STOCKHOLM SCHOOL OF ECONOMICS

# Leverage Effect on Investment Efficiency in Over- and Underinvesting Firms

## - A Study on Swedish Listed Firms 1997-2005

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**Thesis within Finance**

This thesis studies the effects of leverage on investment efficiency in Swedish listed firms 1997-2005. The effects are studied separately for over- and underinvesting firms. To measure investment efficiency we employ three different measures: marginal q, absolute investments (defined as capital expenditures plus research and development expenditures) and Tobin's Q. The application of three different investment efficiency measures rather than one is one of the main contributions of this thesis. The investment efficiency of overinvesting firms was hypothesized to be improved by higher leverage. The results based on marginal q accepted this hypothesis. The absolute investments and Tobin's Q results could not accept nor reject the hypothesis, but indicated an improvement of investment efficiency for overinvesting firms as a result of increased leverage. For underinvesting firms, investment efficiency was hypothesized to decrease with leverage. The marginal q and Tobin's Q results rejected this hypothesis. The absolute investments results could only accept this hypothesis on the 10% significance level. Thus, the results of this thesis indicate that investment efficiency increases with leverage for both groups of firms.

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# 1 Introduction

The concept of investment efficiency stem all the way from the intuition of Keynes (1936) and Grunfeld (1960) that if an investment increases the firm's market value, the investment should be undertaken. Neoclassical investment theory predicts that investments are made up to a point where the expected marginal rate of return on investment equals the cost of capital (Jorgenson, 1963). At this point investments are efficient. However, some firms invest inefficiently by engaging in under- or overinvestment. Firms which invest at returns above the cost of capital underinvest, as there are further positive net present value (NPV) projects to exploit. Firms investing below the cost of capital overinvest, since they have depleted their profitable investment opportunities and now invest in negative NPV projects. Two conflicts cause these investment efficiencies. If managers pursue their own interests instead of those of the shareholders, a conflict between these groups arises, which is hereafter referred to as the manager-shareholder conflict. Additionally, the shareholders can gain at the expense of debt holders, resulting in a conflict hereafter referred to as the shareholder-debt holder conflict. When managers and shareholders cater only to their self-serving interest in the first and second conflict, respectively, investment efficiencies might arise. This thesis studies these conflicts and their effect on investment efficiency.

Researchers have rigorously attempted to find an optimal measure for investment efficiency. Brainard and Tobin (1968) and Tobin (1969) developed Tobin's Q for this purpose. It has since then been the most widely used measure of investment efficiency. However, there is an ongoing discussion on how to optimally measure investment efficiency and numerous authors have tried to develop the technique originating from Tobin's Q. Marginal q, originally developed by Mueller and Reardon (1993), is an attempt to refine Tobin's Q and is used in a small but growing number of studies. Howe and Vogt (1996), Ogawa and Kitasaka (1999) and Erickson and Whited (2006) among others explore and compare different versions of Tobin's Q and related measures in their studies. Nevertheless, no consensus has yet been reached among researchers on how to optimally measure investment efficiency.

The leverage effects on investment efficiency have been widely debated in the theoretical literature. An agreement exists in this literature that leverage plays a central role in explaining investment inefficiencies, since it affects the manager-shareholder as well as the shareholder-debt holder conflict (e.g. Jensen and Meckling, 1976, Myers, 1977, Jensen, 1986). Yet, most empirical studies so far in the field of investment efficiency have tested the effects of other factors than leverage, such as ownership structure, insider ownership and the legal framework (e.g. Gedajlovic and Shapiro, 1998, Thomsen and Pedersen, 2000, Pindado and de la Torre, 2009). We aim to add scope to the niche of literature which empirically tests the leverage effects on investment efficiency. To our knowledge, this niche mainly consists of Berger and Bonaccorsi di Patti (2006), Degryse and de Jong (2006), Margaritis and Psillaki

(2007) and Zhang (2009). These are all studies which have performed their tests outside of the Swedish setting. We contribute to the geographical reach of this literature by studying Swedish firms.

One explanation for the relatively few empirical studies on the leverage effects on investment efficiency is the difficulty in finding a measure of investment efficiency that reflects the agency costs from the manager-shareholder and shareholder-debt holder conflict (e.g. Ross et al., 2005, Beattie et al., 2006).[1] The uncertainty is also reflected in the niche of literature empirically studying these effects, since the methodology for measuring investment efficiency varies significantly between the studies.[2] In each of these studies one investment efficiency measure is employed. Our main contribution to the relevant niche is that we employ three investment efficiency measures. Similar to Zhang (2009), we use absolute investments, defined as capital expenditures plus research and development expenditures, to measure investment efficiency. Additionally, we use the most widely employed investment efficiency measure, Tobin's Q. The third measure in our thesis is marginal q, which receives increasing support from researchers thanks to its ability to measure investment efficiency on the margin. As far as we know, marginal q has not previously been applied to test the effects of leverage on investment efficiency.

By employing these three different measures, we hope to contribute to the methodology of previous research by addressing the measurement problems related to investment efficiency in a more comprehensive manner. Since we, to our knowledge, are the first to test the three measures simultaneously on the leverage effects on investment efficiency, the similarities and differences between the measures will be highlighted in a new context.

The manager-shareholder conflict is assumed to be modest in Swedish firms due to high ownership concentration. The high ownership concentration causes this conflict to be replaced by a conflict between controlling owners and minority shareholders in Swedish firms, hereafter referred to as the controlling owner-minority shareholder conflict. The manager-shareholder and controlling owner-minority shareholder conflicts are assumed to cause investment efficiency in a similar manner. Additionally, leverage is presumed to have the same effect on both conflicts. Thus, since the controlling owner-minority shareholder conflict is more relevant for Swedish firms and fundamentally plays the same role as the manager-shareholder conflict, the thesis will mainly be based on the controlling owner-minority shareholder conflict instead of the manager-shareholder conflict. Nevertheless, when referring to literature specifically addressing the manager-shareholder conflict, we will use the same terminology.

[1] The agency costs resulting from the manager-shareholder and shareholder-debt holder conflicts are referred to as agency costs of equity and debt, respectively.

[2] To measure investment efficiency Berger and Bonaccorsi di Patti (2006) use profit efficiency, i.e. the proximity of a firm's profits to the benchmark of a best-practice firm facing the same exogenous conditions. Degryse and de Jong (2006) employ investment-cash flow sensitivity for this purpose. Margaritis and Psillaki (2007) measure investment efficiency as the distance from the industry's best-practice production frontier. Zhang (2009) employs capital expenditures plus research and development expenditures, in the thesis defined as absolute investments, to measure investment efficiency.

Still, the arguments presented in this literature will be applied to the controlling owner-minority shareholder conflict.

To sum up, the purpose of this thesis is to study the effects of leverage on investment efficiency in Swedish firms. The effects will be studied separately for over- and underinvesting firms. Three different measures of investment efficiency are employed; marginal q, absolute investments and Tobin's Q. The data for our empirical tests consist of Swedish listed firms between 1997 and 2005.

The outline of the thesis is as follows. After this introduction we present the theoretical background in chapter 2. Here we also present the hypotheses to be tested in the thesis. Chapter 3 covers the methodology employed to test our hypotheses and chapter 4 discusses the data and variables used for our empirical tests. Our results are presented in chapter 5. Chapter 6 contains a more in depth discussion of the findings of this thesis, followed by chapter 7, which sums up our conclusions.

# 2 Theoretical Background and Hypotheses

The thesis aims to study the effects of leverage on investment efficiency in over- and underinvesting Swedish firms. Ideally, all firms should invest efficiently. In the first section of this chapter, we explain why this is not the case in practice. Section 2 discusses the role of leverage in this context. In the third section, we present the setting for Swedish firms with respect to the causes of investment inefficiency. Thereafter, in section 4, the predicted leverage effects on investment efficiency in over- and underinvesting firms including our hypotheses are presented. Finally, section 5 covers other factors than leverage affecting investment efficiency, i.e. presents the control variables for the empirical tests.

## 2.1 Causes of Investment Inefficiency

Neoclassical investment theory predicts that investments are made up to a point where the expected marginal rate of return on investment equals the cost of capital (Jorgenson, 1963). In that case, investments are efficient from the perspective of all investors. However, there are conflicts of interest within the firm that prohibit firms from investing efficiently. When the interests of managers and shareholders are not aligned a conflict arises. This conflict is replaced by the controlling owner-minority shareholder conflict in Swedish firms. These conflicts can cause firms to invest inefficiently. Similarly, a conflict between shareholders and debt holders can cause investment inefficiencies.

### *2.1.1 The Manager-Shareholder and Controlling Owner-Minority Shareholder Conflict*

This sub section covers how the manager-shareholder or controlling owner-minority shareholder conflict causes investment inefficiency. Additionally, we aim to explain how the manager-shareholder conflict shifts into the controlling owner-minority shareholder conflict in Swedish firms.

The interests of managers and shareholders are not always aligned, which can lead to inefficiently high investment levels (overinvestment). Jensen (1986), for example, argues that managers seek to grow firms beyond their optimal size. Managers aim to do so because growth increases their power and might improve their compensation. This implies that in firms where the manager-shareholder conflict is severe, i.e. where managers' interests are far from the interests of the shareholders and where the managers can pursue other interests than those of the shareholders, the tendency to overinvest is larger. A manager-shareholder conflict of this kind is most important for firms with large free cash flows and scarce positive NPV projects according to Jensen.[3] Jensen also claims that the threat of hostile

[3] Jensen (1986) defines free cash flows as cash flows in excess of those needed to finance all available positive NPV projects of the firm. Hereafter free cash flows refer to this definition unless stated otherwise.

takeovers can mitigate this conflict. Firms with wasteful managers become more attractive targets for hostile takeovers, as such takeovers are seen as one solution to the overinvestment problem (Jensen, 1986, Myers, 2001). Managers facing a threat of a hostile takeover thus have an incentive to distribute free cash flows to shareholders rather than investing them in negative NPV projects.

Ownership concentration is also predicted to affect the manager-shareholder conflict. A literature based on Berle and Means (1932) argue that high ownership concentration mitigates the manager-shareholder conflict, since a large shareholder has incentives to monitor the manager and becomes a strong opponent in that conflict.[4] In firms with dispersed ownership, the shareholders have a limited incentive to carefully monitor the management. The ability of dispersed owners to affect the decisions of the firms is also limited, increasing the managerial discretion.

As the ownership concentration increases, managers become more accountable to the shareholders. In firms with high ownership concentration, i.e. with controlling owners, the manager-shareholder conflict becomes less important. The conflict shifts to instead prevail between the controlling owners and the minority shareholders in such firms (see e.g. Cronqvist and Nilsson, 2003). When comparing the difference between having a controlling owner instead of the manager as the opponent in the conflict, there are some differences. Controlling owners and minority shareholders have more aligned incentives than managers and dispersed shareholders. This is due to the fact that controlling shareholders unlike managers have substantial fractions of the firms' shares, encouraging the controlling owners to maximize shareholder value. However, the discretion of controlling owners to pursue their own interests is larger than for managers, since the controlling owners, unlike the managers, can make the decisions on the shareholders' meetings.

As the capital stake of the controlling owners, i.e. the ownership concentration, rises, their capital incentives become more aligned with the minority shareholders. At the same time their discretion to pursue their own goals is enhanced. However, the positive effect on the controlling owner-minority shareholder conflict of more aligned capital incentives is expected to overwhelm the negative effect resulting from higher discretion of the controlling owners, as ownership concentration increases. That is, similar to the manager-shareholder conflict, increased ownership concentration is on the whole predicted to mitigate the controlling owner-minority shareholder conflict. Thus, although the controlling owner-minority shareholder conflict does not exist at low levels of ownership concentration, the conflict is mitigated by increased ownership concentration once it exists. Managers as well as controlling owners are in general encouraged to maximize shareholder value when ownership concentration increases.

[4] Here managers are assumed not to hold large stakes of the firms' shares.

For the Swedish firms studied in this thesis, the controlling owner-minority shareholder conflict is generally more relevant than the manager-shareholder conflict, since the ownership concentration is high in the Swedish setting. This will be elaborated on in section 2.3. The mechanisms described in this section to affect the manager-shareholder conflict, influence the controlling owner-minority shareholder in a similar manner. The following discussion in the thesis will mainly refer to the controlling owner-minority shareholder conflict. Nevertheless, when referring to literature specifically addressing the manager-shareholder conflict, the terminology of this literature will be used.

To sum up, the controlling owner-minority shareholder conflict, and thus overinvestment, is expected to be most severe in firms with few profitable investment opportunities, large free cash flows, a limited threat of hostile takeover and relatively dispersed ownership.

#### *2.1.2 Shareholder-Debt Holder Conflict*

Inefficient investment levels can also stem from a shareholder-debt holder conflict. In this conflict managers are assumed to act in the best interest of the shareholders, i.e. manager and shareholder interests are perfectly aligned. The shareholder-debt holder conflict only exists if there is a risk of default (Myers, 2001). When there is a risk of default, shareholders can gain at the expense of debt holders. The higher the default risk, the stronger is generally the shareholder-debt holder conflict. The conflict is mainly represented by asset substitution or debt overhang. The two phenomena have opposite effects on investment levels and are elaborated on below.

Asset substitution causes overinvestment (Jensen and Meckling, 1976), since managers in firms facing a default risk are tempted to choose risky and sometimes negative NPV projects at the expense of debt holders due to the limited liability of the shareholders. By increasing risk, the upside for shareholders increases whereas the downside to a certain extent is captured by the debt holders. The higher the risk of default, the more of the downside is captured by debt holders. Thus, asset substitution increases in default risk. Moreover, default risk, all else equal, increases in leverage. Asset substitution is expected to be most severe in highly levered firms with limited profitable investment opportunities.

Debt overhang causes underinvestment, implying that the firm refrains from investing in positive NPV projects (Myers, 1977). In this case, firms facing default risk avoid equity-financed investments in positive NPV projects, since wealth will be transferred from shareholders to debt holders after the investment. The higher the risk of default, the larger is the benefit to existing debt holders from additional investment at the expense of shareholders. Consequently, debt overhang increases in default risk and leverage. The debt overhang problem is expected to be most important for highly levered firms with a high abundance of profitable projects.

### 2.2 The Effects of Leverage

The Modigliani Miller Theorem (Modigliani and Miller, 1958, 1961) says that the value of a firm and the investment decisions should be autonomous from its capital structure. In other words, leverage should have no effect on investment decisions. However, the Modigliani Miller Theorem assumes a world with no taxes, information asymmetries or agency costs. Later theories argue that leverage clearly can matter due to the effect of taxes, information and agency costs (Myers, 2001). The tradeoff theory says that firms seek debt levels that balance the tax advantages of additional debt against the costs of possible financial distress. The pecking order theory says that the firm will borrow, rather than issue equity, when internal cash flow is not sufficient to fund capital expenditure. Firms prefer debt to equity here because of the information investors infer from the decision to issue equity (Myers and Majluf, 1984, and Myers, 1984). An equity issue might signal to investors that the shares are overvalued, causing borrowing to become the better choice.

