Joakim Blix Prestmo

Three perspectives on real investments in the manufacturing industry

An empirical approach

Doctoral thesis
for the degree of philosophiae doctor

Trondheim, March 2020

Norwegian University of Science and Technology
Faculty of Economics and Management
Department of Economics

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Contents

Abstract

This Ph.D. thesis discusses the real investment in the manufacturing industry in Norway and the firms' decision-making-process from three different perspectives. I show, using a novel approach, that firms, and particularly small firms, in the manufacturing industry do, to a lesser degree, use standard methods to shed light on their investment decision. Analyzing a business survey with panel data methods, I find that it is access to credit and demand expectations that are the most critical factors in explaining changes in investment plans. Lastly, the last chapter of this thesis suggests a model for aggregate investments in the manufacturing industry can. Based on the findings of the first chapters of this thesis, I suggest a way to expand the classic investment Euler equation such that it includes financial conditions and the cost of external financing. The investment Euler equation is estimated empirically using standard time series methods, and the estimated equation can forecast the decline in investments during the financial crisis.

Preface

This thesis is submitted to the Norwegian University of Science and Technology (NTNU) for partial fulfillment of the requirements for the degree of Philosophiae Doctor.

The doctoral work has been performed at the Department of Economics, NTNU, Trondheim. Professor Gunnar Bårdsen, John Dagsvik and Håvard Hungnes have supervised the work. Gunnar, my main supervisor, has been supporting me throughout the writing of this thesis, and I owe him a great thank for his patience. I would also thank John for his excellent suggestion and lively discussions. Håvard, thank you for giving me the necessary motivation to finish my dissertation when I left Statistics Norway for my job at BN Bank. I want to thank all of them for their guidance and many comments on my writing.

I would also take the opportunity to thank my former colleagues at Statistics Norway, and particularly Roger Bjørnstad, for encouraging me to start the work on my dissertation. I will also thank Ådne Cappelen and Torbjørn Eika, for the many discussion we had; they played an essential role in the papers of this thesis. I am grateful to my current employer, BN Bank, which gave me time to focus on finishing the Ph.D study – thanks to Trond Søraas.

Last, but not least, I would like to thank my wife Sina Therese, as well as my parents and the rest of my family for all the support they have given me.

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Trondheim, March 2020
Joakim Blix Prestmo

Chapter 1

Preamble

1.1 Introduction

Real business investments; investments in machines, research and development, and buildings and transportation vehicles; fluctuates significantly. During the last two decades, the growth and decline of aggregated business investments have several times shown two-digit figures for the yearly change in investments. The high fluctuations must be seen in contrast to the development in private and public consumption, which shows far less fluctuation, both in absolute and relative terms. This is supporting the view that investment behavior is crucial for predicting economic trends.

Explanations for the fluctuations in real investments are many, but there is still no consensus in the fields of economics about the driving factors behind the variations in investments from one year to another. My research project makes use of three different methodological strategies to shed light on factors explaining investment behavior. The strategy attacks the problem from three different angles, and the hypothesis is that this will help us to gain new insight for understanding the fluctuations in real investments.

1.2 Research question

This Ph.D. dissertation addresses the question: What causes the large fluctuations in real investments in the manufacturing industry, and how can we forecast aggregate investment?

My approach to answering this question is to apply three very different methodological strategies. I combine insight from a survey I sent out to the industry, with

an empirical analysis of a quarterly investment survey and an empirical analysis of macroeconomic data. The first essay discusses a business survey I sent out in 2012. In this essay, I show that there are substantial differences in how large and small firms plan their investments. Valuable insight from this study is that the cost of capital is less important, but access to financial capital is so. The second essay builds on this insight from the first essay and finds supporting evidence for the results of the first essay. Studying a couple of years of data from a business tendency survey, I show that demand expectations and access to credit are by far the most important factors affecting revisions in investment plans. In the first essay I present figures showing that a motive for firms' investments is to reduce labor costs. This result contrasts the conclusion in second essay, where I show in the very short run that it is a positive relationship between capital and labor. These are all hints that tell us that we should model long-term and short-term investments different. The third and last essay of this thesis uses the insight from the two first essays to propose a twist to the classic Q-theory model of Tobin (1969). I suggest that instead of the traditional investment cost function, where there is a cost of installation of the new capital, we should take into effect the cost of funding that is caused by the tightening of the credit market. This way of extending the Q-model is inspired by Kaplan and Zingales (1997). However, in contrast to Kaplan and Zingales (1997), I suggest a way to specify this cost function. In an empirical analysis using time series data, I show how long and short-run investment can be modeled in a way that utilizes the theory model and fully describes the decline in real investments during the financial crisis in 2008 and the lack of growth in investment the years that follow.

1.3 Theoreticalbackground

There are four leading investment theories, all of which are built on the idea that the motivation of the firm is profit-maximizing:

1. The Q-theory, (Tobin 1969)
2. The neo-classical investment theory (Jorgenson 1963) and (Jorgenson and Hall 1967)
3. The Euler-equation (Smith 1960), (Whited 1998) and (Chirinko 1993)
4. Putty-clay (Johansen 1959), (Atkeson and Kehoe 1999) and (Gilchrist and Williams 2005)

The goal of the firm is per definition (in economics) to maximize the profit of the owner. The firms' motivation for running the firm then has some obvious implications.

1. The firm wants to keep costs at a minimum,

   (a) Which imply that the firms should keep employ as low as possible

   (b) Buy the cheapest factor input, given the quality

2. The firm would put/invest its money where the return is the highest

Following those two theorems, we may find the level of the firms' consumption of goods, their level of employment, and their choice of capital investment by minimizing costs at given revenues or by maximizing sales given the costs.

All four investment models generate the result that an investment project starts – if and only if – the return of the investments, measured by the net present value of the future profit stream relative to the investment cost, is larger than the estimated hurdle rate or the market return. Moreover, if the firm receives a higher profit of investing in the firms' money elsewhere, the manager would not invest in her company.

The results in the first essay show that firms only, to some degree, calculate the profitability of their investment projects. They also put their calculations into question. I further show that a fundamental motive for the firm is to both keep the firm alive and create jobs, as well as making a profit, which means that the manager is likely to conduct investments when the profitability is unknown. These results put the researcher in a situation where he wants to question the assumptions above – that one of the goals of this thesis.

1.4 Data

The data used in this dissertation comes from three very different sources. The first essay studies the result of a one-off business survey conducted by myself. The second essay studies the results from the quarterly business tendency survey by Statistics Norway. While the third essay studies aggregated time series investment data from the National account.

These are three widely different data sources, which need profoundly different modeling techniques. The first study is an empirical study on individual firm level (managers are questioned). The second study also has a quantitative approach and is still at an individual firm level, but because the survey is repeated every quarter, the data is organized as a panel dataset. The third and last study is purely quantitative, and the data is macroeconomic data aggregated up to industry level.

1.5 Empiricalstrategy

The empirical methods applied in this thesis are, because of the variance of the data type, highly different. The first essay makes use of a combination of ordered logit models and multinomial logit models to find the firms' most preferred method for making investment decisions. I combine this with two-way diagrams and non-parametric statistics in order to verify the results of the survey.

The second essay studies a binary dependent variable. To study the change in the probability of a change in the firms' response, a probabilistic model, like the probit or logit model, is most appropriate. Due to the dynamics in the panel data, the choice of methodology is not apparent; this is why several model specifications are tested.

The third essay studies whether the knowledge gained from the two first articles may apply to macroeconomics. Using time-series data, the methodology changes dramatically. I apply standard time-series methods, like the Error correction models (ECM) and bounds testing. I have also tested a vector autoregression (VARX), without changing the results of the analysis. Hence the simple ECM framework is kept.

1.6 Summary of the essays

This section gives a brief overview of the papers in this thesis.

1.6.1 Paper 1

The first paper discusses the which methods, if any, are the most preferred ones when the firms make their investment decision. To answer this question, I send out a business survey to firms in the manufacturing industry in Norway. The business survey poses several questions to business managers in the manufacturing industry regarding capital budgeting and how they plan their investment projects. Questions, such as which methods they use to calculate the profitability of their investment decisions and how the firms fund their investments. The firms are further asked a range of questions that might shed light on the driving factors behind which methods they use. The motivation behind this survey is, therefore, to uncover some qualitative characteristics of the investment decisions; this is done by applying both descriptive methods and empirical analysis.

To answer which method is the preferred one, I apply a two-step process. The first step is to estimate the frequency of choosing a given method, using an ordered logit model. The second step utilizes the results from the ordered logit model by inserting the estimated parameters in a multinomial logit model. This gives us an

estimated probability that the given method is most preferred by the firm.

The analysis in the first essay shows that the managers' practice differs between small and large firms. I find that smaller firms embrace simple methods for these calculations, and the results show that small firms have less sophisticated decision rules than large firms. A surprisingly large share of the firms prefers to use the Payback model for calculating the profitability of an investment. Moreover, nearly no firms prefer the net present value methods, which is the method textbooks recommend.

1.6.2 Paper 2

Firms continuously analyze whether to stand by their planned investment projects or whether they need to adjust their investment plans. This essay applies panel data to assess the relative contribution of factors explaining changes in firms' investment plans. The analysis builds on data from a quarterly business tendency survey as well as national accounts statistics and register data. Conventional register data on investment decisions contain systematic measurement error due to time lag from when an investment decision is taken to it is effectuated. In contrast, survey data do not suffer from this problem and therefore are particularly well suited for studying investment behavior. I find that changes in the firms' expected demand and access to credit are the most important variables for explaining changes in investment plans. Firms; independent of size; are most likely to adjust their investment downwards when demand expectations are weak, and credit conditions are tight. Neither changes in capital costs nor the financing costs seem to play a significant role in the short-run investment dynamics.

1.6.3 Paper 3

The third paper shows how the Investment Euler equation may be extended to capture the cost of external funding and the tightness in the credit market. The theoretical model is tested empirically on aggregated time series data for the manufacturing industry in Norway. I find empirical support for the theoretical model, and present a model where real aggregated investments are explained by the cost of external finance, production, profitability, and the credit spreads. Aggregated manufacturing investments are modeled using the bounds testing approach, together with the error correction framework using national accounts figures and financial statistics. I find that an increase in the cost of external funding relative to the cost of internal funding reduces the return on investments. The analysis shows that a one percentage point increase in the credit spread decreases investments with 7 percent. The profit ratio is known to be essential for investments. I find that the effect of a one percent increase in the profit to production ratio raises investments

with a rate of 0.13 percent.

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Investments and Capital Budgeting Practice: Is there a difference between small and large firms?*†

Joakim Blix Prestmo[a, b]

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[a,]The Norwegian University of Science and Technology (NTNU), Department of Economics, N-7491 Trondheim, Norway, e-mail: Joakim.Prestmo@ntnu.no

[b]Statistics Norway, Reserch Department,P.O. Box 8131 Dep., N-0033 Oslo, Norway

Abstract

To increase our understanding of how business executives plan their investment budget, this paper analyses the results from the business survey that was sent out to a representative sample of firms in the manufacturing industry in Norway. The business survey was conducted in cooperation with The Business Tendency Survey of Statistics Norway. This linking to the Business tendency survey leads to a far higher response rate compared with similar studies, and it covers a representative share of the firms in the Norwegian manufacturing sector. I find, as many papers have shown before, that there are mismatches between theory and practice, but in contrast to earlier work, there seems to be a considerable mismatch. There is substantial firm size heterogeneity in capital budgeting: Smaller firms embrace simple methods for these calculations, and the results show that small firms have less sophisticated decision rules. Finally, a surprisingly large share of small and middle-sized firms do not put significant weight on their calculated investment criteria. If firms do not put weight on their calculations, this helps us in explaining why firms use gut feeling rather than thorough calculations to decide which investment project they start. Interestingly, being a subsidiary cancels the firm size effect. Indicating that there exists a sharing of best practices across larger corporations.

Keywords: Business Survey, Discount Rates, Capital Budgeting, Firm Size Heterogeneity

1 Introduction

Aggregate investments have been low in most OECD countries in the years following the financial crises, Banerjee et al. (2015). There is no agreement on what caused the investment level not to pick up to the pre-crisis levels. Some analysts have pointed to low expected demand as a possible cause, while others look to the over-capacity caused by larger than sustainable investment levels before the Financial crisis. Difficulties in getting credit is another cause for low investments. In recent years there has been an increased amount of studies analyzing the effect of credit and economic activity on, see e.g. Gertler and Gilchrist (2018) or Borio (2017). In the build-up to the Financial crisis, there was an accumulation of cash holdings in many firms, Bates et al. (2009). The increased cash holdings should have eased the need for credit, thus reducing financial constraints.

The goal of my paper is to study the manager's practice in capital budgeting and investment planning. To bring new insight to the table, I have conducted a one-off business survey of the manufacturing industry in Norway. My hope is that the survey may shed light on the discussion about the lack of investment growth from a different perspective than traditional empirical analysis have given us.

Specifically, the paper discusses which methods are preferred by the managers to support the investment decision. I am particularly interested in studying to what extent their practices are consistent with, or goes against the textbook approach. Textbooks in corporate finance recommend firms to use the net present value method to calculate the expected profitability of an investment[1]. The hurdle rate used to discount the expected cash flow is supposed to take into account the riskiness of the project, but also the share of debt funding. With several projects, the internal rate of return could assist the management with the ranking of its projects, according to this theory. Lastly, the theory recommends that firms should analyze the sensitivity of the assumptions it made to calculate its expected cash flow. If firms follow those recommendations, they will behave as predicted by the Neoclassical investment models. If not, how should we think about modeling real investments?

