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Investment-Cash Flow Sensitivity for Swedish Firms

Is overinvestment and underinvestment related to positive and negative free cash flow?

Abstract

The aim of this bachelor thesis is to determine whether there exists a relationship between a firm's level of overinvestment or underinvestment and its level of positive free cash flow or negative free cash flow respectively. We collect data from 165 Swedish firms listed on OMX Stockholm Stock Exchange between 2008-2014. Contrary to previous studies on U.S. data, our results indicate no relationship between a firm's level of overinvestment (underinvestment) and its level of positive (negative) free cash flow. While such a relationship cannot be established, we are able to show that a firm's level of cash flow from assets in place has a positive relation with its level of new investment. Our results thus indicate that investments increase with internal funds, suggesting that there are either financing constraints in place restricting the firm's investment level when internal funds are missing or that agency problems give rise to wasteful spending as internal funds rise or both.

Authors: Victor Abrahamsson (23108) and Sofia Knobel (23023)
Tutor: Håkan Thorsell

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1. Introduction

1.1 Purpose of the study

We aim to examine whether firms with positive free cash flow spend these cash flows on excessive investments whose rates of return are lower than the firm-wide required rate of return, and also whether negative free cash flow prevents firms from engaging in all of its NPV positive projects. We base our research on non-financial Swedish listed firms on the Stockholm Stock Exchange (OMXS). To relate the firm's investing behavior to its free cash flow, we use an investment expectation model, developed by Richardson (2006) that based on a regression of new investment against the firm's growth outlook and a set of control variables predicts the firm's appropriate level of new investment. We then relate the difference between observed and predicted new investment against the firm's free cash flow, to explain the residual investment. Examining potential overinvestment or underinvestment for Swedish listed firms as a consequence of positive or negative cash flows lets us test the generalizability of Richardson's (2006) results on U.S. firms, that indicate that firms indeed tend to overinvest when they have positive free cash flows and underinvest when their cash flow are negative. As such, our study aims to answer the following research question:

Does a firm's overinvestment (underinvestment) relate to its level of positive (negative) free cash flow?

1.2 Background

In a perfect capital market setting, firms are expected to partake in all of their NPV positive projects at hand, since external funds constitute a perfect substitute for internal funds (Modigliani & Miller, 1958). As such, the level of internal finance does not influence a firm's investment decision. However, previous theory and empirical evidence has shown that external funds do not perfectly substitute internal funds, as a result of market imperfections in the form of financing constraints and agency costs (Myers & Majluf, 1984; Myers 1977; Fazzari et al., 1988; 1986; Jensen & Meckling 1976). Myers & Majluf (1984) argue that when firms evaluate an investment opportunity, they should assess it independently of the firm's eligibility to use internal or external funds as financing. Nonetheless, when there exists an information asymmetry between managers and new stockholders that managers take advantage of to the benefit of old stockholders, the external equity market will view shares issues as bad news, making equity financing more costly than internal funds (Myers &

Majluf, 1984). Hence, when a manager is faced with an NPV positive investment opportunity, but has to resort to costly equity financing rather than using internal funding, the investment might no longer be profitable and consequently be discarded. Myers (1977) also proposes that risky debt issues impose a cost on the firm by inducing a suboptimal investment strategy. The firm's unwillingness to engage in all of its NPV positive investment opportunities, under this scenario, is a result of managers acting in the interest of existing stockholders. Because most of the benefits from the investment fall to debt holders, who hold the senior claim, the investment is NPV negative from an equity owner's perspective, causing managers to reject the NPV positive investment opportunity. Fazzari et al. (1988) show empirically that firms are susceptible to the types of financing constraints that Myers (1977) and Myers & Majluf (1988) propose, by presenting evidence of firms cutting back on investment activity when experiencing periods of low cash flows, rather than financing their investments with external funds. Unable to finance some investment opportunities with external funds, these investment-cash flow sensitive firms instead choose to retain most of their earnings, indicating that internal funds and external funds are not interchangeable. Thus, when an NPV positive investment requires external funding, such that the project becomes NPV negative to existing stockholders, the managers' reluctance to fund the investment with new external capital represents a financing constraint imposed on the firm. We define the rejection of an NPV positive project as an underinvestment. Contrary to the cost of discarding NPV positive projects is pursuing projects that are NPV negative to the firm. Jensen (1986) proposes that when managers can use internal funds to finance their projects, making them free from capital market monitoring, they will waste the internal resources on NPV negative projects in line with their personal interest, rather than the interest of the firm. The act of engaging in wasteful spending is the result of an agency problem (Jensen & Meckling 1976). We define managers' decision to invest in negative NPV projects as an overinvestment.

1.3 Contribution

Determining if positive (negative) free cash flows lead to overinvestment (underinvestment) is a value relevant issue to study as overinvestment and underinvestment impairs both firm and shareholder value. Therefore, it is important to study further the prevalence of overinvestment and underinvestment, so the magnitude of these costs can be unearthed. Whereas previous research has been made on overinvestment by U.S. firms, little research has been made on the overinvestment behavior of Swedish listed companies. There are potential reasons why the investing behavior of Swedish firms should differ from the behavior of

American firms. Previous research on the effects of firm performance with respect to ownership concentration has concluded that firm performance increases with higher ownership concentration (Thomsen & Pedersen, 2000). Related to firm performance is a firm's ability to make profitable investments. Since the typical ownership structure of Swedish companies is more concentrated than the typical American ownership structure, whose shareholders are more diluted (Swedish Corporate Governance Board), we expect that the ownership structure of Swedish firms will mitigate overinvestment, as heavily vested owners are more motivated to oversee managerial activities, reducing investments that lack economic substance (Thomsen & Pedersen, 2000). Moreover, the general focus of previous research has been on overinvestment, rather than underinvestment. We expand Richardson's (2006) scope of relating positive free cash flows to overinvestment by also looking at the prevalence of underinvestment when the firm experiences negative free cash flows.

1.4 Scope of investigation

The scope of our investigation is limited to Swedish listed non-financial firms on the Stockholm Stock Exchange (OMXS) during 2008-2014. The sample period has been specified to 2008-2014 due to limitations imposed by data collected from the database Retriever. We do not intend to evaluate whether overinvestment or underinvestment is more prevailing. Moreover, we do not look at any alternative uses of free cash flow, other than overinvesting, or how they interplay with a firm's overinvesting behavior. In the case that firms do overinvest, we are not interested in what types of overinvestment, whether it involves non-profitable empire building, pet projects or diversification. We also leave out any advice on how overinvestment or underinvestment should be remedied by firms, for example through corporate governance constellations that better prevent reckless spending of free cash flows.

2. Theoretical Framework and Previous Research

In their 1958 paper "The Cost of Capital, Corporation Finance and The Theory of Investment", Miller and Modigliani propose that a firm's investment decisions are uncorrelated with its cash flow levels in a perfect capital market setting. More recent literature has however provided evidence of a positive relationship between a firm's investment level and its cash flows. Blanchard, Lopez-de-Silanes and Shleifer (1994) provide empirical evidence of increased investment spending in firms with sudden cash windfalls for U.S. firms

between 1980-1986. Moreover, Richardson (2006) finds that firms with positive free cash flow, defined as excess cash after the firm has financed all its assets in place and investments to meet future growth, tend to invest more heavily, suggesting that a firm's investment decisions are in fact affected by its cash flows. Hoshi, Kashyap and Scharfstein (1991) investigate the effects of information asymmetry on investment-cash flow sensitivity by looking at two subsets of Japanese firms; those affiliated with *keiretsu's*, Japanese company groups that often include large banks, and those not. They find that the former subset shows a significantly lower investment-cash flow sensitivity. They argue that the lower investment-cash flow sensitivity is a result of lower information asymmetry between these firms and banks within the same *keiretsu*, thereby reducing the costs of external financing. Furthermore, Kaplan and Zingales (1997) test the idea that a firm's investment is interdependent with its level of free cash flow and find that whereas financially constrained firms indeed are more investment-cash flow sensitive, their investment-cash flow sensitivity does not correspond to their level of financing constraint, suggesting that the relationship is not monotonic. We find support for a positive relationship between free cash flows and the chosen level of investment from the following two theories: the financing constraint theory developed by Myers & Majluf (1984) and the agency cost theory put forward by Jensen and Meckling (1976).

2.1 Financing Constraint Theory

In absence of perfect capital markets, there are costly frictions associated with raising external capital, because managers are assumed to act in the interest of existing shareholders. As capital markets are aware of the manager's allegiance with existing stockholders, capital markets will interpret the manager's actions as favorable to existing stockholders at the expense of new providers of finance. Consequently, providers of new capital, regardless of them providing debt or equity financing, will demand a higher premium (Stein, 2003). The premium that the providers of new capital demand is a result of financing frictions, described by Kaplan and Zingales (1997) as "…a wedge between the internal and external cost of funds". Consequently, when financing constraints exist and managers are resource constrained and have to turn to the external capital market to fund new investments, some NPV positive investments will be forfeited (Stein, 2003).

2.1.1 Cost of External Equity Finance

Financing constraints are a result of the adverse selection problem first illustrated by Akerlof (1970), who problematizes the firm's ability to raise external equity on capital markets. Given that managers favor current shareholders over new ones, they will be more likely to issue new shares when the firm's shares are overvalued. Hence, a share issue will convey negative information to capital markets, which make accurately valued firms that need to finance future growth opportunities reluctant to raise equity through shares issues, as they will have to sell their shares at a discounted price (Myers & Majluf, 1984). If the cost that results is sufficiently high, then the NPV of the intended investment will no longer be positive, meaning that the firm will discard the investment.

2.1.2 Cost of Debt Finance

2.1.2.1 Credit Rationing

Stein (2003) proposes that Myers and Majluf (1984) arguments on costs related to adverse selection in the equity market can be extended also to the debt market, whereby managers are prone to resort to debt financing if the manager's private information suggests there is a notable likelihood of default. Furthermore, since equity resembles a call option on a firm's assets (Black & Scholes, 1973), there is moral hazard associated with the issuance of debt, as managers that do borrow to an extent that the firm could default in some state of the world, have an increased incentive to take additional risk to increase shareholder wealth, thereby jeopardizing debt-holders promised return (Jensen & Meckling 1976). Both the prevalence of moral hazard and adverse selection in the debt market can lead to credit rationing, restricting firms' access to debt financing by 1) rationing the amount of debt the firm can borrow at the prevailing market interest rate and 2) imposing too high interest rates making the firm unwilling to borrow (Jaffee, Russel 1976). Jaffee and Russell show how the existence of "dishonest" and "unlucky" firms creates credit-rationing conditions on the debt market. Dishonest firms are defined as firms who default on their loan whenever the costs of default are sufficiently low. Unlucky firms are defined as firms that default despite their intention not to. When there are known proportions of dishonest and unlucky firms but the creditor cannot identify the firms belonging to these two groups, the creditors restrict the total amount of funds available in the market. This credit rationing creates an inefficient flow of capital, whereby honest and lucky firms may be unable to raise the necessary funds to finance their profitable investments.

2.1.2.2 Debt Overhang

Myers (1977) find that when firms hold debt large enough to burden the balance sheet and the debt matures after the manager chooses to invest, the manager's decision to invest will be restricted by the level of debt, even if the investment is profitable. New creditors, holding a junior claim, and equity holders, holding the residual claim, will refrain from offering the firm financing for the investment when a large enough amount of the cash flow generated from the investment will be distributed to old debt holders. This makes the project an NPV negative investment for the external providers of capital, whether they be equity financiers or creditors. The burden on the balance sheet, resulting from the large portion of debt, as such prevents the firm from investing in some NPV positive projects.