Theory also supports that leverage matters due to the effect on agency costs. Such agency costs are related to the conflicts described in the previous section. Leverage is predicted to reduce the agency costs from the manager-shareholder conflict, thereby mitigating the investment inefficiency resulting from this conflict. Increased leverage has this effect by reducing the free cash flows for self-serving managers to waste in negative NPV projects Jensen (1986). Furthermore, Jensen argues that debt also imposes strong control effects on managers. Debt holders can exert a stronger control of the firm than shareholders. A promise to shareholders to payout a certain amount in dividends is considered weak since it is not binding (dividends can be reduced in the future). Debt creation, however, forces managers to effectively bond their promise to pay out future cash flows. The debt holders have the right to take the firm to bankruptcy court if the firm cannot make its debt service payments. The threat caused by failure to make debt service payments serves as an effective motivation force for managers to make their firms more efficient. Thus, through the reduction of free cash flows and control effects, leverage is presumed to mitigate the manager-shareholder conflict and overinvestment. Recall that we can translate Jensen's arguments directly to the controlling owner-minority shareholder conflict to make it relevant for the Swedish setting.

As explained in sub section 2.1.2, leverage worsens the shareholder-debt holder conflict. Leverage exacerbates overinvestment through asset substitution or underinvestment through debt overhang by increasing the default risk.

Table 1 below summarizes the causes of investment inefficiency, its symptoms and how leverage impacts these symptoms.

**Table 1. Causes of investment inefficiency**

| Mechanisms causing investment inefficiency | Symptoms | Effect on investments | Effect of leverage on symptoms |
|---|---|---|---|
| Manager-shareholder conflict<br>*Swedish version:*<br>Controlling owner-minority shareholder conflict | Empire building | + overinvestment | mitigating |
| Shareholder-debt holder conflict | Asset substitution | + overinvestment | worsening |
| | Debt overhang | - underinvestment | worsening |

### 2.3 Swedish Setting

Since the ownership concentration is high in Sweden (e.g. Morck et al., 2005), the controlling owner-minority shareholder conflict is more important for Swedish firms than the manager-shareholder conflict. There is a growing literature claiming that the controlling owner-minority shareholder conflict in Sweden is negatively affected by the high separation of voting and cash flow rights in Swedish firms (Cronqvist and Nilsson, 2003, Henrekson and Jakobsson, 2006, Bjuggren et al., 2007, Eklund, 2009b). The most common structure causing this separation is dual class shares.[5] The separation creates a wedge between the ability and incentives of controlling owners to maximize shareholder value. These owners have the ability to behave in a shareholder value-maximizing manner as they are in control of the votes. However, due to relatively small cash flow rights they refrain from exerting sufficient effort to maximize shareholder value as the profits, but not the effort, are shared by others. Moreover, in Sweden hostile takeovers are rare (e.g. Bjuggren et al., 2007), which should worsen the controlling owner-minority shareholder conflict. However, there is still not sufficient empirical support for the worsening impact of the separation of voting and cash flow rights and the worsening impact of the limited threat of hostile takeovers on the controlling owner-minority shareholder conflict in Swedish firms. Thus, it cannot be concluded that the controlling owner-minority shareholder conflict is especially strong in Swedish firms.

[5] Single class shares refer to shares with one vote. Dual class shares imply that there are more classes of shares, which entitle different voting rights per share (Bjuggren et al., 2007).

Based on ownership concentration, it could be argued that this conflict should be relatively weak in Swedish firms.[6]

Another feature of Swedish firms is that executive stock options are relatively uncommon (KPMG, 2009). Studies have acknowledged that the risk preferences of managers and shareholders are not always aligned (e.g. Jensen and Meckling, 1976, Williams and Rao, 2006). If managers are only paid fixed salaries, the managers might favor lower risk than the shareholders, since the managers are not rewarded for risk-taking. In cases where managers only have a fixed salary, they do not capture much of the upside of a profitable investment. However, the managers still have to face the possible downside of an investment by damaging their reputation or possibly losing their job if the project fails. One way to align the risk preferences of managers and shareholders is to employ executive stock options, as they encourage managers to assume more risk (e.g. Haugen and Senbet, 1981, Hall, 1998). In Swedish firms where executive stocks options generally do not exist, this alignment effect is missed out on. Thus, as Swedish managers are not compensated for risk, they might reduce the risk of their investments to levels where profitable projects are not exploited. This would aggravate underinvestment. However, due to the high ownership concentration in Swedish firms, mainly the controlling owners should influence the investment decisions in the Swedish setting. The misalignment of risk preferences discussed here is mainly between managers and shareholders, and not between controlling owners and minority shareholders. Thus, the misalignment of risk preferences between managers and shareholders should only contribute marginally to a worsening of the underinvestment in Swedish firms.

### 2.4 Hypotheses

Here we present the hypotheses to be empirically tested in the thesis. In the hypotheses we choose to focus on the effects of leverage on investment efficiency separately for over- and underinvesting firms. This is necessary in order to make the results interpretable because of the nature of the chosen investment efficiency measures. This will be elaborated on in sub section 3.5.2. Furthermore, leverage is predicted to affect the investment efficiency in the two groups through different mechanisms. In the overinvesting group, the change in investment inefficiency, here represented by overinvestment, as a result of higher leverage is due to effect of leverage on the controlling owner-minority shareholder conflict and asset substitution. In the underinvesting group, the change in investment inefficiency, here characterized by underinvestment, resulting from higher leverage is assumed to be caused by debt

[6] Recall that although a certain level of ownership concentration causes the controlling owner-minority shareholder conflict to exist, the conflict is mitigated by increased ownership concentration once it exists.

overhang. Studying the two groups individually allows us examine these mechanisms separately, which enables us to draw clearer conclusions.

### *2.4.1 Leverage Effect on Overinvesting Firms*

Firms are assumed to overinvest, i.e. invest in projects with returns lower than the costs of capital, because they are exposed to the controlling owner-minority shareholder conflict and/or asset substitution. In firms where the controlling owner-minority shareholder conflict is the dominating cause of overinvestment, leverage is predicted to mitigate overinvestment (see section 2.2). If, however, asset substitution is the dominating cause, leverage will pronounce overinvestment. Although the controlling owner-minority shareholder conflict in Swedish firms is expected to be mitigated by the high ownership concentration, we believe that this conflict is the most important cause of overinvestment in Swedish firms. The reason for this is that every firm is affected by the conflict, however to varying extents.[7] Asset substitution, on the other hand, only pertains to firms with a relatively significant default risk. Thus, the controlling owner-minority shareholder conflict is overall expected to be a more important cause of overinvestment than asset substitution, however not substantially more important as the conflict is weakened by the high ownership concentration in Swedish firms. Based on this expectation, the mitigating effect of higher leverage on overinvestment from lessening the controlling owner-minority shareholder conflict is on the whole predicted to overcome the worsening effect on asset substitution, resulting in a net alleviating effect of higher leverage on overinvestment. From this our first hypothesis follows:

*H1: For overinvesting Swedish firms, overinvestment should decrease with leverage.*

### *2.4.2 Leverage Effect on Underinvesting Firms*

Firms are assumed to underinvest, i.e. abstain from positive NPV projects, due to debt overhang. Debt overhang, and thus underinvestment, is predicted to be pronounced by higher levels of leverage. This allows us to form our second hypothesis.

*H2: For underinvesting Swedish firms, underinvestment should increase with leverage.*

[7] For simplicity we assume here that all Swedish firms have concentrated ownership and thus are exposed to the controlling owner-minority shareholder conflict. The argument will still hold for the few Swedish firms with no controlling owner, since they are instead exposed to the manager-shareholder conflict with a similar impact on overinvestment.

### 2.5 Other Factors Affecting Investment Efficiency Treated as Control Variables

The hypotheses presented above are based on how leverage affects investment efficiency. There are also other factors impacting investment efficiency. These factors will be treated as control variables and are discussed in this section. The technical treatment of the control variables is presented here and summarized in chapter 4.

Sub section 2.1.2 states that the shareholder-debt holder conflict only exists if there is a default risk. If a firm has no debt, i.e. is an all-equity firm, there is no default risk. Hence, the shareholder-debt holder conflict does not exist in all-equity firms, implying that there is no debt overhang or asset substitution in such firms. We control for this by creating a control variable called all equity. This control variable is a dummy variable equaling one if the firm is an all-equity firm and zero if not. We expect overinvesting all-equity firms to invest less efficiently than levered ones, since the benefits of leverage are assumed to outweigh the drawbacks with respect to investment efficiency in Swedish firms (see sub section 2.4.1). Underinvesting all-equity firms will be exempt from debt overhang and are hence predicted to invest more efficiently than levered ones. This control variable is closely associated with the leverage effect on investment efficiency, which is our explanatory variable of interest. As a result, the variable all equity will be given more focus than the other control variables in the following discussions.

In sub section 2.1.1, we argue that the overinvestment problem should be stronger for firms with higher levels of free cash flows. Free cash flows are defined as cash flows in excess of those needed to finance all available positive NPV projects of the firm (Jensen, 1986). We use cash as a control variable for free cash flows. Alternatively, some measure of retained earnings (e.g. net profits plus depreciation minus dividends) could have controlled for free cash flows. However, we argue that cash better represents the funds available for investment in a firm than retained earnings and thus better relates to Jensen's underlying arguments. Cash is employed as a control variable for the over- as well as underinvesting group, although free cash flows are predicted to have a more significant impact on overinvesting firms. Firms with capital constraints are anticipated to underinvest more severely. Consequently, cash should affect underinvesting firms as well. Cash in this thesis simply refers to the firms' cash holdings and does not include marketable securities or short-term investments.[8] In the regressions cash was scaled by the total assets from the previous year to normalize the effect. Hereafter the control variable discussed here is referred to as scaled cash.

Sub section 2.1.1 also predicted the controlling owner-minority shareholder conflict to be less severe in firms with high ownership concentration. To control for this fact we use a control variable for ownership

[8] The reason for not including marketable securities and short-term investments was that the data on these items were not sufficient in the applied database. Nevertheless, this should only be a minor drawback since cash represents the funds most easily used for investments.

concentration. This control variable is obtained by adding the two largest owners with respect to capital stake in each firm. Alternatively, the control variable could have been constructed based on voting rights. However, capital stakes better capture the incentive of the shareholders to invest more efficiently. Similar to free cash flows this control variable should be more important for overinvesting firms, as it mainly pertains to the controlling owner-minority shareholder conflict, which is less relevant for underinvesting firms. Nevertheless, the control variable for ownership is also included in the regression for underinvesting firms, as it might impact the shareholder-debt holder conflict. As ownership concentration increases, the shareholders are expected to become stronger and more united in the shareholder-debt holder conflict. This should allow the shareholders to exploit the debt holders through debt overhang. Accordingly, debt overhang is predicted to increase with ownership concentration, causing us to control for ownership concentration also for underinvesting firms. The control variable discussed here is hereafter referred to as ownership concentration.

Section 2.3 states that there is a growing literature claiming that the controlling owner-minority shareholder conflict in Swedish firms is severed by the high separation of voting and cash flow rights (Cronqvist and Nilsson, 2003, Henrekson and Jakobsson, 2006, Bjuggren et al., 2007, Eklund, 2009b). Bjuggren et al. (2007) and Eklund (2009b) employ a dummy for dual class shares to illustrate this effect. We have included such a dummy for dual class shares to control for the possible effects on the controlling owner-minority shareholder conflict. Even though the effect of dual class shares is expected to be greater for overinvesting firms, the control variable is applied also for the underinvesting group based on a similar reasoning as in the previous paragraph. The control variable is hereafter referred to as dual class shares.

We also want to control for other factors, which might impact controlling owners' (and managers') incentives to invest efficiently. Zhang (2009) argues that the size of the firm is one such factor. He uses size as a control variable when testing the leverage effect on investment efficiency. We also choose to control for size, which is defined as the logarithm of the firm's market value (i.e. the market value of debt and equity). Investors and other stakeholders are generally more interested in larger firms, since they are more involved in such firms. Thus, larger firms are more scrutinized by the media and financial analysts than smaller firms. This scrutiny in larger firms should have positive incentive effects for controlling owners and managers in these firms. The control variable is hereafter referred to as size.

Thus, we use the control variables all equity, scaled cash, ownership concentration, dual class shares and size when testing the effect of leverage on investment efficiency. These control variables are applied for all three dependent variables (marginal q, absolute investments and Tobin's Q). We also include additional control variables, which are typically used for the specific dependent variable. E.g. Zhang (2009) and Eklund (2009a) use Tobin's Q as a control variable when applying absolute investments as

the dependent variable. In line with these studies we employ Tobin's Q as a control variable in the absolute investments regressions. In this context, Tobin's Q controls for the investment opportunities faced by the firm. A high Tobin's Q generally indicates that firms face a high abundance of investment opportunities as the firm's assets on average are worth more than the price paid for them. A low Tobin's Q suggests the opposite. See sub section 3.3.2 for a more detailed description of the interpretation of Tobin's Q. Tobin's Q is lagged one year in our regressions to avoid endogeneity problems. This control variable is hereafter referred to as lagged Tobin's Q.

Zhang (2009) and Eklund (2009a) also use measures based on sales as control variables when testing effects on absolute investments. Sales-based control variables are applied, since investments are assumed to grow with the firm's sales (Abel and Blanchard, 1989). In line with Zhang, we use sales scaled by total assets from the previous year to control for this effect. The sales are scaled by the total assets from the previous year to become normalized and empirically testable. This control variable is hereafter referred to as scaled sales. Based on Abel's and Blanchard's assumption, scaled sales are also employed as a control variable in our Tobin's Q regressions.

Either Tobin's Q or scaled sales have been employed as control variables in previous studies testing marginal q as the dependent variable. Thus, we also exclude those control variables in our marginal q regressions.

# 3 Methodology

This thesis aims to test the effects of leverage on investment efficiency. Accordingly, investment efficiency is the dependent variable in the empirical tests, whereas leverage and the control variables are the explanatory variables. We will test the hypotheses using three different measures for investment efficiency as the dependent variable: marginal q, absolute investments and Tobin's Q. Marginal q is a relatively new and less frequent measure for investment efficiency compared to absolute investments and Tobin's Q. A small but growing literature argues for the empirical advantages of marginal q compared to the other measures (e.g. Mueller and Reardon, 1993, Gugler and Yurtoglu, 2003 and Bjuggren et al., 2007). Since marginal q is still a relatively unknown measure for investment efficiency, a substantial part of this chapter will describe its properties.

Furthermore, this thesis focuses on the effects of leverage on investment efficiency separately for over- and underinvesting firms. Thus, our sample needs to be split into these groups. Marginal q and Tobin's Q are employed for this purpose. The split of the sample is elaborated on in sub section 3.5.2.

The first section of this chapter explains the basic properties and derivation of marginal q. The second section covers how marginal q is calculated for each firm. The third section presents and compares the three investment efficiency measures employed in the regressions, namely marginal q, absolute investments and Tobin's Q. The fourth section is devoted to the explanatory variable of interest in this thesis, leverage. Finally, in section five, the final considerations for the empirical tests are described. This section also presents the equations used for the regressions.

