder to monitor the firm, thus giving more leeway for the management to decide on the appropriate strategy. The effects of this must then greatly depend on what other corporate governance-structures are in place – executive compensation, risks of takeovers etc.

7. Executive compensation

7.1 Executive compensation in a nutshell

The basic idea of using executive compensation as a tool for aligning the interests of management with the interests of shareholders is that by tying together shareholder value and management compensation, management will act in the interests of shareholders. There are two main ways to tie the two together, either by connecting executive compensation and some accounting measure of shareholder value, or to tie it directly to directly to the stock value. Accounting measures focus on historic results, often quarterly or annual results. It is a doubtful proxy of actual shareholder value, as it is ruled by other guidelines than just economic accuracy. Such measures do not take important issues such as market share, strategic positioning and future investments into account. (Jacobs, 1991)

Performance pay for top management is instead often tied directly to the performance of the stock, through indexing, stock options and other similar instruments. However, some studies have shown no correlation at all between the sensitivity of pay to management and the actual wealth gains of shareholders. This can be a result of many shortcomings of the practical implementation of performance pay. In order for the sensitivity of pay to have any effect on management behaviour, the pay must make some difference for the wealth of the manager. As many incentive programs do not actually contain any downside, only upside, this is very expensive. (Jacobs, 1991)

7.2 Applied to pharmaceutical R&D

The study by Deshow and Sloan, published in 1991, examined the R&D investment behaviour of CEO's in firms with significant ongoing R&D activities during the CEO's final years in office. Their findings suggest that CEO's spent less on R&D during these years, but that these effects can be mitigated by CEO stock ownership – a form of executive compensation aligning management and shareholder interests. (Deshow, Sloan, 1992)

One of the critical roles of management is to allocate funds to the projects with the highest potential payoffs. Management compensation linked to firm performance is thought to mitigate some incentives that increase the private benefits for managers at the expense of owners/shareholders, such as funding of pet projects. This makes long-term performance pay seem like the natural choice for aligning interests of management and shareholders, since pharmaceutical R&D is inherently long-term. According to a study by Wulf and Lerner published in 2007, the compensation model of corporate heads of R&D underwent significant changes during the 1990's, putting much more emphasis on long-term incentives (e.g. stock options and restricted stock), a shift that was also reflected in overall senior management compensation. They find that long-term incentive pay for R&D managers is correlated with higher values for innovation proxies mentioned below in firms with centralized R&D organizations. They do not find such a relationship between the short-term incentives (such as bonuses) and higher levels of innovation. (Wulf, Lerner, 2007)

However, since the Wulf and Lerner study measured innovation as (a) the number of awards given to a firm in a given year, (b) the mean number of citations to the firm's patents awarded in a given year, and (c) a standardized estimate of the "originality" of the firm's awards in a given year, and not level of R&D investment, which is the most commonly used measurement in this thesis, their results are not comparable. Secondly, there is the causality issue – does long-term incentive pay increase innovative activities in a firm, or does it mean higher attractiveness to managers with higher quality/competency? (Wulf, Lerner, 2007)

A study by Balkin, Markman and Gomez-Mejia compared the relationship between innovation (as measured by investment in R&D and number of patents) and CEO pay in 90 high-technology firms with 74 low-technology firms. They found a relationship between innovation and short-term CEO compensation in the high-tech firms, after controlling for firm size, performance and a number of other factors. However, the relationship between long-term compensation and innovation was less consistent. The authors reported no similar correlation between innovation and long or short-term CEO compensation in low-technology firms. (Balkin, Markman, Gomez-Mejia, 2000)

Anderson, Banker and Ravindran demonstrated in 2000 a positive relationship between management options-programs and firm performance in the IT-sector, a relationship that was significantly different to other industries studied. (Anderson, Banker, Ravindran, 2000)

7.3 Executive compensation analysis

A manager in a pharmaceutical company contemplating investments can hardly take into account compensation tied to relatively short-sighted accounting measures, as they will not reflect the strategic value or the future payoff of such an investment. Assume that the manager of a pharmaceutical company has a salary divided into three parts: base salary, performance pay linked to accounting measures and performance pay linked to some long-term share development. In evaluating whether to make an initial investment in research, he realizes that the investment would lower the salary bonus based on accounting measures as it would depress the cash flow and other accounting measures. Due to the uncertainties of pharmaceutical research discussed earlier in the thesis, even if the manager was absolutely certain that the investment would lead to a viable product, the market would not add the value of this investment to the value of the company for about ten more years. Even given that the long-term performance pay took such long-term development into account (whether or not the manager would still be active within the company), it is not very likely that the future payoff for the manager would offset the depressed short-term salary. If we reintroduce the actual uncertainty of payoff for the investment, the discount rate of the potential payoff would be so high that the likelihood of management to adjust behaviour in relation to a highly uncertain payoff in the future would be limited. This is likely to be reinforced by the common absence of downside in these programs.

The result of the study by Balkin, Markman and Gomez-Mejia is promising, but since the innovation horizon for many high technological firms such as IT-firms is very short, it is not fully

applicable to pharmaceutical innovation. Even though the investment outcomes are highly unpredictable and not unlikely to be lost due to another firm "getting there first", and therefore carry high risks, the investment decision for IT-firms can not be viewed as fully comparable to that in the pharmaceutical industry due to the difference in payoff horizon. The indications that short-term incentive pay influences innovation activities while the evidence of the benefits of long-term incentives are less conclusive may be a consequence of the difficulty of creating any long-term executive incentive program which takes external risk into account, e.g. the risk of "creative destruction" of a well planned and executed innovation investment because a competitor managed to file a patent blocking further development into a specific area.