2.2 Agency Cost Theory

When a firm is abundant with internal funds, the agency cost theory predicts that managers can use these internal funds to act in line with their own agenda at the expense of shareholders, given that shareholders are less informed about the firm than managers and therefore unable to question managerial judgment (Jensen and Meckling 1976). If managers instead are forced to seek external funding to finance new projects, investors require specific information to assess the attractiveness of the investment and also require influence and supervision over the manager's use of funds. Therefore, the manager will be unable to sell an NPV negative investment that benefits the manager at the expense of the firm and the new investor. In the case of debt issuance, the creditor may impose debt covenants, restricting the discretion of the manager's use of funds. As such, when an investment is financed by external capital, the discretion with which the manager can use available funds is limited (Hoshi, Kashyap, Scharfstein 1991; Myers, Majluf, 1984). By using internal funds, managers can avoid the scrutiny of the external capital market, leaving room for managers to pursue their private objectives, such as the preference for running larger firms (empire building), the incentive to partake in investments that boost the manager's reputation, or the allowance of suboptimal investments due to managerial attitudes (Jensen, 1986; Scharfstein and Stein, 1990; Narayanan, 1985; Bertrand and Mullainathan, 2003; Roll, 1986)

2.2.1 Empire building

Jensen (1986, 1993) finds that empire-building preferences cause managers to excessively invest internal funds on investment projects, suggesting that investment will be increasing with the level of internal resources. Managers may have an interest in running larger firms at the expense of the firm's profitability, which creates a conflict in interest between stockholders and managers (Stein, 2003). Grossman & Hart (1988), Stulz (1990) and Hart & Moore (1995) incorporate managers' empire building preferences in formal models by linking the managers' private benefits to their investment decisions. Grossman and Hart (1988) state that management is rewarded by acting in the interest of shareholders, because as long as it does, it remains in power, conditioned that the firm's voting structure enables takeovers. If managers divert from acting in the interest of the shareholders and engage in NPV negative projects that benefit them privately but deprive firm value, the likelihood of a takeover, and replacement of management increases. Given that managers are interested in remaining in control of the company, they will benefit themselves by acting in the interest of their shareholders, by only pursuing NPV positive projects. Stulz (1990) argues that the firm's financing policy also monitors the manager's ability to overinvest. The assumption made is that managers derive perquisites from all investments the firm undertakes, including those that are NPV negative, and as such always claim cash flows are too low to finance all positive investments. Consequently, when cash flows in fact are too low, the manager will find it difficult to raise the necessary capital. Restrictions to funds thus only allows the manager invest too much, in line with personal interest, when cash flows are high. Holding debt will reduce the investment a manager pursues in all states of the world, as debt payments force the manager to pay out cash, making internal funds less available. Hart and Moore (1995) also examine the role of debt as a tool to monitor the manager's level of investment. They show that as the cash flow generated by assets in place increases, the level of long-term debt should increase, restricting managers' ability to engage in wasteful spending as payoffs are distributed to debt holders. Conversely, they show that as the level of future cash flow, generated by its investment opportunities, increases, the level of long-term debt should decrease, allowing managers to initiate all of their profitable investment opportunities. Thus, Hart and Moore argue that there is an optimal capital structure with respect to a firm's investment decisions.

One explanation to manager's empire building preference, proposed by Amihud and Lev (1981), is the manager's incentive to diversify the firm into new industries in order to

reduce the exposure to industry specific risks. Moreover, Shleifer and Vishny (1989) suggest that managers are especially prone to invest in projects requiring their specific human capital, entrenching their role in the firm.

2.2.2 Reputational and Career Concerns

Scharfstein and Stein (1990) propose the herding incentive as one explanation to managers' tendencies to both overinvest and underinvest. They suggest managers follow industry wide trends rather than acting on private information in fear of missing or misinterpreting business information signals that other managers in the industry seemingly receive (Scharfstein & Stein, 1990). The manager's fear of taking the wrong action is motivated by reputational and career concerns. If the manager takes an investment decision that impairs firm value, the assumption is that the labor market will value the manager's services less (Holmström, 1999). Therefore, a manager that observes other firms investing in specific projects will be inclined to make the same kind of investment even if private information suggests that the investment is inappropriate. Additionally, if the manager observes that other firms avoid or discontinue certain investments, the manager will apt to follow the behavior of the industry peers. This is explained by the fact that the reputational repercussion on missing out on a profitable investment that is made by competitors (or equivalently, making an investment against the industry mode) is greater than if the investment is made in agreement with the industry as a whole, but turns out as unprofitable. This is what Scharfstein and Stein refer to as the "sharing the blame effect".

Narayanan and Stein also propose that firms incur agency costs because managers have a short-term perspective due to reputational concern. Narayanan (1985) shows that managers have an incentive to engage in short-term sub-optimal investments with immediate payoff, at the expense of more profitable long-term investments, in an ambition to boost their own reputation. Stein (1989) proposes that managers forsake good investments in an effort to boost current earnings at the expense of future profitability. If the assumption is that the manager's skill is reflected in the share price, the manager will appear skillful if current earnings are increased at the expense of future profitability by refraining from making new investments even if they are NPV positive.

2.2.3 Managerial attitudes

Bertrand and Mullainathan (2003) suggest that managers have a preference for continuing to pledge and maintain assets in established business segments rather than new ones because

they refrain from making tough decisions. The authors call this preference a preference for the quiet life, which may result in both over- and underinvestment. By avoiding the tough decision of divesting an existing business that is no longer profitable, companies engage in overinvestment. Conversely, the firm is underinvesting when not taking the decision to enter a new business segment with profitable prospects.

When managers aver overly optimistic about their skills, Roll (1986) argues that their hubris may result in excessive spending on company acquisitions in vain belief that the acquisition is justified by sufficiently large synergies (Roll, 1986). Heaton (2002) observes that there exists an overinvestment - underinvestment tradeoff related to free cash flow, resulting from managerial overconfidence. Optimistic managers may believe that the capital market undervalues their securities, and will therefore be reluctant to sell debt or equity to finance future investments with the result that some NPV positive investments will be missed out. Managers may also be overly optimistic when it comes to assessing the value of an investment opportunity, making them inclined to undertake an NPV negative project that to the manager appears to be NPV positive. Thus, regardless of the level of free cash flow, the firm is exposed to costs of over- or underinvestment.

3. Hypotheses

The theoretical background presented above provides a framework for the relationship between investment and free cash flows that this paper aims to examine. We conclude that previous theory points to the idea that a firm's free cash flow positively affects its investment level. If the cash flows are positive and large, the manager's discretion over the firm's funds increases, letting the manager engage in wasteful spending. If the firm's free cash flow is negative, the firm is faced with financing constraints, preventing it from raising sufficient capital to partake in all of its profitable investment opportunities. With respect to the above argumentation, we formulate our first hypothesis:

H1: Firms with positive free cash flows will overinvest and firms with negative free cash flows will underinvest

With respect to Kaplan and Zingales (1997), we proceed to investigate whether the relationship between free cash flow and investment slack (overinvestment or underinvestment) is non-monotonic. By this we mean that we wish to examine whether a

dollar increase in positive free cash flow corresponds to an increase in overinvestment of equal magnitude as a dollar decrease in negative free cash flow corresponds to a decrease in underinvestment. To investigate the respective effects we formulate our second hypothesis:

H2: The effects from positive free cash flow on overinvestment and negative free cash flow on underinvestment are dissimilar

4 Method

4.1 Data collection

The selection process that led us to our sample of 165 firms over the period 2008 - 2014 began with us collecting observations from Swedish-listed firms on the OMX Stockholm Stock Exchange, totaling 324 currently listed firms and 120 delisted firms. Based on the Global Industry Classification Standard (GICS) used by Nasdaq, we exclude all financial companies (GICS code 40), as these firms have an unclear distinction between operating, investing and financing activities. From this initial sample we select only those firms whose data for our measures of investment, free cash flow, growth opportunities and control variables are available in either of our databases: Datastream, Retriever and Capital IQ. Out of the initial sample, the accessible data thus limits us to a selection of 165 firms, 158 currently listed and 7 firms that have been delisted during the period, totaling 819 firm years. See Table 1 and Table 2 in Appendix for sample distributions across industries and sample distributions across years.

4.2 Research method and statistical tests

To analyze the potential overinvestment or underinvestment in firms with positive or negative free cash flow, we will predict the firm's estimated level of new investment using an investment expectation model developed by Richardson (2006). We compare the predicted level of new investment to the firm's actual level of new investment to identify any overinvestment or underinvestment, represented by the residual from the investment expectation model. We then relate the residual investment to the firm's free cash flow to investigate whether there is a relationship between the firm's free cash flows and its residual investments.

4.2.1 Investment Expectation Model

The regression model for estimating expected investments is expressed as:

$$I_{NEW,t} = \hat{\alpha} + \beta_1 (V_{AIP}/P)_{t-1} + \beta_2 Leverage_{t-1} + \beta_3 Cash_{t-1} + \beta_4 Age_{t-1} + \beta_5 Size_{t-1} + \beta_6 Stock\ return_{t-1} + \beta_7 I_{NEW,t-1} + \sum Year\ indicator + \sum Industry\ indicator + I^{\varepsilon}_{NEW,t}$$

Where,
$I_{NEW,t}$: New investment scaled by average total assets
$(V_{AIP}/P)_{t-1}$: Growth opportunities, value of assets in place to market value
$Leverage_{t-1}$: Opening balances for debt over debt plus equity
$Cash_{t-1}$: Opening balances for cash holdings scaled by average total assets
Age_{t-1}: Numbers of years listed on the stock exchange OMXS
$Size_{t-1}$: Natural logarithm of opening balance of total assets
$Stock\ return_{t-1}$: Change in market value for the year prior to the investment year
$I_{NEW,t-1}$: Lagged new investment scaled by lagged average total assets
$I^{\varepsilon}_{NEW,t}$: Residual investment

To increase the number of observations for the regression, we base our regression on panel data, meaning we perform one regression for expected new investment for all firms over the time period 2008-2014. By using panel data we include observations for each firm for consecutive years in the same regression. To eliminate the effects from changes between years, we therefore include year dummies. In order for an OLS regression to truthfully estimate the coefficients of our model, the assumption that our error terms are uncorrelated with our independent variables must not be violated. If the error terms affect our independent variables, there is an additional indirect effect on the coefficients estimates, making the coefficients biased. To address this issue, we include industry dummies in addition to the year dummies to control for any endogeneity between our error terms and any of our independent variables. Thus our investment expectation model controls for omitted variables specific to time and industry that potentially correlate with our independent variables.

4.2.2 Hypothesis 1

To test our first hypothesis whether firms with positive free cash flows tend to overinvest and firms with negative free cash flows tend to underinvest, we run a pooled regression on the residual investment resulting from the investment expectation model against the firm's free cash flow. The regression model for residual investment is expressed as:

$$I^{\varepsilon}_{NEW,t} = \delta FCF_t + \varepsilon$$

Where,
$I^{\varepsilon}_{NEW,t}$: Residual investment
FCF_t: Free cash flow

The null hypothesis states that there is no relationship between the firm's residual investment and its level of free cash flow. The alternative hypothesis states that there is a positive correlation between a firm's level of free cash flow and its residual investment, which would suggest a positive value for the coefficient δ.

$$H_0: \delta = 0, H_1: \delta > 0$$

4.2.3 Hypothesis 2

Given that there is an effect from free cash flow on the firm's residual investment, we test our secondary hypothesis. To test the magnitude each dollar of positive (negative) free cash flow has on overinvestment (underinvestment), we divide our sample of free cash flows into positive free cash flows and negative free cash flows, restricting the observations in the former group to be positive or zero where a negative value exits and the observations in the latter group to be negative or zero where a positive value exits. We perform a pooled regression on residual investment against free cash flow:

$$I^{\varepsilon}_{NEW,t} = \delta_1 (FCF < 0)_t + \delta_2 (FCF > 0)_t + \varepsilon$$

Where,
$(FCF < 0)_t$: Negative free cash flow
$(FCF > 0)_t$: Positive free cash flow

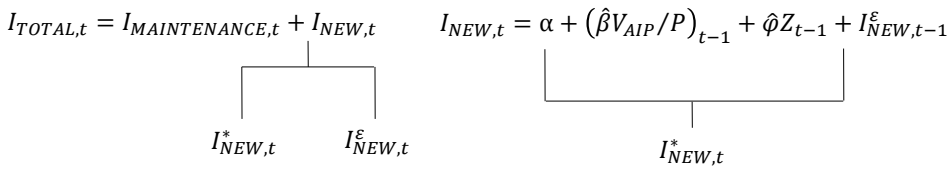
The null hypothesis states that the negative effect of one dollar of negative free cash flow on the firm's residual investment is of equal magnitude as the positive effect of one dollar of positive free cash flow on residual investment. The alternative hypothesis states that the negative effect of a one-dollar decrease in negative free cash flow on residual investment is dissimilar from the positive effect of a one-dollar increase in positive free cash flow on residual investment. We interpret the coefficients δ_1 and δ_2 as the effects on residual investment from a one percentage change in free cash flow. Hence, if the coefficients δ_1 and δ_2 take different values at a significant level, we reject the null hypothesis.

$$H_0: \delta_1 = \delta_2, H_1: \delta_1 \neq \delta_2$$

4.3 Defining Investments

We specify total investment (I_{TOTAL}) as investments to maintain assets in place ($I_{MAINTENANCE}$) plus investments in new projects (I_{NEW}). Investments in new projects are further decomposed into expected new investments (I^{*}_{NEW}), given by the investment expectation model, and residual investments (I^{ε}_{NEW}), which represent deviations from the expected new investment level. The expected new investment level is that which lets the firm engage in all of its eligible NPV positive projects. Any new investment level that exceeds the expected new investment level represents an overinvestment, which would yield a positive value for the residual investment. Conversely, any new investment level below what the investment expectation model predicts represents an underinvestment and yields a negative value for the residual investment.