### 3.1 Properties and Basic Derivation of Marginal q[9]

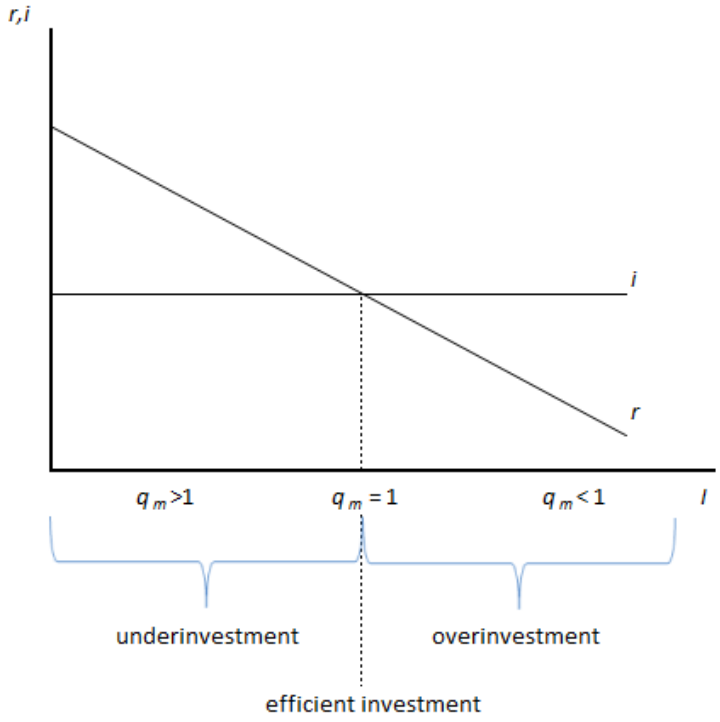
Marginal q, originally developed by Mueller and Reardon (1993), is employed in this thesis for two purposes. First it is used to split our sample into over- and underinvesting firms. Then it is used as a dependent variable in the regressions. Marginal q is a measure of investment efficiency. For investments to be efficient marginal q should be equal to one. If marginal q is less than one, firms are overinvesting. Conversely, if marginal q is greater than one, firms are underinvesting.

Mueller and Reardon's (1993) method to estimate marginal q, $q_m$, links investments to changes in the market value.[10] The intuition behind their method is that $1 worth of investment should be reflected by

[9] This section is based on Mueller and Reardon (1993) unless stated otherwise.
[10] Market value is defined as the market value of equity plus debt.

at least $1 increase in market value. If $q_m$>1 the return on investments is above the cost of capital. This implies that there exist further profitable investments still not undertaken by the firm. If this is the case the firm is underinvesting. On the contrary, if $q_m$<1 firms are investing at returns below their cost of capital and all positive NPV projects are already undertaken. In such cases firms are overinvesting. The relationship is illustrated in Figure 1.

**Figure 1. Illustration of the relationship between over- and underinvestment and marginal q, $q_m$**




Marginal q at time t, $q_{m,t}$, can be derived from the simple insight that any investment, $I_t$, should be evaluated against the present value, $PV_t$, of future cash flows that the investment generates:

(1)

$$PV_t = \frac{I_t r_t}{i_t} = q_{m,t} I_t$$

where $i_t$ is the discount rate and $r_t$ is assumed to be the permanent rate of return of the investments.[11] To simplify the interpretation equation (1) can be rearranged as follows:

(2)

$$\frac{PV_t}{I_t} = \frac{r_t}{i_t} = q_{m,t}$$

If firms are investing at a marginal q equal to one, $q_{m,t}$ = 1, investments are efficient (see Figure 1).[12] In this case firms are investing at returns equal to the cost of capital as shown by $r_t$=$i_t$. This means that there are no further profitable investment opportunities and that the firm has fully utilized their positive NPV projects. A $q_{m,t}$ below one suggests that $r_t$<$i_t$, implying that the returns on the firm's marginal investments are lower than the cost of capital. In this case the market values the investment lower than the investment cost. In this case managers are overinvesting. Conversely, a $q_{m,t}$ above one corresponds to $r_t$>$i_t$, showing that the return on the firm's current investments is higher than the cost of capital. In such situations the firm should invest more as they have positive NPV projects to invest in. I.e. the firm is underinvesting.

Marginal q can also be understood in the context of the market's reaction to the firm's investments in a given year, i.e. how the market value of the firm changes as a result of the investments that year. The market value of the firm, $M_t$, is the market value of equity plus debt. It can also be defined as the sum of the market value of its physical capital, $KK_t$, the intangible capital it has as a result of past advertising, $AK_t$, or research and development expenditures, $RK_t$, and the goodwill capital, $GK_t$:

(3)

$$M_t = KK_t + AK_t + RK_t + GK_t$$

Investments, $I_t$, are defined as:

(4)

$$I_t = NetIncome_t + Depreciation_t - Dividends_t + \Delta D_t + \Delta E_t + R\&D_t + ADV_t$$

[11] The notification here follows Mueller and Reardon (1993) and subsequent studies on marginal q, e.g. Gugler and Yurtoglu, 2003. Mueller and Reardon (1993, p. 2) explains equation (1): "With the same real discount rate $i_t$, the investment $I_t$ would have the same present value $PV_t$, if it earned the return $r_t$ in perpetuity."

[12] Please note that equations (1) and (2) are based on the present value and not the net present value that the investments generate. This is in line with Mueller and Reardon (1993) and subsequent studies on marginal q. If the equations were based on net present value the marginal q would be interpreted in a different manner. In that case a marginal q of zero, and not of one, would indicate investment efficiency.

$\Delta D_t$ and $\Delta E_t$ are capital raised through new debt and equity issues. Since the two income statement items research and development expenditures, $R\&D_t$, and advertising, $ADV_t$, are long term investments which increase the market value of the firm, but are not capitalized, they should also be included. The investments in equation (4) should capture all investments which affect the market value of the firm in equation (3). The first five terms in equation (4) yield the funds spent on physical capital, $KK_t$, and goodwill capital, $GK_t$. The last two terms reflect the investments for the period in the intangible capital it has as a result of past advertising, $AK_t$, and research and development expenditures, $RK_t$.

In equation (5) below, the market value of the firm, $M_t$, at time $t$ is a function of the market value at time $t$-1, $M_{t-1}$, and the present value of the cash flows stemming from the investments made during the year, $PV_t$. Furthermore, it also depends on the depreciation rate of the market value during the year, represented by $\delta_t$. The market's error in evaluating $M$ at time $t$ is denoted by $\mu_t$.

(5)

$$M_t = M_{t-1} + PV_t - \delta_t * M_{t-1} + \mu_t$$

Subtracting $M_{t-1}$ from both sides and replacing $PV_t$ with $q_{m,t}I_t$ (see equation (1)) yields:

(6)

$$M_t - M_{t-1} = q_{m,t} * I_t - \delta_t * M_{t-1} + \mu_t$$

Equation (6) is the distillation of the marginal q method. According to the efficient market assumption, the expected value of the error term $\mu_t$ is zero.

In equations (5) and (6) the intuition behind marginal q is illustrated again. If the company has investments, $I_t$, as defined in equation (4) of for example 100, the market value of the firm, $M_t$, as defined in equation (3) should rise by the same amount, assuming no depreciation. If not, the market evaluates the investments as inefficient.[13]

Marginal q stems from the equations presented in this section. The extensions of these equations used to calculate marginal q follow in the next section.

[13] It should be noted that equations (5) and (6) are based on present value and not net present value. This follows from how the market value of the firm, $M_t$, in equation (3) relates to the investments, $I_t$, in equation (4). $M_t$ grows by the amount of present value added to its components (not the present value). For example, if assets with a present value, $PV_t$, of 100 are acquired, the market value of the firm, $M_t$, when defined as in equation (3), will increase by 100 regardless of the investments, $I_t$, made in those assets, i.e. regardless of how much the firm paid for the assets. If the investment in those assets was less than 100, say 90, the acquisition has a NPV of 10. In this case the market value of the firm will still increase by 100 and not 10. The positive NPV of the investment in this example would be reflected in a marginal q above one (100/90) as indicated by equation (2).

### 3.2 Calculation of Marginal q

In this section we describe how marginal q is calculated for each firm. First, marginal q is calculated for each firm in order to split our sample into over- and underinvesting firms. Additionally these values are applied when marginal q is used as a dependent variable in the regressions. Marginal q can be calculated for each firm from two different versions of marginal q. The first sub section of this section presents these versions of marginal q. Only one of the two versions is chosen for the calculation of marginal q. The first subsection covers our reasoning behind this choice. Sub section 2 discusses the assumption on the depreciation rate for the marginal q calculation. In the third and last sub section, the steps in the calculation of marginal q are summarized.

#### *3.2.1 Versions of Marginal q*

Here the two versions of marginal q are presented. The two versions presented here return marginal q values for each firm, i.e. are firm-specific.

Starting from equation (6) in the previous section the two different, but closely related, versions of marginal q can be derived. The version of marginal q presented in equation (7) below, hereafter referred to as the first version of marginal q, is a firm- and time-specific marginal q. Time-specific means that a marginal q value for each selected period is computed, in this case for each year. This version is obtained by simply rearranging equation (6) and looks as follows:

(7)

$$q_{m,t} = \frac{M_t - (1-\delta_t)M_{t-1}}{I_t} - \frac{\mu_t}{I_t}$$

The version of marginal q presented in equation (8) below, hereafter referred to as the second version of marginal q, is a multi-period weighted average of the first version, i.e. of equation (7). In other words, the second version is the weighted average of the first version over a selected number of years, in this case 1997-2005. Similar to the first version, the second version is firm-specific. It is, however, not time-specific unlike the first version. For the second version, only one marginal q value per firm can be calculated over the selected number of years. The first version computes a marginal q value per each firm *and* year in the selected number of years. A detailed derivation of the second version is presented in Appendix A. The second version of marginal q is computed according to:[14]

[14] Equation (8) is derived according to Eklund (2009a).

(8)

$$\bar{q}_m = \frac{M_{t+n} - M_{t-1}}{\sum_{j=0}^{n} I_{t+j}} + \frac{\sum_{j=0}^{n} \delta_{t+j} M_{t+j-1}}{\sum_{j=0}^{n} I_{t+j}} - \frac{\sum_{j=0}^{n} \mu_{t+j}}{\sum_{j=0}^{n} I_{t+j}}$$

The last term in the above equation approaches zero as n grows.

Recall that we use marginal q for two purposes. First, marginal q must be calculated for each firm to split the sample into over- and underinvesting firms. Second, these values are used when marginal q is employed as a dependent variable.

For the choice of version of marginal q for the calculations we now compare the two versions. The second version is to prefer from an empirical point of view. If the market fails to assign a correct market value in year t, the first version will give an incorrect estimate of marginal q for this year due to its single-period nature. Assuming that the errors in the market valuation are not persistent and that possible errors are corrected by the market in subsequent periods, the second version will still be an accurate measure of marginal q, since it computes a weighted average over several years (Eklund, 2009b). However, the first version calculates a marginal q value for each firm *and* year. By doing so, the first version measures the investment efficiency closer to the margin than second one.[15] A more marginal measure of investment efficiency is generally to prefer, since it reduces endogeneity problems. Endogeneity problems are more likely to be encountered with inframarginal measures as they do not indicate the efficiency at a given point in time. Instead they indicate an average over a longer period. Nevertheless, the empirical advantage of version two described in this paragraph more than compensates for disadvantage of being less marginal. Thus, the choice for the calculations landed on the second version of marginal q, the multi-period weighted average marginal q. Previous studies which have calculated firm-specific marginal q values, have also applied the second version (e.g. Mueller and Reardon, 1993, Eklund, 2009b).

### *3.2.2 Assumed Depreciation Rate*

Since the second version is applied for all calculations of marginal q in this thesis, marginal q hereafter refers to this version, unless stated otherwise or implied by the context.

Equation (8) implies that it is necessary to assume a depreciation rate, $\delta_{t+j}$, of the market value of the firm for the calculation of marginal q. Mueller and Reardon (1993) consider the depreciation rates of the

[15] Investment efficiency is said to be measured on the margin if it reflects the investment efficiency of the next unit of investment. An investment efficiency measure is called marginal if it measures the investment efficiency on the margin. The first version of marginal q is more marginal than the second version. The reason for this is that the first version computes the investment efficiency for each year, whereas the second version computes a weighted average for a number of years.

components in equation (3) to estimate an average depreciation rate for all firms. They use Hulten's and Wykoff's (1981) finding that the average depreciation rate of physical capital, $KK_t$, is around 10% per year. Furthermore, it is argued that the depreciation on past research and development expenditures, $RK_t$, is around 10%. The depreciation rate of advertising, $AK_t$, is suggested to exceed 10%, whereas the depreciation rate of goodwill, $GK_t$, is below this figure. These suggestions cause Mueller and Reardon to assume a depreciation rate of approximately 10% on average for all firms. An assumption, which is used in their calculations of marginal q. Eklund (2009b), also assumes a 10% constant depreciation rate when computing marginal q for Swedish firms. Furthermore, Eklund measures the average depreciation rate for Scandinavian firms and find it to vary around 9%. Based on these findings the standard assumption for the depreciation rate in our calculations will be 10%. We robust check this assumption by also testing our hypotheses assuming depreciation rates of 5% and 15%.

#### *3.2.3 Summary of the Stages in the Calculation of Marginal q*

As a first step in obtaining our results the marginal q value for each firm was calculated using equation (8). For our standard case a depreciation rate of 10% was assumed. Based on the calculated marginal q values the sample was split into over- and underinvesting firm. Firms with a marginal q below one were placed in the overinvesting group and those with a marginal q above one ended up in the underinvesting group. The marginal q values calculated for the division were then employed for marginal q as a dependent variable in the regressions. To robust check our results from the 10% regression, the procedure described here was repeated for depreciation rates of 5% and 15%.

### 3.3 Marginal q, Absolute Investments and Tobin's Q

The dependent variable in this thesis is investment efficiency. The explanatory variable of interest, leverage, is elaborated on in the next section. We test our hypotheses using three measures to indicate investment efficiency. I.e. three different investment efficiency measures are employed in separate regressions: marginal q, absolute investments and Tobin's Q. To our knowledge, marginal q has not been employed as the dependent variable with leverage as the explanatory variable of interest. We believe that marginal q is an appropriate dependent variable thanks to its ability to concretely indicate the investment efficiency in a firm. However, the results from the marginal q regressions should be interpreted with caution, since marginal q has not been used in this context before. Marginal q is complemented with two other investment efficiency measures to address this issue. Obtaining results from using three measures rather than one also enables us to compare and contrast the results from the three regressions. This should add interpretive strength in the analysis of the results.

This section is organized as follows. Since marginal q has been discussed in detail in previous sections, the remainder of this section does not focus on this measure separately. The first sub section of this section covers the properties of absolute investments when measuring investment efficiency. Sub section 2 contains a similar discussion on Tobin's Q. The third and last sub section provides a more extensive comparison between the three investment efficiency measures.

### *3.3.1 Absolute Investments*

Absolute investments in this thesis refer to capital expenditures (capex) plus research and development expenditures (R&D). Alternatively, only capex could have been included. R&D is, however, considered an investment when calculating marginal q. Thus, including R&D in absolute investments causes our measure of absolute investments to become more consistent with marginal q. In addition, by including R&D, absolute investments become a more complete measure of the investments undertaken in a given year. To include R&D is in line with Zhang's (2009) way of measuring absolute investments.

Absolute investments become an indicator of investment efficiency when splitting the sample into over- and underinvesting firms. For overinvesting firms increased absolute investments should have a negative impact on investment efficiency, since the firm is already investing at rates lower than the cost of capital. Conversely, for underinvesting firms increased absolute investments should positively impact investment efficiency, as the underinvesting firms have profitable investment opportunities. Thus, if absolute investments increase with leverage for overinvesting firms, it indicates that overinvestment is severed by increased leverage, i.e. the investment efficiency is worsened. Decreasing absolute investments for overinvesting firms, as a result of increased leverage, indicate declining levels of overinvestment, i.e. the investment efficiency is improved. For underinvesting firms the relationship between absolute investments and investment efficiency is reversed.