However, it is not unlikely that if a manager is to be rewarded for keeping the organizational capacity for innovation and targeting the optimal level of R&D risk, the compensation likely needs to be modelled for both the short and the long-term, rewarding on actions that have potential for profitable innovation and the realized profit from such innovative activities. This is plausible when looking at the much longer time frame for realization of pharmaceutical innovation and a manager's career within a certain firm, the latter of which may only stretch for half the duration of the former.

8. Board structure

The board, being the shareholders' representatives and charged with monitoring and evaluating the management, is one of the classic corporate governance tools that has been less debated on the basic text book level. However, it has been the center of more and more attention, especially in the view of the abundance of corporate scandals that unfolded during the 21st century. The link between R&D expenditure and the structure of corporate boards has to this authors knowledge not been heavily researched from a pure corporate governance perspective, but is discussed in the organisational-theory context. I have tried to limit the discussion here to the context of corporate governance, but in some cases the wider perspective has been difficult to leave out. As the focus of discussion here I have chosen insider/outsider board members and insider board member ownership. I will also present some geographical differences in regulation of board structure.

8.1 Corporate boards in a nutshell

Where the management is in charge of decision management, decision control must be the responsibility of the company board. This entails that the management is not the only evaluator of their decisions and strategies, and that their performance will be scrutinized by a group of directors with the shareholders best interests in mind. (Baysinger, Hoskisson, 1990)

While most countries with a developed capital market have boards representing shareholders vis-à-vis the managers of the firm, the rules and regulations of these boards differ greatly between countries. In Germany, the functions of the board are divided between the executive board and the supervisory board, in what is called a two-tier system. The supervisory board is under regulation to divide the seats equally between employee representatives and shareholder representatives, with the board chairman, a shareholder representative, holding the swing vote. There is some academic consensus that the ownership structure together with stakeholder regulations such as this creates a system of "patient capital", which in concurrence with the tradition of consensus-based decisions creates an atmosphere conducive to long-term planning. However, the ownership structure of large shareholders together with the board system makes the threat of takeovers in countries with such regulations weak. The comparatively weak market of corporate governance through takeovers and other shareholder activism can be seen as muting the assumed demands of short-term returns by small shareholders. (Casper, Matraves, 1997)

8.2 Applied to pharmaceutical R&D

One may question if decision management is separate from decision control when there is a prevalence of insiders on corporate boards. On the other hand, can outsider directors, with less knowledge of the specific firm and the decision process of top management, fulfill the task of evaluating management performance? (Baysinger, Hoskisson, 1990; Bathala, Rao, 1995)

Board members in the US are either part of the management team or outsiders selected by the CEO or a nominating committee often influenced by the CEO. In the former case the board members

report to the CEO and it is unlikely that they will be strong critics of management. In the latter case the members may know little of the firms operations and therefore be very dependent on CEO and other senior officers to supply them with relevant information. The CEO often serves as chairman of the board in the US; around 1995 only about twenty percent of the S&P 500 companies had separated the offices of CEO and chairman. This can be contrasted to Great Britain, where publicly traded companies often have outside (non-management) chairmen. (Blair, 1995) However, after the latest wave of corporate scandals, stronger regulation requires independent directors for firms on the major stock exchanges in the US. (Landier, Sraer, Thesmar, 2005)

Even though the basic principle is that directors serve at the discretion of the shareholders it is very hard for the shareholders in the US to remove any specific member of the board and in many cases near to impossible to nominate new members outside of a proxy fight. In practice, all that most shareholders can do is to choose whether to vote for the directors nominated or not. (Blair, 1995)

8.2.1 Information advantages

Since managers are not all-powerful to determine the performance of the company, it is important for those evaluating the performance of the manager to differentiate between decisions and actual outcomes. Without differentiating between the two it is likely that managers will adopt risk-averse behaviour. (Baysinger, Hoskisson, 1990)

To assume that all directors have the same capacity to evaluate top management would be hasty. It would be more logical to suspect that insider directors have more information about the relevant topics, as well as superior quality of information, than outsiders. Outside directors are at risk of having to base their opinions of top management on the actual financial performance of the firm instead of the strategic decisions that came before. The more complex the firm or industry/environment, the harder it would be for any board member to differentiate between management performance and company performance. (Baysinger, Hoskisson, 1990)

This view is supported by Nicole Lacetera in his study of corporate governance and innovation. In addition, granting key research professionals authority such as a seat on the board, may increase likelihood of keeping the competency in the firm and motivate higher investment in the relevant HR. He found that nearly all of the drug companies in his sample had at least one scientist on the board, though the boards in general were dominated by outsiders. (His sample consisted of 27 large US pharmaceutical companies, accounting for over 75 % of the domestic market.) (Lacetera, 2001)

To contrast, it is also argued that ties between insider board-members and the CEO are serious threats to objectivity and efficiency in their role as decision controllers. Some claim that while this is a reasonable objection, it may not be as detrimental as it sounds. The legal liability of all directors, inside or outside, suggests that very few directors would stay loyal to an obviously corrupt or incompetent CEO. Additionally, since the economic and reputational health for inside directors are

tied to the wellbeing of the firm, loyalty to the CEO is likely to be based on his or her competence. (Baysinger, Hoskisson, 1990)