I have tried to design the survey such that the answers can be used to rank the different

[1] An example of a corporate finance textbook is Brealy et al. (2017)

methods used by the managers for its investment planning. An additional motive has been to obtain insight about the underlying assumptions behind the Neoclassical investment models. To address these issues, the survey questionnaire contains questions about the firms' qualitative questions concerning its assumptions, such as how significant emphasis it puts to its calculated hurdle rate. I do not believe that I can validate or falsify the different theoretical models using the results from this survey. However, it will increase our insight into which perspective a practitioner is taking on in capital budgeting and investment planning, and by this increase our understanding of investment fluctuations. The findings from this survey have been essential to the results of paper 2 and 3 in this Ph.D. dissertation. The results from this paper helps us to put the empirical models of in the second paper in context, while the theoretical model in the last paper is motivated with on the insight from the survey.

The business survey was conducted during the winter 2012/2013 and is unique in the sense that the response rate is as high as 42 percent. Furthermore, being able to use the same respondents as in Business Tendency Survey (BTS) of Statistics Norway, the sample would be stratified. The sample is linked to administrative data and the Statistics Norways's quarterly Investment Survey which enables us to address more detailed research questions. The high response rate and the fact that the survey is representative of the whole population of manufacturing firms make it possible to study firm size effects using ordered logit model and two-way tables in a way few other studies have done.

My research shows that decision-making processes varies substantially between small and large firms. Small firms use different methods than large firms and pay less attention to the formal capital budgeting process. This implies that aggregate investments in countries with a relatively high share of large firms respond differently to shocks affecting firms' expectations than how a similar shock would affect investments in countries with a relatively high share of small firms. Hence, I argue that one has to take into account heterogeneity in the firm size distribution for different countries when modeling aggregate investments. Thus, this paper contributes to the literature on firm size heterogeneity and management practice. I have studied management practice in its use of investment and corporate finance theory and present empirical evidence showing that there is a different management practice between small, middle-sized, and large firms.

The paper starts with a brief literature review in the next section. Section 3 discuss the data and the business survey. The empirical and descriptive methods are explained in section 4, while the analysis is described in section 5. The analysis starts by going through the survey results briefly. This gives detailed coverage of the firms' practice and strategy. Then an econometric model is applied to analyze the business survey data together with administrative data to uncover what methods the firms choose for their capital budgeting process and which factors are best at describing their choices. Section 6 summarizes the paper. Detailed figures, a description of the survey, tables with statistical tests of the survey results, and further survey results not discussed in the paper are found in the appendix.

2 Literature

The study of management practice, and particularly the firms' choices related to its investment decision have been conducted in decades. A comprehensive study of the Chief Financial Officers' (CFO) practice of capital budgeting and investment planning is found in Graham and Harvey (2001). The survey is covering three distinct topics: Capital budgeting, cost of capital, and capital structure. The focus of Graham and Harvey (2001) is to identify whether the standard theory is backed up by empirical findings. One of the strengths of the paper is that the survey covers a large part of the theories discussed by the corporate finance literature. However, many countries are, in contrast to the US, less dominated by large firms and corporations and have a relatively large share of small firms. Graham and Harvey (2001) mainly focus their attention on large corporations, for good reasons. Brounen et al. (2006) extend the work of Graham and Harvey (2001) through their particular focus on capital structure policies. An important message from Brounen et al. (2006) is that capital structure policies differ substantially across countries. There is consequently a need to fold out different management practices since they also seem to differ widely between countries. A potential weakness with both Graham and Harvey (2001) and Brounen et al. (2006) is that both papers have a relatively low response rate. They report a response rate of nine percent and five percent, respectively. A low response rate may make it somewhat difficult to generalize the results. If the respondents are unfamiliar with the terms used in the questionnaire, they are more likely to drop out of the survey. If

there are selection effects present in the survey, this can bias the responses towards the use of more complicated methods, and away from more straightforward decision rules.

In a study of venture capitals (VC) Gompers et al. (2019) surprisingly find that few VC funds use the methods recommended by academic textbooks. Their finding goes against Graham and Harvey (2001) showing that only a small share of the funds use the NPV method to calculate the valuation of their investment and supports the view that gut feeling plays a large role in the investment decision. They do not find any firm size effect on the methods chosen by the VC fund to value the investment, but they find that small funds are more likely to rely on gut feeling when taking their decisions.

Bloom and Reenen (2010) surveys the management practice of plant managers at medium-sized firms around the world. Based on their survey, they find substantial differences in practice between countries, with the US rating highest. Their study highlights the importance of studying management practice and they also find that it is not sufficient to study management practice in a few counties. Kengatharan (2016) discusses the empirical research of corporate finance during the last 20 years and represent valuable insights into management practice.

Except for Gompers et al. (2019), none of the papers above focus mainly on how practice varies between small and large firms. However, firm size heterogeneity and management practice are discussed in several other studies. Gertler and Gilchrist (1994) study how firm size affects the firm's response to a monetary policy shock. They find empirical support for a more significant contraction in inventories, sales, and short-term debt in small firms relative to larger firms when the credit supply tightens. Calomiris and Hubbard (1990) have also highlighted the role of firm size heterogeneity. They discuss how firm heterogeneity caused by information asymmetry affects the capital structure and their access to credit. Runyon (1983) also studies investment practices in small US businesses. Runyon (1983) finds that small firms embrace more straightforward methods than Graham and Harvey (2001), but the paper does not compare the practice of small firms with middle-sized and large businesses. This makes it challenging to study relative differences of practice.

3 Data

3.1 The Norwegian Manufacturing Industry

The Norwegian manufacturing industry is characterized by having a relatively large share of small and middle-sized firms. The Norwegian offshore petroleum industry is sizeable, and because of this, the manufacturing industry has a relatively large share of the firms in the ship and rig building industry compared to other OECD countries. Furthermore, the manufacturing industry is prominent in the production of inputs and investment goods and characterized by few producers of consumer goods.

In OECD countries, the average number of employees per enterprise in the manufacturing industry were 17.4 in 2012.[2] The trio – US, Germany, and Switzerland had nearly twice as many employees per enterprise than the average OECD country. The South European countries: Greece, Italy, Portugal, and Spain are at the bottom of the scale with far fewer employees per enterprise than the average country. Norwegian enterprises are also below the average OECD with 13.2 employees per enterprise. If one does not take into account the firm size composition, then studies of corporate finance practice in the US, UK or the Germanic-speaking countries, will not be directly comparable to result from the studies of countries like France, Poland, Netherlands or Norway. All are countries with an average employee per enterprise of about 13. Hence, studying Norwegian data as a representative for countries with a larger share of smaller firms, might further increase our insight into firm behavior.

Recall that the purpose of the survey is to obtain data that can be applied to study which methods the firms prefer when evaluating investment projects. The survey questionnaire contains further questions that are useful for understanding their choice of methods. The business survey builds on the quarterly Business Tendency Survey (BTS) by the Division for Manufacturing Statistics at Statistics Norway. The BTS is a survey that is based on questioning the firms about the business' prospects and their investment budget, which I analyze in the second paper of this thesis. I sent the questionnaire to the same respondents as those that participate in the BTS. Hence, the respondents have experience in filling out business surveys. The respondents are, in most cases, the general manager or the chief

[2]Unweighted average; data source: OECD Productivity statistics; stats.oecd.org

Table 1: The distribution of firms and employment in the total population and the sample within each firm size category, all figures measured in 2013

	Firms			Employees		
Category	*N*	In pop.	In sample	*N*	In pop	In sample
Total manufacturing	13 518	100 %	745	188 954	100 %	92 845
Small manufacturing firms	12 640	93.5 %	34.0 %	49 281	26.1 %	7.2 %
Middle manufacturing firms	540	4.0 %	56.6 %	74 088	39.2 %	29.4 %
Large manufacturing firms	338	2.5 %	9.4 %	65 584	34.7 %	63.3 %

Notes: The table shows figures for number of firms and total employment in the population. The "In pop" and "In sample" figures shows the relative distribution of small, middle and large sized firms in the total population and in the sample respectively. Firms without employment are excluded from this summary table.

accountant. In the largest firms, the respondents are typically the Chief Financial Officers (CFO). The advantage of using the respondents of the BTS is three-folded.

Regarding data quality, the respondents in this survey are accustomed to answering questionnaires related to expectations and investment practices. Statistics Norway has strong confidence among businesses, which both enhance truthful answers and a high response rate. Second, the sampling procedure used by Statistics Norway secures that the sample is representative and unbiased both across firm size and across industries. Third, the respondents are linked to their firms' organization number, which makes it possible to link the survey data to administrative data from the Business and Enterprise Statistics and data from the quarterly Investment Survey, both from Statistics Norway. Linking survey data with administrative data enables us to cross-validate some of the responses given to the questionnaire with the administrative data. After I added the administrative data to the survey data, it was possible to study if there are any biases in average debt to asset ratio, investment level or the number of employees between the firms that responded to the survey and firms that did not respond.

Managers of manufacturing firms typically have a varied educational background. Table 2 shows the education of the respondents. The survey shows that a large share of the respondents has high education and that CFOs and CEOs of large firms are much more likely to have a decree within economics. It is also interesting to note that among smaller

Table 2: The education level of the respondents. In percent

	Lower 2nd	Upper 2nd. Pract.	Upper 2nd. General	Technological Ba or M.Sc	Economics Master	Economics Bachelor	Other University	Other studies
Small	1.8	5.4	8.1	15.3	20.7	19.8	27.0	1.8
Middle	0.0	6.7	5.2	7.4	31.9	28.2	18.5	2.2
Large	0.0	0.0	5.5	7.3	34.6	21.8	29.1	1.8
All firms	0.7	5.0	6.3	10.3	28.2	23.9	23.6	2.0

Table 3: Summary statistics for each employment category (no. of employees) of firms in the total population of Norwegian manufacturing industry. Average for the years **2011-2014**

	0 - 9	10-19	20-49	50-99	100-199	200+	All firms
Number of firms	15 663	1 759	1 381	514	271	159	19 747
Employees**	30 391	23 728	42 596	35 463	37 037	63 808	233 023
Value added*	15 787	14 902	28 943	26 273	34 930	71 812	192 646
Gross investments*	2 164	1 239	2 360	2 753	4 354	6 931	19 800

*Notes: *In million NOK, **Total employed within this category. Value added in market prices*

firms there is a large share of firms where the managers have a technical background, typically a bachelor's degree from a university college or a master of science from a university. Table 3 summarizes the administrative data of the firms participating in this survey.

Data is organized as a cross-section set. Because data is sampled once, one would expect that the business trends are affecting some of the answers in an unknown direction. If the perception of the firms' prospects varies with the business cycle, the level of uncertainty will also vary. Hence, one would expect that practice related to the investment decisions also varies with the business cycle. Even though the questions are formulated in a general way, an important concern was to conduct the survey when the Norwegian business climate was close to neutral, i.e., when investments increase with a rate close to the long-run growth rate. In such a climate the business managers are more likely to have a balanced view of the prospect of their firms'.[3]

[3]For a detailed description of real-time the business climate see Chart 1.10 in the Monetary Policy Report 1/2013, published by the Central Bank of Norway

The survey design is based on stratified sampling. The BTS divides the firms into four different strata, and the respondents are drawn randomly from each stratum. The probability of being drawn from the population increases with firm size. Also, all firms within the stratum of the largest firms are included in the sample. The population includes firms in the Norwegian mining and manufacturing sector with more than ten employees. The total number of respondents, drawn from the full population, is 745 firms. The mining and manufacturing industry in Norway consists of almost 20 000 firms, and slightly above 9 000 firms have no employees, and a further 6 500 have less than ten employees. Firms with none or few employees amount to a small fraction of the total employment and total investments in the manufacturing industry. Those firms were excluded from the population before the sampling. Details about the composition of the firms are shown in Table 20 in the appendix. The firms included in the sample add up to approximately 40 percent of the total employment in the manufacturing industry, while it covers 3.5 percent of the total number of firms in the industry.

After correcting for non-responses, 36.5 percent are small firms, 55.2 percent are middle firms, and 8.1 percent are large firms. I want to test whether there are any biases in firm size composition between the response and non-response groups. Using a t-test to test for differences in mean employment of the group with a response and the group with a non-response, I find that the difference in firm size distribution is insignificant between the two samples. Hence, it is possible to argue that there are no selection issues related to firm size between the respondents and the non-respondents in the sample.[4]

To achieve a high response rate, I reduced the number of questions in this survey compared to those occurring in Graham and Harvey (2001) and Brounen et al. (2006). Furthermore, for every question, the respondents could choose to answer that the question was "Not relevant for our firm". The motivation for including this response category was to encourage the respondents unfamiliar with the concepts questioned to respond. Finally, the information letter contained detailed information about the survey and it requested the

[4] A two-sided Welch t-test for the difference in mean employment between the group of response and non-response $\Pr(T > |t|) = 0.63$, i.e. I do not reject the H_0 : difference in means is zero. A test for difference in mean employment with the Wilcoxon rank-sum test gives a p-value of 0.37, i.e., one does not reject H_0: difference in means is zero. I do a similar test for difference in the debt to asset ratio, revenue, and total investments, and all indicate that there are small biases between firm responding and not to the survey.