### *3.3.2 Tobin's Q*

The third measure used to estimate investment efficiency is Tobin's Q, which was developed by Brainard and Tobin (1968) and Tobin (1969). It is defined as the market value of a firm relative to the replacement costs of its assets.

High values of Tobin's Q encourage firms to invest more capital because their assets are on average worth more than the price paid for them. Low values of Tobin's Q have the opposite effect on investment levels as the assets on average are worth less than the purchase price. For Tobin's Q as well as marginal q a value above one indicates underinvestment, whereas values below one suggest overinvestment.

The main difference between marginal q and Tobin's Q is that Tobin's Q measures the average investment efficiency with respect to all investment decisions ever made in the firm. Marginal q measures the investment efficiency on the margin, i.e. with respect to the investment decisions currently being made in the firm.[16] Thus, recent literature argues that marginal q is a more appropriate dependent variable than Tobin's Q when testing hypotheses about investment efficiency. Only in a competitive equilibrium where all firms are price takers, marginal q and Tobin's Q will equal (Hayashi, 1982).

### *3.3.3 Comparison between the Three Investment Efficiency Measures*

One advantage of marginal q and Tobin's Q compared to absolute investments is that marginal q and Tobin's Q directly measure investment efficiency (i.e. how firms invest compared to their cost of capital). Absolute investments, on the other hand, are an indirect measure of investment efficiency as the effect on investment efficiency has to be deduced from the change in investment amounts. Per se absolute investments only capture the investment amount, whereas marginal q and Tobin's Q are based on the investment amount as well as the profitability of the underlying investments. Marginal q and Tobin's Q capture the investors' evaluation of the profitability of investments by reflecting how the investment affects market value. Absolute investments contain no such link to market value.

Absolute investments and Tobin's Q have the advantage of being more objective and easily obtained than marginal q. For marginal q, a depreciation rate has to be assumed in order for it to be calculated.[17] This might increase the room for errors in measuring marginal q and reduce the comparability between firms. An additional advantage of absolute investments and Tobin's Q compared to marginal q are that they have been more extensively employed in previous research, enhancing their credibility.

Absolute investments and marginal q gain from being more marginal investment efficiency measures than Tobin's Q (see footnote 15 for discussion on the term marginal). More marginal investment efficiency measures are considered more appropriate than an average measure such as Tobin's Q, when testing hypotheses about investment efficiency. The more marginal investment efficiency measures better relate the investment efficiency to the level of the explanatory variable in the period of interest, thanks to their ability to indicate investment efficiency closer to the margin. Tobin's Q indicates the average investment efficiency of all investment decisions ever made in the firm. As a result, it may fail to

[16] As pointed out in sub section 3.2.1, the version of marginal q applied in this thesis does not measure investment efficiency exactly on the margin. The reason for this is that the applied version calculates the weighted average of the investment efficiency over a selected number of years. However, the version of marginal q applied in the thesis still measures the investment efficiency significantly closer to the margin than Tobin's Q, since Tobin's Q indicates the average investment efficiency over the entire life of the firm.

[17] The depreciation rate can also be estimated instead of assumed when calculating marginal q. When estimating the depreciation rate, it is usually assumed to be constant over time and across industries. This is a simplifying assumption, which causes similar drawbacks, as when the depreciation rate is simply assumed instead of estimated.

relate the level of the explanatory variable to the investment decisions which were made in the period of interest, causing Tobin's Q to be more exposed to endogeneity problems than absolute investments and marginal q.

In Table 2 below we summarize how the three investment efficiency measures should be interpreted for overinvesting firms. Table 2 shows what signs the investment efficiency measures have when investment efficiency increases. Such an understanding is necessary for the interpretation of the regression results in chapter 5. If the marginal q rises for overinvesting firms, investment efficiency increases. Recall that overinvesting firms have marginal q values below one and that a marginal q of one indicates the optimal level of investment efficiency. When marginal q increases for overinvesting firms, marginal q approaches one, suggesting a higher level of investment efficiency. For underinvesting firms a decreasing marginal q (thus the minus sign in Table 2) implies higher levels of investment efficiency. Underinvesting firms have marginal q values above one. When marginal q decreases, the marginal q values of the underinvesting firms move closer to one, increasing the investment efficiency. Tobin's Q should be interpreted similarly to marginal q for over- as well as underinvesting firms. As explained in sub section 3.3.1, increased absolute investments affect the investment efficiency of overinvesting firms negatively, as they are already investing in negative NPV projects and only have such projects left to invest in. Instead overinvesting firms should reduce their levels to increase investment efficiency, hence the minus sign in Table 2. For underinvesting firms the opposite is true. By increasing absolute investments, these firms increase investment efficiency as they have profitable projects to invest in. For underinvesting firms, reduced absolute investments are associated with lower levels of investment efficiency as these firms then give up more positive NPV projects.

**Table 2. The signs of the investment efficiency measures when investment efficiency increases**

| | Marginal q | Absolute Investments | Tobin's Q |
|---|---|---|---|
| Overinvesting firms | + | - | + |
| Underinvesting firms | - | + | - |

### 3.4 The Explanatory Variable of Interest

The explanatory variable of interest in this thesis is leverage. Leverage was obtained for each firm by dividing the debt outstanding by the book value of total assets. Alternatively, the market value of the firm could have been used as a denominator instead of the book value of total assets. However, using the book value of total assets is better linked to the theoretical reasoning behind the hypotheses. Incentive effects from the threat of bankruptcy are a central part in the reasoning behind our hypotheses. Bankruptcy is usually decided based on the book rather than the market value of equity. Using the book value of equity in the denominator thus better applies to our theoretical reasoning. Hereafter leverage refers to leverage based on the book value of total assets unless stated otherwise.

### 3.5 Final Considerations for the Empirical Tests

We have now discussed the variables to be tested in the thesis. This section covers the last issues which must be considered before testing the effects on investment efficiency. The first consideration is the model choice for the regressions, which is discussed in sub section 1. Thereafter, in sub section 2, we explain the benefits of splitting the sample and how the split was carried out. The benefits have been mentioned, but not discussed in detail previously in the thesis, since a more in depth understanding of the investment efficiency measures is needed to fully explain the benefits. Now that the investment efficiency measures have been presented, such an explanation is suitable. Finally, in sub section 3, the equations which will be regressed to obtain the results are presented. Some technical details concerning these equations are also clarified.

#### *3.5.1 Model Choice*

The choice of model for the empirical tests serves the same purpose as the control variables, namely to control for other effects on investment efficiency than the pure effect of leverage. Our control variables are described in section 2.5. The effects controlled for by the control variables, e.g. the effects of a given access to free cash flows and level of ownership concentration, can be assumed to differ across industries. For example, more mature industries can be assumed to include firms with larger free cash flows. To control for such unobserved heterogeneity across industries, a fixed effects model is employed. The model uses industry (indicated by two-digit SIC codes) as the panel variable. F-tests performed on our data also show that a fixed effects model is applicable.

### *3.5.2 Splitting the Sample*

Now that we have covered the characteristics of the three investment efficiency measures, it is easier to highlight the advantages of studying the effects of leverage on investment efficiency separately for over- and underinvesting firms. After highlighting the benefits of studying the groups separately, we explain how the split was carried out.

For all three measures, splitting the sample facilitates the interpretation of the results significantly. For marginal q and Tobin's Q, it is impossible to draw conclusions from the signs of the regression coefficients unless you know whether the studied sample on average is over- or underinvesting. For example, it cannot be deducted whether a positive regression coefficient indicates increased or decreased investment efficiency, if it is not known whether the firms in the sample on average over- or underinvest. If the firms overinvest, the positive regression coefficient implies increased efficiency, but decreased efficiency if the firms underinvest. To make such a coefficient interpretable, there are two options. Either the average marginal q or Tobin's Q is calculated for the entire sample to see if the sample on average is over- or underinvesting. The other option is to split the sample into over- and underinvesting firms. The option of splitting the sample, which is employed in this thesis, is superior when it comes to the interpretation of the results, since it ensures that *every* firm in the sub sample is over- or underinvesting. This allows us to draw stronger conclusions from the results than we could if we would only know that a given sample is over- or underinvesting on average.

A similar interpretive benefit of splitting the sample holds for absolute investments. For example, increased absolute investments may increase or decrease the investment efficiency depending on whether the studied firms are over- or underinvesting. Larger absolute investments decrease the investment efficiency for overinvesting firms, but increase it for underinvesting ones. Thus, it is necessary to know whether the firm is over- or underinvesting. Splitting the sample in the manner carried out in this thesis conveys that information.

Marginal q and Tobin's Q are employed to split the sample into over- and underinvesting firms. As for measuring investment efficiency, marginal q is less common than Tobin's Q as a sample divider. Marginal q and Tobin's Q are applied in a similar manner when dividing the sample. A marginal q or Tobin's Q value is calculated for each firm. Both measures have straightforward interpretations. If the calculated value is below one, the firm is overinvesting, whereas a value above one indicates underinvestment. This simple rule is used to divide the sample into over- and underinvesting firms. One advantage of Tobin's Q in this context is that no depreciation rate has to be assumed for its calculation as for marginal q. Tobin's Q is simply defined as the market value of the firm relative to the replacement costs of its assets. Accordingly, the Tobin's Q value can be measured in an objective and straightforward manner. Nevertheless, marginal q has the advantage that it measures the investment efficiency of the

firm over a selected period. Tobin's Q measures the average investment efficiency over the entire life of the firm. When using marginal q as a divider, the firm can be categorized as over- or underinvesting over the period, for which the hypotheses are tested (in this case 1997-2005). This empirical advantage of marginal q has not been utilized in previous studies testing the leverage effects on investment efficiency, as they have not used marginal q as a sample divider. One contribution of this thesis is that it fills this gap. In the thesis, marginal q is used as a sample divider for the marginal q and absolute investments regressions. For the Tobin's Q regressions, Tobin's Q is applied as divider, which is necessary to make the interpretation of the Tobin's Q results meaningful.

### *3.5.3 Equations Employed for the Regressions*

To sum up the discussion in this section, we present the three equations which are regressed in the thesis. Some technical aspects related to testing the individual equations are also discussed. The equations will be applied using fixed effects regressions with industry as the panel variable. Furthermore, the equations will all be regressed separately for over- and underinvesting firms. The equations are as follow:

(9)

$$Marginal\ q = \beta_1 + \beta_2 leverage_t + \beta_3 all\ equity_t + \beta_4 scaled\ cash_t + \beta_5 ownership\ concentration_t + \beta_6 dual\ class\ shares_t + \beta_7 size_t$$

The regressions based on equation (9) will be performed for marginal q values calculated with assumed depreciation rates of 5%, 10% and 15%, see sub sections 3.2.2-3. The regressions originating from this equation will hereafter be referred to as the marginal q regressions. These correspond to six regressions; three for the overinvesting group and three for the underinvesting group. The two regressions based on a 10% depreciation rate will be the regressions mostly focused on. These will hereafter be referred to as the primary marginal q regressions. The regressions based on depreciation rates of 5% and 15% are treated as robustness checks. These regressions will hereafter be referred to as the secondary marginal q regressions. Worth pointing out is that the divisions into over- and underinvesting firms are carried out based on marginal q values calculated using the same depreciation rate as the marginal q values used for the dependent variable. For example, the marginal q values for the split into over- and underinvesting firms will be based on a 5% depreciation rate, if the marginal q values for the dependent variable have been calculated assuming a 5% depreciation rate. Consequently, there will be differences in the sizes of the groups of over- and underinvesting firms between the regressions, depending on the depreciation rate applied for the split.

(10)

$$Absolute\ investments = \beta_1 + \beta_2 leverage_t + \beta_3 all\ equity_t + \beta_4 scaled\ cash_t + \beta_5 ownership\ concentration_t + \beta_6 dual\ class\ shares_t + \beta_7 size_t + \beta_8 scaled\ sales_t + \beta_9 lagged\ Tobin's\ Q_t$$

The two regressions originating from equation (10), one regression for the overinvesting group and one for the underinvesting group, will hereafter be referred to as the absolute investment regressions. Previously we have referred to absolute investments as the sum of capex and R&D. In the regressions this sum is scaled by the total assets from the previous year to normalize the effect. Thus, hereafter absolute investments refer to the sum of capex and R&D scaled by the total assets from the previous year. The division of the sample into over- and underinvesting firms for the absolute investment regressions are based on marginal q values calculated with an assumed depreciation rate of 10%.

(11)

$$Tobin's\ Q = \beta_1 + \beta_2 leverage_t + \beta_3 all\ equity_t + \beta_4 scaled\ cash_t + \beta_5 ownership\ concentration_t + \beta_6 dual\ class\ shares_t + \beta_7 size_t + \beta_8 scaled\ sales_t$$

The two regressions originating from this equation, one for the overinvesting and one for the underinvesting group, will hereafter be referred to as the Tobin's Q regressions. The division of the sample into over- and underinvesting firms for the Tobin's Q regressions will be based on Tobin's Q. The division follows the same logic as when marginal q is employed as a divider: firms with values below one are placed in the overinvesting group, whereas values exceeding one place firms in the underinvesting group. In the marginal q and absolute investment regressions, the sample is divided using marginal q. For the Tobin's Q regression, however, Tobin's Q must be used for this purpose in order for the regression results to become consistent and meaningful.

# 4 Data

In this chapter the data used in the thesis will be described. The first section presents how the original dataset was collected. In addition, an overview of the data variables is provided. In the second section we explain how the original dataset was filtered into three different data samples; one sample for marginal q, absolute investments and Tobin's Q, respectively. The third section discusses the general features of the three data samples.

## 4.1 Dataset and Variables

This section covers how the original dataset with data on 216 firms and 1480 observations was collected. The dataset contains Swedish non-financial listed firms between 1997 and 2005. When collecting the dataset, banks and financial firms were excluded. To exclude such firms is a common procedure when studying marginal q since the nature of their investments causes them to be incomparable to other firms with respect to the effect on marginal q (e.g. Gugler et al., 2004, Bjuggren et al., 2007).

The main part of this dataset was collected from Standard and Poor's Compustat Global Database, hereafter referred to as Compustat. The 2006 version of Compustat offered variables necessary for our calculations not available in more recent versions of the database. Thus, the 2006 version was used as the base for the data collection.[18] The variables cash and capital expenditures were added from the 2009 version. Data on dual class shares and ownership concentration were manually gathered from the Owners and Power in Sweden's Listed Firms by Sundin and Sundqvist (2002). The information from 2002 is assumed to be constant for all years between 1997 and 2005. In Sweden, firms relatively seldom change the voting structure and the largest owners tend to stay in control (e.g. Bjuggren et al., 2007). As a result, the fact that the information on dual class shares and ownership concentration collected from one year is applied for all years should not impact the results significantly. The data variable for dual class shares is a dummy variable. The dummy variable indicates "yes" if the firm has dual class shares and "no" if it does not. The variable for ownership concentration was collected by adding the percentage of the capital stake of the two largest owners.

Table 3 illustrates a list of the variables which were collected. The variable names presented in Table 3 will hereafter be the names referred to in the thesis. All figures have been adjusted by harmonized consumer price indexes to 2005 constant prices.