8.2.2 Financial performance and risky environments

As outside directors may have to rely on financial controls, top management can become highly sensitive to measures such as short-term cash flow, net profit, growth or quarterly earnings. These controls are relatively simple to implement and do not require great in-depth information for the outside directors. However, this is likely to have an effect not only on the level of effort by the management, but also of steering that effort away from what may be good but risky strategies and a long-term orientation. Increasing the sensitivity of managers to short-run financial performance can increase short-term profits, but reduce incentives to take risks and implement long-term strategies. R&D-intensive firms are always exposed to technological uncertainty. Any one investment can come to naught due to outside events, and behaviour that reduces this risk will be encouraged by high use of financial performance when evaluating top management to the detriment of using strategic decision-performance. It may be that the ratio between insider/outsider board members should be dependent on the level of complexity and uncertainty of the firm and the environment in which it is active. (Baysinger, Hoskisson, 1990)

In 1995, Bathala and Rao found evidence supporting the hypothesis that managers in firms in riskier environments prefer to have more insiders on the board, in line with the implications of Baysinger and Hoskisson. (Bathala, Rao, 1995) Even though there have been some evidence indicating that appointing independent directors leads to small abnormal positive returns on the stock market, there is no consistent evidence that independent directors actually improve profitability or the value of corporate assets (when removing the causal effect of already poorly performing firms' tendency to hire independent directors, which can make the correlation misleadingly negative.) (Landier, Sraer, Thesmar, 2005)

Interestingly, several studies from 1975 to 1989 were unable reconcile different results on the positive or negative relationship between the ratio of insiders/outsiders and company performance. (Bathala, Rao, 1995) However, findings showed that boards dominated by outsiders are more likely to oust a badly performing CEO or involve themselves in restructuring actions. (Bathala, Rao, 1995; Johnson, Hoskisson, Hitt, 1993)

8.2.3 Insider ownership and board representation

How the decision-making centres, as the board of directors, are composed will directly affect the resource allocation process. It is essential that decision makers have the appropriate information concerning the firm and markets in order to correctly handle the challenge of innovation. By granting insiders strategic decision power, one may create a powerful incentive to share competencies and knowledge within the organization, even though much of the traditional corporate governance discourse considers the presence of insiders on boards to be detrimental to the monitoring task of the

board. In Lacetera's view, the presence of insiders may improve the monitoring ability, as inside directors may be in a better position to evaluate management due to better information of the firm's operations. (Lacetera, 2001)

Lacetera found significant positive effects on research intensity from ownership concentration and share of scientists on the board, but no such significant correlation for neither insider ownership nor insider presence on the board. He presented the conclusion that the utilization of specific skills may be far more effective in the pharmaceutical industry than traditional incentive alignment. (Lacetera, 2001)

Other studies have shown that board ownership has positive effects on the market value of the firm, but when that ownership goes beyond five percent (5-25 percent) the effect is negative. This is believed to be a consequence of entrenchment having larger negative effects than the positive effects on agency issues. The alignment of incentives through insider cash-flow ownership eases agency conflicts, but increases in control seem to reduce capital expenditure, meaning that high insider control ownership may lead to underinvestment. (Gompers, Ishii, Metrick, 2004)

8.3 Board structure analysis

The system of two-tiered boards and employee representatives leading to "patient capital" does imply the risk of self-serving management, a risk which always will be present when giving the management the freedom and opportunity to make sizeable long-term investments. However, the possibility of discretionary spending does not necessarily bring on a higher level of risky long-term investments. The danger of risk aversion due to high insider ownership should also be taken into account. Lacetera's results, containing no significant correlation between insider ownership and research intensity, may be seen as supporting this last warning.

The internal and external environment of a pharmaceutical firm is characterized by risk and complexity, two features which would greatly support the need for industry- and firm-specific knowledge on the board of directors for effective decision control. The risk of insider presence weakening the monitoring role of the board may be alleviated by other means of monitoring.

Outside directors with low industry competence will likely rely on financial controls, but the effect of this will depend on the type of financial controls implemented. If the key measures used for management evaluation are focused on decision results (e.g. short-term earnings, market share, etc) the effect may be lowered incentives for long-term risky investments. Incorporating measures of innovative activities and processes (e.g. ratio of projects lasting to clinical trials, patent application statistics, etc) might mitigate this. The fact that managers in high-risk business environments prefer a higher ratio of insider board members may be due to an aversion to being evaluated on external events outside of management control, e.g. creative destruction of research investment and knowledge by a competing firm, but there is little evidence presented here to indicate that simple insider board members will increase investment in pharmaceutical R&D.

9. Conclusions

9.1. Concluding remarks and areas of interest

We have concluded that the technology environment and business conditions in the pharmaceutical industry are characterized by internal risk, low probability of any one research project coming to fruition as a commercialized product; as well as external risk, the likelihood of a competitor getting either a product which fills the market's needs or of causing creative destruction, e.g. getting a patent impeding further research and application of gained knowledge.

The former can be found in other industries, such as IT development: at any one time the common software company has a large portfolio of projects in development, but only a handful of these will lead to a product for users. This is however a source of continuous innovative feedback, is not very costly, and as individual projects have relatively short lead times it makes the issue of sunk costs relatively small.

The second issue, external business risk, can be understood intuitively by imagining a large bridge-building project. Such a project is very different from drug R&D: the end goal is clear and reasonably certain to be attainable and its progress is easy to measure. Although substitute products may appear, such as a high speed train, no identical bridge is suddenly going to appear beside it, severely reducing the value of previously made investments.

The level of business risk, a comparatively long lead time from the start of research to a marketable product, and the substantial costs involved, create some distinctive problems for effective pharmaceutical innovation. In this thesis, I have pointed out the following:

- Managers may inflate short-term performance to the detriment of optimal long-term performance, in order to cash in on inappropriately structured incentive pay, lower employment risk or accommodate market pressure for short-term results.
- Low valuation of products in the research-pipeline may induce managers to reduce R&D spending to levels inefficient inte the long term.
- Managers may under invest in positive-NPV projects in order to fund expenditure on research for potential blockbuster compounds, leading to too low investment in less risky projects and high investment in high-risk projects.
- Low valuation of products in the research pipeline may induce managers to prematurely force expensive clinical development investments, as investors will gauge such projects as having higher value.