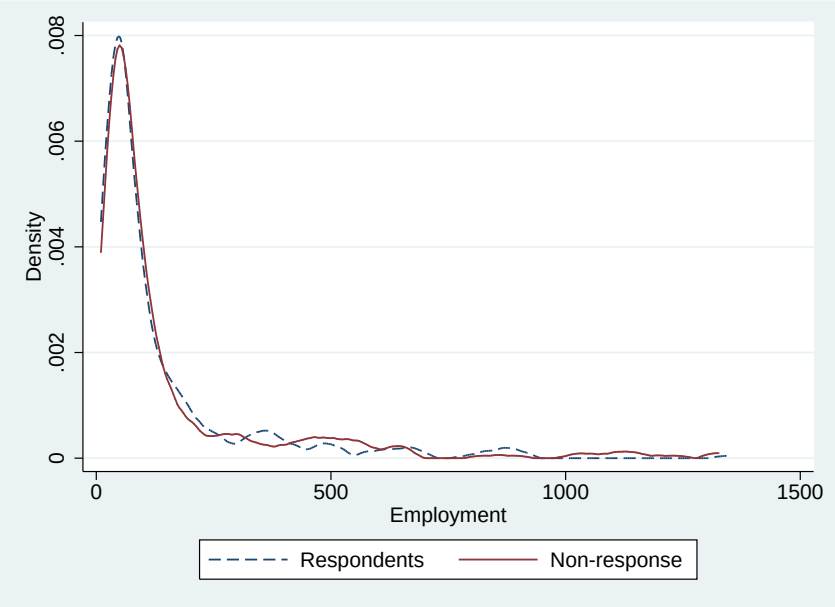


Figure 1: Kernel density distribution of firm employment. Non-response and respondents.

respondents not to hesitate to answer even if they were unfamiliar with the topic addressed in the question. This resulted in a high response rate from both from large as well as small firms, with a response rate of 42 percent.

The survey uses an Internet-based survey program called Enalyser. Respondents were contacted by e-mail, and they replied using an Internet questionnaire. All respondents are linked to their firms with an organization number. The organization's number makes it possible to link the survey results with firm data from administrative registers for Statistics Norway. The survey was initiated Medio November 2012, and a dunning letter was sent Medio December and ultimo January 2013, with a deadline 31st of January. The last questionnaire was received in February 2013.

In order to reduce the possibility that the first response category dominates the survey results, the ordering of the response categories in the questionnaire was rotated whenever it was possible and logical. To make the analysis relevant, I needed to ensure that the firms that responded to the questionnaire conducted investments regularly. Hence, I asked when they conducted their last investment. Two-thirds of the firms had made investments within a half year before they were surveyed, and only 5 percent had conducted their last investments more than two years before the survey. In addition, 2 percent of the firms said investing in real capital was not relevant for their firms. These firms was taken out of

Table 4: Correlation matrix, estimated using the polychoric transformation. Method for calculating profitability of investment project

	EAC	IRR	NPV	Payback	Several methods	No methods
EAC	1					
IRR	0.04	1				
NPV	-0.05	0.50	1			
Payback	-0.21	0.16	0.13	1		
Several models	-0.38	-0.33	-0.30	-0.50	1	
No model	.	.	-0.99	-0.78	-0.51	1

Table 5: Correlation matrix, estimated using the polychoric transformation. Funding source of investment project

	Equity	Bank loan	Bonds	Currency loan	New shares	Parent loan
Equity	1					
Bank loan	-0.50	1				
Bonds	-0.07	0.33	1			
Currency loan	-0.02	0.40	0.76	1		
New shares	-0.13	0.35	0.74	0.70	1	
Parent loan	-0.09	-0.12	0.32	0.31	0.38	1

the sample before the empirical analysis. There is a trade-off between asking all relevant questions and keeping the survey short. The longer the survey is, the lower is the response rate likely to be. It has been important for the quality of this survey to ensure a high response rate and to capture the heterogeneity among firms. Therefore, the information letter was carefully designed in order to achieve a high response rate. I put a great deal of attention in convincing the respondents not to be afraid of failing to know the concepts that are taken up by the questionnaire.

Table 4-6 shows the correlation matrix of the responses to the question about methods used by the firms. In this paper, all responses are ordered or binary. When the data series of interest is designed as categorical data, a standard correlation analysis, known as the Pearson correlation coefficient, will introduce bias. A polychoric correlation analysis is more suitable for ordinal and binary data. This method lets you find the correlation of a normally distributed latent variable that is represented with an ordinal variable, Kolenikov et al. (2004). The correlation analysis of the latent variables is estimated using maximum

Table 6: Correlation matrix, estimated using the tetrachoric transformation. Hurdle rate for calculating the profitability of investment projects

	Bank loan rate	Bond rate	FRA	WACC	CAPM	Several	Other
Bank loan rate	1						
Bond rate	-0.10	1					
FRA	-0.05	0.72	1				
WACC	-0.22	0.71	0.65	1			
CAPM	-0.10	0.79	0.65	0.81	1		
Several	-0.14	0.73	0.63	0.78	0.84	1	
Other	-0.29	0.69	0.56	0.65	0.67	0.72	1

likelihood. I have implemented the stata procedure - poloychoric - by Kolenikov et al. (2004). Note that the method is called tetrachoric if it is used on binary data. Obviously, the correlation is high between methods that are used by few and therefore have several zeros. The important result from the correlation analysis is that the correlation between popular methods is low.

4 Structural analysis of firms' preferences over different investment methods

The purpose of this section is to develop an econometric approach for analyzing the most preferred method the respective firms apply when evaluating potential investment projects. There is a reason to believe that firms apply different methods on different prospects and in addition, the preferred method may vary over time even for the same type of investment prospect. This may be due to the complexity of the projects, changes of stakeholders for the respective projects or changes in the manager's view about which is the preferred method. Also, other factors than purely economic ones may influence investment decisions. Thus, even under identical "external" choice conditions, a manager may use different methods at different points in time due to his inability to assess precise and definite values of the methods once and for all. This matter is discussed in the literature on decision making in organizations, see Simon (1979) and March (1991), and in the context of a normative decision-making model, see e.g. Schwartz and Howard (1981). Schwartz and

Howard (1981) highlights the effects of personal and social norms on decision making.

To obtain information about preferences, one possibility would be to ask each firm to rank order the different methods, or to ask which method is the most preferred one. However, a complication with this approach is that it might be difficult for the manager to decide which is the most preferred method unless one specifies details of the actual investment project. To make a precise description review of my approach, let V_{tij} be a latent index that represents the utility of method j at time t, as viewed by firm i. That is, the more often the firm uses method j, the higher is V_{tij}. Let $j = 0$ represent the response "No method" and assume that the latent popularity index has the structure

$$(1) \quad V_{tij} = \alpha_i + \beta_{j0} + X_i\beta_j + Z_{tij}\theta + \eta_{tij} \text{ with } V_{ti0} = \alpha_i + \varepsilon_{ti0}$$

where α_i is a fixed firm specific effect, β_{j0} is an alternative specific constant, X_i is a vector of observed explanatory variables that might depend on both the firm and the method, with the associated parameter vector β, Z_{tij} a variable that characterizes the potential investment project t considered by firm i for method j. Typical attributes that varies with the different investment projects are the size of the investment, what kind of real capital the firm currently invests in, the life span of the investment project, the level of uncertainty of future cash flow, etc. With no loss of generality, I assume that the mean value of Z_{tij} across time is zero. For later use, define $Z_{ti} = (Z_{ti1}, Z_{ti2}, ...)$. The terms η_{tij} and ε_{ti0} are IID random variables.

Under suitable distributional assumption about the stochastic error terms $\{\eta_{tij}\}$ one can derive the probability that firm i shall choose method j at time t, conditional on X_i and Z_{tij}, expressed formally as:

$$(2) \quad P_j(X_i, Z_{ti}) = P(V_{ij} = \max_r V_{tri} | X_i, Z_{ti})$$

For example, if the stochastic error terms are independent and standard Gumbel distributed the model in (2) becomes a multinomial logit model. To estimate the unknown parameter, one can obtain data from a traditional stated preference survey (SP). To design the questionnaire of SP, one needs to specify hypothetical values of $\{Z_{tij}\}$ in order to formulate precise survey questions, Kroes and Sheldon (1988). In the context of this paper, this may be difficult because there may be a variety of investment projects, and some of their attributes may be hard to quantify. However, since there is a variety of investment projects,

I am in this paper more interested in revealing the average choice behavior of the firms regarding the preferred method. More precisely, our ambition is not to obtain an estimate of $P_j(X_i, Z_{ti})$, but instead.

$$(3) \quad P_j(X_i) = P(V_{ij} = \max_r V_{ir} | X_i) = E_Z P_j(X_i, Z_{ti})$$

where E_Z denotes the expectation operator with respect to the temporal (investment project) variation in Z_{ti}. Thus, in the choice probability given in (3) the unobservable vector (unobservable in our case) is integrated. If panel data on realized choices among methods, including Z_{ti}, were available so that estimates of $P_j(X_i, Z_{ti})$ could then be obtained, and one could then calculate $P_j(X_i)$ as:

$$(4) \quad \frac{1}{T} \sum_{t=1}^{T} P_j(X_i, Z_{ti})$$

However, such data are not available in our case, and therefore, another alternative approach is called for. The alternative approach used in this paper consists of a two-stage procedure as follows. In the first stage, I analyze the intensity with which the respective methods are used by the firms. In other words, at this stage the purpose is to estimate a model of how often the respective methods are used by the firm. To this end, the ordered logit (or probit) modeling framework can be applied. In the second stage, the estimation results from the first stage are used to calculate choice probabilities of the most preferred method, as given in (3).

To obtain suitable data the survey questionnaire contains questions on how often firms use the respective evaluation methods, and which can be used for estimating the first stage model, namely the ordered logit model. The questions in the survey questionnaire that are appropriate to this end are questions like; is a given method always used, or often used, or rarely used, etc... Thus, these answers correspond to response categories, $k = 1, 2, ..., m$, those firms that are in category 1 are those who state that they always use a given method, those who are in category 2 are those who often use the method, etc. Let $\varepsilon_{1ij} = Z_{1ij} + \eta_{1ij}$ for $j > 0$. Recall that the distribution of Z_{1ij} is assumed to be independent of t. Since Z_{1ij} is unobservable, I model ε_{1ij}, similarly to η_{1ij} as a random variable (from the viewpoint of the researcher). Consequently, under specific distributional assumptions about $\{\varepsilon_{1ij}\}$ it is possible to calculate the choice probability given in (4). Let $P(Y(k)) = 1$ if firm i is

observed to be in response category k given method j and zero otherwise. Assume that $\varepsilon_{1ij},\ j=0,1,2,\ldots$ are IID and let $F(\cdot)$ be the c.d.f. of $\varepsilon_{1ij}-\varepsilon_{1i0}$. Hence, it follows that:

$$P(Y_{ij}(k)=1|X_i)=P(\gamma(k)<V_{1ij}-V_{1i0}<\gamma(k-1)|X_i) \tag{5}$$

$$=F(\gamma(k)-X_i\beta_j-\beta_{j0})-F(\gamma(k-1)-X_i\beta_j-\beta_{j0}) \tag{6}$$

where $\gamma(k)$ are unknown threshold values which are estimated jointly with the parameter vector β_j and β_{j0}. The reason why I consider $V_{1ij}-V_{1i0}$ instead of V_{1ij} is because I wish to get rid of the fixed effect while retaining a reasonable interpretation, Ferrer-i Carbonell and Frijters (2004). Thus, V_{1i0} represents an "anchoring" effect that makes the evaluation scales comparable across firms.

The threshold parameters $\{\gamma(k)\}$ are implicitly representing the average of the firm's interpretation of the response categories, such as "often" or "rarely", for example. Note that here it is assumed that $\{\gamma(k)\}$ do not depend on the method j. It seems reasonable that the threshold levels do not depend on the evaluation methods. It follows from the above expression that I can rewrite (6):

$$P(Y_{ij}(k)=1|X_i)=F(\tilde{\gamma}_j(k)-X_i\beta_j)-F(\tilde{\gamma}_j(k-1)-X_i\beta_j) \tag{7}$$

where $\tilde{\gamma}_j(k)=\gamma(k)-\beta_{j0}$. Hence, I obtain $\tilde{\gamma}_j(k)$ by taking the respective mean across the threshold levels $\gamma(k)$, $k=1,2,..,m$ such that $\bar{\tilde{\gamma}}_j(k)=\bar{\gamma}(k)-\beta_{j0}$. Note that although I cannot identify the unknown parameter β_{j0}, but because it is a constant it cancels in utility comparisons and therefore is irrelevant in this context. Figure 2 illustrates the relationship between the threshold parameters, $\gamma(k)$ and the k ordered response categories

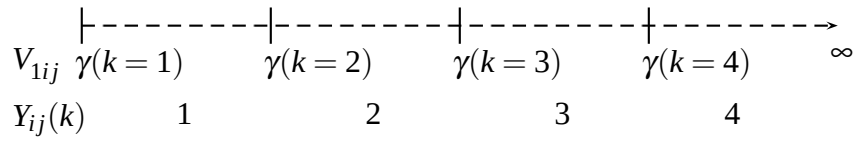


Figure 2: Relationship between threshold values, $\gamma(k)$ with the corresponding preference level, V_{ij} and the response categories of the endogenous variable, $Y_{ji}(k)$. Firms that prefer a given method as high as it can, will have a value of $V_{ij}>\gamma(k=4)$

In the following, I shall assume that $\varepsilon_{1ji},\ j=1,2,3,...$ are independent Gumbel distributed. Which, implies that that the c.d.f. of the error is given by $\exp(-e^{(-x)})$. Then it is

well known that $F(\cdot)$ becomes a logistic distribution function so that the model in (6) and (8) becomes an ordered logistic model which can readily be estimated by the method of maximum likelihood. The model parameters are estimated separately for each method:

$$(8) \quad P(Y_i(k)=1|X_i) = F(\tilde{\gamma}_j(k) - X_i\beta) - F(\tilde{\gamma}_j(k-1) - X_i\beta)$$

Consider next how the results above can be used to obtain the probability of the most preferred evaluation method, given that the parameters of the utility function have been estimated. Under the assumption of IID Gumbel distributed error terms, independent across methods, it follows that the probability that evaluation method j is the most preferred method, as view by firm i, is equal to

$$(9) \quad P(V_{ij} = max_r V_{ir}|X_i) = \frac{\exp(X_i\hat{\beta}_j - \bar{\tilde{\gamma}}_j)}{\sum_{r=1}^{m}\exp(X_i\hat{\beta}_r - \bar{\tilde{\gamma}}_r)}$$

The empirical counterpart of the choice probability in (9) is the fraction of time firm i would choose method j, given the explanatory variables. Note that the multinomial model given in (9) depends crucially on $Corr(\varepsilon_{1ji}, \varepsilon_{1ki})$ being independent of j and k for $j \neq k$. This assumption could in principle be tested by estimating a multivariate ordered logit model in the first stage, but that is not done in this paper. The average probability of choosing method j is calculated as

$$(10) \quad \frac{1}{N}\sum_{i=1}^{N} P(V_{ij} = max_r V_{ir}|X_i) = \frac{1}{N}\sum_{i=1}^{N}\left(\frac{\exp(X_i\hat{\beta}_j - \bar{\tilde{\gamma}}_j)}{\sum_{r=1}^{m}\exp(X_i\hat{\beta}_r - \bar{\tilde{\gamma}}_r)}\right)$$

The empirical model is estimated by using the maximum likelihood using STATA with the *oglm* and *glm* packages. The calculation of the predictions and the calculated probabilities of the preferred method is done in Python with the *numpy* and *pandas* libraries.