[18] Johanna Palmberg at Jönköping International Business School provided us with raw data from the 2006 version of Compustat.

**Table 3. Collected variables**

**The following variables have been collected**

*From Compustat 2006:*

| Compustat mnemonic | Variable |
|---|---|
| AT | Total Assets |
| DIV | Dividends |
| DP | Depreciation |
| DT | Total Debt |
| MKVAL | Market Value of Equity |
| IB | After Tax Profit |
| PRSTKC | Purchase of Common and Preferred Stock |
| SALE | Sales |
| SSTK | Equity Stock Addition |
| XRD | R&D |
| XSGA | Advertising |

*From Compustat 2009:*

| Compustat mnemonic | Variable |
|---|---|
| CAPX | Capex |
| CH | Cash |

*Manually Collected Variables:*

| Variable |
|---|
| Ownership Concentration |
| Dual Class Shares |

Table 4 shows the variables calculated in STATA from the input variables in Table 3. The variable names presented in Table 4 will also be the names referred to in the thesis.

**Table 4. Created variables**

**The following variables have been created in STATA**

*Starting Calculations**

| Abbreviation in STATA | Variable name | Calculations |
|---|---|---|
| DDT | Change in Total Debt | DT-DT_1 |
| I | Investments** | IB-DIV+DP+SSTK-PRSTKC+DDT+XRD+XSGA |
| INVESTMENTS | Unscaled Absolute Investments | CAPX+XRD |

*Explanatory Variable of Interest*

| Abbreviation in STATA | Variable name | Calculations |
|---|---|---|
| BLEV | Book Value of Leverage | DT/AT |

*Efficiency Measures*

| Abbreviation in STATA | Variable name | Calculations |
|---|---|---|
| MULTIPERIODWEIGHTEDAVERAGEQM | Marginal q*** | |
| SCALEDINVESTMENTS | Absolute Investments | INVESTMENTS/AT_1 |
| Q | Tobin's Q | (MKVAL+DT)/AT |

*Control Variables*

| Abbreviation in STATA | Variable name | Calculations |
|---|---|---|
| ALLEQUITY | All Equity | 1 if DT=0, otherwise 0 |
| SCALEDCH | Scaled Cash | CH/AT_1 |
| SUMCAP | Ownership Concentration | The sum of the two largest capital stakes |
| DUALCLASS | Dual Class Shares | 1 if dual class shares, otherwise 0 |
| SIZE | Size | log(MKVAL+DT) |
| SCALEDSALE | Scaled Sales | SALE/AT_1 |
| QLAG | Lagged Tobin's Q | Q_1 |

* These variables were calclulated first and are used for the further calculations, but are not used independently.
** Used for the calculation of marginal q. Hereafter, "investments" refer to this variable unless stated otherwise.
*** This refers to the version of marginal q called the multi-period weighted average marginal q, elaborated on in sub section 3.2.1. The full calculation is not displayed here for illustrative purposes. See sub section 3.2.1 for full calculation.

### 4.2 Filtering of Dataset

This section covers how the original dataset with 1480 observations was filtered into three slightly different data samples; one sample for the marginal q, absolute investments and Tobin's Q regressions, respectively. The samples for marginal q, absolute investments and Tobin's Q are hereafter referred to as the marginal q sample, absolute investments sample and Tobin's Q sample.

First, firms with negative investments were eliminated from the original dataset.[19] The computation of marginal q to divide the sample does not make sense when investments are negative or equal to zero (Eklund, 2009b). A firm will have negative investments if it is making losses that are larger in absolute

[19] Note that investments here refer to the investments used for the calculation of marginal q.

terms than new equity and debt. From this operation 180 observations were deleted for all three investment efficiency measures.[20]

For each investment efficiency measure, i.e. marginal q, absolute investments and Tobin's Q, the upper 95 and lower 5 percentiles were eliminated. The purpose of trimming the sample in this way is to reduce the weight of extreme values. For marginal q, such extreme values are typically represented by smaller firms which have either a very high return on invested capital or a massive loss in market value. There are several plausible explanations for these extreme values. Firms may for example introduce radical innovations that do not require any substantial investments but nevertheless substantially increase firm value. E.g. Eklund (2009b) adjust his sample in a similar manner when studying marginal q. From this elimination 131 observations were deleted for marginal q. 337 and 127 observations were deleted for absolute investments and Tobin's Q, respectively.

The rest of the observations which were excluded from the original dataset were automatically dropped by STATA. This was due to missing values stemming from firms without data on dual class shares and ownership concentration and missing values from the creation of lagged variables. Out of the 318 observations dropped for marginal q, 127 observations were firms without data on dual class shares and ownership concentration. The corresponding numbers are 125 of 133 and 141 of 341 for absolute investments and Tobin's Q, respectively.

The filtering resulted in three data samples. The final samples for the marginal q, absolute investments and Tobin's Q regressions contain 851, 830 and 832 observations, respectively.

### 4.3 Filtered Samples

Here we present and discuss some general features of the filtered data samples used for the regressions.

#### *4.3.1 Marginal q*

The marginal q regressions assuming a 10% depreciation rate are run on an unbalanced dataset containing 153 firms and 851 firm-year observations. The table below, Table 5, summarizes some important features of this dataset.[21]

[20] This argument is only valid for the marginal q and absolute investment regressions, since marginal q is only used as a divider for these regressions. Still, this elimination is performed for the Tobin's Q sample as well to make the samples comparable.
[21] The figures in Table 5 are based on our standard depreciation assumption of 10%. This assumption is discussed further in sub section 3.2.1.

**Table 5. Descriptive statistics for the marginal q sample**

| | | | | | |
|---|---|---|---|---|---|
| No. of firms | All firms | 153 | | | |
| | Overinvesting | 110 | | | |
| | Underinvesting | 43 | | | |
| No. of obs. | All firms | 851 | | | |
| | Overinvesting | 649 | | | |
| | Underinvesting | 202 | | | |
| | | **Mean** | **Median** | **Max** | **Min** |
| Marginal q | All firms | 0.591 | 0.498 | 3.717 | (3.223) |
| | Overinvesting | 0.191 | 0.307 | 0.971 | (3.223) |
| | Underinvesting | 1.879 | 1.566 | 3.717 | 1.036 |
| Leverage | All firms | 0.191 | 0.179 | 0.635 | 0.000 |
| | Overinvesting | 0.199 | 0.192 | 0.634 | 0.000 |
| | Underinvesting | 0.165 | 0.128 | 0.635 | 0.000 |

The mean marginal q for all firms in our sample is 0.59, implying that Swedish firms on average overinvest, which is in line with previous studies (e.g. Gugler et al., 2002, Bjuggren et al., 2007). This means that in the period 1997–2005 the Swedish listed firms in our sample had an average return on investments that was 41% below the cost of capital. For overinvesting firms the mean marginal q is as expected considerably lower than for all firms, namely 0.19. For underinvesting firms the mean is 1.88, which also matches our expectations. These figures depend on the assumption that depreciation rates for all firms are 10%. When increasing the depreciation rate, the marginal q will increase for all firms in the sample. The number of overinvesting firms will then decrease. This assumption is elaborated on in sub section 3.2.2.

With respect to leverage, the mean in Swedish listed firms during this period is 19% of the book value of the assets. We can see that overinvesting firms on average tend to be more levered than underinvesting firms, 19.9% versus 16.5%.

### *4.3.2 Absolute Investments*

The absolute investments regressions are run on an unbalanced dataset containing 175 firms and 830 firm-year observations. Recall from Table 4 that absolute investments refer to capex plus R&D relative to total assets from the previous year. The table below, Table 6, summarizes some important features of this dataset.

**Table 6. Descriptive statistics for the absolute investments sample**

| | | | | | |
|---|---|---|---|---|---|
| No. of firms | All firms | 175 | | | |
| | Overinvesting | 124 | | | |
| | Underinvesting | 51 | | | |
| No. of obs. | All firms | 830 | | | |
| | Overinvesting | 623 | | | |
| | Underinvesting | 207 | | | |
| | | **Mean** | **Median** | **Max** | **Min** |
| Absolute investments | All firms | 0.086 | 0.067 | 0.299 | 0.007 |
| | Overinvesting | 0.086 | 0.068 | 0.298 | 0.007 |
| | Underinvesting | 0.084 | 0.061 | 0.299 | 0.007 |
| Leverage | All firms | 0.182 | 0.171 | 0.617 | 0.000 |
| | Overinvesting | 0.194 | 0.188 | 0.617 | 0.000 |
| | Underinvesting | 0.149 | 0.105 | 0.548 | 0.000 |

The mean absolute investments for all firms in our sample are 0.086. This means that an amount corresponding to 8.6% of the value of the preceding year's assets was invested each year. There is no large difference between the investment levels of over- and underinvesting firms. However, overinvesting firms do invest slightly more, on average 0.2% more, relative to total assets from the previous year.

The pattern spotted in the marginal q sample that overinvesting firms on average tend to be more levered than underinvesting firms, prevails also in this data sample, 19.4% versus 14.9%. For the whole absolute investments sample the mean is 18%.

### *4.3.3 Tobin's Q*

The Tobin's Q regressions are run on an unbalanced dataset containing 254 firms and 832 firm-year observations. The table below, Table 7, summarizes some important features of this dataset.

**Table 7. Descriptive statistics for the Tobin's Q sample**

| | | | | | |
|---|---|---|---|---|---|
| No. of firms | All firms | 254 | | | |
| | Overinvesting | 108 | | | |
| | Underinvesting | 146 | | | |
| No. of obs. | All firms | 832 | | | |
| | Overinvesting | 331 | | | |
| | Underinvesting | 501 | | | |
| | | **Mean** | **Median** | **Max** | **Min** |
| Tobin's Q | All firms | 1.434 | 1.154 | 4.926 | 0.498 |
| | Overinvesting | 0.765 | 0.767 | 0.999 | 0.498 |
| | Underinvesting | 1.877 | 1.602 | 4.926 | 1.002 |
| Leverage | All firms | 0.186 | 0.172 | 0.634 | 0.000 |
| | Overinvesting | 0.195 | 0.188 | 0.634 | 0.000 |
| | Underinvesting | 0.160 | 0.113 | 0.548 | 0.000 |

The mean Tobin's Q for all firms in our sample is 1.43, implying that Swedish firms on average have been underinvesting over their life time. Thus, on average, the return on investments was 43% above the cost of capital over the entire lives of these firms. This is an interesting contrast to marginal q, which finds that Swedish firms on average overinvest on the margin.

The pattern spotted in the marginal q and absolute investment samples regarding the difference in leverage between over- and underinvesting firms is also observed in the Tobin's Q sample. For the whole sample, the average leverage level is 19% for the period. For over- and underinvesting firms the mean is 19.5% and 16.0%, respectively.

# 5 Results

In this chapter we present the results from the regressions. For an overview of the regressions tested in the thesis, see sub section 3.5.3. From now on in the thesis, results are regarded statistically significant if they have a statistical significance of 5% or lower unless specified otherwise. In this chapter, the results from the different measures are presented and discussed separately and only compared briefly. A further discussion on the similarities and differences between the results from the different measures follows in the next chapter. In the first section of this chapter we present the results from the marginal q regressions. Sections 2 and 3 cover the results from the absolute investments and Tobin's Q regressions, respectively. The first section and second sub section of each section covers over- and underinvesting firms, respectively. Sections 2 and 3 will build on the discussion of the results for marginal q in section 1. Thus, a more elaborate discussion of the results is presented in section 1 than in the other two sections. Since the arguments in section 1 also hold for the later sections if the results are similar, the results in sections 2 and 3 will primarily be elaborated on if they differ significantly from those presented in section 1.

## 5.1 Marginal q

This section presents the results for the marginal q regressions. In sub section 3.5.3 we stated that the marginal q regressions based on the 10% depreciation rate, referred to as the primary marginal q regressions, will be the regressions mostly focused on. Nevertheless, the marginal q regressions based on the 5% and 15% depreciation rates, referred to as the secondary marginal q regressions, will also be taken into account. From now on, the results for a given variable in the marginal q regressions will be considered statistically significant if the primary regression plus at least one of the secondary regressions show statistical significance for that variable.

The split into over- and underinvesting firms are based on marginal q values calculated with the same depreciation rate as the marginal q values used for the dependent variable in the marginal q regressions. As a result, there will be differences in the sizes of the groups of over- and underinvesting firms between the regressions, depending on the depreciation rate used for the split.

### *5.1.1 Overinvesting Firms*

The results from regressing equation (9) on the overinvesting group are presented in Table 8 below. Recall from Table 2 that positive regression coefficients indicate increased investment efficiency (i.e.

decreased overinvestment) for the overinvesting group when employing marginal q as the measure of investment efficiency.

**Table 8. Regression results for overinvesting firms with marginal q<1**

**Dependent variable: marginal q**

*The regression coefficients are given on the same row as the variable name. The next unlabelled row repeatedly gives the t-values for the respective above standing regression coefficients*

| Depreciation rate | 5% | 10% | 15% |
|---|---|---|---|
| Constant | (1.001) *** | (0.852) *** | (0.376) *** |
| | (5.90) | (5.75) | (2.79) |
| Leverage | 0.733 *** | 0.424 ** | 0.053 |
| | 3.03 | 2.00 | 0.28 |
| All Equity | (0.223) ** | (0.187) ** | (0.275) *** |
| | (2.20) | (2.04) | (3.41) |
| Scaled Cash | (0.594) *** | (0.715) *** | 0.084 |
| | (2.92) | (3.88) | 0.54 |
| Ownership Concentration | 0.007 *** | 0.007 *** | 0.003 ** |
| | 3.96 | 4.58 | 2.36 |
| Dual Class Shares | 0.068 | (0.025) | 0.137 *** |
| | 1.05 | (0.44) | 2.69 |
| Size | 0.091 *** | 0.107 *** | 0.063 *** |
| | 5.37 | 7.29 | 4.53 |
| Within $R^2$ | 0.16 | 0.20 | 0.11 |
| No. of obeservations | 702 | 649 | 549 |
| No. of firms | 121 | 110 | 95 |
| F-value | 21.08 | 25.45 | 10.84 |
| Mean marginal q | 0.029 | 0.191 | 0.281 |
| Median marginal q | 0.212 | 0.307 | 0.365 |

* statistically significant result on the 10% significance level
** statistically significant result on the 5% significance level
*** statistically significant result on the 1% significance level

Our first hypothesis states that overinvestment should decrease with leverage for overinvesting firms. The results in Table 8 accept this hypothesis. The primary marginal q regression for overinvesting firms shows a positive leverage coefficient, which is statistically significant on the 5% level, indicating an alleviating effect of leverage on overinvestment. The secondary marginal q regression based on a 5% depreciation rate shows the same effect on the 1% significance level, whereas the regression based on 15% depreciation rate is statistically insignificant for leverage. Thus the overall effect from the marginal

q regressions with respect to leverage is considered statistically significant.[22] The economic significance of leverage is also to be considered. The economic significance, when based on the primary marginal q regression, shows that if the firm increases its leverage by one unit (i.e. goes from an all-equity to a completely levered firm) marginal q increases by 0.42. To illustrate an example using an average Swedish firm with a leverage of 0.2 (debt over total assets) an increase of 0.1 to 0.3 in leverage would increase the marginal q of this firm by 0.042 (0.1 times 0.42). For the average Swedish overinvesting firm, this change would increase its marginal q from 0.191 to 0.233.