After analysing a selection of academic material covering classic points of corporate governance in relation to these specific issues in the pharmaceutical industry there is little evidence to suggest that any one of these have effects contrary to or strongly different from their effect in an any other industry. However, the finer workings are coloured by the peculiarities of the pharmaceutical industry, in particular by influencing the risk aversion of the management and the signalling incentives

inherent in visible investment decisions. In some cases there is a risk of aggravating agency conflicts between stakeholders and management, as well as conflicts of interest between risk averse creditors and shareholders. My findings and speculations are summarized below. The reader is also invited to follow the more detailed overview of the author's reasoning, which has been included as an appendix for the purpose of discussion, but which contains thinking and suggestions beyond what can be thouroghly supported by previous research. Below I will highlight some of those points which I deem most promising for future, especially empirical, research.

It may be that the utilization of the often disapproved-of antitakeover measures could mitigate, the specific innovation troubles listed above in a setting where investment decisions in pharmaceutical R&D is to an extent visible to the market. A low market valuation of the firm may be enhanced by moving projects further along the development phase, while reducing investments in less visible projects in the early stages of development.

As expected, debt financing and high leveraging of a pharmaceutical firm may not be optimal for maintaining high research intensity and innovative capabilities, in particular in reference to the potentially increased risk aversion it may create in management. The career risk of management may lead to increasing self-serving behaviour in the form of inflating short-term earnings, while high leveraging also reduces discretionary funds available for innovative activities in the firm. A more cooperative and flexible relationship with creditors, increasing likelihood of restructuring debt in high default risk, may alleviate the suboptimal risk aversion of managers, but may leave the firm with a significant and highly risk averse stakeholder with high level of knowledge and control over the firm's investment risk strategy.

In order to handle the complex internal decision parameters and a risky external business environment, concentrated (and/or insider) ownership and possibly insider board representation may be the most suitable tools. These settings facilitate incentive and competencies to effectively monitor management actions, while limiting effects on discretionary internal funds that may be used for R&D purposes and a measure of "patient" capital due to some lock-in effects. This may reduce risk of both too little R&D investment as well as bias towards high risks.

The issue of premature investment in a pharmaceutical project as a form of signalling to the market has been prevalent in the analysis in this paper, and deserves a final look. I have focused mostly on the danger of value destruction in progressing a project which may never had moved into the latter stage of development if a more rational decision had been made, and possibly incurring costs that might have been used for more productive and innovative investments. However, there is an additional signalling issue that I have touched upon to a lesser degree. Returning to the metaphor of the bridge, the possibility of advancing projects to clinical trial before such a decision is warranted introduces what may be called "progress subjectivity", which is not available for the bridge building manager as the progress of a large bridge is clearly visible. If the image is to conform to the reality of pharmaceutical R&D investment, the bridge being built would have to be invisible to outsiders, or at

least closely covered up. This is the reality of pharmaceutical R&D, where the outside world is dependant on reports from the firm itself to determine what progress is being made. The company or its managers now enjoy an enormous scope for manipulating short-term outside valuation by giving false or just misleading reports. If they have an investment program that signal that the project is closer to completion than it is then immediate valuations may go up, but this value is based on progress which has not yet been achieved, and is thus being borrowed from the future - even a future that might not exist. If the already claimed progress eventually *is* made, no further credit can be received for it. Additionally, if the project is then terminated, the artificially inflated value will be lost. This opportunity will be tempting for management when investment is visible and there is, for management, reason to e.g. raise the share price. In the long-term, this behaviour will incur faulty distribution of capital between projects, sunk costs that could have been avoidable and disrupt the credibility of future signals sent by the investment decisions in the firm.

9.2. Overview of Analysis

(Table 9.1)