Fig. 1. Decomposition of the investment expectation model



We define total investment as the change in the sum of intangible and tangible assets for the year, plus depreciation and amortization and expensed research and development for the year. Accounting standards require that R&D activities whose future economic benefits are uncertain be expensed. However, because R&D activities are in endeavor to generate future economic benefits, we consider R&D expenses as discretionary investment and include them in total investments for the year. We use depreciation and amortization as a proxy for determining the level of investment needed to finance assets in place, as it represents the exhaustion of existing assets and consequently the amount necessary to replace with new assets, given that the firm's depreciation schedule truthfully represents the use of the asset.

Fig. 2. The components of total investment and maintenance investment

$$I_{TOTAL,t} = \sum Tangible\ assets_t + Intangible\ assets_t - \sum Tangible\ assets_{t-1} + Intangible\ assets_{t-1} + Deprecaiton\ \&\ Amortization_t + Expensed\ Research\ \&\ Development_t$$

$$I_{MAINTENANCE} = Depreciation\ \&\ Amortization_t$$

4.4 Estimating Growth Opportunities

We will include a measure for growth opportunities as explanatory variable in our model for expected new investment, as we expect the firm's investment level to be an increasing function of the number of NPV positive projects available to the firm. To estimate the firm's growth opportunities, we comply with common practice and relate the firm's fundamental value with its market value (Richardson, 2006). Prevalent constructs for growth opportunities are book-to-market of equity (BM), earnings-to-price (EP) and Tobin's Q (Lewellen & Lewellen, 2014; Vogt, 1994). However, in order to use either BM or EP alone as statistics for growth opportunities, earnings must be entirely transitory or permanent respectively (Richardson, 2006). It is well documented that earnings display some, but not complete persistence between years (Dechow, Hutton & Sloan, 1999). Thus, BM and EP are insufficient statistics for growth opportunities when used separately. In line with Richardson (2006), we will calculate the fundamental value of the firm by using the residual income framework, originally developed by Ohlson (1995), to calculate the value of assets in place (V_{AIP}) based on the book value of equity and current value of earnings.

Fig. 3. Presentation and decomposition of value of assets in place

$$V_{AIP} = (1 - \alpha r)BV + \alpha(1 + r)X - \alpha r d$$

Where, $\alpha = \omega/(1 + r - \omega)$, r is the firm specific cost of equity, BV is the book value of equity, X and d are net income and dividends for the year respectively and ω is the earnings persistence parameter (Restriction: $0 < \omega < 1$)

We make a departure from Richardson's approach to calculate value of assets in place where he chooses:

1) to apply the same discount rate in the calculation of V_{AIP} for each firm every year
2) to use operating earnings as the chosen earnings figure

We regard it as an improper method to use a common discount rate for operating measures and equity and we also consider it to be too general of an approach to apply the same discount rate to companies with different risks. Instead we choose to apply the firm specific cost of equity in the calculation of V_{AIP} for each firm year. The firm's specific cost of equity is estimated from the CAPM model, by performing a regression on the excess stock return over the risk-free rate against the excess market return over the risk-free rate.

$$R_i - R_f = \alpha + \beta \times (R_m - R_f) + \varepsilon$$

As we examine the potential overinvestment and underinvestment in relation to positive free cash flow and negative free cash flow respectively for Swedish listed companies on the OMXS, we cannot resort to using the earnings persistence parameter of 0.62 (Dechow, Hutton & Sloan, 1999) that Richardson applies as it is based on data for US firms. We therefore calculate our own earnings persistence parameter (ω) based on net earnings, book value of equity and the calculated cost of equity for the firms in our data sample. We specify the persistence of earnings by running a pooled regression on the abnormal return on earnings for the current period against the abnormal return on earnings for the previous period. Abnormal earnings are calculated as the difference between net earnings and the required return on equity that the firm's cost of capital demands. The resulting coefficient (0.78) from the regression (ω) is then used as our measure for earnings persistence in the calculation of value of assets in place (V_{AIP}) for each individual firm year.

$$abnormal\ return_t = \alpha + \omega \times abnormal\ return_{t-1} + \varepsilon$$
$$abnormal\ return_t = Net\ Income_t - r_E \times Book\ Value\ of\ Equity_{OB;t}$$

By relating the fundamental value of the firm as measured by V_{AIP} to the market value of the firm, we arrive at a statistic for growth opportunities (V_{AIP}/P) that relates the market value of equity to both current earnings and book value of equity in one measure. Whereas the use of a weighted average of BM and EP allows earnings persistence to take any value between being entirely transitory and entirely persistent, for BM and EP to be appropriate measures for growth, earnings persistence must be entirely transitory ($\omega = 0$) or entirely persistent ($\omega = 1$) respectively. The weighting of the book value of equity and current earnings is dependent on the persistence of earnings exhibited in our data sample, where a high earnings persistence puts more weight on earnings than book values of equity and vice versa.

By identifying (V_{AIP}/P) as a linear combination of BM and EP, it becomes evident why these measures are insufficient statistics for growth opportunities whenever earnings display some means of earnings persistence. If book-to-market values of equity $\left(\frac{BV}{MV}\right)$ are used to describe growth opportunities, the fundamental value of the firm must equal the book value of equity in order for BM not to misstate growth opportunities. Only when there is no earnings

persistence, the value of assets in place will be made up entirely of the book value of equity. Under this scenario BM becomes a sufficient statistic for growth opportunities.

Assuming earnings are completely transitory ($\omega = 0$)
Inserting $\omega = 0$ into α gives $\alpha = 0/(1 + r - 0) = 0$
Inserting $\alpha = 0$ into V_{AIP} gives $V_{AIP} = (1 - \ 0 \times r)BV + \ 0 \times (1 + r)X - \ 0 \times rd = BV$

When earnings are completely permanent, the quoted book value of equity becomes superfluous in calculating the value of assets in place. Instead, the book value of equity is derived from current earnings generated by assets in place when calculating the value of assets in place.

Assuming earnings are completely permanent ($\omega = 1$)
Inserting $\omega = 1$ into α gives $\alpha = 1/(1 + r - 1) = \frac{1}{r}$
Inserting $\alpha = \frac{1}{r}$ into V_{AIP} gives $V_{AIP} = \left(1 - \frac{1}{r}r\right)BV + \frac{1}{r}(1 + r)X - \frac{1}{r}rd = \frac{X}{r} + X - d$

In the case of temporarily low current earnings, using EP alone as a proxy for growth opportunities might misleadingly indicate strong growth prospects for the firm. Thus, earnings-to-price, $\frac{X}{MV}$ is only a satisfactory proxy for growth opportunities in the case of earnings that are completely permanent. As temporarily depressed current earnings will not depress BM, it becomes relevant to incorporate the information in BM alongside the information embedded in EP whenever estimating growth opportunities for a firm whose earnings exhibit low persistence. Using V_{AIP}/P as our proxy for growth opportunities then correctly classifies the firms with the lowest values for BM and the lowest values for EP as the firms with the strongest growth prospects.

4.5 Predicted Signs of Independent Variables

As our measure for growth opportunities relates the firm's value of assets in place to its market value, which is made up of the value of assets in place and the value of growth opportunities, firms that exhibit smaller values for V_{AIP}/P are those with higher growth opportunities. Therefore, we expect the sign of the coefficient for growth opportunities (V_{AIP}/P) in our regression to be negative, meaning that higher values for V_{AIP}/P lead to lower values for I_{NEW}. We include control variables that induce either agency cost effects or

financing constraints effects, affecting the firm's investment decision. We use $Leverage_{t-1}$ as a control variable in the regression of expected new investment because increased leverage is expected to reduce the investment level of the company since issuing debt commits future cash outflow to debt holders, and therefore reduces the agency cost of free cash flow by reducing the cash amount available for spending at the discretion of managers (Jensen, 1986). Leverage also causes firms to pass on some investment opportunities, as a result of financing constraint costs associated with leverage (Myers, 1977; Myers & Majluf, 1984; Jaffee & Russell, 1976). We also use cash as control variable as the investment level is expected to be an increasing function of cash. Opler et al. (1999) find evidence that firms with large cash balances relative to total assets spend more on acquisitions and have higher capital expenditure than other firms, even when the investment opportunities for the firm appear as low. On the other hand, firms with large cash pools avoid more costly external financing alternatives, reducing the impact from financing constraint costs (Myers & Majluf, 1984).

Age is also included as a control variable as theory suggests that the cost advantage that internal funds have over external funds, resulting from asymmetric information, which inhibits providers of external finance to correctly assess a firm's investment opportunities, is decreasing with increasing firm maturity (Fazzari et al., 1988). This research suggests that mature companies with well-known prospects to a lesser extent, if even at all, are subject to financing constraints that inhibits investments. If we make the assumption that a firm's maturity is contingent on its age, we expect investment to be an increasing function of firm age. Furthermore, Fazzari et al. (1988) show that smaller firms to a lesser extent can access external capital markets, making it more difficult for smaller firms to raise the necessary amount of cash to fund new investments. Hence, we expect the investment level to be increasing with firm size.

Whereas stock returns are unassociated with agency costs or financing constraints, previous empirical studies have shown that lagged stock returns have strong explanatory power for increased investment expenditure (Barro, 1990). Lamont (2000) argues that investment lags are the reason for the positive covariation between lagged stock returns and investment expenditures, as well as for the negative contemporaneous covariation between investments and current stock returns. An exogenous change in the form of a lowered discount rate would induce increased investment, as the hurdle rate on investment falls. As a result of the lowered discount rate, the sum of future discounted cash flows increases, causing stock prices to immediately rise. Considering investments lags, the time lag between the decision to invest and the actual cash outflow on new investments, increased

investments would naturally follow increases in stock returns. We thus expect investments to be an increasing function of lagged stock returns. Because we use depreciation and amortization as proxy for maintenance investments, our investment expectation model is subject to bias from firm specific attitudes toward depreciation rates. If the firm chooses to accelerate (decelerate) its depreciation-rate to the extent that it no longer represents the use of the asset, maintenance investments will appear too large (small). To control for firm attitudes toward depreciation rates, we include previous new investments ($I_{NEW,t-1}$). To the extent that aforementioned behaviors are constant over time, we expect the control variable previous investments in new projects to be increasing with current investments.