4.1 Descriptive methods

To verify the business survey using administrative data and study if there are any differences in how the choice of the method the firm uses or how often the firm apply different measures varies between small and large firms. I test for differences in means between the respective groups and between response categories. To do this, I apply two types of tests. I use the t-test and the Wilcoxon Rank Sum test for comparing the results in two

sub-samples, and I use the Kruskal-Wallis and ANOVA to compare both between groups and blocks.

The above-mentioned tests may all be used to test whether I can reject or not the hypothesis of differences in the mean between groups and/or between blocks. However, neither the ANOVA nor the Kruskal-Wallis test can pinpoint exactly which response category that is significantly different from the other. For this, I employ Dunn's test, which can account for multiple pairwise comparisons of the Kruskal-Wallis rank test or the Tuckey-Kramer pairwise comparison for the two-way ANOVA. Applying the full apparatus of tests, I find that there are significant differences in firms' decision rules. Detailed results and explanations of the methods are reported in the appendix.

5 Empirical Analysis

Neoclassical investment models have been, and still are, the standard framework for analyzing investment decisions both in corporate finance and in economics in general. The net present value (NPV) model and the Q-model both highlight the importance of the net discounted profit for the investment decision. This section analyses the results from the business survey and sheds light on how business managers choose methods to support their investment decision process. I start each subsection with a description of the methods and a brief overview of earlier findings. Then I continue with a descriptive analysis of the survey results and round off each subsection with a description of the results from the empirical study.

5.1 How do firms calculate their hurdle rate?

In capital budgeting, it is important to have a view of the firm-specific risk. This is because it is a crucial part of the cost of capital. The traditional view is that the risk-free interest rate normally equals the interest rate on long term government bonds, like Treasury bonds, see e.g. Huang and Huang (2012). Hence, the firm-specific interest rate, r_j, can then be expressed as the risk-free rate, r_F, plus the firm-specific risk premium, θ_j:

$$r_j = r_F + \theta_j \tag{11}$$

What kind of method the firm uses to specify the company or project risk varies between companies. A textbook approach for finding the θ_j is based on the use of the capital asset price model (CAPM), see Lintner (1965). By estimating the stock return, σ_j, relative to the market return, σ_M, called the β, one finds the firm's risk premium: $\theta_j = \frac{\sigma_j}{\sigma_M}(r_m - r_F) = \beta(r_m - r_F)$, where r_m is the market return.

Following this approach, when calculating the minimum acceptable rate of return (hurdle rate), one assumes that the project risk premium equals the average firm risk premium. For investment projects, it is not always the average company cost of capital, but the risk and cost of the specific project that is relevant. To obtain identification of the project risk might be demanding. An approach suggested by Brealy et al. (2017) when it is difficult to calculate the internal project risk is to identify firms with homogeneous project portfolios that match your investments project and estimate their θ_j based on the CAPM.

The CAPM excludes the cost of debt when estimating the firm-specific hurdle rate. By calculating the weighted-average cost of capital (WACC), the cost of debt is taken into account. An alternative to the CAPM is to use the difference between the cost of debt and riskless debt instruments as the market valuation of the firms' risk, unless there are provisions or restrictions reducing the value of debt, Merton (1974). This will be a less demanding approach and reduce the time spent on investment analysis.

A particular focus of this paper is the effect of firm size heterogeneity on firms' investment decision making. When analyzing the firm size heterogeneity I divide the firms into small, middle, and large firms based on their number of employees. Compared to the volatility of the firms' employment figures, the volatility of the sales figures varies significantly. Therefor, employment is the preferred measure for splitting the sample into firm size categories. Small firms include firms with less than 50 employees, middle firms include firms with 50 or more, but less than 500 employees, and large firms include firms with 500 or more employees. Out of the total sample: 34 percent of the firms are small firms, 57 percent are middle firms, and 9 percent are large firms.

The survey questionnaire contains questions about which hurdle rate the firm normally uses when doing its profitability analysis. Table 7 shows the result for the share of the firms that answers that it always uses the different hurdle rate calculations. It turns out that more than half of the firms (51.7 percent) use their bank loan rate as their hurdle rate. This

Table 7: Questions about firms' choice of hurdle rate

Methods used by firms to calculate the hurdle rate, percentage answered: Methods that always are used by the firm. In percent[a)]				
	All firms	Small firms	Middle-sized firms	Large firms
Bank rate*	51.7	68.3	45.1	15.0
Bond rate*	0.6	0.0	1.0	0.0
FRA	11.5	7.5	13.1	16.7
WACC*	15.9	3.1	21.2	30.0
CAPM	4.5	1.5	6.2	6.7
Several*[1]	5.4	0.0	8.7	6.3
Other*[2]	20.5	13.3	21.7	42.1
The firms' appraisal of its calculated hurdle rate, by firm size. In percent[b)]				
Great	28.0	30.8	27.2	25.2
Moderate	41.9	57.7	42.9	41.2
Small	17.2	11.5	16.9	17.7
No	5.4	.	4.2	3.4
Not relevant	7.5	.	8.8	12.6

*Firm size differences are significant using the Kruskal-Wallis equality-of-population rank test.

1, 2) Several = Several different models and Other = Other models.

a) The rows do not sum to 100 percent since the firms might use more than one calculation method.

b) In order to motivate the respondents to answer, the firms could answer either *"No"* or *"This question is not relevant to our firm"*

Table 8: Factors affecting firms' choice of hurdle rate

	Bank loan rate	Bond rate	FRA	WACC	CAPM	Other models
Small firms	0.558*	-0.175	-0.199	-0.351	-0.162	-0.005
	(1.73)	(-0.51)	(-0.66)	(-1.11)	(-0.49)	(-0.02)
Large firms	-0.651*	0.266	0.199	0.111	0.869**	0.878**
	(-1.83)	(0.58)	(0.49)	(0.26)	(2.00)	(2.08)
Subsidiary	-0.237	1.013***	1.138***	0.987***	1.034***	0.862***
	(-0.86)	(3.12)	(3.92)	(3.28)	(3.31)	(3.01)
Funding investments w/equity	0.156	-0.222	0.687	-0.363	-0.058	0.257
	(0.43)	(-0.44)	(1.45)	(-0.81)	(-0.12)	(0.57)
Funding investments w/debt	0.634**	0.281	0.603**	0.416	0.690**	-0.008
	(2.17)	(0.83)	(1.98)	(1.33)	(2.12)	(-0.03)
Sensitivity analysis	-0.704***	0.787**	0.614*	1.511***	0.868**	0.549*
	(-2.62)	(2.18)	(1.94)	(4.41)	(2.54)	(1.68)
Threshold 1	-1.248	2.570***	2.448***	2.206***	2.754***	2.542***
	(-1.58)	(2.83)	(3.03)	(2.68)	(3.14)	(3.04)
Threshold 2	-0.290	6.486***	3.890***	4.052***	5.196***	3.548***
	(-0.38)	(5.93)	(4.67)	(4.73)	(5.57)	(4.15)
Threshold 3	0.522		5.416***	4.797***	6.646***	4.748***
	(0.68)		(6.18)	(5.46)	(6.52)	(5.39)
Controls	✓	✓	✓	✓	✓	✓
No. of observations	228	228	228	228	228	228
Log-likelihood	-261.75	-139.67	-232.90	-206.65	-181.08	-238.47
χ^2- test, p-value	0.000	0.000	0.000	0.000	0.000	0.000
Pseudu R^2	0.065	0.115	0.075	0.124	0.125	0.078

Notes: The empirical model for the probability that the firm chose a given method to calculate its hurdle rate is estimated using a ordered logit model: $Y_i = F(\tilde{\gamma}(k) - X_i\beta) - F(\tilde{\gamma}(k-1) - X_i\beta)$, where $\tilde{\gamma}$ is the thresholds parameters, X_i is the firm specific variables, and $F()$ is the logit function. Control variables include administrative data on firm level such as debt to asset ratio, profit ratio, last year investments. Standard errors are bootstrapped, with the significance levels of the z-test represented with stars: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

The category "Several different models" represent the **baseline method**, noted as V_{ti0} in the section above.

is especially true for small firms, while large firms to a lesser degree use bank loan rates as a substitute for calculating their own hurdle rate. Looking into the figures, it turns out that 73 percent of the firms that are financing their investments with bank loans answer that they use bank loan rate for calculating profitability. Still, 53 percent of the firms not funding their investment with bank loans use bank lending rates as their hurdle rate. Since profitability depends on the expected prices and volumes, it is the expected interest rate that should be used in calculations. Interest rates from the forward rate agreements (FRA) market reflect market expectations. Hence, it should be more suited for profitability calculations than bank loan rates. A decent share of the firms is using interest rates from the FRA market, and on average, it is chosen by 11.5 percent of the firms. It is also relevant to note that 12 percent of the firms respond "No" or "Not relevant" for all models.

As explained in section 4, the way I will study firms' preferred methods is by the

two-step procedure. To find which method the firms prefer to use to calculate its hurdle rate, I will be using a combination of the ordered logit model and the multinomial logit model. The results from the empirical model, shown in table 8, show that firm size is also important for explaining how the firms calculate their hurdle rate. Large firms are less likely to use the bank loan rate as their hurdle rate, but large firms have a higher probability of choosing advanced methods to calculate its hurdle rate than middle-sized and small firms do. The effect of being a subsidiary does also affect the calculation of the hurdle rate. Hence, strengthening the evidence that there is a spill-over-effect regarding how capital budgeting is done within corporations.

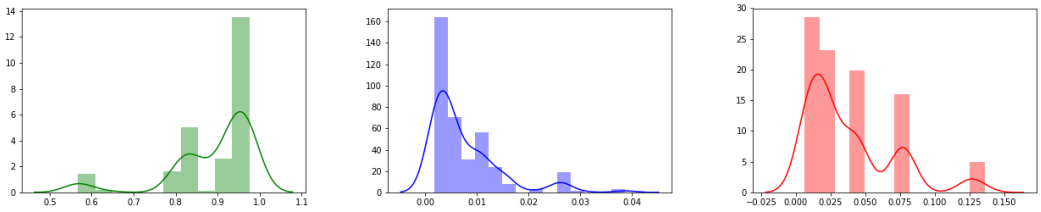
Interestingly, firms with debt funding have a higher probability of calculating their hurdle rates than firms with predominantly other funding sources. I question the firms about their use of sensitivity analysis to shed light on the uncertainty of investments, and if the firm respond that they use sensitivity analysis often, then it is a higher probability that they are using sophisticated methods for calculating the hurdle rate, while it reduces the probability of using bank loan rates as their hurdle rate. To see if the emphasis the firms put on the estimated hurdle rate affects which method they chose, I ran models where this variable was included. How strong emphasis the firms put on its hurdle rate did not affect which method is preferred, with one exception and that was the method "Other models". I control for the financial situation of the firm by adding debt to asset ratio and the profit margin, defined as earnings before interest and tax (EBIT) relative to total revenues. Neither variables have an effect on the choice of what method the firm prefers.

Note that the threshold values or cut points, as they also are called, are estimated constants that help us categorize the predicted values. I use γ to label the threshold values in the discussion of the econometric methods in section 4. See figure 2 in the same section for a visual explanation of the cut points.