	Premature progress into clinical development phase	*Selfserving inflation of short term profit by management*
Takeovers and takeover threat	If investment decisions in R&D are highly visible to current and potential investors in a pharmaceutical firm, there is incentive to adapt a policy of early clinical trials for a category of research processes of high interest to the market. The possibility of higher market valuation of the research pipeline is an alternative strategy for management believing that the share price is too low when there are no measures to prevent takeovers.	If investment decisions are visible to the market, cutting total investment and thus undercutting the research pipeline in order to increase short term performance and stave off takeover threats will likely be apparent for even cursory monitoring by stakeholders, in particular in the pharmaceutical industry, where continuous investment in R&D is the norm. (Investment in more physical assets in other industries may possibly be deferred less conspicuously.) Means to limit shareholder power, such as staggered boards or poison pills will likely increase management capacity for self serving behavior, and may lead to lower long term investment in cases where investment decisions are not visible.
Debt and Creditor Monitoring	Debtholders are risk averse and have little share in the upside of projects in pipeline. Since the alternative value of past investment in pharmaceutical R&D is limited, debtholders are more likely to base lending and default decisions upon tangible assets and already commersialized products. Signalling value of debt is likely limited for large and diversified companies (i.e. with a number of commercialized products and tangible assets). Limited propensity to engage in high risk behavior, unless there is significant chance of default.	The career risk for management is very high when dealing with default – the downside for managements' future career is substantial. Management is therefore likely to be as, or even more, risk averse than creditor when deciding on investment policy in a high risk environment with a realistic risk of defaulting. The possibility of restructuring and negotiating new terms will however be determined in part on possible alternative value of research projects in pipeline.
Concentrated Ownership	Inefficient project phase policy may be less likely with risk averse and/or professional stakeholders with significant incentives to monitor management (such as banks and institutional owners) with insight into proprietary knowledge of the firm. The hold-up problem, concerning risk averse block holders doubling as creditors (e.g. banks), may impede investment level if there is limited amout of internally generated capital, leading to greater efficiency and selectivity in investment decision.	Sophistication in monitoring, high incentive to monitor and potential informational advantage suggests reduced potential for self serving behavior by management.
Executive Compensation	Long term performance incentives are not likely to lead to short term inefficient and costly investment policy. Innovation incentives may lead to increased number of products in latter stage pipeline, depending on care of measures chosen and some incorporation of performance/efficiency measures as to avoid incentivizing cost. Basing incentive pay on e.g. number of compounds in clinical trials would increase risk of management prematurely advancing projects erroneously, indicating that efficiency and/or performance indicators may be suitable to combine with measures of innovation activity results/effects, e.g. number of granted patents.	Short term self serving behavior such as this will have little, or negative, effect on performance incentive pay. However, the negative effects may be too distant in time to have true impact on management payoff, in particular when taking into account the difficulties of managing a well functioning long term incentive program. It is not clear that performance pay to incentivize long term innovation is cost effective when looking at studies done so far.
Board Composition	Insider ownership and insider share in board composition, providing high level of industry and firm specific competencies in board, may reduce risk of inefficient policies in projects phasing due to greater understanding of decision criteria, though this has not been established	While insider ownership may increase monitoring industry compentency and incentives to monitor management, it has not been established to increase R&D investment. Dependend insiders (e.g. employees) are argued have reduced capabilities to prevent self serving behavior by management, though share of scientists in board presence may induce higher levels of research intensity

Low level R&D spending due to low investor valuation of projects	*Underinvest in positive NPV-projects in favor of high risk blockbuster projects*
Visible investment decisions reduces possibility of generally lowering R&D spending without reducing investor confidence in future prospects. With antitakeover measures in place, pressure to maintain high share valuation in order to prevent hostile takeovers by, in managements' view, using temporary too low share prices, may be less likely to lead to limiting R&D expenditures, though evidence suggests low visiblity of investment may then lead to underinvestment	Visibility of investment decisions offers possibility of bias towards high risk blockbuster drug projects. Presence of anti-takeover measures may facilitate high-risk behavior, but is not in itself a determinant of increased or decreased number of innovative activities though evidence suggests low visiblity of investment may lead to underinvestment. Total research intensity and risk strategy will likely be determined by other corporate governance factors, such as level of monitoring.
Low valuation of research projects by shareholders and substantial creditor monitoring, displaying risk averse behaviour, is likely to enhance preference to reduce R&D investment.	Necessity of servicing debt constraints funds available for management to allocate to R&D. Shifting towards a high risk strategy is less likely, unless in exceptions as possible use to signal confidence in issuing equity to service the debt. More likely, high leverage may lead to stronger focus on low risk products, such as mee-too drugs.
Smaller studies have shown correlation between concentrated ownership and research intensity. Non-corporate blockholders in related industries may value R&D investments higher than average investor. Potential lock-in effect may lead to investors suppling "patient capital" suitable for long term investment, while the hold-up problem may induce capital constraints and lower R&D investment levels.	Monitoring, both in the case of ownership in related industries and professional large scale, is likely to increase visibility of high risk strategy, leading to compensation by investors by higher cost of captial. The hold-up problem, concerning risk averse block holders doubling as creditors (e.g. banks), may impede investment level if there is limited amout of internally generated capital.
Lowering level of R&D expenditures in favour of higher performance figures will be contrary to incentives (both performance and innovation incentives) - unless short term performance pay, more readily accessible, compensates. Evidence of long term incentives having little effect on research R&D puts effectiveness of these incentives into question however.	Limited downside in incentive program, a common occurrence, may increase propensity for high risk investment – leading to either higher general R&D activities or shifting focus to high risk blockbuster projects.
Insider ownership has not been shown to lessen effect of low investor valuation of R&D projects, though theory suggests that higher levels of industry and firm specific competency could increase monitoring effectiveness and reduce risk of non-competitive level of R&D activities.	High industry and firm specific competencies in board coupled with own stakeholder interest to monitor suggests reduced of likelihood of high risk strategy being opaque, and therefore hard to identify and prevent, to insider. Dependent insider may however be less able to influence management behavior, despite competency to identify high risk behavior. (There might also be a risk for self serving behavior for insider owner/director "pet projects" limiting incentives to effectively monitor.)

9.3. Validity and relevance of findings

The usual approaches to studying corporate governance issues are case studies or limited quantitative studies. A pharmaceutical firm's research and development into new drugs is characterized by proprietary information however, as the field is highly competitive and information and knowledge may be interpreted and used by competitors in determining their own research strategies. In the wake of several gloomy international reports on the slowdown of pharmaceutical innovation in the beginning of the 21st century, I became interested in the incentives for a CEO to commit to large-scale investments with long lead times to the finished product.

I had a notion that with the emergence of smaller, high risk companies devoted fully to first stage research in a number of fields – pharmaceutical biotech companies, functional-food development firms, etc – that the idea of housing the entire pharmaceutical value chain, from first-stage research to mass production and distribution, under the same corporate roof might no longer be ideal. As a practical limitation I chose to focus on pharmaceutical R&D in a traditional firm setting and from a strict corporate governance standpoint, hoping to find interesting areas of inquiry by looking at previous academic work. The limitations of a entirely literature-based study has at times been challenging, but has been a necessity of time and resources. Making new claims based on old knowledge, which is the essence of a litterature study, will always call into question the validity of findings when compared to the varying forms of empirical studies – the success of this author at the task shall be judged by the reader. Those findings that I have deemed too speculative to present as factual I have tried to label clearly, but have still included them in my discussions for the purpose of completeness in covering my subject area. From this mixture of results I hope that something can be learned, and that interesting angles for future studies can be found.