Table 1. Predicted signs of independent variables

Explanatory- & Control Variable	Expected sign of coefficient
$(V_{AIP}/P)_{t-1}$	−
$Leverage_{t-1}$	−
$Cash_{t-1}$	+
Age_{t-1}	+
$Size_{t-1}$	+
$Stock\ Returns_{t-1}$	+
$I_{NEW,\ t-1}$	+

This table shows the predicted signs for the coefficients included in the regression of new investment, I_{NEW}, against growth opportunities $(V_{AIP}/P)_{t-1}$ and our chosen control variables:
I_{NEW} is the difference between I_{TOTAL} and $I_{MAINTENANCE}$, where, $I_{MAINTENANCE}$ = Depreciation & Amortization. $(V_{AIP}/P)_{t-1}$ is calculated as the ratio of the value of the firm (V_{AIP}) and market value of equity. V_{AIP} is calculated as $V_{AIP} = (1 - \alpha r)BV + \alpha(1 + r)X - \alpha rd$ where, $\alpha = (\omega/(1 + r - \omega))$. r is the average firm-specific cost of equity calculated as an average over the time period 2002-2006. ω is the estimated abnormal earnings persistence parameter from the model by Dechow et al. (1999). BV is the book value of common equity, d is annual dividends and X is net income. $Leverage_{t-1}$ is the lagged book value of debt deflated by the lagged sum of book value of debt and book value of equity. $Cash_{t-1}$ is calculated as lagged cash by the end of the year deflated by average total assets. Age_{t-1} is the lagged natural logarithm of the number of years since the firm was listed on the OMX SSE. $Size_{t-1}$ is the natural logarithm of a firm's total assets in MSEK measured at the beginning of the year t $Stock\ Returns_{t-1}$ is measured as the change in market value of the firm. $I_{NEW,\ t-1}$ is lagged new investment.

4.6 Defining Free Cash Flow

We define free cash flow (FCF) as the cash flow beyond what is necessary to maintain assets in place and to finance the expected level of new investments. There are two components included in the measure of free cash flow: cash flow generated from assets in place (CF_{AIP}) and expected level of new investment expenditure (I^*_{New}). CF_{AIP} is estimated by adding back expensed research and development and subtracting investments necessary to maintain assets in place ($I_{MAINTENANCE}$). Research and Development (RD) is expensed in the income statement in lieu with prudent accounting standards. However, since we regard RD expense as discretionary investment, we add expensed RD back to cash flow from operating activities

($CFFO$) when estimating CF_{AIP}. Because we regard maintenance investments as non-discretionary investments we deduct it from $CFFO$ when estimating CF_{AIP}. FCF is then estimated by deducting I^*_{New} from CF_{AIP}.

$$CF_{AIP,t} = CFFO_t - I_{MAINTENANCE,t} + RD_t$$
$$FCF_t = CF_{AIP,t} - I^*_{NEW,t}$$

4.7 Data processing

Before using the data to regress the coefficients for our investment expectation model, we adjust the data for anomalies, removing observations that lack substance or show evidence of obvious data flaws. $Cash_{t-1}$, I_{NEW} and $I_{NEW,t-1}$ are scaled with average total assets for the year, which puts a mathematical limit for the values of our variables. Moreover, we limit our results to only include firms whose book value of equity is non-negative. We exclude values for $Leverage_{t-1}$ that exceed one or fall below zero, as the former implies a negative value for the firm's book equity and the latter implies a negative debt balance. We also eliminate all values for which $Cash_{t-1}$ exceeds two or is less than zero. A value for cash exceeding two suggests that the firm's cash holdings are greater than their total assets at the closing balance and a value for cash less than zero suggests the firm has a negative cash balance. We exclude all negative values for $(V_{AIP}/P)_{t-1}$, or values greater than two, as negative values indicate a negative value for book value of equity and values greater than two imply than the market grossly underestimates the market value of the firm. Lastly, we exclude values for $I_{NEW,t}$ and $I_{NEW,t-1}$ below -2 and above 2. A value lower than -2 means that the firm has divested more than 100% of the closing value of its assets, and a value over 2 suggests that the firm has invested in new assets whose closing book value is greater than its total assets at the closing balance. The adjusted data is then winsorized in STATA at the 1st and 99th percentiles to reduce the impact of outlier values, except for $Cash_{t-1}$, $Stock\ Returns_{t-1}$, $I_{NEW,\,t}$ and $I_{NEW,t-1}$ that are winsorized at the 5th and 95th percentiles, due to the presence of extreme outliers.

We calculate our beta values by regressing the firm's weekly stock return against the index return (OMXS30) for 60 months or a minimum of 24 months prior to 2006. For firms whose betas are not significant, whose listing period is too short to estimate a reliable beta from, or whose stock prices could not be retrieved from Yahoo! Finance, we choose not to use the

estimated betas. Instead we assign these firms with the industry average beta, calculated from our sample. Please refer to Table 2 & 3 for definitions of variables and their components.

Table 2. Description of variables

Variables	Definition	Source	Use
$(V_{AIP}/P)_{t-1}$	$V_{AIP} = (1 - \alpha r)BV + \alpha(1 + r)X - \alpha rd$ P = market value of firm	Retriever Datastream	Explanatory Variable
$Leverage_{t-1}$	Leverage is the sum of the book value of short- and long term debt deflated by the book value of equity and total debt	Capital IQ	Control Variable
$Cash_{t-1}$	Cash by the end of the year t-1 is deflated by average total assets for year t-1	Retriever	Control Variable
Age_{t-1}	Age is the log of the number of years the firm has been listed on the OMXS from its last listing.	Nasdaq Nordiqs, Erik Eklund	Control Variable
$Size_{t-1}$	Natural logarithm of a firm's total assets in MSEK measured at the beginning of the year t	Capital IQ	Control Variable
$Stock\ Returns_{t-1}$	Stock return is measured as the change in market value for the firm over the year	Datastream	Control Variable
$I_{NEW,t}$ & $I_{NEW,t-1}$	New investment is scaled by average total assets	Retriever	Dependent & Control Variable

Table 3. Description of components

Components	Definition	Source	Use
Risk free rate	The Swedish 10-year government bond. The average weekly return between year-end 2001 and year-end 2006. The average yearly return year 2006-2014	Riksbanken	Beta CAPM
Beta	Market beta from regressing the firm's weekly excess stock return on the weekly OMX Stockholm index excess return, using 24 to 60 months between year-end 2001 and year-end 2006	Yahoo! Finance	CAPM
Earnings Persistence Parameter	Earnings persistence parameter from regressing abnormal returns for period t on abnormal returns for period t - 1. Abnormal return is calculated as net income less the required return (cost of equity times opening book value of equity)	Retriever	VAIP
Market risk premium	The Swedish market risk premium for the period 1998-2014 (5.6%)	PWC	CAPM

5. Results

5.1 Descriptive statistics for Investments

The average firm invests 9.5% of its asset base for the period 2008-2014. Investment made to maintain existing assets in place ($I_{MAINTENANCE}$) is 3.6% of the assets base for the average firm whereas investment made into new projects represents (I_{NEW}) 5.9% of the asset base for the average firm. The components $I_{MAINTENANCE}$ and I_{NEW} each constitute 32% and 68% of the average firm's total investment respectively.

Table 4. Descriptives for Investment Expenditure

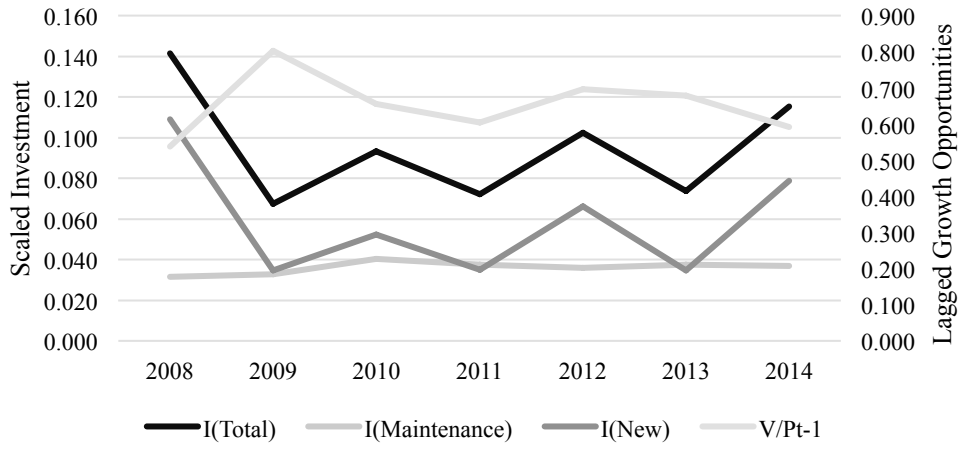
	Mean	Std. Dev.	P1	Q1	Median	Q3	P99
I_{TOTAL}	0.095	0.154	-0.214	0.024	0.065	0.132	0.699
$I_{MAINTENANCE}$	0.036	0.025	0.000	0.021	0.033	0.045	0.100
I_{NEW}	0.059	0.153	-0.251	-0.006	0.028	0.089	0.667

This table presents the decomposition of investment expenditure for a sample of 819 firm-year observations between 2008-2014. All measures of investment expenditure are scaled by average total assets.
I_{TOTAL} is total investment expenditure. $I_{MAINTENANCE}$ is the amount of investment expenditure that is required to maintain assets in place. I_{NEW} is the amount investment in new projects. I_{TOTAL} = (Tangible assets +Intangible assets)$_{CB}$ - (Tangible assets +Intangible assets)$_{OB}$ + DA+ RD
Where, DA = Depreciation & Amortization; RD = Research & Development
$I_{MAINTENANCE}$ = Depreciation & Amortization
$I_{NEW} = I_{TOTAL} - I_{MAINTENANCE}$

Figure 4 reports I_{TOTAL}, $I_{MAINTENANCE}$, I_{NEW} and growth opportunities $(V_{AIP}/P)_{t-1}$ for the average firm for the period 2008 – 2014. Investment made to maintain existing assets in place is stable around 3% to 4% of the asset base for the average firm. The low volatility for $I_{MAINTENANCE}$ is expected since firms tend to depreciate their assets for a specified period. For the average firm in our sample covering 165 firms listed on the Stockholm OMXS the depreciation period is approximately 28 years (1/0.036). Investments made to partake in new projects (I_{NEW}) demonstrate a greater volatility, where the trend is for new investments to drop if the level of investment was high for the preceding year. We expect to see increased investment level following increased growth opportunities. As growth opportunities are lagged by one year, this means that the pattern we expect to see is an increase (decrease) in new investment when there is a decrease (increase) in $(V_{AIP}/P)_{t-1}$. In figure 4 we see that this pattern holds to be true during the period 2008 – 2010 as well as for the period 2013 – 2014. During the period 2010 – 2013 we instead see an increase (decrease) in investment expenditure following a decrease (increase) in lagged growth opportunities, as represented by a higher (lower) value for $(V_{AIP}/P)_{t-1}$. One plausible explanation to this inconsistency in the relation between new investment and lagged growth opportunities could be that the investment lag, which we

measure as one year with reference to Richardson (2006), is non-constant during the period we are covering. Another plausible explanation is the fact that lagged growth opportunities $(V_{AIP}/P)_{t-1}$ is rather constant during the period 2010 – 2013, indicating that there could be some other factors that drive the fluctuation in new investment.

Fig. 4. Trends for scaled investments and lagged growth opportunities



$(V_{AIP}/P)_{t-1}$ is calculated as the ratio of the value of the firm (V_{AIP}) and market value of equity. V_{AIP} is calculated as $V_{AIP} = (1 - \alpha r)BV + \alpha(1 + r)X - \alpha rd$ where, $\alpha = (\omega/(1 + r - \omega))$. r is the average firm-specific cost of equity calculated as an average over the time period 2002-2006. ω is the estimated abnormal earnings persistence parameter from the model by Dechow et al. (1999). *BV* is the book value of common equity, *d* is annual dividends and *X* is net income.
I_{TOTAL} = (Tangible assets +Intangible assets)$_{CB}$ - (Tangible assets +Intangible assets)$_{OB}$ + DA+ RD
Where, DA = Depreciation & Amortization; RD = Research & Development
$I_{MAINTENANCE}$ = Depreciation & Amortization
$I_{NEW} = I_{TOTAL} - I_{MAINTENANCE}$
All measures of investment expenditure are scaled by average total assets.

Table 3 in the Appendix shows the Pearson correlation coefficient between the dependent and independent variables used in the investment regression model. Our explanatory variable that captures growth opportunities $(V_{AIP}/P)_{t-1}$ has a weak negative correlation (-0.223) with new investment (I_{NEW}) at a significance level of 1%, which is in line with our expectation. As a lower value of $(V_{AIP}/P)_{t-1}$ represents more growth opportunities, the negative correlation indicates that more growth opportunities correlates with increased investment level.