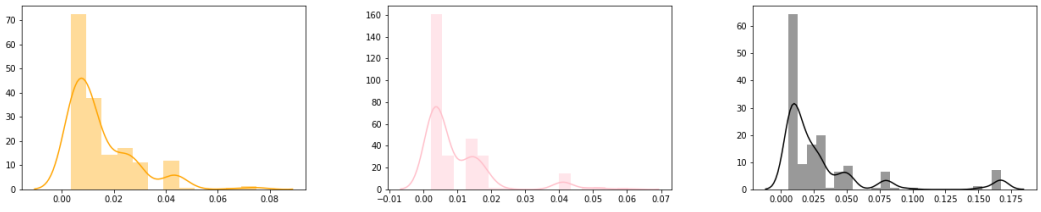
Step two of the calculation of the most preferred method includes the use of the multinomial probability model. I insert for the estimated parameters from the ordered logit model, as shown in section 4. The response category "Several models" is used as the reference category. Table 16 summarize the results, with the predicted mean, which is our estimate of the share of firms that prefer this method in front of the other methods to

Table 9: Multinomial probabilities for the different investment profitability calculation methods

	Bank loan rate	Bond rate	FRA	WACC	CAPM	Other models
mean	0.8974	0.0076	0.0385	0.0150	0.0098	0.0316
std	0.0979	0.0071	0.0324	0.0134	0.0110	0.0396
min	0.5836	0.0017	0.0063	0.0034	0.0021	0.0056
P25	0.8440	0.0025	0.0109	0.0057	0.0028	0.0106
P50	0.9383	0.0050	0.0226	0.0100	0.0045	0.0176
P75	0.9686	0.0109	0.0473	0.0246	0.0141	0.0327
max	0.9771	0.0399	0.1402	0.0774	0.0626	0.1720



(a) Bank loan rate **(b)** Bond rate **(c)** FRA



(d) WACC **(e)** CAPM **(f)** Other models

Figure 3: Distribution of estimated multinomial probabilities for the most preferred method. Histogram and kernel density estimator

calculate its hurdle rate. The results show that the majority of firms prefer to use the bank loan rate. A small share of firms prefer the FRA or to use "Other models", while the other methods are estimated to be the preferred one by nearly none of the firms. To visualize the distribution of the different firms' most preferred method, I show the distribution of the predicted probabilities for preferring the given method in Figure 3.

5.2 Investment criteria

The firms' choice of investment criteria to its capital budgeting process is an intensively studied topic in applied corporate finance. The textbook methods presented in Brealy et al. (2017) for calculating investment projects are the Net present value (NPV), Internal rate of return (IRR), Payback method, Book of return, and profitability analysis. Boye and Koekebakker (2006), a popular book among Norwegian business schools, also includes the Equivalent annual cost (EAC) as a recommended method. Brealy et al. (2017) present the NPV method as the benchmark model for calculating investment projects. Equivalent annual cost (EAC) is an extension of the NPV method. In contrast to the NPV, it adjusts the estimated NPV for differences within the lifespan of projects, making projects with a longer lifespan less worth.

Even though the NPV is assumed to give the most accurate assessment of a project's profitability, Graham and Harvey (2001) find that the internal rate of return is slightly more common among CFOs. Brealy et al. (2017) argue that one reason for the popularity of the IRR might be due to the fact that financial officers need to convince their executives or its owners to get the project approval. The reason is that the IRR might be chosen because it is easier to grasp than the NPV. The Payback method, Book of return and Profitability analysis are all less common than the NPV and IRR, but 57 percent of CFOs use the payback method occasionally, see Graham and Harvey (2001). Kengatharan (2016) conclude as in Graham and Harvey (2001) that discounted cash flow (DCF) methods are most common.

My findings differ from those found in Graham and Harvey (2001). When questioned which method executives use when calculating the profitability of projects, my analysis shows that the most common method is the payback method. The figures in Table 10 shows the proportion of firms using the different methods *often* or *now and then*. The survey results show that a total of 37 percent of the respondents said they normally use

Table 10: Investment criteria used to calculated profitability of investment projects. Percentage of firms responding that the method is used by the firm

	All Firms	Small	Medium	Large
EAC	9.52	7.5	10.1	14.8
IRR*	28.6	14.2	33.9	55.6
NPV*	35.4	19.2	40.7	70.4
Payback period	37.2	31.7	40.7	37.0
Other methods	15.5	20.8	12.2	14.8
No method*	19.0	25.8	17.5	0

*) Firm size differences are significant using the Kruskal-Wallis equality-of-population rank test.

a) The rows do not sum to unity since the firms might use more than one calculation method.

b) In order to motivate the respondents to answer, the firms could answer either *"No"* or *"This question is not relevant to our firm"*.

Table 11: How often the firm cannot give a good estimate of the expected cash flow. In percent

	All firms	Small firms	Middle-sized firms	Large firms
Always	2.4	5.0	1.1	.
Often	28.2	24.0	31.2	26.9
Now and then	47.2	50.4	45.7	42.3
Rarely	19.2	18.2	18.3	30.8
Never	3.0	2.5	3.8	.

the payback method, while 35 percent use the NPV method and slightly fewer firms, 29 percent, use the IRR method.[5] This is surprising given the results in Graham and Harvey (2001). Furthermore, I find that the Equivalent annual cost method is less common, with only 10 percent of the respondents using this method. More interestingly, 20 percent of the respondents said that they do not use any formal method at all, and 15 percent have a model, but not one of the methods listed in Table 10.

To explain how firm size and other factors explain the firms' choice of method for

[5]The difference in the response rate between NPV and payback is not significantly different at a 5 % significance level.

calculation of profitability, I use a simpler version of the ordered logit model that contains only two response categories, namely “often” or “never”. In contrast to the ordered logit model presented in section 4 there is now only one threshold. Otherwise, the interpretation is unchanged, and I use the same two-step model to predict the preferred method. After I have modeled the ordered logit model, I do as earlier and calculate the most popular method given the explanatory factors using the multinomial logit choice probability. Table 12 summarize the estimation results from the simple ordered logit model while table 16 shows the multinomial choice probabilities. The empirical analysis from the simple ordered logit model shows that the importance of firm size varies heavily between the different methods. There is a strong positive firm size effect for the probability of the firm using IRR or NPV. Both methods, and particularly the NPV, is used predominantly by large firms, and less by small firms. This result holds even if I control for the education level of the manager. It is the most educated managers that use NPV and IRR, while education counts negative for firms that respond that they are not using a model for calculating the profitability. This is a result backed up by Brounen et al. (2004). For the other methods, I find that the probability is slightly higher for larger and smaller firms than middle-sized. The empirical results show that whether the firm is a subsidiary or not is important for explaining if the firm uses a known calculation method. I find that firms that are subsidiaries are more likely to use formal calculation methods, such as IRR and Payback indicating that there is some transfer of knowledge and practice within the corporations, which smaller firms benefit from. Funding sources also affect which method is preferred. If the firm funds it selves with equity, the probability of using one of the methods described above increases compared to firms funding their investments with a bank loan.

To avoid that any random composition affects the results, I create several new variables. Those variables are: Firm investments in machines relative to buildings; this variable is 1 if the ratio is greater than 1, maintenance and repair, a variable that is 1 if the respondent that the motive of their last investment was in the category maintenance and repair, real investments relative to employment, debt to asset ratio and profitability. Since this is not the variables of interest, I have not added them to the results shown in table 12.

To find the most commonly used model, I calculate the multinomial logit probabili-

Table 12: Factors affecting firms' choice of investment criteria

	EAC	IRR	NPV	Payback	No model
Small cap	0.047	-0.142	-1.152***	-0.183	0.544
	(0.08)	(-0.34)	(-2.62)	(-0.51)	(1.03)
Large cap	0.426	1.265***	0.956**	0.292	.
	(0.72)	(2.96)	(2.26)	(0.77)	.
Higher education	0.282	0.626*	0.857**	0.259	-1.046**
	(0.54)	(1.68)	(2.26)	(0.82)	(-1.99)
Subsidiary	0.588	0.583*	-0.217	0.465	-1.009
	(1.21)	(1.70)	(-0.62)	(1.52)	(-1.63)
Freq. of EquityFunding	0.459	0.244	-0.565**	0.287	-0.538
	(1.09)	(0.96)	(-2.15)	(1.29)	(-1.36)
Freq. of DebtFunding	-0.288	0.064	-0.522***	0.201	-0.013
	(-1.20)	(0.38)	(-3.06)	(1.36)	(-0.05)
Sensitivity analysis	-0.251	1.348***	1.167***	0.274	.
	(-0.45)	(3.80)	(3.14)	(0.81)	.
Imp. of HurdleRate	1.637	2.404***	2.054***	0.943**	-3.212***
	(1.54)	(2.95)	(3.24)	(2.02)	(-5.31)
Threshold	-4.752***	-5.333***	-1.166	-3.637***	3.143**
	(-2.72)	(-4.30)	(-1.15)	(-3.96)	(2.24)
Controls	✓	✓	✓	✓	✓
No. of observations	236	236	236	236	146
Log-likelihood	-66.57	-113.61	-113.10	-139.86	-56.67
χ^2-test, p-value	0.448	0.000	0.000	0.004	0.000
Pseudu R^2	0.086	0.249	0.281	0.103	0.324

Notes: The empirical model for the probability that the firm is using the current method for calculating its profitability is estimated using a logit model: $logit(Y_i) = X_i\beta + \varepsilon_i$, where X_i is the firm specific variables. Control variables include administrative data on firm level such as debt to asset ratio, profit ratio, last year investments. Standard errors are bootstrapped, with the significance levels based on the z-values represented with stars: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

The category "Other models" represent the **baseline method**, noted as V_{ti0} in the section above.

Table 13: Multinomial probabilities for the different investment profitability calculation methods

	EAC	IRR	NPV	Payback
mean	0.1605	0.7996	0.0004	0.0394
std	0.1146	0.1349	0.0005	0.0349
min	0.0105	0.4022	0.0000	0.0033
P25	0.0687	0.7219	0.0001	0.0153
P50	0.1389	0.8266	0.0003	0.0314
P75	0.2363	0.9148	0.0006	0.0451
max	0.5170	0.9830	0.0046	0.1752

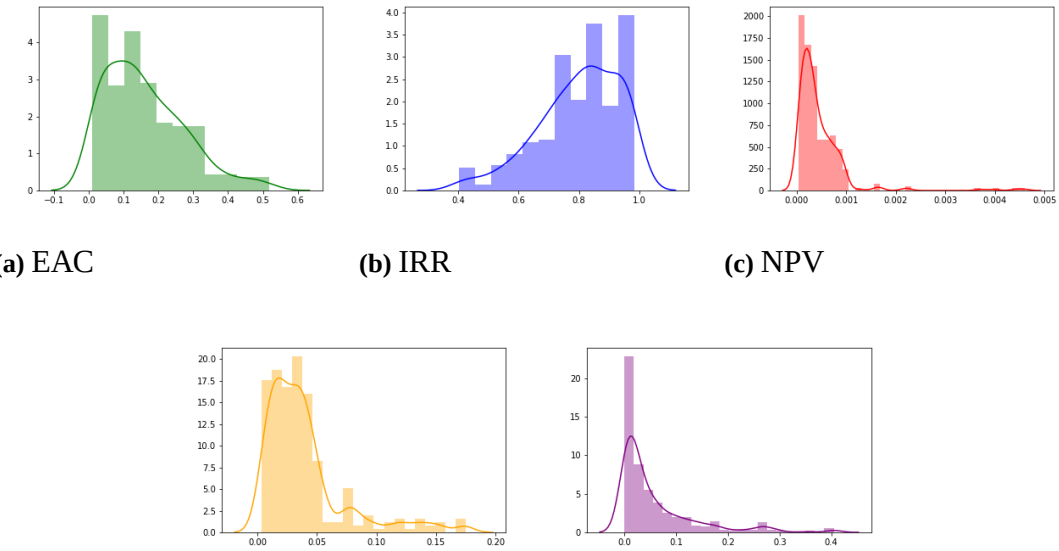
ties, as shown above. The results show that the Internal rate of return is the most preferred method to calculate the profitability of an investment. The firms are divided into two. While most firms are estimated to prefer the IRR, about a quarter of the firms prefer the EAC. The multinomial probability model predicts practically zero probabilities of choosing the NPV and the Payback-model. Based on the responses, the model estimate that the firms that are using the NPV or the payback together with the IRR, prefer the IRR before one of these two models.

5.3 Investment funding

To get an understanding of how funding source affects investment behavior, the survey questionnaire contains questions on how the firms finance their investments. The theory of corporate finance is not clear on what is the best strategy. Bessler et al. (2011) summarize capital structure theory by highlighting three theories:

1. Trade-off theories discuss how firms adjust their debt. There is a trade-off between higher tax-deductibility (in the case of tax non-neutrality), and financial distress, such as the increased risk of bankruptcy as the debt rises

2. Pecking order theories describe how asymmetric information affects the financing



(a) EAC **(b)** IRR **(c)** NPV

(d) Payback **(e)** Several models

Figure 4: Distribution of estimated multinomial probabilities for firms' preferred method for calculating the profitability. Histogram and kernel density estimator

structure. Because of the information advantage the manager has above the market, the firms will strive to increase its debt ratio rather than issuing equity when the firms' market value is below the managers' estimation of the firm value

3. Market timing theories tell a story where the firm raises equity capital preferably when the stock market conditions are good. One measure for market conditions could be the market to book values, and a policy could be to issue equity when this ratio is relatively high

These three groups of theories may give insight into how companies finance their investments.