Thank You for Your attention.

10. References

Anderson Mark C., Banker Rajiv D., Ravindran Sury, 2000, Executive Compensation in the Information Technology Industry, *Management Science*, Vol. 46, No. 4, Information Technology Industry (Apr.), 530-547.

Balkin David B., Markman Gideon D., Gomez-Mejia Luis R., 2000, Is CEO Pay in High-Technology Firms Related to Innovation?, *The Academy of Management Journal*, Vol. 43, No. 6 (Dec.), 1118-1129.

Bathala Chencuramaiah T., Rao Ramesh, 1995, The Determinants of Board Composition: An Agency Theory Perspective, *Managerial and Decision Economics*, Vol. 16, No. 1 (Jan. – Feb), 59-69.

Bátiz-Lazo Bernardo, Holland Sarah, 2001, Strategy and structure of the pharmaceutical industry, Economics Working Paper, Archive EconWPA in its series Industrial Organization, June nr 0211018, 18-20. <http://econwpa.wustl.edu:80/eps/io/papers/0211/0211018.pdf>

Baysinger Barry, Hoskisson Robert E., 1990, The Composition of Boards of Directors and Strategic Control: Effects on Corporate Strategy, *The Academy of Management Review*, Vol. 15, No.1, 71-72, 76-78, 82-84.

Berrone Pascual, Surroca Jordi and Tribó Josep A, 2005, Working Paper 05-46, Business Economics Series 11, Departamento de Economía de la Empresa, Universidad Carlos III de Madrid. <http://docubib.uc3m.es/WORKINGPAPERS/WB/wb054611.pdf>

Casper Steven, Matraves Catherine, 1997, Corporate Governance and Firm Strategy in the Pharmaceutical Industry, Working paper, Social Science Research Center Berlin,No FS IV 97-20, September, ISSN Nr. 0722-6748, 10-12.

Comanor, William S., 1964, Research and Competitive Product Differentiation in the Pharmaceutical Industry in the United States, *Economica, New Series*, Vol. 31, No. 124, 372-384.

Dao Thi D., 1984, Drug Innovation and Price Competition, *Managerial and Decision Economics*, Vol. 5, No. 2, 80-84.

Davidson Sinclair, Brooks Robert, 2004, R&D, Agency Costs and Capital Structure: International Evidence, Econometric Society 2004 Australasian Meetings, No. 59. 2004, 4.

Dechow, Patricia M., and Richard G. Sloan, 1991, Executive Incentives and the Horizon Problem, *Journal of Accounting and Economics* 14, 51-89.

Fama, Eugene F. and Jensen, Michael C., 1998, Separation of Ownership and Control, *Foundations of Organizational Strategy*, Harvard University Press, 1998, and *Journal of Law and Economics*, Vol. 26, June 1983, 301-302.

Gompers Paul A., Ishii Joy L., Metrick Andrew, 2004, Incentives vs. Control: An Analysis of U.S. Dual-Class Companies, January, NBER Working Paper No. W10240. <http://www.nber.org/papers/w10240.pdf>

Gray Cheryl W., 1997, Creditors' Crucial Role in Corporate Governance, *Finance & Development*, June, World Bank Publications, 29-30.

Hall Bronwyn H., 2002, The Financing of Research and Development, Oxf Review of Economic Policy 2002; 18:35-51 (12-13) (Revision forthcoming 2008 as Financing of Innovation, Blackwell Handbook of Technology and Innovation Management)

Hansen Gary S., Hill Charles W. L., 1991, Are Institutional Investors Myopic? A Time-Series Study of Four Technology-Driven Industries, *Strategic Management Journal*, Vol. 12, No.1 (Jan., 1991), 1-3, 9-13.

Hirshleifer David A., Chordia Tarun, Lim Sonya Seongyeon, 2001, Firm and Managerial Incentives to Manipulate the Timing of Project Resolution, March 21, Dice Center Working Paper, No. 2001-4, 2-5, 22-24.

Jacobs Michael T., 1991, Short-term America – The Causes and Cures of Our Business Myopia, *Harvard Business Press,* Boston Massachusetts, 1991, 35f.

Johnson Richard A., Hoskisson Robert E., Hitt Michael A., 1993, Board of Director involvement in Restructuring: The effects of Board Versus Managerial Controls and Characteristics, *Strategic Management Journal*, Vol. 14, Special Issue: Corporate Restructuring (Summer, 1993), 33-50

Lacetera Nicola, 2001, Corporate Governance and the Governance of Innovation: The Case of Pharmaceutical Industry, *Journal of Management & Governance*, Volume 5, Number 1, 2001, 15-16, 22-25, 28.

Malekzadeh Ali R., McWilliams Victoria B., Sen Nilanjan, 1998, Antitakeover Amendments, Ownership Structure, and Managerial Decisions: Effects on R&D Expenditure, *Journal of Applied Business Research*, Vol. 14, No. 3, 53 – 62.

Matraves Catherine, Market Structure, 1999, R&D and Advertising in the Pharmaceutical Industry, *The Journal of Industrial Economics*, Vol. 47, No. 2, Blackwell Publishing, Jun.1999, 180-182.

Marginson David, McAulay Laurie, 2007, Exploring the debate on short-termism: A theoretical and empirical analysis, *Strategic Management Journal*, Vol. 29, Issue 3 2007, 273-292.