With respect to our set of control variables, whose predicted signs are shown in brackets, we can conclude that $(V_{AIP}/P)_{t-1}$ (-), $Leverage_{t-1}$ (-), $Cash_{t-1}$ (+) and $I_{NEW,t-1}$ (+) have the expected correlation signs at a significance level of 1% and $Stock\ returns_{t-1}$ (+) at a significance level of 10%. The Pearson correlation coefficients for our two remaining control variables Age_{t-1} (+) and $Size_{t-1}$ (+) contradicts our prediction, as they are negative. We base our predictions on theory suggesting a diminishing financial constraint, and hence less restricted investment, as

firm size and firm maturity increases. (Fazzari et al., 1988). Contrary to our expectation, the negative sign for the Pearson correlation coefficients for Age_{t-1} and $Size_{t-1}$ with respect to $I_{NEW,t}$ suggest that lower investment levels are consistent with larger and more mature companies. Nonetheless, we choose to include these variables to control for their effect on investment, since their Pearson correlation coefficients against $I_{NEW,t}$ are significant, indicating that there is an effect. $Cash_{t-1}$ and $Leverage_{t-1}$ show the highest Pearson correlation coefficient in absolute terms (|- 0.44|). There is however no problem associated with multicollinearity for $Cash_{t-1}$ and $Leverage_{t-1,}$ as indicated by variance inflation factors (VIF) below two for all our predictor variables for regression 1, shown in Table 5 in Appendix. These VIF-values are far below the common practice cutoff value of ten, suggesting no problems of multicollinearity (Wooldridge, 2012).

5.2 Investment Expectation Model

Table 5 reports the results from the OLS regression of the investment expectation model (1) with robust standard errors clustered at firm level using panel data. We regress New investment ($I_{NEW,t}$) against Lagged growth opportunities $(V_{AIP}/P)_{t-1}$ with a set of control variables; $Leverage_{t-1,}$ $Cash_{t-1,}$ $Size_{t-1,}$ $Age_{t-1,}$ $Stock\ returns_{t-1}$ and $I_{NEW,t-1.}$ The investment expectation model specifies an expected level of new investment (I^{*}_{NEW}) from the fitted values of the regression and specifies over- or underinvestment (I^{ε}_{NEW}) depending on whether the sign of the residual is positive (overinvestment) or negative (underinvestment). The coefficient for our explanatory variable $(V_{AIP}/P)_{t-1}$, which captures a firm's growth opportunities, is negative (-0.048***) and statistically significant at 1%. The interpretation of the coefficient is that a one-percentage increase in $(V_{AIP}/P)_{t-1}$, corresponding to a one-percentage decrease in growth opportunities, results in a 0.048 percentage decrease in new investment activity ceteris paribus. Assuming firms will want to engage in NPV positive investments, a coefficient of -0.048 for the firm's growth opportunities against its future new investments may appear low. The intuition behind the flat relationship between the firm's growth opportunities and its new investments for the subsequent year is that whereas the firm's growth opportunities represent its potential to partake in all future NPV positive investments, the dependent variable $I_{NEW,t}$ only captures the investments the firm makes in the succeeding year. Compared to Richardson's (2006) study on US firms, the suggested effect from a firm's growth opportunities on its level of new investment is greater for Swedish listed firms (-0.0477) than for US listed firms (-0.013).

Whereas we correctly predict the coefficients for the variables $Leverage_{t-1}$, $Size_{t-1}$ and $I_{NEW,t-1}$ in model 1 significant at 1%, the variables $Cash_{t-1}$ and $Stock\ returns_{t-1}$ are not significant at any accepted level when included in the model. In addition, the coefficient for our variable Age_{t-1} is negative and significant at 1%, in line with the negative sign for the Pearson correlation coefficient between Age_{t-1} and $I_{NEW,t}$, but contrary to our prediction that more mature firms would invest more due to lower financial constraints with reference to previous literature (Fazzari et al., 1988). One explanation could be that more mature firms would invest less as their growth opportunities are lower, as suggested by the positive Pearson correlation coefficient between Age_{t-1} and $(V_{AIP}/P)_{t-1}$. Another possibility is that some other unknown factor, not included in the model, influences the sign of the coefficient for Age_{t-1}. We note that 80.4% (1-R^2) of the sample variance is explained by factors the model does not include. As such, there is a possibility that the error-terms affect our independent variables, affecting the sign and magnitude of our model's coefficients. This is also the case for the signs and coefficients of those variables we were able to predict.

The adjusted R^2, which measures the explained sample variance relative to the total sample variance, shows that 19.6% of the sample variance for investments can be explained by the variables included in the model for the unbalanced panel data. This value is lower than Richardson's (2006) adjusted R^2 of 32.6%. Because the regression is used to predict an optimal level of investment, and investment residuals for each firm-year observation, a low adjusted R^2 becomes problematic. The expected level of new investment is a component of our measure for free cash flow, which we use to explain the level of overinvestment or underinvestment, as represented by the residual from our regression of expected new investment. If our investment expectation model only explains 19.6% of the sample variance, 80.4% of the variance is determined by factors that the model omits. This leaves room for significant miss-prediction of the optimal level of investment I^*_{NEW}, and hence the residual investment level I^{ε}_{NEW}. As such, if an erroneously predicted value is used to explain over- or underinvestment, there is a risk that the explanatory power of that model is weak. Furthermore, there is problem with using unbalanced panel data if observations are systematically omitted. This causes the estimated coefficients for the independent variables to be biased because the sample is no longer random (Wooldridge, 2012). To ensure that the clustered robust standard errors are not understated in the unbalanced model, we also perform a regression (model 2) on balanced data to allow for greater variation within firms. In the balanced dataset, only including those firms we have observations for all years between 2008-

2014, all variables except $Leverage_{t-1}$ and $Size_{t-1}$ loose their significance. The adjusted R^2 value increases to 31.8%.

Table 5. The Investment Expectation Model

Investment Expectation	Predicted sign	(1) $I_{NEW,t}$	(2) $I_{NEW,t}$
$(V_{AIP}/P)_{t-1}$	−	-0.0477***	-0.0269
		(0.0117)	(0.0164)
$I_{NEW,t-1}$	+	0.146***	0.0994
		(0.0477)	(0.0664)
$Cash_{t-1}$	+	0.0284	-0.132
		(0.0630)	(0.0921)
$Stockreturn_{t-1}$	+	-0.00110	-0.00309
		(0.0107)	(0.0105)
$Leverage_{t-1}$	−	-0.113***	-0.103***
		(0.0267)	(0.0297)
$Size_{t-1}$	+	0.00700***	0.00522*
		(0.00237)	(0.00262)
Age_{t-1}	+	-0.0197***	-0.00912
		(0.00620)	(0.00673)
Industry Fixed Effects		Yes	Yes
Year Fixed Effects		Yes	Yes
Balanced		No	Yes
Observations		819	392
Firms		165	56
R-squared		0.196	0.318

The table presents results from an OLS regression of new investment $I_{NEW,t}$ against a measure for growth opportunities $(V_{AIP}/P)_{t-1}$ and a set of control variables. Robust standard errors, clustered at firm level are shown in parentheses. I_{NEW} is the difference between I_{TOTAL} and $I_{MAINTENANCE}$, where, $I_{MAINTENANCE}$ = Depreciation & Amortization. $(V_{AIP}/P)_{t-1}$ is calculated as the ratio of the value of the firm (V_{AIP}) and market value of equity. V_{AIP} is calculated as $V_{AIP} = (1 - \alpha r)BV + \alpha(1 + r)X - \alpha rd$ where, $\alpha = (\omega/(1 + r - \omega))$. r is the average firm-specific cost of equity calculated as an average over the time period 2002-2006. ω is the estimated abnormal earnings persistence parameter from the model by Dechow et al. (1999). BV is the book value of common equity, d is annual dividends and X is net income. $Leverage_{t-1}$ is the lagged book value of debt deflated by the lagged sum of book value of debt and book value of equity. $Cash_{t-1}$ is calculated as lagged cash by the end of the year deflated by average total assets. Age_{t-1} is the lagged natural logarithm of the number of years since the firm was listed on the OMX SSE. $Size_{t-1}$ is the natural logarithm of a firm's total assets in MSEK measured at the beginning of the year t $Stock\ Returns_{t-1}$ is measured as the change in market value of the firm. $I_{NEW,\,t-1}$ is lagged new investment. Significance levels are presented accordingly: *** p<0.01, ** p<0.05, * p<0.1

An important realization is that the use of balanced data eliminates all firms that were either delisted or became listed during 2008-2014, creating a survivorship bias. The increased explanatory power of a firm's investment level is as such only applicable to firms that have been listed during the entire period.

5.3 Descriptive statistics for free cash flows

The average firm has a positive cash flow from assets in place (CF_{AIP}) equal to 6.3% of its average asset base between 2008-2014. In order to meet its expected level of new investment (I^*_{NEW}), the average firm should invest 5.9% of its average asset base for the year, meaning the average free cash flow (FCF) is 0.5%. As overinvestment and underinvestment is the residual predicted from the investment expectation model, the average value for overinvestment or

underinvestment is, and should be zero (see Table 6). We also find that 60.9% (39.1%) of the firms in our sample have positive (negative) free cash flows, 83.2% (16.8%) have positive (negative) cash flows from assets in place and 42.7% (57.3%) of the firms overinvest (underinvest).

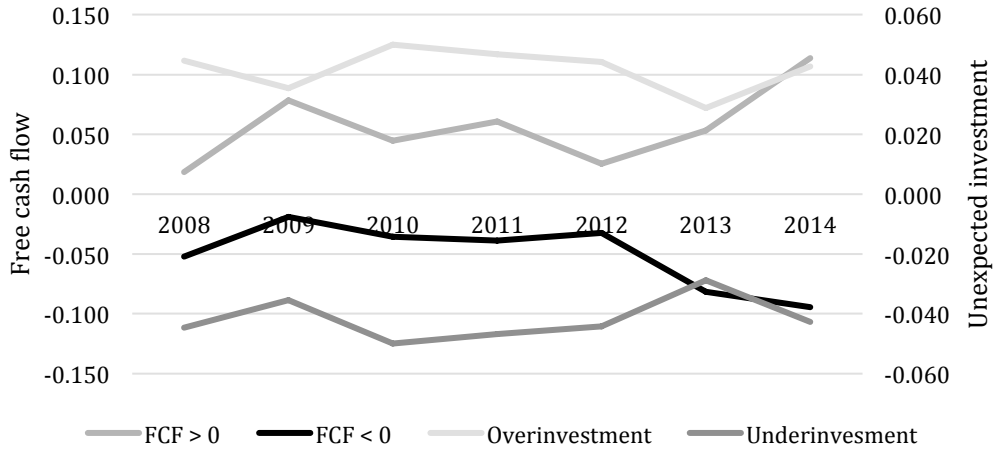
Table 6. Descriptives for cash flow and expected new investment

	Mean	STD. DEV.	P1	Q1	Median	Q3	P99
FCF	0,005	0,524	-0,393	-0,032	0,019	0,064	0,357
I^*_{NEW}	0,059	0,058	-0,061	0,021	0,055	0,096	0,198
CF_{AIP}	0,063	0,525	-0,288	0,022	0,069	0,114	0,523
I^{ε}_{NEW}	0,000	0,142	-0,328	-0,061	-0,015	0,037	0,566

This table shows descriptive statistics for free cash flow (*FCF*), expected new investment (I^*_{NEW}), cash flows from assets in place (CF_{AIP}) and residual investment (I^{ε}_{NEW}) for a sample of 809 firm years divided between 165 firms over the period 2006-2014. All numbers are scaled by average total assets for the year. CF_{AIP} is calculated as operating cash flows less $I_{MAINTENANCE}$ plus research & development expense. *FCF* is calculated as CF_{AIP} less I^*_{NEW} where:
$I_{MAINTENANCE}$ = Depreciation & Amortization
I^*_{NEW} is the fitted value from the investment expectation model
$I^{\varepsilon}_{NEW} = I_{NEW,t} - I^*_{NEW}$

Figure 5 reports the yearly average of positive (negative) free cash flow and overinvestment (underinvestment) for our sample during the period 2008-2014. Both overinvestment and underinvestment are stable, ranging between 3-5% of the average firm's total assets for the year. The overinvestment and underinvestment is the greatest in 2010 (5%) and the least in 2013 (3%). Positive and negative free cash flows show greater volatility. The average firm with positive free cash flow has a positive free cash flow ranging between 2-11% and the average firm with negative free cash flow has a negative free cash flow ranging between 2-9% between 2008-2014. The trend for positive free cash flow during the period is upward sloping with 2008 showing the lowest value for average positive free cash flow (2%) and 2014 showing the highest average positive free cash flow (11%). The trend for negative free cash flows is however downward sloping, with 2009 showing the highest value (-2%) and 2014 showing the lowest (-9%). As we test the relationship between positive free cash flows and overinvestment, and between negative free cash flows and underinvestment, we expect to see that increases in absolute values in either positive or negative free cash flows are accompanied with increases in overinvestment and underinvestment respectively. The extent to which this relationship can be observed is dubious. We see that for positive free cash flow and overinvestment, the two only show a positive relationship between 2011-2012 and 2013-2014. For negative free cash flow we see that there is a positive relationship 2008-2010, 2011-2012 and 2013-2014.