Leverage increases asset substitution but mitigates the controlling owner-minority shareholder conflict. Our results as expected suggest that the mitigating effect of leverage on the controlling owner-minority shareholder conflict overwhelms the exacerbating effect on asset substitution. Our first hypothesis is based on an assumption that the controlling owner-minority shareholder conflict is a more important explanatory factor for overinvestment in Swedish firms than asset substitution. The results for leverage in Table 8 support this assumption.

The coefficient on the variable all equity is negative and statistically significant for all three regressions in Table 8, suggesting that the controlling owner-minority shareholder conflict is relevant in overinvesting firms. The results show that all-equity firms overinvest more than levered firms. Also here it seems that the benefit of being levered, namely the mitigation of the controlling owner-minority shareholder conflict, overcomes the disadvantage of increased asset substitution.

The overall negative and significant coefficient on scaled cash suggests that overinvestment is severed in overinvesting firms if they hold more cash. This is in line with our initial expectations. Cash proxies for free cash flows here. As the free cash flows of overinvesting managers increase, so should the overinvestment, as they have more funds to waste (Jensen, 1986).

The positive and significant coefficient on ownership concentration implies a mitigating effect on overinvestment, thereby improving investment efficiency. This coincides with our original expectations. Ownership concentration was expected to improve investment efficiency for overinvesting firms by mitigating the controlling owner-minority shareholder conflict. However, this is shown with low economic significance in the results.

Dual class shares generally have no statistically significant impact on investment efficiency for overinvesting firms. The results can only weakly support the view that the separation of voting and cash flow rights worsens the controlling owner-minority shareholder conflict.

[22] Recall that we consider the results for a given variable in the marginal q regressions to be statistically significant if the primary marginal q regression plus at least one of the secondary marginal q regressions are significant for that variable.

The results for the control variable size imply that the size of the firm improves investment efficiency, which corresponds to our prediction. Large firms are more monitored by the analysts and media, which should positively influence controlling owners' (and managers') incentives investment efficiency.

### *5.1.2 Underinvesting Firms*

The results from regressing equation (9) on the underinvesting group are presented in Table 9 below. As was illustrated in Table 2, negative regression coefficients indicate increased investment efficiency (i.e. decreased underinvestment) for the underinvesting group when employing marginal q as the measure of investment efficiency.

**Table 9. Regression results for underinvesting firms with marginal q>1**

**Dependent variable: marginal q**

*The regression coefficients are given on the same row as the variable name. The next unlabelled row repeatedly gives the t-values for the respective above standing regression coefficients*

| Depreciation rate | 5% | 10% | 15% |
|---|---|---|---|
| Constant | 2.640 *** | 2.729 *** | 2.332 *** |
| | 12.75 | 9.25 | 7.97 |
| Leverage | (1.044) *** | (1.763) *** | (1.235) *** |
| | (3.30) | (4.30) | (2.79) |
| All Equity | 0.014 | (0.599) *** | (0.433) *** |
| | 0.14 | (4.76) | (3.15) |
| Scaled Cash | 0.247 | 0.139 | 0.665 ** |
| | 1.10 | 0.57 | 2.35 |
| Ownership Concentration | 0.008 *** | 0.010 *** | 0.013 *** |
| | 3.23 | 2.93 | 3.76 |
| Dual Class Shares | (0.360) *** | (0.220) * | 0.092 |
| | (4.08) | (1.85) | 0.77 |
| Size | (0.112) *** | (0.087) ** | (0.093) *** |
| | (4.56) | (2.40) | (3.14) |
| Within $R^2$ | 0.48 | 0.26 | 0.19 |
| No. of obeservations | 149 | 202 | 300 |
| No. of firms | 32 | 43 | 58 |
| F-value | 19.00 | 10.29 | 10.44 |
| Mean marginal q | 1.812 | 1.879 | 1.919 |
| Median marginal q | 1.599 | 1.566 | 1.487 |

* statistically significant result on the 10% significance level
** statistically significant result on the 5% significance level
*** statistically significant result on the 1% significance level

Our second hypothesis states that underinvestment should increase with leverage. That is, leverage should worsen the investment efficiency in underinvesting firms. Our results in Table 9 reject this hypothesis. All three regressions in Table 9 indicate an alleviating effect of leverage on underinvestment. The results for leverage from all three regressions in Table 9 are significant on the 1% significance level. Additionally, the economic significance is considerable. It shows that if the firm increases its leverage by one unit (i.e. goes from an all-equity to a completely levered firm) marginal q decreases by roughly 1.8, based on the primary marginal q regression. To illustrate an example using an average Swedish firm with a leverage of 0.2 (debt over total assets) an increase of 0.1 to 0.3 in leverage would decrease marginal q of this firm by 0.18 (0.1 times 1.8). For the average Swedish underinvesting firm, this change would decrease its marginal q from 1.88 to 1.70. Thus, the marginal q regressions indicate that leverage improves investment efficiency for over- as well as underinvesting firms.

The results suggest that the improving effect of leverage on investment efficiency is stronger for under- than overinvesting firms. This is surprising. Due to debt overhang, theory supports that underinvestment should increase with leverage. Our results suggest the opposite. One reason for this might be that the managers' and shareholders' risk preferences are poorly matched due to the low holdings of executive stock options in Swedish firms (see section 2.3). The managers should prefer lower risk than the shareholders, since the managers are not compensated for risk-taking. Swedish managers have relatively fixed salaries and thus the managers do not capture much of the upside of a profitable investment, but might risk losing their jobs or incur reputational costs if an investment fails. This could cause managers to reduce the risk of the investments to levels where profitable and risky projects are not exploited, pronouncing the potential underinvestment. However, leverage increases the threat of bankruptcy. By doing so, leverage might force overly cautious underinvesting managers to invest in positive NPV projects, which they would otherwise have avoided due to the high risk. At higher levels of leverage, the personal losses for managers associated with bankruptcy become more likely if positive NPV projects are not undertaken, possibly motivating them to undertake such projects. In section 2.3, we expected that the problem of overly cautious managers would not have a significant impact on underinvestment, as Swedish firms are exposed to the controlling owner-minority shareholder conflict, rather than the manager-shareholder conflict. Thus, the controlling owners, who have better incentives to take risks than managers, should mainly make the investment decisions. Therefore, the issue of too cautious managers is probably not able to fully explain the results obtained in Table 9. However, the results suggest that the issue might be more severe than initially proposed.

Another possible reason for the mitigating effect of leverage on underinvestment, presented in Table 9, could be that in situations of extreme default risk, the controlling owner (or manager) is willing to abstain from engaging in debt overhang to avoid bankruptcy. The threat of bankruptcy, if debt service

payments are not made, possibly creates an incentive for underinvesting controlling owners to invest in positive NPV projects, although a substantial part of the proceeds go to the existing debt holders. In this case, the shareholders probably do not gain from additional investments. However, the controlling owners might exploit the minority shareholders to pursue their own agenda, such as the prestige of being in charge of a listed company. That is, the controlling owners could be willing to transfer wealth from their own (and the minority shareholders') pockets to the debt holders to keep the firm alive, as the survival of the firm allows them to enjoy personal benefits. By increasing the bankruptcy risk, increased leverage might put controlling owners in situations where they are willing to give up debt overhang, and thereby increase investment efficiency. However, this argument should only pertain to a limited number of firms in our sample, as the default risk must be so high that bankruptcy is almost certain. For the other levels of default risk, debt overhang should dominate. Additionally, it is also questionable whether the controlling owners in general are willing to transfer wealth to debt holders for the sake of the personal benefits related to continuing the operations of the firm. Therefore, these reasons should only be able to explain a small part of the results presented in Table 9.

The two possible reasons presented above for the alleviating effect of leverage on underinvestment might explain part of this effect. However, due to the highly economically and statistically significant mitigating effect of leverage, the effect should not be fully explained by the two reasons. Theoretically, in the setting studied, the worsening effect on underinvestment due to debt overhang should overwhelm the effects of the proposed reasons, as leverage rises. Thus, further research is needed to completely disentangle the explanation of the results presented for leverage in Table 9.

The variable all equity overall has a negative and significant coefficient, implying that underinvesting all-equity firms invest more efficiently than levered underinvesting firms. This is in line with our original expectation, since underinvesting all-equity firms are exempt from the investment inefficiency created by debt overhang.

The control variable scaled cash is positive and generally insignificant, implying that cash weakly intensifies underinvestment. This is somewhat unexpected as increased cash levels should allow underinvesting firms to fund new profitable projects, thereby mitigating underinvestment. The contradicting and statistically weak result might be explained by the fact that cash holdings for the funding of projects are of relatively little relevance to the studied group of firms, since the studied firms should have favorable access to external capital by being listed. Thus, the firms might fund their projects directly by share or debt issues, instead of building cash reserves.

Ownership concentration is shown to exacerbate underinvestment on the 1% significance level for all three regressions, which corresponds to our initial expectations. When ownership concentration

increases, the shareholders should become stronger in the shareholder-debt holder conflict, increasing the discretion of shareholders to engage in debt overhang. This would explain why underinvestment is severed as ownership concentration increases. However, the effect has low economic significance.

Overall, dual class shares weakly mitigate underinvestment. The weak effect was expected since dual class shares are mainly argued to impact overinvestment through the controlling owner-minority shareholder conflict.

Size is shown to improve investment efficiency for underinvesting firms with statistical significance. The supervision of managers of large firms from media and analysts might induce managers to utilize more positive NPV projects. When the manager is supervised by media and analysts he might incur higher reputational costs if he does not utilize positive NPV projects, possibly motivating the managers to exploit such projects.

### 5.2 Absolute Investments

In this section the results from the absolute investments regressions are focused on. The results from regressing equation (10) on the over- and underinvesting groups are presented in Table 10 below. The division of the sample into the over- and underinvesting groups was based on marginal q values calculated with an assumed depreciation rate of 10%. Remember from Table 2 that for overinvesting firms negative regression coefficients imply increased investment efficiency (i.e. decreased overinvestment) when absolute investments operate as the dependent variable. For underinvesting firms, positive regression coefficients imply increased investment efficiency (i.e. decreased underinvestment) in the absolute investment regressions. When interpreting the results in Table 10, also note that absolute investments refer to capex plus R&D scaled by total assets from the previous year. As a result, the economic significance, which will be expressed as a percentage in the discussion of the results, should be interpreted as the sum of capex and R&D relative to total assets from the previous year. This partially explains the relatively low numbers for the economic significance in Table 10.

**Table 10. Regression results for over- and underinvesting firms**

**Dependent variable: absolute investments**

*The regression coefficients are given on the same row as the variable name. The next unlabelled row repeatedly gives the t-values for the respective above standing regression coefficients*

| | Overinvesting firms Marginal q<1 | Underinvesting firms Marginal q>1 |
|---|---|---|
| **Depreciation rate** | **10%** | **10%** |
| Constant | 0.114 *** | 0.203 *** |
| | 6.67 | 6.06 |
| Leverage | (0.016) | (0.080) * |
| | (0.73) | (1.67) |
| All Equity | 0.009 | 0.005 |
| | 0.93 | 0.38 |
| Scaled Cash | 0.011 | 0.056 ** |
| | 0.49 | 2.25 |
| Ownership Concentration | (0.000) | (0.001) *** |
| | (1.10) | (4.49) |
| Dual Class Shares | (0.003) | (0.042) *** |
| | (0.57) | (2.99) |
| Size | (0.001) | (0.001) |
| | (0.80) | (0.21) |
| Scaled Sales | (0.012) *** | (0.037) *** |
| | (3.01) | (4.37) |
| Lagged Tobin's Q | 0.006 *** | 0.007 *** |
| | 3.22 | 3.62 |
| Within $R^2$ | 0.06 | 0.30 |
| No. of obeservations | 623 | 207 |
| No. of firms | 124 | 51 |
| F-value | 4.70 | 9.04 |

* statistically significant result on the 10% significance level
** statistically significant result on the 5% significance level
*** statistically significant result on the 1% significance level

### *5.2.1 Overinvesting Firms*[23]

The first hypothesis predicts that overinvestment should decrease with leverage for overinvesting firms. As illustrated in Table 10, the absolute investments regression on overinvesting firms confirms this hypothesis, but only weakly so since the leverage coefficient is statistically insignificant and shows a low

[23] In this and the next sub section, "investments" refer to capex plus R&D.

economic significance. The economic significance implies that if the firm increases its leverage by one unit (i.e. goes from an all-equity to a completely levered firm) the investments relative to total assets decrease by merely 1.6%. To illustrate an example using an average Swedish firm with a leverage of 0.2 (debt over total assets) a increase of 0.1 to 0.3 in leverage would decrease the investments relative to total assets by 0.16% (0.1 times 1.6%). For the average Swedish overinvesting firm, this change would decrease its investments relative to total assets from 8.60% to 8.44%.

The weak total effect of leverage on absolute investments observed here might be explained by the fact that the mitigating leverage effect on the controlling owner-minority shareholder conflict and the pronouncing leverage effect on asset substitution roughly cancel out. The effect of leverage on overinvestment in the absolute investments regression is in line with the effect suggested by the marginal q regression. The two regressions, however, differ with respect to significance. This is further elaborated on in the next chapter. Table 10 implies the same effect of the variable all equity for absolute investments and marginal q. Thus, the arguments concerning all equity in sub section 5.1.1 generally hold here. However, the arguments should be considered weaker for absolute investments, since the results, unlike for marginal q, are statistically insignificant and exhibit low economic significance.

The results for the variables scaled cash, ownership concentration and size when absolute investments are the dependent variable are similar to the results presented in sub section 5.1.1 for marginal q. Again, however, the results presented for the marginal q regression are statistically significant, whereas the absolute investments regression yields statistically insignificant results for these control variables. The control variable dual class shares is statistically insignificant in both of the regressions. For absolute investments the sign of the dual class shares variable indicates a weak mitigation of overinvestment. However, the economic and statistical significance is so weak that the mitigating effect cannot be concluded.

Surprisingly, the control variable scaled sales exhibits a negative and significant coefficient. The general view is that absolute investments should increase with sales. The control variable lagged Tobin's Q yields a positive and significant coefficient, as we expect. Lagged Tobin's Q is a proxy for the investment opportunities the firm faces. If these opportunities increase, so should the level of absolute investments.

### *5.2.2 Underinvesting Firms*

Our second hypothesis predicts that underinvestment is severed as leverage rises. The negative leverage coefficient for underinvesting firms in Table 10 accepts this hypothesis, however only on the 10% significance level. The result indicates that debt overhang increases with leverage, exacerbating the underinvestment. This finding contradicts the result from the marginal q regression in Table 9, where underinvestment was mitigated by higher leverage. Interestingly, absolute investments are shown to

decline with leverage for over- as well as underinvesting firms. For the overinvesting firms, this has a positive effect on investment efficiency, whilst worsening investment efficiency for underinvesting firms.

Although the economic significance for leverage is higher here than for the absolute investments regression for overinvesting firms, it is still relatively weak. If a firm increases its leverage by one unit (i.e. goes from an all-equity to a completely levered firm) the investments relative to total assets decrease by 8%. To illustrate an example using an average Swedish firm with a leverage of 0.2 (debt over total assets) an increase of 0.1 to 0.3 in leverage would decrease the investments relative to total assets by 0.8% (0.1 times 8%). For the average Swedish underinvesting firm, this change would decrease its investments relative to total assets from 8.4% to 7.6%.