Maury Benjamin, Pajuste Anete, 2004, Multiple Large Shareholders and Firm Value, Working Paper, SSE, March 24, 3, 31. (Published 2005, *Journal of Banking & Finance*, Vol. 29, Issue 7.)

Nolan Dermot, Capital Structure and Short-term Decisions, February 1998, Royal Holloway, University of London: Discussion Papers in Economics, Available at the Royal Holloway University of London, 4, 6-8. <http://www.rhul.ac.uk/economics/Research/WorkingPapers/pdf/dpe9810.pdf>

Parthiban David, Hitt Michael A., Gimeno Javier, 2001, The role of activism by institutional investors in influencing R&D, *Academy of Management Journal*, Feb. 2001, 44: 144-157.

Stein Jeremy C., 1988, Takeover Threats and Managerial Myopia, *The Journal of Political Economy*, Vol. 96, No. 1 (Feb., 1988), 1-80.

Stein Jeremy C., 1989, Efficient Capital Markets, Inefficient Firms: A Model of Myopic Corporate Behaviour, *The Quarterly Journal of Economics*, Vol. 104, No. 4 (Nov., 1989), 655-69.

Wahal Sunil, McConnell John J., 2000, Do institutional investors exacerbate managerial myopia?, *Journal of Corporate Finance* 6 2000, 307-329

Wulf Julie M, Lerner Josh, 2007, Innovation and Incentives: Evidence from Corporate R&D, *Review of Economics and Statistics*, November 2007, Vol. 89, No. 4, 634-644 (2-3, 10, 17-18, 22-23).

Non-Academic Sources – Newspaper and Magazine articles

The Economist, 3/19/2005, An overdose of bad news – The Drug Industry, Vol 374 Issue 8418, 73-75.

The Economist, 7/13/2002, Mercky Prospects, Vol. 364 Issue 8281, 51.

The Economist, 6/8/2005, Testing Times, Vol. 375 Issue 8431, Special Section 5-10.

The Economist, 14/10/2006, Dispensed With, (electronic version 21/05/2008 available: <http://www.economist.com/research/articlesbysubject/displaystory.cfm?subjectid=531766&story_id=7915375&CFID=6411910&CFTOKEN=54308716> *)*

Other sources

Balance Robert, Pogány János, Forstner Helmut, (Balance Robert et al), 1992, The World's Pharmaceutical Industries – An International Perspective on Innovation, Competition and Policy, Edward Elgar Publishing Company, Old Post Road, Brookfield, Vermont 05036, USA, 110.

Blair Margaret M., 1995, Ownership and Control: Rethinking corporate governance for the twenty-first century, The Brookings Institution, 1775 Massachusetts Avenue, N.W., Washington.

Landier Augustin, Sraer David, Thesmar David, 2005, Bottom-Up Corporate Governance, March 15, AFA 2006 Boston Meetings Paper, SSRN (Social Science Research Network), 2-3. <http://papers.ssrn.com/sol3/papers.cfm?abstract_id=687542#PaperDownload>

Savignac Frédérique, 2006, The Impact of Financial Constraints on Innovation: Evidence from French Manufacturing Firms, Paper provided by Université Panthéon-Sorbonne (Paris 1) in its series Cahiers de la Maison des Sciences Economiques, nr v06042, 2-4, 20. <http://econpapers.repec.org/scripts/redir.pl?u=ftp%3A%2F%2Fmse.univ-paris1.fr%2Fpub%2Fmse%2Fcahiers2006%2FV06042.pdf;h=repec:mse:wpsorb:v06042>

I. Appendix

Table 4.1. Takeover threats

Potential corporate governance problems in the industry	*R&D efforts visible to market*	*Presence of antitakeover measures*	*No antitakeover measures*
Premature progress into clinical development phase	Strengthen – High signalling value due to visibility	Weaken – Limited need to artificially increase shareholder valuation in short term	Strengthen – Low valuation may lead management to artificially increase shareholder valuation in short term, esp. if investment is visible
Self-serving inflation of short term profit by management	Weaken – Limiting total investment highly noticeable to investor	Strengthen – Limited shareholder power (takeover threat) increases management ability for self serving behaviour. Visibility of investments in this setting is less likely to mean increased level of R&D	If investment is visible, management may artificially increase shareholder valuation in short term by signalling high value projects - in other case hidden underinvestment may be more likely
Low level R&D spending due to low investor valuation of projects	Weaken – Limited total investment highly noticeable to investor, even if any one project has limited value effect	Weaken – Limited need to artificially increase shareholder valuation in short term	Strengthen – Low valuation of R&D efforts increases incentives to artificially enhance investor valuation though short term earnings increase, not investment signalling
Underinvestment in positive NPV-projects in favour of high risk blockbuster projects	Ambivalent – Over- or underinvestment dependent on market pressures, but visibility does not predict risk level of investment policy	Strengthen – Low takeover-threat facilitates high risk behaviour, but may reduce total innovative activities	Strengthen – Behaviour keeps sum of total R&D investment down, enhancing short term earnings, while creating a high risk environment for already high risk LBO's and signalling high value blockbuster potential