The importance of funding is addressed in several papers. Two recent studies of the importance of funding show that access to liquid funds and funding is important for investment decisions. The debt-equity ratio is studied by Lewis and Tan (2016), by exploiting the variation in R&D investment, they are able to show how the funding affects profits. Using a natural experiment Rauh (2006), finds that there are strong cash flow effects on investments. I have a somewhat different approach to the funding decision. I want to find

Table 14: Investment funding source, by firm size. Average response, response categories 1 to 3

Firm size	Equity*	Bank Loan*	Bonds	Currency loan	New shares	Parent loan*
Small	2.30	2.17	1.03	1.09	1.01	1.38
Middle†	2.53	1.92	1.00	1.07	1.03	1.74
Large†	2.37	1.58	1.08	1.13	1.00	1.68
All firms	2.43	1.98	1.02	1.08	1.02	1.61

Note: Response categories: 3: Yes, almost always; 2: Now and then; 1: No, almost never. The reported results are average responses, the higher the figure, the larger is the share of the firms responding that they use the specific financing source. *Firm size is significant at the 5 percent level using a Kruskall-Wallis rank test. †Difference in mean between the different response categories are significant for large and middle-sized firms using two-way ANOVA with the Tuckey-Kramer multiple pairwise comparison test.

the most common source of funding, and with a hypothesis that this will make it easier to understand what limits new investment projects. Note that this paper does not intend to test the capital structure theories explicitly, but rather identify some qualitative characteristics about factors affecting firms' funding decisions. Hence, sufficient liquid funds are a necessity for investments and having knowledge about where the company gets its funding from is necessary for understanding what might restrict the access to liquidity. Without equity capital, the firm needs external funding, either from banks, in the form of bank loans, or from the credit market, in the form of issued bonds or shares.

Titman (2002) summarizes his paper with a hypothesis about the bond market in the EU before and after the introduction of the Euro. He suggests that firms with their main activity in small countries might find it more profitable to raise funding in the bond market after the Euro was implemented. This is because the single currency decreases the risk premiums on bonds in small countries with illiquid markets because the common currency reduces the exchange rate risk. Hence, the gap between the observed cost of issuing bonds and shares are reduced. If this is correct, I should find that Norwegian firms are to a little degree exposed to the bond market. An interesting finding in Harford and Uysal (2014) shows that unrated firms are less likely to get bond financing. Knowing that small and middle-sized firms to a less degree take the cost of being rated, one would expect that fewer of them finance investments with bonds.

Table 15: Factors affecting the choice of funding source

	Equity	Bank Loan	Parent Loan
Middle sized firms	0.221	-0.315	0.464*
	(0.26)	(0.25)	(0.26)
Large firms	0.722*	-1.112***	1.010***
	(0.38)	(0.33)	(0.34)
Debt to asset ratio	-1.983***	1.600***	0.385
	(0.65)	(0.60)	(0.60)
Net profit to book value	0.025**	-0.014	0.003
	(0.01)	(0.01)	(0.01)
Paid dividends	-0.112	0.703***	-0.767***
	(0.30)	(0.27)	(0.29)
Importance of cash for investments	-0.384	1.005***	0.084
	(0.27)	(0.26)	(0.26)
Threshold 1	-5.164***	0.100	0.616
Threshold 2	-3.200***	0.710	1.283**
Threshold 3	-0.904*	2.488***	2.977***
Controls	✓	✓	✓
No. of observations	281	281	281
Log-likelihood	-252.067	-345.799	-325.104
χ^2-test, p-value	0.000	0.000	0.001
Pseudu R^2	0.056	0.067	0.041

Notes: The empirical model for the probability that the firm fund its investments with Equity, Bank loan or Parent loan is estimated using a ordered logit model: $Y_i = F(\tilde{\gamma}(k) - X_i\beta) - F(\tilde{\gamma}(k-1) - X_i\beta)$, where $\tilde{\gamma}$ is the thresholds parameters, X_i is the firm specific variables, and $F()$ is the logit function. Control variables include administrative data on firm level such as debt to asset ratio, profit ratio, last year investments. Standard errors are bootstrapped, with the significance levels of the z-test represented with stars: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

The results from the survey responses regarding firms' funding sources are summarized in Table 14. I find that more than half of the firms use equity and retained earnings to finance all its new projects. Furthermore, the results show that there are significant differences between small, middle, and large-sized firms in how they finance their investments. Nearly a third of the firms answered that they finance their investments with a loan from banks, and 15 percent get financing through its parent company. None of the firms uses currency loans; bonds or issues new shares to finance its project on a regular basis, but a few firms use one those three funding sources now and then.

To extend the study of what affects the firms' choice of funding source, I estimate an ordered logit model to explain factors affecting which funding source they prefer. The ordered logit model exploits the ranking of the responses in the questionnaire and uses

both administrative data and the survey responses to explain the funding choice. I present estimation results for three models in Table 15, one for the probability that the firm is funding its investment with equity, one for funding investment with a bank loan and one model for funding investments with parent loan. The other funding sources are used by too few firms that I can make a valid model for them. The explanatory variables are the response to the question of whether access to cash is limiting firm investments, firm size dummies, and firm-level administrative data.

The analysis shows that firms with high profitability are more likely to fund themselves with equity, while profitability has no effect on firms choosing debt funding. Firms that respond that their investments are limited by its availability to liquid funds do have a higher likelihood of funding themselves with bank loans, than firms which report not to be limited by access to cash. Large firms have a reduced likelihood to fund their investments with bank loans relative to small and middle-sized firms, showing that small firms are most likely to fund their investments with bank loans. Studying firms that are funding their investments with equity, I find that things are turned around. The results show that large firms are more likely to fund their investments with equity than small firms are. Controlling for the financial situation of the firm, I find that firms with a high debt to asset ratio are more likely to fund their investments with bank loans relative to firms with low debt ratios, which are more likely to fund their investments with equity.

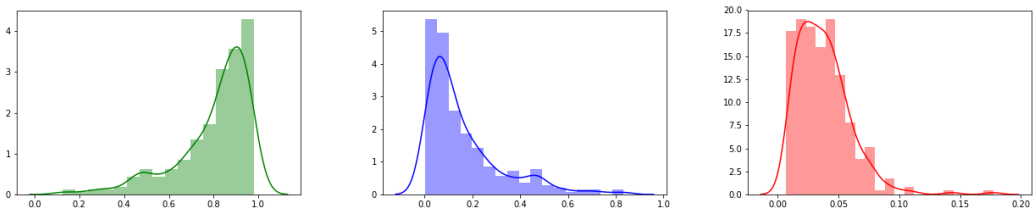
Not surprising, as shown in Table 16, more than 3/4 of the firms prefer funding its investments with equity, while 16 percent prefer a bank loan. A few firms are found to prefer funding from its parent company. Based on the survey results, I know that most of the subsidiaries finance investments with retained earning, explaining the low figure of firms preferring parent loans as funding. Figure 5 shows the distribution of the estimated probabilities for the three funding sources.

5.4 Leaning towards model results or gut feeling?

A capital budgeting process might start with an analytical approach, where the firm calculates its cost of capital and then the profitability of the investment project. However, figures showing the profitability are of no use if the investment decision does not hinge on the calculated profitability. I was curious about how the firms anticipated the results from

Table 16: Multinomial probabilities for the funding choice

	Equity funding	Bank loan funding	Parent loan
mean	0.80044	0.16169	0.03785
std	0.16678	0.16026	0.0221
min	0.12658	0.00329	0.00707
P25	0.72857	0.05009	0.02159
P50	0.85789	0.09926	0.03487
P75	0.92320	0.21396	0.04914
max	0.98169	0.83331	0.17705



(a) Equity funding **(b)** Bank loan funding **(c)** Parent loan

Figure 5: Distribution of estimated multinomial probabilities for the preferred funding source. Histogram and kernel density estimator

their calculations, so I included a few questions in the questionnaire regarding how they considered the results and how the firms in the business survey handled the uncertainty of their projects.

The questionnaire contains questions on whether the calculated hurdle rate is important for the decision of implementing the investment project. Table 7 showed that 27 percent of the respondents put great emphasis on the calculated hurdle rate, and close to half of the firms put moderate emphasis on the calculations. Looking at the firms putting no or only some emphasis on the hurdle rate, one could wonder why they bother calculating it. 16 percent of the firms put only some emphasis on the calculation and 4 percent no emphasis. 9 percent answered that calculating the hurdle rate is not relevant for their firms. Keeping in mind that 20 percent of the firms said they did no profitability analysis; this figure is not surprising.

There are several uncertain elements the firm has to take an decision on when they are calculating the hurdle rate or the expected profitability. The inputs used by the methods depend on market prospects, entry or exit of firms, etc. It is not obvious how to estimate the inputs for the calculations. The firm has to ask themselves whether there are any reasons to believe that the forecasted future income stream or cost is biased, or their inputs are reasonable. If firms find it difficult to forecast the input variables to the profitability analysis, one would expect that the firm would put less emphasis on the analysis. The survey questionnaire continues to question how often firms cannot give a good estimate of the expected project cash flow. Table 7 shows that one out of three respondents answered that high uncertainty often or always made it close to impossible to calculate the cash-flow of the project. Almost half of the firms said that they *now and then* experienced such uncertainty. Only a fifth of the respondents said that they *rarely* or *never* experienced such uncertainty. Given the response, it is obvious that formal capital budgeting methods play a smaller role in the investment decision than the impression one gets from textbooks on corporate finance.

To study which factors that explain which firms put higher than the average emphasis on the calculation of the hurdle rate, I employ the ordered logit model. The empirical results are shown in Table 17. In the case where the firm put high weight on the profitability analysis when taking its investment decision, one expects that the firm put effort to calcu-

Table 17: Factors explaining the level of emphasis the firms' put in its calculated hurdle rate

Uncertain cash flow estimates	-0.769**
	(0.35)
Using theory-close methods	0.504**
	(0.26)
Subsidiary	0.622**
	(0.28)
Using sensitivity analysis	1.315***
	(0.35)
Threshold 1	-2.444***
Threshold 2	-1.888***
Threshold 3	-0.509
Threshold 4	1.836***
Controls	✓
No. of observations	189
Log-likelihood	-231.38
χ^2-test, p-value	0.000
Pseudu R^2	0.084

Notes: The model is estimated using a ordered logit model: $Y_i = F(\tilde{\gamma}(k) - X_i\beta) - F(\tilde{\gamma}(k-1) - X_i\beta)$, where $\tilde{\gamma}$ is the thresholds, X_i is the firm specific variables, and $F()$ is the logit function. Control variables include administrative data on firm level such as debt to asset ratio, profit ratio, last year investments. Standard errors are bootstrapped, with the significance levels of the z-test represented with stars: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 18: Survey responses, by firm size. In percent

Percentage of firms conducting sensitivity analysis as a part of its investment planning				
	Small	Middle	Large	All firms
Always	5.8	9.7	15.4	8.7
Often	8.3	22.0	30.8	17.7
Now and then	19.8	20.4	23.1	20.4
Rare	19.0	23.7	26.9	22.2
Never	47.1	24.2	3.9	30.9
Percentage of firms considering the opportunity cost of capital, by firm size				
	Small	Middle	Large	All firms
Always	24.8	19.6	34.6	22.7
Often	12.4	9.2	11.5	10.6
Now and then	20.7	27.7	26.9	25.1
Rare	14.9	19.0	15.4	17.2
Never	27.3	24.5	11.5	24.5

a Because of the way the data is organized, in this case the Kruskal-Wallis equality-of-populations rank test show whether the average response differ.

b The differences in firm size are significant at the 5 percent level using the Kruskal-Wallis test.

late the hurdle rate. I find that it is a higher likelihood that the firm puts a high emphasis on the hurdle rate if it is a subsidiary. Interestingly there is no effect on the manager's education nor firm size. However, firms that use the methods preferred by theory such as the WACC or FRA to calculate the hurdle rate or the IRR and NPV to calculate profitability puts a higher weight on the hurdle rate than firms that employ simpler methods.

5.5 Project analysis

A sensitivity analysis is a good way of illustrating the risk of a project. Classic sensitivity analysis identifies which part of the project where the possible losses or gains can come from. One might also use such an analysis to estimate the success-rate for an investment project. A break-even analysis is another type of sensitivity analysis that can illustrate the

uncertainty of a project. This method has the advantage that it calculates the number of sold products, the product price or the average costs needed to get a positive NPV, and by this illustrates key target values for the investment project. More advanced methods might include analyzing the sensitivity of a project with a Monte Carlo simulation of the investment calculations. By building an economic model and then test it by running a Monte Carlo simulation, one might get a better and more accurate description of the risk involved in a specific project. In order to get an overview of this topic, the firms were questioned whether they used sensitivity analysis to shed light on the project uncertainty. If so, I question the firm if they had any knowledge about real options modeling or Monte-Carlo simulations.

Table 18 shows that approximately 26 percent of the firms answered that they always or often conduct a sensitivity analysis before an investment project is initiated, while 43 percent of the firms say they do it now and then. Even though they consider the uncertainty related to future costs and income to be large, nearly 31 percent of the firms do not conduct any sort of sensitivity analysis. Table 18 shows how the response differs when I sort the firms by size. While the small firms to a lesser degree do sensitivity analysis, this is rather common among large firms.

Results from an ordered logit model, see Table 19, shows that there are several factors that explain which firms that are using sensitivity analysis actively to understand the risk of a project. Here I define that a firm conducts sensitivity analysis if it answers if it is conducted “Now and then” or more often. The empirical results show that firms that use theory preferred methods to calculate the hurdle rate or profitability are more like to conduct a sensitivity analysis than firms that use different methods.

Large firms have a higher probability of conducting a sensitivity analysis than small and middle-sized firms. Subsidiaries are more likely to conduct a sensitivity analysis, backing up the findings I earlier have shown that subsidiaries are more likely to chose the textbook methods in investment planning. The effect is so strong that it cancels the effect of being a small firm.