The variable all equity, as expected, implies increased investment efficiency, however with statistical insignificance.

The coefficient on scaled cash is positive and significant, implying that investment efficiency increases as underinvesting firms hold more cash. An explanation for this is that they improve their possibilities of funding profitable projects. The marginal q regression indicated the opposite with statistical insignificance. Ownership concentration pronounces underinvestment with statistical significance in the absolute investments as well as the marginal q regressions.

The negative and significant coefficient on dual class shares signifies that dual class shares worsen underinvestment. Possibly, this can be explained by the fact that the shareholders become stronger in the shareholder-debt holder conflict by a higher voting power, allowing them to exploit the debt holders through debt overhang. However, the marginal q regression indicated the opposite with weak significance.

The coefficient on size in Table 10 is negative and insignificant, implying a weak increase in underinvestment as a result of size.

Scaled sales have a statistically significant negative impact on absolute investment levels for underinvesting firms. This is surprising as the absolute investments levels are expected to rise with sales. As expected the control variable lagged Tobin's Q is statistically significant and positive.

### 5.3 Tobin's Q

This section focuses on the results from the Tobin's Q regressions. The results from regressing equation (11) on the over- and underinvesting groups are presented in Table 11 below. The division of the sample

into the over- and underinvesting groups in Table 11 was carried out using Tobin's Q. Recall from Table 2 that the signs of the regression coefficients should be interpreted similarly for Tobin's Q and marginal q. That is, for the overinvesting group, positive regression coefficients indicate increased investment efficiency (i.e. decreased overinvestment). For the underinvesting group, negative regression coefficients indicate increased investment efficiency (i.e. decreased underinvestment). The Tobin's Q results are generally similar to either the results from the marginal q or absolute investments regressions. Therefore, we refer to the discussion on the marginal q and absolute investments results in the two preceding sections for a more elaborate interpretation of the results presented for Tobin's Q.

**Table 11. Regression results for over- and underinvesting firms**

**Dependent variable: Tobin's Q**

*The regression coefficients are given on the same row as the variable name. The next unlabelled row repeatedly gives the t-values for the respective above standing regression coefficients*

| | Overinvesting firms Tobin's Q<1 | Underinvesting firms Tobin's Q>1 |
|---|---|---|
| Constant | 0.545 *** | 1.478 *** |
| | 8.51 | 6.77 |
| Leverage | 0.098 | (1.166) *** |
| | 1.59 | (3.39) |
| All Equity | (0.013) | 0.021 |
| | (0.31) | 0.21 |
| Scaled Cash | 0.238 *** | 1.249 *** |
| | 2.66 | 5.77 |
| Ownership Concentration | 0.001 | (0.006) *** |
| | 1.33 | (3.00) |
| Dual Class Shares | (0.029) | (0.118) |
| | (1.50) | (1.53) |
| Size | 0.019 *** | 0.090 *** |
| | 3.84 | 3.88 |
| Scaled Sales | 0.016 | (0.035) |
| | 1.07 | (0.70) |
| Within $R^2$ | 0.07 | 0.13 |
| No. of obeservations | 331 | 501 |
| No. of firms | 108 | 146 |
| F-value | 3.17 | 10.11 |

* statistically significant result on the 10% significance level
** statistically significant result on the 5% significance level
*** statistically significant result on the 1% significance level

### *5.3.1 Overinvesting Firms*

The first hypothesis stating that leverage should alleviate overinvestment is confirmed, however with statistical insignificance. The marginal q and absolute investments regressions also confirmed our first hypothesis, with statistical significance for marginal q and insignificance for absolute investments. The results for Tobin's Q for overinvesting firms coincide with the results for absolute investments with respect to leverage. Both measures show statistical insignificance for the leverage variable. In addition, both measures yield a low economic significance. For a one unit increase in leverage, Table 11 indicates that Tobin's Q only rises by 0.098. To illustrate an example using an average Swedish firm with a leverage of 0.2 (debt over total assets) an increase of 0.1 to 0.3 in leverage would increase Tobin's Q of this firm by 0.0098 (0.1 times 0.098). For the average Swedish overinvesting firm, this change would increase its Tobin's Q from 0.765 to 0.7748.

The weak total effect of leverage on Tobin's Q shows that the mitigating leverage effect on the controlling owner-minority shareholder conflict and the pronouncing leverage effect on asset substitution almost cancel out. With respect to the variable all equity the results for Tobin's Q and absolute investments for overinvesting firms coincide. See sub sections 5.1.1 and 5.2.1 for further discussion.

Ownership concentration is shown to mitigate overinvestment with statistical insignificance and weak economic significance. The marginal q regressions gave a similar result, but with statistical significance. For further arguments see sub section 5.1.1.

The control variable dual class shares indicates a weak worsening effect on overinvestment. This result is similar for marginal q, see sub section 5.1.1. As in the marginal q regression, the control variable size shows a statistically significant mitigating impact on overinvestment. The control variable scaled sales is statistically insignificant. The sign of scaled sales surprisingly indicates that sales alleviate overinvestment.

### *5.3.2 Underinvesting Firms*

The second hypothesis claiming that underinvestment should be worsened by higher leverage is rejected on the 1% significance level. Furthermore, the leverage coefficient has relatively high economic significance. For a one unit increase in leverage, Tobin's Q will decrease by more than one. To illustrate an example using an average Swedish firm with a leverage of 0.2 (debt over total assets) an increase of 0.1 to 0.3 in leverage would decrease Tobin's Q of this firm by 0.1166 (0.1 times 1.166). For the average Swedish underinvesting firm, this change would decrease its Tobin's Q from 1.877 to 1.7604.

The marginal q regression for underinvesting firms yielded a similar result. See sub section 5.1.2 for further discussion. Similar to marginal q, Tobin's Q shows that investment efficiency increases for over- as well as underinvesting firms. However, the effect is significantly stronger for underinvesting firms, which is surprising. The variable all equity is statistically insignificant for the underinvesting firms in Table 11. The sign indicates that all-equity firms underinvest more severely than levered firms, which is opposite to what we initially expected and to the results from the marginal q regressions for underinvesting firms. This could partially be due to the proposed mitigating effects of leverage on underinvestment presented in sub section 5.1.2. We expected all-equity firms to underinvest to a smaller extent, since they are exempt from debt overhang.

In the Tobin's Q regression for underinvesting firms, the control variables ownership concentration and size show opposite results to the marginal q regressions for the same group. For Tobin's Q, ownership concentration mitigates underinvestment. Size is shown to increase underinvestment. A discussion on possible reasons for such differences between the measures is presented in section 6.3.

The control variable scaled cash surprisingly shows that underinvestment is severed by higher levels of cash holdings. The marginal q regression also provide this result, but with statistical insignificance. See sub section 5.1.2 for possible explanation. The control variable dual class shares shows a weak mitigating effect on underinvestment, similar to marginal q. See sub section 5.1.2 for interpretation. The coefficient on scaled sales as expected indicates that increased sales lead to reduced levels of underinvestment. The indication is however weak due to statistical insignificance.

# 6 Discussion

Chapter 5 mainly focused on the results separately for the three investment efficiency measures. This chapter builds on the arguments in chapter 5 by further discussing the joint effects of the three measures with respect to leverage. Table 12 below summarizes the results of our regressions. Section 1 covers the effect of leverage on investment efficiency for overinvesting firms, considering the three investment efficiency measures jointly. The second section contains a similar discussion for the underinvesting firms. Section 3 analyzes the differences between the three measures with respect to the results and why differing results may appear. The fourth section compares the thesis to previous studies, which have empirically tested the effect of leverage on investment efficiency. Thereafter, in section 5, a discussion on the contribution of this thesis follows. Finally, in section 6, the limitations of the thesis and suggestions for further research are discussed.

**Table 12. Summary of regression results**

| | Effects on Overinvestment | | | Effects on Underinvestment | | |
|---|---|---|---|---|---|---|
| | Marginal q | Absolute Investments | Tobin's Q | Marginal q | Absolute Investments | Tobin's Q |
| Leverage | - | - | - | - | + ¤ | - |
| All Equity | + | + | + | - | - | + |
| Scaled Cash | + | + | - | + | - | + |
| Ownership Concentration | - | - | - | + | + | - |
| Dual Class Shares | + | - | + | - ¤ | + | - |
| Size | - | - | - | - | + | + |

statistically significant result on at least the 5% significance level

statistically insignificant result on the 5% significance level

¤ statistically significant result on the 10% significance level

## 6.1 Overall Effect of Leverage on Overinvesting Firms

For all three measures leverage is shown to mitigate overinvestment, however with varying statistical significance. As seen in Table 12, marginal q shows statistical significance for leverage, whereas absolute investments and Tobin's Q give statistical insignificance. Thus, overall our results are in line with the first hypothesis, which states that leverage should mitigate overinvestment. The results of this thesis indicate

that for overinvesting firms, the mitigating effect of leverage on the controlling owner-minority shareholder conflict overcomes the exacerbating effect on asset substitution. According to our results the mitigating effect of leverage on the controlling owner-minority shareholder conflict is important. Thus, our results indicate that the controlling owner-minority shareholder conflict in Swedish firms, and not asset substitution, is the main explanatory factor for overinvestment.

The variable all equity also points at the fact that the controlling owner-minority shareholder conflict is the main explanatory factor for the overinvestment in Swedish firms. All three measures show that overinvesting all-equity firms invest less efficiently than levered firms. Marginal q does so with statistical significance, unlike absolute investments and Tobin's Q. Thus, both of the variables leverage and all equity imply that the advantage of being levered, i.e. the mitigation of the controlling owner-minority shareholder conflict, overcomes the disadvantage of increased asset substitution. However, for leverage as well as all equity, absolute investments and Tobin's Q yield statistically insignificant results, indicating that the mitigating effect of leverage on overinvestment is weak. This implies that the alleviating effect of leverage on the controlling owner-minority shareholder conflict only slightly overwhelms the intensifying effect of asset substitution. As a result, although our results suggest that the controlling owner-minority shareholder conflict is the central explanatory factor for overinvestment in Swedish firms, the results cannot conclude that the conflict is severe.

### 6.2 Overall Effect of Leverage on Underinvesting Firms

Our second hypothesis states that underinvestment should increase with leverage. Overall the results point at a rejection of this hypothesis. The results based on marginal q and Tobin's Q, significant on the 1% significance level, reject the hypothesis. The absolute investments results accept the hypothesis, but only on the 10% significance level. Thus, overall the three measures indicate a mitigating effect of leverage on underinvestment. We suggest two possible explanations for this, which are discussed in more detail in sub section 5.1.2. First, we argue that the risk preferences of managers and shareholders in Swedish firms might be poorly aligned, since the Swedish managers generally have low holdings of executive stock options. As a result, Swedish managers might not be rewarded for taking risks, causing them to avoid risky projects even if they have a positive NPV. In this case, increased leverage by increasing the risk of bankruptcy might force managers to invest in risky positive NPV projects, which they would otherwise have avoided due to their high risk. By doing so, leverage would mitigate underinvestment. However, this explanation should not likely account for the entire mitigating effect of leverage on underinvestment observed in our results. The reason for this is that the controlling owners rather than managers should be in charge of the investment decisions in Swedish firms due to the high

ownership concentration. The problem of too cautious risk-taking is less relevant for controlling owners than for managers.

Another phenomenon which could contribute to the alleviating effect of leverage on underinvestment is that controlling owners, in situations where bankruptcy is almost certain, might choose to abstain from debt overhang. That is, the increased bankruptcy risk from leverage could cause the controlling owners to invest in positive NPV projects to keep the firm alive, although a significant part of the proceeds go to the debt holders.[24] The reason for possibly doing so is that the survival of the firm enables them to further enjoy private benefits. In this case, the private benefits for the controlling owners from keeping the firm alive must exceed the loss from the wealth transfer to debt holders. However, this wealth transfer should generally inhibit the controlling owners from pursuing the option to invest in further projects. In addition, this phenomenon should only concern the firms in our sample with extreme default risk. Thus, for most of the firms in our sample this argument should not be a valid explanation to why leverage mitigates underinvestment. Nevertheless, it could explain a small part of the decreased underinvestment as a result of higher leverage.

The two possible explanations for the mitigating effect of leverage on underinvestment, should not completely explain these results. However, they might account for a part of this effect. Further research is needed to more completely clarify the reasons behind the results.

Marginal q and absolute investments show a mitigating effect of the variable all equity on underinvestment, with the effect from marginal q being significant and the effect from absolute investments insignificant. Tobin's Q shows a severing and statistically insignificant effect of the all equity variable on underinvestment. Thus, jointly the three measure overall indicate that the underinvesting all-equity firms underinvest less than underinvesting levered firms. This is expected as all-equity firms are exempt from debt-overhang.

### 6.3 Differences between the Investment Efficiency Measures

In the tests Tobin's Q and especially marginal q give more statistically significant results than absolute investments. One reason for this might be that marginal q and Tobin's Q per se are direct measures of investment efficiency. Absolute investments, one the other hand, are per se a measure of the investment amount in a given year. When employing absolute investments as an investment efficiency measure, the impact on investment efficiency has to be deduced from the change in investment levels.

[24] The reason for investing in positive NPV projects in this case is to generate funds to pay the debt holders, thereby ensuring that the firm will not be liquidated.

By directly measuring investment efficiency instead of deducing it from investment levels, marginal q and Tobin's should be able to capture more information on the underlying investments than absolute investments. Absolute investments capture the investment amount, but not the nature of the investments. Marginal q and Tobin's Q take into account both the investment amount and the nature of the projects invested in. This might be one reason why marginal q and Tobin's Q show more statistically significant results. To illustrate an example of what is meant here, recall that increased absolute investments are assumed to have a negative impact on investment efficiency for overinvesting firms but a positive effect for underinvesting ones. If, for example, an underinvesting firm increases its absolute investments by 100 units in a given year, it is seen as positive for investment efficiency regardless of the nature of the projects invested in, when employing absolute investments to measure investment efficiency. Whether these 100 units of absolute investments consist of highly or only moderately profitable investments will not be taken into account, when studying absolute investments. We only see that absolute investments rise by 100 units. However, if marginal q or Tobin's Q is applied to measure investment efficiency in this example, they will convey how value-adding the 100 units of investments are according to the market. More specifically, these two measures indicate how the investments affect the market value of the firm. When the market evaluates the 100 units of investments, it will not only consider the investment amount, but also how profitable the investments are expected to be. Marginal q and Tobin's Q reflect both of these considerations and should thus capture more information than absolute investments. This could be one reason why marginal q and Tobin's Q pick up stronger effects than absolute investments, as indicated by the higher statistical significance.

Between marginal q and Tobin's Q, marginal q shows more statistically significant results. The main critique against Tobin's Q, when compared to marginal q, is that Tobin's Q is a highly inframarginal measure, since it measures the average investment efficiency over the entire life of the firm (e.g. Mueller and Reardon, 1993, Gugler and Yurtoglu, 2003). Tobin's Q is argued to fail to fully absorb the effect of the explanatory variables on investment efficiency. As Tobin's Q measures the average investment efficiency over the entire life of the firm, it becomes insensitive to changes in investment efficiency for individual years. This might be one explanation why Tobin's Q yields insignificant results for more variables than marginal q.