Table 5.1. Debt and creditor monitoring

Potential corporate governance problems in the industry	*Banks as large stakeholders with access to proprietary information*	*Public/high risk of default*	*Cooperative relationship with debt holder (implied access to proprietary information)*	*Debt as signalling tool*
Premature progress into clinical development phase	Weaken – Larger debt holders are risk averse and have little share in upside of investment	Strengthen – Bias towards high-risk projects in final stages of development is possible. May be used as signal to increase payoff at new equity issue at high default risk	Weaken – High level of monitoring by risk averse debt holder taking little part in upside, but may increase likelihood of restructuring debt since the alternative value of R&D projects are low (possibility of recouping sunk costs)	Ambivalent – Less credible for diverse pharmaceutical firms, but may be attractive for the smaller firm with fewer commercialized projects
Self-serving inflation of short term profit by management	Strengthen – The stigma of default means high employment risk for management	Strengthen – The stigma of default means high employment risk for management	Weaken – High level of creditor monitoring reduces management discretion to act self servingly	Weaken – Less credible for diverse pharmaceutical firms, but may be attractive for the smaller firm with fewer commercialized projects
Low level R&D spending due to low stakeholder valuation of projects	Strengthen – Debt holders take little share of upside and will be more willing to enter and maintain low risk creditor relationships	Strengthen – Debt holders take little share of upside and will be more willing to maintain low risk creditor relationships. Low valuation of projects will limit possibility of using new equity to service loan	Strengthen – High level of monitoring by risk averse creditor may bias investment decisions towards low risk projects (e.g. me-too projects)	Weaken – High leverage and limiting investment may, if visible, signal lack of future potential, not a high degree of confidence
Underinvestment in positive NPV-projects in favour of high risk blockbuster projects	Weaken – Debt holders take little share of upside and will be more willing to enter and maintain low risk creditor relationships	Strengthen – Bias towards high risk projects in final stages of development is possible. May be used as signal to increase payoff at new equity issue at high default risk.	Strengthen – High level of monitoring by risk averse creditor may bias investment decisions towards low risk projects (e.g. me-too projects)	Strengthen – Visible high investment in potential BB's coupled with confidence signalling of high leverage may increase credibility of signal

Table 6.1. Concentrated ownership

Potential corporate governance problems in the industry	*Bank/financial institution as block holder*	*Non-financial corporate block holders*	*Institutional block holders*
Premature progress into clinical development phase	Weaken – Risk averse block holders with information advantage, coupled with hold-up problems reduces this risk	Weaken – Monitoring, in particular in the case of ownership in related industries, is likely to increase visibility of suboptimal strategy	Weaken – High demand on short term performance, information advantages and sophistication in monitoring of management makes inefficient investments less likely
Self-serving inflation of short term profit by management	Weaken – Financial institutions with informational advantage monitoring management reduces potential for self serving behaviour	Weaken – Management incentives more likely to motivate innovation activities in business linked ownership (note that less monitoring competence may counteract this)	Weaken – Sophistication in monitoring of management makes meeting short term earnings demand by visible self serving behaviour risky
Low level R&D spending due to low investor valuation of projects	Strengthen – Banks likely to be more risk averse and value high risk R&D projects lower than the average investor	Weaken – Potential of research synergies between firms likely to increase block holder valuation of projects	Ambivalent – Locked in effect combating with propensity of short term focus
Underinvestment in positive NPV-projects in favour of high risk blockbuster projects	Weaken – Risk averse block holders with information advantage, coupled with hold-up problems reduces this risk	Weaken – Monitoring, in particular in the case of ownership in related industries, is likely to increase visibility of high risk strategy	Weaken – High demand on short term performance, information advantages and sophistication in monitoring of management limits incentives to increase risk level of investment strategy

Table 7.1. Executive compensation

Potential corporate governance problems in the industry	*Executive compensation incentivizing long term performance*	*Executive compensation incentivizing innovation*
Premature progress into clinical development phase	Weaken – Will have little impact, or negative impact, on long term incentive pay	Strengthen – Depending on measures used in tracking innovative activities, management may artificially increase number of projects in pipeline
Self-serving inflation of short term profit by management	Weaken – Will have little impact, or negative impact, on long term incentive pay	Weaken – Will likely have little impact, or negative impact, on innovation incentive pay
Low level R&D spending due to low investor valuation of projects	Weaken – Will lower expected value of long term incentive pay	Weaken – Will likely have negative effect on innovation incentive pay
Underinvestment in positive NPV-projects in favour of high risk blockbuster projects	Strengthen – Limited downside, common in incentive pay, may decrease risk aversion in management	Ambivalent – Highly dependent on types of measures of innovative activities used and combination of other incentive structures

Table 8.1. Board Composition

Potential corporate governance problems in the industry	*Insider Ownership*	*Insider in Board Composition (insider scientist)*
Premature progress into clinical development phase	Weaken – High industry and firm specific competencies in board may reduce risk of inefficient policies in projects phasing	Weaken – High industry and firm specific competencies in board may reduce risk of inefficient policies in projects phasing, but reduced monitoring capabilities may lead to higher management discretion than optimal in determining investment policy
Self-serving inflation of short term profit by management	Ambivalent – Insider ownership may increase monitoring ability and incentive to monitor if the ownership is substantial (concentrated ownership effects), though this may lead to risk aversion	Weaken – High industry and firm specific competencies in board may reduce risk of self serving behavior
Low level R&D spending due to low investor valuation of projects	Ambivalent – If substantial, alignment of incentives may be at odds with reduced monitoring capabilities in dependency insider relatioship	Weaken – High industry and firm specific competencies in board likely to reduce risk of shareholder short term pressure leading to suboptimal investment strategy
Underinvestment in positive NPV-projects in favour of high risk blockbuster projects	Ambivalent – High industry and firm specific competencies in board coupled with own stakeholder interest to monitor may reduce likelihood of high risk strategy being opaque to insider, though the effect of this is not established	Ambivalent – High industry and firm specific competencies in board reduces likelihood of high risk strategy, but reduced monitoring capabilities may lead to higher management discretion than optimal in determining risk profile of investment policy