The survey question on how strong emphasis the firm put on the calculated hurdle rate. Including this response to the empirical model, I find that firms that put a moderate or high emphasis on its hurdle rate have a higher probability of making a sensitivity analysis

Table 19: Factors explaining the use of sensitivity analysis

Middle sized firms	0.516*
	(0.29)
Large firms	1.658***
	(0.40)
Higher education	-0.044
	(0.27)
Using theory-close methods	1.259***
	(0.29)
Subsidiary	0.498*
	(0.27)
Importance of hurdle rate	0.804*
	(0.45)
Threshold 1	0.493
Threshold 2	1.888***
Threshold 3	3.215***
Threshold 4	4.838***
Controls	✓
No. of observations	224
Log-likelihood	-295.09
χ^2-test, p-value	0.000
Pseudu R^2	0.134

Notes: The model is estimated using a ordered logit model: $Y_i = F(\tilde{\gamma}(k) - X_i\beta) - F(\tilde{\gamma}(k-1) - X_i\beta)$, where $\tilde{\gamma}$ is the thresholds, X_i is the firm specific variables, and $F()$ is the logit function. Control variables include administrative data on firm level such as debt to asset ratio, profit ratio, last year investments. Standard errors are bootstrapped, with the significance levels of the z-test represented with stars: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

before the firm puts its investments decision into action.

6 Final remarks

This paper highlights some of the differences and similarities between corporate finance theory and practice. By analyzing data from a survey among firms in the Norwegian manufacturing industry, I have obtained further evidence on the practitioner's decision-making strategy. I have shown that a significant share of firms struggles with handling uncertainty and risk. The executives' lack of information makes small and middle-sized firms reluctant to analyze the profitability of their projects in-depth using textbook methods. When the executives' express high uncertainty about their profitability analysis one should expect that this increases the use of sensitivity analyses to shed light on the uncertainty, but the survey results show that only a small fraction of the executives do this. Even such basic recommended methods in investment decision making; namely calculation of the NPV or the IRR is not common among executives in small firms. Surprisingly, I also find that executives in middle-sized firms calculate NPV or IRR more rarely than earlier research on international corporations has indicated. The effect of uncertainty is extensively discussed in the literature, but more important than measuring the effect of uncertainty is that the reluctance of using recommended capital budgeting models implies that standard investment models will struggle to explain the actual behavior.

I have shown that while a large share of the investment theory is supported by respondents' answers to the survey questionnaire, a significant share is the theoretical models are not supported by data from this survey.

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A Summary statistics

Table 20: Descriptive statistics of administrative data for firms in the sample. All figures are in million NOK

	Revenues	Profits	Dividends	Equity	Long debt	Short debt	Cash	Debt to asset	Value added	Investment*
Small sized firms										
mean	946.0239	57.68629	.0801511	196550.9	120006.5	262626.1	93.68286	.6454495	25705.36	342.6786
st error	2257.621	370.8038	.3901303	394293.5	267561.4	732945	369.0036	.2349724	75092.37	2503.635
p25	321.9002	-3.33868	0	45880.04	4582.49	65766.58	0	.50165	10106.91	0
median	582.978	14.91542	0	103450.3	36399.43	122674	17.285	.6218786	16181.53	0
p75	953.7294	48.87902	.015	211245.9	107266.7	230476.2	72.28	.7954009	24714.15	0
	234	234	234	234	234	234	234	234	234	233
Medium sized firms										
mean	3674.756	219.4388	.3301665	937967.8	430247.9	1052057	900.6001	.6559518	90997.99	6996.396
st error	4938.763	697.5276	1.357506	1681071	869186.4	1565797	10674.12	.208873	134330.7	42393.8
p25	1274.717	8.74777	0	189241.3	40230.62	301505.8	0	.5204746	37840.98	0
median	2142.848	84.16469	0	431125.9	150560.3	544563.6	28.97	.6640224	56954.62	0
p75	4004.095	210.1488	0	956254.2	376832.3	1203269	132.99	.7883168	93894.12	0
N	322	322	322	322	322	322	322	322	322	322
Large firms										
mean	34064.18	1964.4	3.469569	2.12e+07	9750476	1.63e+07	4673.236	.6574264	759290	54971.17
st error	56530.68	5137.007	13.2933	7.96e+07	3.67e+07	2.81e+07	47479.2	.1982087	1016182	252297.6
p25	8951.95	117.5679	0	1528764	338007.3	2143964	0	.5568067	218895.6	0
median	12546.57	771.3342	0	3292612	1210447	4260649	77.545	.6916347	379892	0
p75	30470.79	2332.82	0	1.21e+07	4351111	1.31e+07	275.89	.7720472	791763.8	0
N	130	130	130	130	130	130	130	130	130	130
Total										
mean	8502.894	494.9415	.8398148	4519734	2090646	3663724	1340.285	.6526488	195370.4	13837.86
st error	27738.96	2398.986	5.985451	3.55e+07	1.63e+07	1.37e+07	21924.78	.2159871	529287.1	115135.3
p25	753.1193	4.64944	0	110537.1	27360.95	170727.9	0	.5186248	19776.36	0
median	1766.895	58.07133	0	324513.1	121058.6	444085.4	27.015	.6549432	44535.94	0
p75	5456.109	234.0651	0	1228627	491875.1	1614622	133.43	.7883168	117956.3	0
N	686	686	686	686	686	686	686	686	686	685

Notes: The means are unweighted, ie. small firms have the same weight as large firms, when calculating sample means.

*Because matching between the survey data and the administrative data were not perfect, there are one observation less in this variable

B Test results

To identify differences in the mean of the variable of interest between two sub-samples there are several test one could apply. The standard approach to apply for testing a hypothesis of no difference in the mean between two groups is the t-test. The t-test hinges on the normality assumption, ie. that the variables that is to be tested have a normal distribution, but the population variance may be unknown. Relax the normality assumption, I could apply the non-parametric Wilcoxon Rank Sum test instead of the t-test.

The second kind of test aims to identify whether the respondents answers the questionnaire in a random way or that there are significant differences between the different response categories. There are several ways to do this. The standard approach is to apply a one-way analysis of variance (ANOVA). An alternative is the Fisher's exact test for contingency tables, but in contrast to the Fisher's exact test the ANOVA also takes into consideration the differences in the variance within the groups, not only the differences in means as the Fisher test. An argument against the ANOVA test is that it assumes normality. Even though our sample is fairly large one might argue that a non-parametric test, such as the Kruskal-Wallis rank test, is more suitable.

In contrast to the one-way ANOVA, the two-way ANOVA tests difference in means between not only groups, but simultaneously also tests for differences between different blocks of questions. This allows us to test responses in two dimensions in one test. In our case, this means that I can test a) whether or not firms answer randomly on a given question and b) whether firm size matter for the responses. Still I have to care about the normality assumption. The Friedman test is a non-parametric variant of the two-way ANOVA for the case where I have one observation per cell. In our case I have multiple observations per cell and the Friedman test cannot be used. Since the data set is sufficiently large, I assume that the two-way ANOVA can be used, but I employ the Kruskal-Wallis test when the question that is analyzed only have one dimension.

This section shows the results from the Tuckey-Kramer and ANOVA test applied to the questionnaire. First part of the procedure is to run a standard ANOVA test with interaction terms. The second step is to apply the Tuckey-Kramer test. If the test reject H_0, then the difference in mean is significantly different from zero at the 5 percent level. After showing

the ANOVA tables do the Tuckey-Kramer test results for pairwise comparison for groups (firm size) and blocks (questions) follows.

Table 21: ANOVA results, for funding source

Source	Partial SS	df	MS	F	Prob > F
Model	1144.66177	17	67.3330452	109.63	0.0000
Financing	602.360771	5	120.472154	196.14	0.0000
cap	4.67547226	2	2.33773613	3.81	0.0224
Financing#cap	35.8678817	10	3.58678817	5.84	0.0000
Residual	926.226828	1508	.614208772		
Total	2070.8886	1525	1.35795974		

N = 1526, R-squared =0.5527, Root MSE = 0.783715

Table 22: Tuckey-Kramer pairwise comparison, firm size effect for choice of funding source

Firms size	group means		difference	TK-test
1 vs 2	1.1538	1.2506	0.0968	3.1686
1 vs 3	1.1538	0.9867	0.1672	3.2725
2 vs 3	1.2506	0.9867	0.2639	5.3682*

* Indicate rejecting of the H_0, ie. difference in mean significantly different from 0

Table 23: Tuckey-Kramer pairwise comparison, for choice of funding source

Funding source	group means		difference	TK-test
1 vs 2	2.4068	1.8172	0.5896	13.0085*
1 vs 3	2.4068	0.2422	2.1647	44.8366*
1 vs 4	2.4068	0.4469	1.9599	40.7558*
1 vs 5	2.4068	0.2679	2.1390	44.3627*
1 vs 6	2.4068	1.2659	1.1410	24.4793*
2 vs 3	1.8172	0.2422	1.5751	31.6413*
2 vs 4	1.8172	0.4469	1.3703	27.6302*
2 vs 5	1.8172	0.2679	1.5493	31.1636*
2 vs 6	1.8172	1.2659	0.5513	11.4479*
3 vs 4	0.2422	0.4469	0.2048	3.9144
3 vs 5	0.2422	0.2679	0.0257	0.4903
3 vs 6	0.2422	1.2659	1.0237	20.0930*
4 vs 5	0.4469	0.2679	0.1790	3.4268
4 vs 6	0.4469	1.2659	0.8190	16.1312*
5 vs 6	0.2679	1.2659	0.9980	19.6117*

* Indicate rejecting of the H_0, ie. difference in mean significantly different from 0

Table 24: ANOVA results for chose of hurdle rate

Source	**Partial SS**	**df**	**MS**	**F**	**Prob > F**
Model	379.669454	20	18.9834727	20.86	0.0000
hurdle rate	125.999034	6	20.999839	23.08	0.0000
cap	20.1111473	2	10.0555737	11.05	0.0000
hurdle rate#cap	49.2487595	12	4.10406329	4.51	0.0000
Residual	1240.37029	1363	.910029557		
Total	1620.03974	1383	1.17139533		

N = 1384, R-squared =0.2344, Root MSE = 0.9539

Table 25: Tuckey-Kramer pairwise comparison, for choice of hurdle rate

Hurdle rate	group means		difference	TK-test
1 vs 2	2.0456	0.5506	1.4951	22.8358*
1 vs 3	2.0456	1.0729	0.9727	15.1913*
1 vs 4	2.0456	1.0529	0.9927	15.4331*
1 vs 5	2.0456	0.8090	1.2366	18.8886*
1 vs 6	2.0456	0.8587	1.1869	18.3082*
1 vs 7	2.0456	1.2400	0.8056	12.7299*
2 vs 3	0.5506	1.0729	0.5224	7.4424*
2 vs 4	0.5506	1.0529	0.5023	7.1302*
2 vs 5	0.5506	0.8090	0.2584	3.6143
2 vs 6	0.5506	0.8587	0.3081	4.3450*
2 vs 7	0.5506	1.2400	0.6894	9.9189*
3 vs 4	1.0729	1.0529	0.0200	0.2895
3 vs 5	1.0729	0.8090	0.2639	3.7604
3 vs 6	1.0729	0.8587	0.2142	3.0783
3 vs 7	1.0729	1.2400	0.1671	2.4516
4 vs 5	1.0529	0.8090	0.2439	3.4621
4 vs 6	1.0529	0.8587	0.1942	2.7801
4 vs 7	1.0529	1.2400	0.1871	2.7341
5 vs 6	0.8090	0.8587	0.0497	0.7009
5 vs 7	0.8090	1.2400	0.4310	6.2009*
6 vs 7	0.8587	1.2400	0.3813	5.5337*

* Indicate rejecting of the H_0, ie. difference in mean significantly different from 0

Table 26: Tuckey-Kramer pairwise comparison, for firm size effect of choice of hurdle rate

Firm size	group means		difference	TK-test
1 vs 2	1.0238	1.2238	0.2001	5.1597*
1 vs 3	1.0238	1.2097	0.1859	2.7500
2 vs 3	1.2238	1.2097	0.0142	0.2167

* Indicate rejecting of the H_0, ie. difference in mean significantly different from 0

Table 27: ANOVA results for chose of investment criteria

Source	**Partial SS**	**df**	**MS**	**F**	**Prob > F**
Model	36.090	17	2.1229	12.71	0.0000
criteria	16.9238	5	3.3847	20.26	0.0000
cap	2.670348	2	1.3351	7.99	0.0003
criteria#cap	12.18441	10	1.2184	7.29	0.0000
Residual	333.7821	1998	.16705		
Total	369.8730	2015	.1835		

N = 2016, R-squared =0.0976, Root MSE = 0.4087

Table 28: Tuckey-Kramer pairwise comparison, for firm size effect of choice of investment criteria

Firm size	group means		difference	TK-test
1 vs 2	0.1986	0.2584	0.0598	4.3397*
1 vs 3	0.1986	0.3210	0.1224	4.8693*
2 vs 3	0.2584	0.3210	0.0626	2.5792

* Indicate rejecting of the H_0, ie. difference in mean significantly different from 0

Table 29: Tuckey-Kramer pairwise comparison, for choice of investment criteria

Investment criteria	group means		difference	TK-test
1 vs 2	0.0952	0.2857	0.1905	8.5423*
1 vs 3	0.0952	0.3542	0.2589	11.612*
1 vs 4	0.0952	0.3720	0.2768	12.413*
1 vs 5	0.0952	0.1548	0.0595	2.6695
1 vs 6	0.0952	0.1905	0.0952	4.2712*
2 vs 3	0.2857	0.3542	0.0685	3.0699
2 vs 4	0.2857	0.3720	0.0863	3.8707
2 vs 5	0.2857	0.1548	0.1310	5.8729*
2 vs 6	0.2857	0.1905	0.0952	4.2712*
3 vs 4	0.3542	0.3720	0.0179	0.8008
3 vs 5	0.3542	0.1548	0.1994	8.9428*
3 vs 6	0.3542	0.1905	0.1637	7.3411*
4 vs 5	0.3720	0.1548	0.2173	9.7436*
4 vs 6	0.3720	0.1905	0.1815	8.1419*
5 vs 6	0.1548	0.1905	0.0357	1.6017

* Indicate rejecting of the H_0, ie. difference in mean significantly different from 0

C Survey methodology and the survey plan

C.1 The Survey

The respondent will answer an Internet questionnaire. The program used is Enalyser. By choosing an Internet survey, one ensures that dunning letters can easily be sent. A dunning letter was sent two times, with approximately one month interval. All respondents received an information letter together with the survey. To strengthen the response rate, the information letter was carefully written. There were put emphasis on two matters. First, the importance of the results the survey might induce. And secondly, that it was not expected that the respondents where familiar with all the concepts that the survey questioned.