The inframarginal nature of Tobin's Q increases the risk of endogeneity problems. For some of the variables Tobin's Q show an opposite result to marginal q. One possible reason for this is endogeneity. One variable for which endogeneity might be involved is scaled cash. According to the Tobin's Q regression on overinvesting firms, overinvestment is mitigated by higher levels of cash which is indicated on the 1% significance level, whereas marginal q indicates the opposite with the same statistical significance. It is difficult to theoretically support that scaled cash should mitigate overinvestment.

Tobin's Q might yield this result, since firms with high average investment efficiency over their entire existences (i.e. high Tobin's Q) are likely to have high cash levels, causing Tobin's Q to increase with cash levels for overinvesting firms. However, we wish to test how cash levels affect investment efficiency in the selected period, not how cash levels are associated with the average investment efficiency over the entire life of the firm. Since Tobin's Q measures the latter alternative, cash might become endogenous rather than exogenous, illustrating the possible endogeneity problems associated with Tobin's Q. Marginal q and absolute investments are more marginal investment efficiency measures, reducing the risk of such endogeneity problems. Thus, for the variables where marginal q and absolute investments show conflicting results to Tobin's Q, it might partially be due to endogeneity problems for Tobin's Q.

Furthermore, the differing results between the three measures should also be impacted by the different definitions of investments for each measure. The investments as defined in the marginal q calculation (see equation (4)) contain different items than absolute investments (capex plus R&D). The definition of Tobin's Q does not include an explicit definition of investments, since Tobin's Q is simply defined as the market value of a firm relative to the replacement costs of its assets. Nevertheless, Tobin's Q implicitly captures all investments which affect the replacement costs of the firm's assets, i.e. all investments which are capitalized. The investments as defined for marginal q are not affected by whether R&D is expensed or capitalized. As a result, firms expensing their R&D are comparable to those capitalizing it, when studying marginal q. This is not the case when absolute investments are applied, since only expensed R&D is added to capex[25]. Absolute investments for firms expensing their R&D will be inflated compared to firms that capitalize it. On the contrary, for Tobin's Q the implied investments will be inflated for firms capitalizing their R&D. For both absolute investments and Tobin's Q, this reduces the comparability between firms within each measure. Additionally, since the investments for the three measures are affected differently with respect to whether R&D is expensed or capitalized, the comparability between the measures is also reduced. Considering that the expensed R&D for the firms in our sample is considerable, this should partially explain the conflicting results between the measures. In sub section 3.3.1 we argued that the investment efficiency measures become more consistent when we add R&D to capex for the calculation of absolute investments. This argument still holds although the R&D treatment in the studied firms affects the three measures differently. The option to exclude R&D would have caused the three measures to become less comparable.

It should also be noted that the comparability between Tobin's Q and the other two measures is diminished by the fact that Tobin's Q is employed to split the sample for the Tobin's Q regressions, whereas marginal q splits the samples for the marginal q and absolute investments regressions. When marginal q is employed as a divider, a significantly larger share of the firms ends up in the overinvesting

[25] Capex as defined in this thesis does not include investments in R&D which are capitalized.

group than when Tobin's Q is used for that purpose. This indicates that the choice of divider matters for the appearance of the resulting groups. However, for the meaningfulness of the results it was necessary to use Tobin's Q as a divider for the Tobin's Q sample. The fact that a different divider is utilized for Tobin's Q should nevertheless be part of the explanation for the difference in the results yielded by Tobin's Q and the other two measures.

### 6.4 Comparison to Previous Studies

Here our results are compared to four studies which have empirically tested the effect of leverage on investment efficiency. The purpose of this section is to put our methodology and results into context. This creates a foundation for the discussion on the contribution of the thesis, which is presented in the next section.

Berger and Bonaccorsi di Patti (2006) investigate how increasing leverage affects investment efficiency using data on US banks. They employ profit efficiency, i.e. the proximity of a firm's profits to the benchmark of a best-practice firm facing the same exogenous conditions, as a proxy for investment efficiency. It is studied how increased leverage affects profit efficiency for different segments of leverage levels (leverage segments), i.e. how lowly levered firms are impacted by increased leverage compared to more highly levered ones. It is found that profit efficiency increases with leverage for almost all leverage segments. Their results support that the mitigating effect of leverage on the manager-shareholder conflict overwhelms the worsening effect on the shareholder-debt holder conflict, thereby improving profit efficiency for virtually the entire range of data. Thus, the results from Berger's and Bonaccorsi di Patti's study are in line with ours, since our results suggests an improved investment efficiency as a result of higher leverage for both of the studied groups.

Margaritis and Psillaki (2007) use the distance from the industry's best practice production frontier, labeled firm efficiency, to estimate investment efficiency. They find a positive relationship between firm efficiency and leverage for the entire range of observed data. These results resemble the results of this thesis, as both find investment efficiency to increase with leverage on average for the studied firms.

Zhang (2009) studies how leverage affects investment efficiency, by solely employing absolute investments to measure investment efficiency. To separate firms with different investment opportunities, Tobin's Q is used. High Q firms are defined as firms having a Tobin's Q above the median Tobin's Q for the whole sample. These firms are assumed to have abundant investment opportunities. The high Q firms overall have similar characteristics to the underinvesting firms in this thesis. Low Q firms have a Tobin's Q below the median and are assumed to have scarce profitable investment

opportunities. These firms largely have similar features to our overinvesting firms. Zhang finds that leverage mitigates overinvestment for low Q firms. We find a similar mitigating effect of leverage on the overinvesting group. For high Q firms, Zhang finds that absolute investment levels decrease with leverage, indicating severed underinvestment as a result of higher leverage. This is consistent with the result yielded from our absolute investments regression for underinvesting firms.[26] Our marginal q and Tobin's Q regressions, however, indicate the opposite by showing that leverage mitigates underinvestment with a statistical significance of 1%. These results highlight that there are differences between the three measures.

Degryse and de Jong (2006) study the effects of leverage on overinvestment in Dutch listed firms. Investment-cash flow sensitivity is employed as a measure of overinvestment. High investment-cash flow sensitivity means that managers are wasteful with internal free cash flows, implying overinvestment. Similar to Zhang (2009), the median Tobin's Q is used to split the sample into a high and low Q group. The low Q group is assumed to overinvest. It is found that highly levered firms in the low Q group have lower investment-cash flow sensitivities. That is, it is shown that leverage mitigates overinvestment. This thesis yields a similar result. Degryse and de Jong (2006) propose the strong manager-shareholder conflict in Dutch firms to be the reason for the mitigating effect of leverage on overinvestment.

### 6.5 Contribution

By empirically testing the relationship between leverage and investment efficiency, we add scope to the relatively small but growing literature which has empirically tested this relationship. To our knowledge, this relationship has not been tested for Swedish firms. Thus, we contribute to the geographical dimension of these tests.

In previous literature, researchers have different opinions on the strength of the controlling owner-minority shareholder conflict in Swedish firms. The thesis examines the strength of this conflict and as a result also contributes to the discussion on the conflict.

Within the niche of the literature which has empirically tested the leverage effect on investment efficiency, the methodologies have differed between the studies. In the previous section, a comparison was provided to the studies within our niche which we believe are the most adjacent to this thesis. Each study in this comparison uses a different measure for investment efficiency. Thus, the disagreement

[26] However, Zhang (2009) obtains this result with a 1% statistical significance, whereas our result exhibits a 10% statistical significance. It should be noted that the results are not perfectly comparable, since we split the sample for the absolute investments regression using marginal q. Zhang employs the median Tobin's Q for the same purpose.

among researchers on how to optimally measure investment efficiency seems to be reflected in our niche. Previous studies in this niche usually employ one measure to measure investment efficiency. One of the main contributions of this thesis is that we employ three investment efficiency measures. By doing so, we address the difficulty in measuring investment efficiency in a more comprehensive way. Additionally, by testing three different measures on the same data, the similarities and differences between the measures are highlighted. It is shown in the thesis that the three measures yield different results. We hope that our findings will contribute to the debate on how to optimally measure investment efficiency.

A growing literature promotes the advantages of marginal q as an investment efficiency measure, especially compared to Tobin's Q. To our knowledge, marginal q has not been employed previously when testing the effects of leverage on investment efficiency. We fill this gap.

Our study also differs from the niche of literature empirically testing the effects of leverage on investment efficiency by employing marginal q to divide the sample into over- and underinvesting firms. Previous studies typically use Tobin's Q for this purpose. We use marginal q (and Tobin's Q for the Tobin's Q sample). Marginal q deduces whether the firm over- or underinvested in the period of interest, whereas Tobin's Q estimates over- or underinvestment over the firm's entire life. This advantage of marginal q allows us to better capture the investment decisions in the firm for the relevant period, thereby reducing endogeneity problems.

Previous studies in our niche have devoted more effort to studying overinvestment than underinvestment. Even the studies separating overinvesting firms from underinvesting ones, mainly focus on the overinvesting group (Degryse and de Jong, 2006, Zhang, 2009). In this thesis, we give underinvesting firms equal attention in our analysis. Accordingly, we add scope to the scarce empirical literature studying the leverage effects on underinvesting firms, especially so for the Swedish setting.

### 6.6 Limitations and Suggestions for Further Research

In this section, the limitations of the thesis and suggestions for further research are discussed. One of the findings of this thesis suggests that underinvestment is mitigated by higher leverage in Swedish listed firms. Theoretically, it is difficult to find explanations for this result. We have suggested that leverage by increasing bankruptcy risk might alleviate underinvestment. By increasing bankruptcy risk, leverage is proposed to possibly force overly risk-averse managers to increase risk to levels where more NPV projects are exploited. Furthermore, the increased bankruptcy risk from higher leverage is suggested to cause controlling owners to avoid engaging in debt overhang in cases where the default

risk is extremely high to keep the firm alive. This will only be the case if the controlling owners are willing to accept a wealth transfer from themselves and the minority shareholders to debt holders. The limitations of these proposed reasons in explaining the observed results are elaborated on in the thesis. Further research is needed to determine the extent to which these arguments hold and to find other reasons for the observed results. Our results suggest that future studies should more closely examine the leverage effects on underinvestment, theoretically and empirically.

To control for the separation between voting and cash flow rights, we employed a dummy variable for whether the firm has dual class shares. However, other factors such as pyramidal ownership and cross-holdings could further increase the wedge between voting and cash flow rights. These were not accounted for in the thesis.

This thesis does not intend to make a statement about which of the three investment efficiency measures studied the thesis that is the optimal one. It does, however, aim to further stimulate a discussion on the differences between the measures of investment efficiency. We leave it up to further research to determine how to optimally measure investment efficiency.

# 7 Conclusion

The purpose of this thesis was to study the effects of leverage on investment efficiency in over- and underinvesting firms. The measures marginal q, absolute investments and Tobin's Q were employed to measure investment efficiency. For overinvesting firms, overinvestment was hypothesized to decrease with higher leverage. That is, for this group leverage was expected to improve investment efficiency. This effect of leverage was confirmed by our three measures. Marginal q does so with statistical significance, whereas absolute investments and Tobin's q yield insignificant results for the leverage coefficient. Overinvesting all-equity firms are shown to overinvest more severely than levered firms, with the same pattern of statistical significance as for the leverage coefficient. These results indicate that the mitigating effects of leverage on the controlling owner-minority shareholder conflict overwhelm the exacerbating effect on asset substitution, resulting in a net alleviation of overinvestment. This implies that the controlling owner-minority shareholder conflict is the main explanation for the overinvestment in Swedish firms. However, as two of our three investment efficiency measures showed statistically insignificant results, our results cannot conclude that this conflict is severe.

For underinvesting firms, leverage was hypothesized to increase underinvestment (i.e. decrease investment efficiency) due to debt overhang. Our results overall contradict this hypothesis. Both marginal q and Tobin's Q rejected the hypothesis on the 1% significance level. However, absolute investments accept the hypothesis on the 10% significance level. Thus, overall our results indicate that leverage mitigates underinvestment, which is surprising. Theory predicts that underinvestment should increase with leverage due to debt overhang. We discuss two reasons in the thesis, which might explain part of the contradictory results. These reasons are related to how leverage by increasing bankruptcy risk possibly reduces underinvestment. However, further research is needed to more fully explain the observed results. Underinvesting all-equity firms are shown to invest more efficiently than levered underinvesting firms. This is in line with our initial expectations, as all-equity firms are exempt from debt overhang. The result was statistically significant for marginal q and insignificant for the other two measures.

Thus, the results suggest that leverage improves investment efficiency for over- and underinvesting Swedish firms.

Our thesis shows that there are significant differences between the results from the three investment efficiency measures. This stresses the need for further research on the differences between the measures employed in this thesis, as they cannot all be correct simultaneously when they show conflicting results. By highlighting the differences between the measures we hope to add to the debate on the use of different measures of investment efficiency.

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## Appendix A: Deriving the Multi-Period Weighted Average Marginal q

Here the version of marginal q applied in our regressions, i.e. the multi-period weighted average of marginal q, is derived following Eklund's (2009a) methodology. We start with equation (5) from chapter 3:

(5)

$$M_t = M_{t-1} + PV_t - \delta_t * M_{t-1} + \mu_t$$

We aim to transform this equation into a multi-period expression of the market value, $M_t$, by adding subsequent periods to the last three terms:

(12)

$$M_{t+j} = M_{t-1} + \sum_{j=0}^{n} PV_{t+j} - \sum_{j=0}^{n} \delta_t M_{t+j-1} + \sum_{j=0}^{n} \mu_{t+j}$$

If this expression is divided by $\sum_{j=0}^{n} I_{t+j}$, we get the following:

(13)

$$\frac{M_{t+j}}{\sum_{j=0}^{n} I_{t+j}} = \frac{M_{t-1}}{\sum_{j=0}^{n} I_{t+j}} + \frac{\sum_{j=0}^{n} PV_{t+j}}{\sum_{j=0}^{n} I_{t+j}} - \frac{\sum_{j=0}^{n} \delta_t M_{t+j-1}}{\sum_{j=0}^{n} I_{t+j}} + \frac{\sum_{j=0}^{n} \mu_{t+j}}{\sum_{j=0}^{n} I_{t+j}}$$

From equation (2) we have:

(2)

$$\frac{PV_t}{I_t} = \frac{r_t}{i_t} = q_{m,t}$$

By turning this equation into a multi-period version we obtain:

(14)

$$\frac{\sum_{j=0}^{n} PV_{t+j}}{\sum_{j=0}^{n} I_{t+j}} = \frac{\sum_{j=0}^{n} q_{m,t+j} I_{t+j}}{\sum_{j=0}^{n} I_{t+j}} = \bar{q}_m$$

Substituting the second part of equation (14) into equation (13) and rearranging, we end up with equation (8). This equation is presented in the thesis as the dependent variable in the tests of our hypotheses:

(8)

$$\bar{q}_m = \frac{M_{t+n} - M_{t-1}}{\sum_{j=0}^{n} I_{t+j}} + \frac{\sum_{j=0}^{n} \delta_{t+j} M_{t+j-1}}{\sum_{j=0}^{n} I_{t+j}} - \frac{\sum_{j=0}^{n} \mu_{t+j}}{\sum_{j=0}^{n} I_{t+j}}$$

Equation (8) is the multi-period weighted average of equation (7):

(7)

$$q_{m,t} = \frac{M_t - (1 - \delta_t) M_{t-1}}{I_t} - \frac{\mu_t}{I_t}$$