Fig 5. Trends for free cash flow and residual investment



FCF > 0 is positive free cash flow and FCF < 0 is negative free cash flow, calculated as cash flow from assets in place CF_{AIP} less expected new investment I^*_{NEW}. I^*_{NEW} is the fitted value from the regression of new investment I_{NEW} against growth opportunities and a set of control variables. Overinvestment and underinvestment is the difference between observed new investment I_{NEW} and I^*_{NEW}, where positive values yield values for overinvestment and negative values yield values for underinvestment.
All variables are scaled by average total assets.

5.4 Hypotheses

To test our hypothesis, whether firms with positive (negative) free cash flow have a positive relation with overinvestment (underinvestment), we perform an OLS regression with robust standard errors clustered at firm level, where we regress the firm's residual investment, the difference between observed new investment ($I_{NEW,t}$) and expected new investment (I^*_{NEW}), against the firm's level of free cash flow, as shown in model (3) presented in Table 7. The coefficient estimate for free cash flow is 0.136, significant at 1%, supporting our hypothesis that a firm's level of free cash flow has a positive relationship with overinvestment ($I^{\varepsilon}_{NEW} > 0$) or underinvestment ($I^{\varepsilon}_{NEW} < 0$). The interpretation of the coefficient is that for positive free cash flows, a one-percentage increase in the firm's positive free cash flow increases its level of overinvestment by 0.136%, or conversely, for firms with negative free cash flows, a one-percentage increase in absolute terms in the firm's negative free cash flows increases its underinvestment by 0.136%. The R^2 for the model is 1.9%. This suggests that free cash flows cannot explain much of the firm's overinvestment or underinvestment. In model (4) the same regression is performed on the set of balanced data. When the regression is performed on the balanced set of data, the coefficient for free cash flow looses its significance at all accepted levels and the adjusted R^2 drops to 0.8%. Whereas model (3) indicates that there in fact exits a relationship between a firm's free cash flows and its level of overinvestment or

underinvestment, model (4) does not show such relationship. The conflicting evidence presented in model (3) and (4) does not allow for us to reject the null-hypothesis, meaning we cannot conclude whether a firm with positive free cash flow tends to overinvest and whether a firm with negative free cash flow tends to underinvest.

Table 7. Regression of residual investment against free cash flow

	Predicted Sign	(3) I^{ε}_{NEW}	(4) I^{ε}_{NEW}
FCF	+	0.136***	0.0927
		(0.0470)	(0.0636)
Constant		-0.00122	-0.00252
		(0.00403)	(0.00382)
Observations		809	385
Firms		165	56
R-squared		0.019	0.008
Balanced		No	Yes

This table presents the results from an OLS regression on residual investment I^{ε}_{NEW} against free cash flow for the period 2008-2014 with robust standard errors, clustered at firm level in parentheses. *FCF* is calculated as cash flow from assets in place CF_{AIP} less expected new investment I^{*}_{NEW}. I^{*}_{NEW} is the fitted value from the regression of new investment I_{NEW} against growth opportunities and a set of control variables. Overinvestment and underinvestment is the difference between observed new investment I_{NEW} and I^{*}_{NEW}, where positive values yield values for overinvestment and negative values yield values for underinvestment.
All variables are scaled by average total assets.
Significance levels at *** p<0.01, ** p<0.05, * p<0.1

A potential problem in explaining such a relationship is that we attempt to describe the relationship with a linear model, when the relationship might be non-linear. If there is a change in the marginal effect of free cash flow on investment slack, a linear model will be a poor description of how free cash flows and investment relate to each other. A scatter plot for residual investment against free cash flow offers little information as to whether the relationship is linear or not (see Appendix fig. 1). Therefore, the choice between a linear or non-linear model will not impact how much of the sample variance we are able to explain. With reference to Richardson (2006), we accept the linear model. If the relationship between positive free cash flow and overinvestment is dissimilar from the relationship between negative free cash flow and underinvestment, such that the gradients for the two relationships are different, then using one common coefficient for free cash flow is improper. To study the relationship between free cash flow and residual investment we decompose our measure of free cash flow into two variables: positive free cash flow and negative free cash flow. Decomposing free cash flow into two variables allows the slopes for positive free cash flow and overinvestment, and negative free cash flow and underinvestment to take distinct values. A decomposition of free cash flow into positive and negative free cash flow would allow us to more thoroughly test our first hypothesis: that firms with positive free cash flows will

overinvest and firms with negative free cash flows will underinvest. Further, decomposing free cash flow into positive- and negative free cash flow also helps us address our second hypothesis, that the relationship between positive free cash flow and overinvestment is dissimilar from the relationship between negative free cash flow and underinvestment. Table 8 presents an unbalanced (model 5) and balanced (model 6) OLS regression using robust standard errors clustered at firm level, where residual investment is regressed against free cash flow decomposed into positive and negative free cash flow. In model 5, the coefficient for positive free cash flow is positive (0.133) but not significant, whereas contradictory to our prediction, the coefficient for negative free cash flow is negative (-0.141) but not significant. In model 6, the coefficient for positive free cash flow is positive (0.0697) but not significant and the coefficient for negative free cash flow is positive (0.156) but not significant. Seeing as the coefficient estimates for both positive free cash flow and negative free cash flow for the unbalanced data sample are nearly significant (p =0.102 p=0.111) unlike those in model 6, we believe it noteworthy to comment on the implication of the coefficients. The interpretation of model 5 is that regardless of the vector of free cash flow (positive or negative), a firm will tend to overinvest as a result of its cash flows. The interpretation would be that the relationship between free cash flows and overinvestment is convex, with an intercept of zero (see Table 8). A convex model with an intercept of zero is however improper, as it cannot explain underinvestment, and our data for residual investment consists of 57.3% negative values (see Table 4 in Appendix).

Table 8. Regression of positive (negative) free cash flow against overinvestment (underinvestment)

	Predicted Sign	(5) I^{ε}_{NEW}	(6) I^{ε}_{NEW}
FCF > 0	+	0.133	0.0697
		(0.0809)	(0.0939)
FCF < 0	+	-0.141	0.156
		(0.0876)	(0.184)
Constant		-0.000959	-0.000824
		(0.00516)	(0.00544)
Balanced		No	Yes
Observations		809	385
R-squared		0.019	0.009

This table presents the results from an OLS regression on residual investment I^{ε}_{NEW} against positive and negative free cash flow for the period 2008-2014 with robust standard errors, clustered at firm level in parentheses. *FCF > 0* and *FCF < 0* are calculated as cash flow from assets in place CF_{AIP} less expected new investment I^{*}_{NEW}, where positive values are recorded as 0 for *FCF < 0* and negative values are recorded as 0 for *FCF > 0*. I^{*}_{NEW} is the fitted value from the regression of new investment I_{NEW} against growth opportunities and a set of control variables. Overinvestment and underinvestment is the difference between observed new investment I_{NEW} and I^{*}_{NEW}, where positive values yield values for overinvestment and negative values yield values for underinvestment.
All variables are scaled by average total assets.
Significance levels at *** p<0.01, ** p<0.05, * p<0.1

Based on our results from models 5 and 6, we fail to reject the null hypothesis ($H_0: \delta_1 = \delta_2$), that the effect from a one dollar increase in positive free cash flow on overinvestment is identical to the effect of a one dollar decrease in negative free cash flow on underinvestment. Based our results from model 3, we are able to reject the null hypothesis ($H_0: \delta = 0$), that a firm's residual investment level is independent from its level of free cash flow, on a 1% level. This means that there is a positive relationship between a firm's level of residual investment and its level of free cash flow. However, based on results from the balanced data (model 4), we fail to reject the same null hypothesis. Seeing as there is no relationship between a firm's level of overinvestment (underinvestment) and its level of positive (negative) free cash flow, as results show in model 5 and 6, we are thus unable to conclusively show a relationship between residual investment and free cash flow. As model 3, but none of models 4, 5 and 6 provide evidence of a positive relationship between residual investments and free cash flow, we cannot show conclusive evidence that our Hypothesis 1 holds to be true.

6. Discussion

6.1 Evaluation of result

The fact that we cannot present conclusive evidence of a relationship between a firm's level of overinvestment and its level of positive free cash flow could possibly be explained by the strong corporate governance mechanisms present in Swedish firms (Swedish Corporate Governance Board). Theory suggests that corporate governance is an effective measure to limit agency costs of wasteful spending (Harford et al., 2008; Shleifer & Vishny, 1986, 1997) Moreover, Shleifer and Vishny (1986) suggest that a more concentrated ownership translates into more active corporate governance, as the cost of supervision is offset by the reduced costs of managerial wasteful spending. Harford et al (2008) show that firms characterized by weaker shareholder rights and excess cash are also characterized by higher levels of capital expenditure and acquisitions. They argue that the weaker shareholder protection and abundance of internal funds give rise to greater agency problems as it allows managers to engage in wasteful spending. They further show that these firms have lower profitability and valuations as a consequence. As Sweden is characterized by a particularly strong corporate governance code, built on the principle of "Comply or Explain", and also is characterized by a particularly concentrated ownership structure, a potential reason as to why we do not observe

overinvestment in relation to positive free cash flow could be an efficient corporate governance of listed firms.

A potential reason to why underinvestment cannot be identified in relation to negative free cash flow could be that the Swedish market, like the Japanese, is characterized by company consortiums (Shleifer & Vishny, 1997; Swedish Corporate Governance Board, 2015). The potential effect of affiliation with banks in the same consortium is that financing constraints are reduced, as information asymmetry is lower relative to firms that are outside the consortium. This in turn would cause firms within a consortium to exhibit lower investment-cash flow sensitivity (Hoshi et al., 1991).

6.2 Measuring overinvestment and underinvestment

Our failure to reject the null hypotheses is contingent on the accuracy of our measurement for overinvestment and underinvestment, estimated as the residual of the investment expectation model. Hence, the accuracy of our regression of the residual investment (I^{ε}_{NEW}) against free cash flow (*FCF*) is dependent on the strength of the investment expectation model. Unfortunately, the explanatory power of the investment expectation model is relatively weak (R^2 =0.196). If the unexplained variance from the investment expectation model (model 1) can be explained by additional variables that have not been included in the first model, the prediction of expected new investment and residual investment is susceptible to bias, making residual investment an inaccurate proxy for overinvestment or underinvestment. Consequently, when we attempt to relate the resulting residual to the firm's level of free cash flow in model (3) and (4), the regression is attempting to explain a biased measure for overinvestment or underinvestment, which potentially could lead us to make a type II error, that is, we do not reject a null-hypothesis that in fact is incorrect. Miscalculated residuals, estimated from the difference between observed and expected new investment, would be a result of biased expected new investment. Consequently, free cash flows would also be biased, since it is calculated as the difference between cash flow from assets in place (CF_{AIP}) and expected new investment (I^{*}_{NEW}). Miscalculated residuals and free cash flow could thus motivate the lack of explanatory power for models 3 and 4 where free cash flow is related to over- and underinvestment. If it instead is the case that the unexplained variance of the sample in the regression of new investment (models 1 and 2) cannot be explained by additional variables, the residuals from models 1 and 2 are fair measurements for overinvestment and

underinvestment, meaning that our failure to reject the null hypothesis, that there is no relationship between firms with positive (negative) free cash flows and overinvestment (underinvestment), is fair.

The accuracy of our measurement for residual investment will also be compromised if the investment expectation model includes variables that not only determine the expected level of new investment, but also control for overinvestment or underinvestment. There is a risk that we control for overinvestment or underinvestment by including previous new investment ($I_{NEW, t-1}$) and industry fixed effects in the investment expectation model. The intention of including previous new investment as independent variable in our regression of new investment is to adjust for the scenario when depreciation and amortization of assets is a misrepresentative proxy for maintenance investment, due to depreciation schedules that do not map with the use of the assets. The effect of having a misrepresentative measure for maintenance investment ($I_{MAINTENANCE}$) is that new investment (I_{NEW}) also will be misrepresentative (see Fig. 1). To the extent that the misrepresentative depreciation and amortization is constant over time, including previous new investment as an independent variable in the regression of new investment will capture this behavior. The problem associated with including previous new investment is that it may not only control for attitudes toward depreciation and amortization, but also toward investment behavior in general. If that behavior is tainted by either overinvestment or underinvestment, the expected new investment will be biased by overinvestment and underinvestment and no longer specify the level of investment that lets the firm engage in all of its NPV positive projects.

If there is a relationship between overinvestment or underinvestment and industry belonging, then controlling for that relationship means that the expected level of new investment for all companies in our sample will build in overinvestment or underinvestment specific to that industry.

Our measurement of maintenance investment could be susceptible to measurement error, resulting from our decision to regard it as non-discretionary, potentially compromising our validity. If managers stand the option to choose between up keeping an asset or divesting it when the decision to divest is NPV positive, maintenance investments should not be regarded as non-discretionary. The effect of regarding it as non-discretionary when managers do have the option to choose is that we could miss identifying potential overinvestments. Because managers may refrain from making tough decisions, such as divesting an unprofitable asset,

they may overinvest in assets that should not be up kept (Bertrand & Mullainathan, 2003). Hence, our assumption to regard maintenance investment as non-discretionary will inhibit us from observing potential overinvestment associated with maintenance investments, as our investment expectation model only explains new investments. By instead assuming that all investments are discretionary, such that total investment, rather than new investments are evaluated, we would be able to capture overinvestment in maintenance. In reality, the discretion managers hold over maintenance investments is not total, but neither negligible. Thus, if we instead were to view maintenance investments as entirely discretionary for all firms this would mean that we include investments that managers cannot be held accountable for, when we look at overinvestment.

6.3 Measuring growth opportunities

Because growth opportunities cannot be readily observed, we use a proxy for growth opportunities whose validity affects our ability to correctly estimate the expected level of new investment for our sample. Our measure for growth is particularly exposed to two potential flaws: that (1) a misrepresentative earnings persistence parameter causes poor (good) performance to depress (amplify) the firm's value of assets in place to the extent that it appears to have higher (lower) growth opportunities when that is not the case, and (2) the possibility that the cost of overinvestment and underinvestment has already been priced into the market.

Because we use the same earnings persistence parameter for all firms in our sample, not acknowledging any differences in earnings persistence between firms, our measure for growth opportunities will be flawed for firms whose individual earnings persistence parameter deviates from the value we apply. Hence, when a firm with a lower earnings persistence than the regressed earnings persistence parameter, assigned to all firms, exhibits poor earnings, our measurement for that firm's value of assets in place will be too low, as we put too much weight on current earnings for that firm when calculating the value of assets in place (see Fig. 3). This would make the firm appear to have higher growth opportunities than it in fact has, as our measure for growth opportunities relates value of assets in place to the market value of the firm. This would introduce a bias to our measurement of expected new investment with the effect that the expected new investment would be overstated.

If the cost of overinvestment or underinvestment already has been priced into the market, our measure for expected new investment will have controlled for overinvestment and underinvestment. This is because our measure for growth opportunities includes the firm's market price. An alternative approach to measure overinvestment or underinvestment is to facilitate the use of industry median investment as a measure for expected new investment. This results in a measure for expected new investment that is entirely unrelated to market price. Any deviation from the median investment level then represents overinvestment or underinvestment, depending on whether the firm's investment level is above or below the industry median. Free cash flow would then be calculated as the cash flows generated from assets in place less the industry median investment level. Using the industry mean as a fair proxy for the expected level of new investment for the firms within that industry necessitates a large enough number of observations within each industry. Hence, when studying overinvestment and underinvestment on the OMXS, using industry median levels of investment becomes problematic, as the limited number of firms in some industries make the industry median level of investment an unfair proxy for expected new investment (see Table 1 in Appendix for the number of observations in each industry).

6.4 Evaluation of Method

Estimating the relation between positive (negative) free cash flow and over- (under-) investment can be criticized for having a mechanical relationship as the measure for free cash flow is determined in part by the level of residual investment (I^{ε}_{NEW}).

$$FCF = CF_{AIP} - I^{*}_{NEW}$$

Which can be rewritten as,

$$FCF = CF_{AIP} - I_{NEW} - I^{\varepsilon}_{NEW}$$

Richardson (2006) proposes that the mechanical relation can be robustness tested by performing a regression that relates positive and negative cash flow from assets in place (CF_{AIP}) to the level of new investment (I_{NEW}). The following regression is performed by Richardson (2006).

$$I_{NEW,t} = \alpha + \delta_A CF_{AIP} < 0 + \delta_B CF_{AIP} > 0 + \beta_1 (V_{AIP}/P)_{t-1} + \varepsilon$$

Richardson (2006) draws the conclusion that his result, that overinvestment positively correlates with positive FCF, can be supported by his result from the above mentioned regression reporting a positive coefficient for δ_B of 0.319, statistically significant at a reported t-value of 15.19. Although the mechanical relation has been eliminated in the regression

relating positive and negative cash flow from assets in place to new investment, conclusions can only be drawn on the effect of cash flow from assets in place on the level of new investment as opposed to the level of overinvestment that Richardson is attempting to explain. We recognize the limitations with this method as a robustness check for the results reported from the regression of positive- and negative free cash flow against residual investment. The model attempts to explain new investment solely based on positive- and negative values of cash flows from assets in place and lagged growth opportunities $(V_{AIP}/P)_{t-1,}$ omitting the control variables otherwise included in the investment expectation model (see model 1 and 2) As such, Richardson uses an incomplete model to test for a mechanic relationship. The reported coefficient δ_B of 0.319 from Richardson's (2006) study on US firms could thus be inconsistent or subject to bias, as a result of omitting variables that have been shown to have an effect on new investment at a significant level.

Recognizing that relating cash flow from assets in place to the level of new investment cannot be used as a robustness check for our results from models 3-6, we note that Richardson's approach suggest a positive relationship between cash flow from assets in place and the level of new investment. We therefore propose an improvement to the investment expectation model where we incorporate cash flow from assets in place ($CF_{AIP,t-1}$) as an additional predictor variable to the level of new investment ($I_{NEW,t}$). The intention is to observe whether new investments increase with internal funds. Following an increase in internal funds, an increased level of investment could point to either 1) a reduction in financing constraints enabling the firm to partake in more positive NPV projects or 2) an increase in wasteful spending as firms invest in negative NPV projects.

Table 9 shows the modified version of the investment expectation model, with CF_{AIP} included in model 7 and CF_{AIP} decomposed into $CF_{AIP} > 0$ and $CF_{AIP} < 0$ in model 8. The coefficient estimate for CF_{AIP} of 0.016, significant at a 10% level, suggests a positive relation between cash flow from assets in place and the level of new investment. The coefficient for $CF_{AIP} > 0$ is not significant but the coefficient for $CF_{AIP} < 0$ is 0.011 and significant at 5%. The adjusted R^2 for the model 7 and 8 increase to 19.7% and 19.9% respectively, compared to an adjusted R^2 of 19.6% for model 1. We can therefore determine that CF_{AIP} has a positive effect on the investment level, showing that as internal funds increase (decrease) investments follow. This could either be the result of suppressed (amplified) financing constraints, an increase in overinvestment (underinvestment) or both, as cash flow from assets in place increases (decreases).

Table 9. Modified Investment Expectation Model

	Predicted Sign	(7) $I_{NEW,t}$	(8) $I_{NEW,t}$
CF_{AIP}	+	0.0162*	
		(0.00868)	
$CF_{AIP} > 0$	+		0.0415
			(0.0552)
$CF_{AIP} < 0$	+		0.0106**
			(0.00435)
$(V_{AIP}/P)_{t-1}$	−	-0.0463***	-0.0458***
		(0.0116)	(0.0115)
$Leverage_{t-1}$	−	-0.111***	-0.109***
		(0.0265)	(0.0266)
$Cash_{t-1}$	+	0.0207	0.0161
		(0.0633)	(0.0644)
$Size_{t-1}$	+	0.00682***	0.00673***
		(0.00237)	(0.00239)
$Stockreturn_{t-1}$	+	-0.000403	-0.000674
		(0.0108)	(0.0108)
$I_{NEW,t-1}$	+	0.142***	0.140***
		(0.0475)	(0.0473)
Age_{t-1}	+	-0.0197***	-0.0190***
Constant		0.0775*	0.0733*
		(0.0413)	(0.0416)
Industry Fixed Effects		Yes	Yes
Year Fixed Effects		Yes	Yes
Balanced		No	No
Observations		812	812
R-squared		0.197	0.199

The table presents results from an OLS regression of new investment $I_{NEW,t}$ against a measure for growth opportunities $(V_{AIP}/P)_{t-1}$ and CF_{AIP} (full and decomposed into positive values of CF_{AIP} and negative values of CF_{AIP}) and a set of control variables. Robust standard errors, clustered at firm level are shown in parentheses. I_{NEW} is the difference between I_{TOTAL} and $I_{MAINTENANCE}$, where, $I_{MAINTENANCE}$ = Depreciation & Amortization. $(V_{AIP}/P)_{t-1}$ is calculated as the ratio of the value of the firm (V_{AIP}) and market value of equity. V_{AIP} is calculated as $V_{AIP} = (1 - \alpha r)BV + \alpha(1 + r)X - \alpha rd$ where, $\alpha = (\omega/(1 + r - \omega))$. r is the average firm-specific cost of equity calculated as an average over the time period 2002-2006. ω is the estimated abnormal earnings persistence parameter from the model by Dechow et al. (1999). BV is the book value of common equity, d is annual dividends and X is net income. $Leverage_{t-1}$ is the lagged book value of debt deflated by the lagged sum of book value of debt and book value of equity. $Cash_{t-1}$ is calculated as lagged cash by the end of the year deflated by average total assets. Age_{t-1} is the lagged natural logarithm of the number of years since the firm was listed on the OMX SSE. $Size_{t-1}$ is the natural logarithm of a firm's total assets in MSEK measured at the beginning of the year t $Stock\ Returns_{t-1}$ is measured as the change in market value of the firm. $I_{NEW,\ t-1}$ is lagged new investment. Significance levels are presented accordingly: *** p<0.01, ** p<0.05, * p<0.1

6.5 Sample bias

Due to lack of data for the dependent- and independent variables in the investment expectation model, a large number of observations have been omitted, inflicting a bias in our sample. Especially, a significant amount of delisted companies have been omitted as a result of missing data, imposing a survivorship bias and making our sample of the population non-representative. From an initial number of 52 delisted companies during the period 2008 – 2014 only seven delisted companies remain in our sample of 165 companies. Overinvestment and underinvestment represent a cost to the firm, as the firm either accepts NPV negative projects (overinvestment) or rejects NPV positive projects (underinvestment). Consequently,

over- and underinvesting can be classified as traits of bad performance. If we assume that firms that are delisted perform worse than firms who survive on the stock exchange, we expect to see over- and underinvestment more concentrated within delisted companies. A plausible consequence of having a low representation of delisted companies in our sample is then that we might be unable to identify the over-and underinvestment that could in fact be present in the population.

6.6 Robustness test

6.6.1 Autocorrelation

Autocorrelation occurs in panel data when the error terms correlate across time. Autocorrelation does not result in biased coefficients but the coefficients become inefficient as standard errors become understated (Wooldridge, 2012). To test for autocorrelation across error terms in our panel data we perform a Wooldridge test with the null hypothesis stating that there is no autocorrelation. A F-value of 27.365 and p = 0.000 indicates that autocorrelation is present in our panel data. We therefore cluster standard errors at the firm level. Each cluster represents one firm and contains all firm year-observations specific to that firm. When standard errors are clustered at the firm level they become larger and more accurate as a representation of the difference between the sample and population coefficients.

6.6.2 Heteroskedasticity

Heteroskedasticity is when the error terms have a variance that is non-constant, meaning that the variance of the error term is greater for some observations than for others. The presence of heteroscedasticity makes OLS standards errors unreliable through its effect on the variance of coefficient estimates and invalidates the F-test for overall significance of the OLS regression (Wooldridge, 2012). To test for heteroscedasticity in our sample we perform a Breusch-Pagan Cook-Weisberg test for heteroskedasticity (BP test) with the null hypothesis stating that all residuals (e_i) have the same variance (homoscedastic) against the alternative hypothesis that the variance of the error terms differs across observations (heteroskedastic). We reject the null hypothesis of homoscedasticity in our sample as indicated by $\mathcal{X}^2 = 120.58$ and p = 0.000. We also reject the null hypothesis of constant variance for the residuals (homoscedastic) when performing a Whites test, as indicated by $\mathcal{X}^2 = 265.50$ and p = 0.000. We use robust standard errors in all our regressions to correct for the identified heteroskedasticity.

6.6.3 Multicollinearity

To check whether our baseline regression is subject to multicollinearity, which is when independent variables are correlated with each other, meaning that the variation in one indicator variable can be explained by variation in another, we calculate the variance inflation factor (VIF) for model 1. The value results from a linear regression of one predictor value against all other predictor values and is calculated as $VIF = 1/(1 - R^2)$. All our predictor variables have VIF values below two, indicating that there is no problem with multicollinearity for our predictor variables (see Table 5 in Appendix). In combination with the observed Pearson correlations coefficients for our variables we can safely conclude that the variance of the respective coefficients for our indicator variables is not inflated to a degree high enough to make the estimate of coefficient variables unstable and unreliable, as a result of linear dependence with other predictor variables (see table 3 in Appendix for Pearson correlation).

7. Conclusion

As overinvestments and underinvestments represent costs to the firm, understanding the causes of investment slack is a value relevant issue to evaluate. Previous literature that has attempted to explain the determinants of over- or underinvestment has primarily been done in an American setting, attempting to relate the firm's level of internal funds to its investment behavior. Little research has been made on the investment behavior in relation to internal funds in a Swedish setting.

The aim of this study is to shed light on how Swedish firms' investments are affected by their level of free cash flow. We do this by relating a firm's level of overinvestment or underinvestment to its level of positive or negative free cash flow respectively, for Swedish listed firms on OMX Stockholm Stock Exchange between 2008-2014.

We define an overinvestment as an investment in NPV negative projects and an underinvestment as the act of discarding NPV positive investments. We estimate the level of over- and underinvestment as the difference between the firm's observed new investment and its expected level of new investment, predicted using an investment expectation model. We relate the calculated over- and underinvestment to the firm's free cash flow, measured as the firms cash flow from assets in place less the expected level of new investment.

Results show no conclusive evidence of a relationship between a firm's level of overinvestment or underinvestment and its level of positive or negative free cash flow. Our findings, contrary to previous empirical studies on US data, could possibly be explained by a more concentrated ownership structure for Swedish firms. Further research is necessary to determine whether the effect of corporate governance has a mitigating effect on management's use of internal funds on wasteful spending. Whereas we are unable to establish a link between a firm's level of overinvestment (underinvestment) and its level of positive (negative) free cash flow, we are able to show that a firm's level of new investment increases with its level of cash flow from assets in place. This result indicates that a firm's investment level is increasing with its level of internal funds, in line with agency-cost explanations and financial constraint models as well as previous empirical evidence in non-Swedish settings.

7.1 Future research

Although we are unable to show that firms with positive free cash flow overinvest and firms with negative free cash flow underinvest, our study could be extended by examining alternative methods of capturing the proposed relationship. If overinvestment or underinvestment behavior has already been priced into the market, then our measure for growth opportunities will be compromised, distorting our prediction for expected new investment. Notwithstanding risking imposing another bias to expected new investment by building in industry specific over- or underinvestment to the expected level of new investment, an alternative approach would be to specify expected new investment without any price component, instead referring to the industry median level of new investment as the expected level of new investment for the firms in that industry. To overcome the problem of too few firm observations for certain industries and to generate more robust results, we propose that such a study be made on all firms listed in a Nordic setting.

In addition, we propose that further studies be made on the potential mitigating effect from corporate governance on overinvestment, as the Swedish corporate governance structure differs substantially from its American counterpart through a more concentrated ownership structure. Moreover, Swedish corporate governance is unique in the sense that listed companies must follow the code of corporate governance based on the principle "Comply or Explain". We expect that the ambitious Swedish corporate governance ethics is likely to have some impact on the firm's investing behavior.

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Appendix

Table 1. Sample distribution across industries

Industry category	Firms	GICS	Observations	Percentage
Energy	3	10	8	0,98%
Materials	11	15	51	6,23%
Industrials	58	20	331	40,42%
Consumer Discretionary	27	25	130	15,87%
Consumer Staples	6	30	30	3,66%
Health Care	23	35	95	11,60%
Information Technology	31	45	142	17,34%
Telecommunications	4	50	23	2,81%
Utilities	2	55	9	1,10%
Total	165		819	100%

Firms categorized according to the Global Industry Classification Standard (GICS)

Table 2. Sample distribution across years

Year	Observations	Percentage
2008	111	13,55%
2009	104	12,70%
2010	116	14,16%
2011	121	14,77%
2012	122	14,90%
2013	122	14,90%
2014	123	15,02%
Total	819	100,00%

Table 3. Pearson correlation

	I_{NEW}	$(V_{AIP}/P)_{t-1}$	$Leverage_{t-1}$	$Cash_{t-1}$	Age_{t-1}	$Size_{t-1}$	$Stock\ Returns_{t-1}$
$(V_{AIP}/P)_{t-1}$	-0.2228***						
$Leverage_{t-1}$	-0.2031***	-0.0016					
$Cash_{t-1}$	0.1639***	-0.1457*	-0.4413***				
Age_{t-1}	-0.1241***	0.1525***	0.0572	-0.0743**			
$Size_{t-1}$	-0.0807**	0.0038	0.3555***	-0.3137***	0.3622***		
$Stock\ Returns_{t-1}$	0.0630*	-0.2464***	-0.0670	0.0726**	-0.0176	-0.0371	
$I_{NEW,\ t-1}$	0.2330***	-0.1355***	-0.0138	0.0998**	-0.1515***	-0.1584***	0.0142

This table shows the Pearson correlation coefficients for the variables included in the regression of new investment against growth opportunities and a set of control variables. I_{NEW} is the difference between I_{TOTAL} and $I_{MAINTENANCE}$, where, $I_{MAINTENANCE}$ = Depreciation & Amortization. $(V_{AIP}/P)_{t-1}$ is calculated as the ratio of the value of the firm (V_{AIP}) and market value of equity. V_{AIP} is calculated as $V_{AIP} = (1 - \alpha r)BV + \alpha(1 + r)X - \alpha rd$ where, $\alpha = (\omega/(1 + r - \omega))$. r is the average firm-specific cost of equity calculated as an average over the time period 2002-2006. ω is the estimated abnormal earnings persistence parameter from the model by Dechow et al. (1999). BV is the book value of common equity, d is annual dividends and X is net income. $Leverage_{t-1}$ is the lagged book value of debt deflated by the lagged sum of book value of debt and book value of equity. $Cash_{t-1}$ is calculated as lagged cash by the end of the year deflated by average total assets. Age_{t-1} is the lagged natural logarithm of the number of years since the firm was listed on the OMX SSE. $Size_{t-1}$ is the natural logarithm of a firm's total assets in MSEK measured at the beginning of the year t $Stock\ Returns_{t-1}$ is measured as the change in market value of the firm. $I_{NEW,\ t-1}$ is lagged new investment.
Significance levels *** p <0.01, ** p<0.05, * p<0.1

Panel B. Pearson correlation between growth opportunities and lagged growth opportunities

	V_{AIP}/P
$(V_{AIP}/P)_{t-1}$	0.3799***

Table 4. Composition of FCF, CF_{AIP} and I^{ε}_{NEW}

Share of total:	Positive	Negative
Free cash flow	60,9%	39,1%
Cash flow: assets in place	83,2%	16,8%
Resiudal investment	42,7%	57,3%

Fig. 1 Scatter plot between residual investment and free cash flow

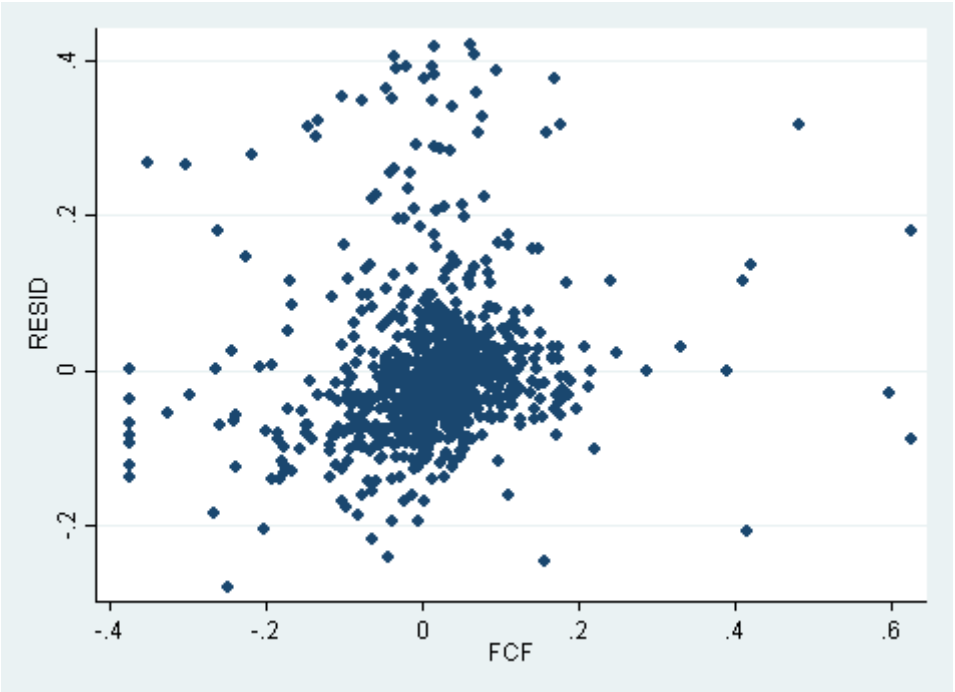


Table 5. VIF Multicollinearity Test

Variable	VIF	1/VIF
$(V_{AIP}/P)_{t-1}$	1.22	0.821444
$Leverage_{t-1}$	1.40	0.714596
$Cash_{t-1}$	1.37	0.729795
$Size_{t-1}$	1.60	0.626071
Age_{t-1}	1.35	0.742354
Stock $Return_{t-1}$	1.38	0.723185
$I_{NEW, t-1}$	1.22	0.817760
GICS		
10	1.04	0.959654
15	1.11	0.897212
25	1.23	0.813136
30	1.09	0.916626
35	1.29	0.775012
45	1.43	0.697264
50	1.11	0.902705
55	1.04	0.957667
Year		
2008	1.79	0.560089
2009	1.94	0.515423
2010	1.71	0.583501
2011	1.72	0.581080
2012	1.81	0.551646
2013	1.77	0.566030

Table 5 shows a variance inflation test for the OLS regression of new investment against the explanatory variable $(V_{AIP}/P)_{t-1}$ and a set of control variables. The sample consists of 819 firm-year observations over the time period 2008 - 2014. GICS classification: 15 = Materials, 20 = Industrials, 25 = Consumer Discretionary, 30 = Consumer Staples, 35 = Health Care, 45 = Information Technology, 50 = Telecommunication Services, 55 = Utilities