The survey was dispatched, by e-mail, to all respondents of SSB's Business Tendency Survey. The latter survey includes firms in the manufacturing sector only and is a voluntary survey, normally with a response rate of 95 per cent. The business tendency survey has approximate 800 respondents, and it accounts to about 3.5 per cent of the population of firms. In the strata with the largest firms (>300 employees), all firms are included in the sample. While in the strata with the smallest firms, a large share is excluded. To be included in the sample, the firm needs to have at least 10 employees. Because of this stratification, the sample covers approximately 40 per cent of the total employment in the manufacturing sector.

Information letter

The letter is included in the survey. The letter explains short about the survey. Further, it informs about the importance of answering also the topics unknown for the executive and that lack of knowledge about corporate finance is expected. It is also informed how their effort might benefit their business and the entire economy by giving the decision-makers better understanding of investment behaviour. They are also informed that the data would be stored in such a way that it will be impossible to identify the different firms. Tracking firms, via identification numbers, is done for sending dunning letter and linking the firms with firm specific variables from account statistics.

C.2 Survey questions

The questionnaire where in Norwegian, so the questions have been translated.

1. How does the firm finance its investments in machines, buildings and means of transportation, ergo investments in real capital?
    - Equity (Yes, almost always/Now and then/No, nearly never/Not relevant for the firm)
    - Bank loan
    - Bonds
    - Currency loan
    - Emission of stocks
    - Loan from parent company
2. Is your firm using one or more of the following calculation methods when doing profitability analysis? (Multiple draws)
    - Equivalent annual cost (Yes/No)
    - Internal rate of return
    - Net present value method
    - Payback method
    - Other method
    - No method
3. If one or more of the mentioned methods are in use, what kind of hurdle rate is normally used?
    - Bank interest rate (Yes, almost always/Now and then/No, nearly never/Not relevant for the firm)
    - Expected bond rate
    - Calculated interest rate, with help of future rate agreements

- Calculated interest rate, with help of the weighted average cost of capital method (WACC)
- Calculated interest rate, with help of the capital asset pricing model (CAPM)
- Calculated interest rate, with several models
- Interest rate calculated in other ways

4. How significant is the calculation of the hurdle rate for the investment project?
    - Great
    - Moderate
    - Small
    - No
    - Not relevant for the firm
5. What was the cause for conducting the last considerably investment project?
    - Wear and tear (Yes/No)
    - Environmental or public issues
    - Increase capacity
    - Change in product composition
    - Old or unfashionable
    - Relocation
    - New and better technology available
    - Desire to reduce personnel cost
    - No specific reason or other reasons
6. In a thought scenario: Would a considerably rise in wage cost induce an increase in investments in real capital? (Yes, to a large degree/Yes, to some degree/No, dubiously)

7. How often is investment projects implemented even though it was not possible to give a good estimate of the cash surplus, e.g., because there is great uncertainty about how much the sale will increase? (Always/Often/ Now and then/Rare/Never)

8. Is sensitivity analysis employed to make the uncertainty in the investment cost visible? (Always/Often/ Now and then/Rare/Never)

9. Real option pricing is a way to express the value of future investment possibilities. Is this a concept you are acquainted with, and if so is the method used?

    - Yes, the method is used often
    - The method is rarely used
    - The method is known, but not used
    - No, is not familiar with the concept

10. Is Monte-Carlo simulations used to reveal uncertainty?

    - Yes, nearly always
    - Often
    - Now and then
    - Rarely
    - No
    - Not familiar with the concept

11. Do you consider an alternative way to use the capital assets, other than paying dividend, before carrying through investment projects? (Always/Often/ Now and then/Rare/Never)

12. If not alternative use is considered, why is that?

    - Financing investments requires collateral, so the capital is not free assets
    - The survival of the firm is more important than a possible extra profit
    - Other reasons

13. What is/or do you think is the most important reason for the firm ownership?
    - Maximising profit
    - Create jobs
    - Realise business ideas
    - Other reasons
14. How would a reduction in the market position of the firm alter its investment plans?
    - The firm would most likely increase investments
    - The firm would neither increase nor decrease investments
    - The firm would probably decrease its investments
    - Not relevant for the firm
15. Liquidity is necessary for investments. How often is this a limiting factor for investment projects?
    - Always
    - Often
    - Now and then
    - Rarely
    - Not relevant for the firm
16. How important is good cash holdings/liquid funds for financing investment projects?
    - Important
    - Less important
    - Not important
    - Not relevant for the firm
17. How important is the firm’s profit for financing investment projects?
    - Important

- Less important
- Not important
- Not relevant for the firm

18. When did the firm complete its last considerable[6] investment?

    - Second half of 2012
    - First half of 2012
    - In 2011
    - In 2010 or earlier
    - Not relevant for the firm

19. What is your highest achieved educational degree?

    - Secondary school
    - Upper secondary school, vocational subject
    - Upper secondary school, general
    - Polytechnic education
    - Graduate, business or economics
    - Undergraduate, business or economics
    - Higher education, other
    - Other educations

[6] I have chosen not to define the size of a considerable investment, because the size of the firms differs substantially and it is no obvious link between firm size and capital stock across different industries. The respondent was given the responsibility to define herself what a considerable investment is.

D Further survey results

Table 30: Percentage of firms considering the opportunity cost of capital, by firm size. Percent

	Small	Middle	Large	All firms
Always	24.8	19.6	34.6	22.7
Often	12.4	9.2	11.5	10.6
Now and then	20.7	27.7	26.9	25.1
Rare	14.9	19.0	15.4	17.2
Never	27.3	24.5	11.5	24.5
Reason for not considering the opportunity cost				
	Small	Middle	Large	All firms
Collateral	8.1	15.7	33.3	14.0
Survival	59.8	45.7	20.0	49.2
Other	33.3	42.9	46.7	39.7
Motive for ownership, by firm size. Percent				
	Small	**Middle**	**Large**	**All firms**
Maximising profit	77.7	77.2	73.1	77.0
Create jobs	31.4	23.9	11.5	25.7
Realise business ideas	37.2	34.2	23.1	34.4
Other motives	8.3	10.3	26.9	10.9

Notes: The respondents could answer more than one category

Table 31: Investment responses of changes in business environment. Percent

In a thought scenario: Would a considerably rise in wage cost induce an increase in investments in real capital? Response by firm size and in percent				
	Small	Middle	Large	All firms
No, doubtfully (unchanged or lowered)	34.7	34.1	42.3	34.9
Yes, might increase	51.2	47.0	46.2	48.5
Yes, would increase	14.1	18.9	11.5	16.6
How would a reduction in the market position of the firm alter your investment plans. Response by firm size and in percent				
	Small	Middle	Large	All firms
Not relevant for us	5.0	3.3	3.9	4.0
Reduce investments	62.2	59.0	69.2	61.0
No change in investments	24.4	24.6	15.4	23.8
Increase in investments	8.4	13.1	11.5	11.3

Table 32: What were the reasons for the firm's last investments. Percent

	Avg. response	Standard error
Lack of capacity	51.2	(0.50)
New technology available	37.3	(0.48)
Existing capital old/unfashionable	33.1	(0.47)
Wear and tear	32.2	(0.47)
Desire to reduce wage costs	25.9	(0.44)
Change in product composition	13.6	(0.34)
Environmental requirements	10.5	(0.31)
Relocation of its facilities	8.1	(0.27)
Other reasons	3.0	(0.17)

Notes: Since the firms could answer more than one reason for investing, the column does not sum to one.

Table 33: How firms decisions are affected by liquidity constraints and cash flow effects.

How often liquidity constraints limit investments, by firm size. Percent

Frequency	**Small**	**Middle**	**Large**	**All firms**
Always or often	39.7	26.2	25.9	31.1
Now and then	27.3	30.1	25.9	28.7
Rare or never	29.8	39.9	48.1	36.9

Importance of cash flow for the financing of investment projects, by firms size. Percent

Importance	**Small**	**Middle**	**Large**	**All firms**
Not important/relevant	5.8	13.2	11.6	10.4
Some importance	13.3	17.6	15.4	15.9
Important	80.0	69.2	73.1	73.9

Importance of profit for new investments, by firm size. Percent

Relevance	**Small**	**Middle**	**Large**	**All firms**
Not important/relevant	2.5	6.0	7.4	4.8
Some importance	16.7	15.9	11.1	15.8
Important	80.8	78.1	81.5	79.4

Table 34: Proportion familiar with real option models, by firm size

Relevance	**Small**	**Middle**	**Large**	**Total**
No, is not familiar with the concept	46.88	44.68	36.00	44.35
The method is known, but not used	48.44	47.52	60.00	49.13
The method is rarely used	3.13	7.80	4.00	6.09
Yes, method used often	1.56	0.00	0.00	0.43

Table 35: Proportion answering that Monte Carlo analysis is done to reveal uncertainty, by firm size

Relevance	Small	Middle	Large	Total
Not familiar with the concept	55.38	52.14	44.00	52.17
No	38.46	33.57	52.00	36.96
Rarely	6.15	8.57	0.00	6.96
Now and then	0.00	4.29	4.00	3.04
Often	0.00	0.71	0.00	0.43
Yes, nearly always	0.00	0.71	0.00	0.43
Number of respondents	65	140	25	230

Table 36: Response to the question: What were the reasons for the firm last investments. Percentage of respondents answering yes. By firm size

	Mean	Standard deviation
Small firms		
Wear and tear	0.31	0.47
Environmental	0.066	0.25
Capacity	0.53	0.5
Product composition	0.13	0.34
Old/Unfashionable	0.37	0.49
Relocation	0.066	0.25
New technology	0.4	0.49
Reduce wage costs	0.24	0.43
Other reasons	0.025	0.16
Middle firms		
Wear and tear	0.31	0.47
Environmental	0.11	0.31
Capacity	0.52	0.5
Product composition	0.12	0.32
Old/Unfashionable	0.3	0.46
Relocation	0.092	0.29
New technology	0.35	0.48
Reduce wage costs	0.27	0.45
Other reasons	0.038	0.19
Large firms		
Wear and tear	0.42	0.5
Environmental	0.27	0.45
Capacity	0.38	0.5
Product composition	0.27	0.45
Old/Unfashionable	0.35	0.49
Relocation	0.077	0.27
New technology	0.38	0.5
Reduce wage costs	0.27	0.45
Other reasons	0	0

Investments and Capital Budgeting Practice: Is there a difference between small and large firms?*†

Joakim Blix Prestmo[a, b]

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[a,]The Norwegian University of Science and Technology (NTNU), Department of Economics, N-7491 Trondheim, Norway, e-mail: Joakim.Prestmo@ntnu.no

[b]Statistics Norway, Reserch Department,P.O. Box 8131 Dep., N-0033 Oslo, Norway

Abstract

To increase our understanding of how business executives plan their investment budget, this paper analyses the results from the business survey that was sent out to a representative sample of firms in the manufacturing industry in Norway. The business survey was conducted in cooperation with The Business Tendency Survey of Statistics Norway. This linking to the Business tendency survey leads to a far higher response rate compared with similar studies, and it covers a representative share of the firms in the Norwegian manufacturing sector. I find, as many papers have shown before, that there are mismatches between theory and practice, but in contrast to earlier work, there seems to be a considerable mismatch. There is substantial firm size heterogeneity in capital budgeting: Smaller firms embrace simple methods for these calculations, and the results show that small firms have less sophisticated decision rules. Finally, a surprisingly large share of small and middle-sized firms do not put significant weight on their calculated investment criteria. If firms do not put weight on their calculations, this helps us in explaining why firms use gut feeling rather than thorough calculations to decide which investment project they start. Interestingly, being a subsidiary cancels the firm size effect. Indicating that there exists a sharing of best practices across larger corporations.

Keywords: Business Survey, Discount Rates, Capital Budgeting, Firm Size Heterogeneity

1 Introduction

Aggregate investments have been low in most OECD countries in the years following the financial crises, Banerjee et al. (2015). There is no agreement on what caused the investment level not to pick up to the pre-crisis levels. Some analysts have pointed to low expected demand as a possible cause, while others look to the over-capacity caused by larger than sustainable investment levels before the Financial crisis. Difficulties in getting credit is another cause for low investments. In recent years there has been an increased amount of studies analyzing the effect of credit and economic activity on, see e.g. Gertler and Gilchrist (2018) or Borio (2017). In the build-up to the Financial crisis, there was an accumulation of cash holdings in many firms, Bates et al. (2009). The increased cash holdings should have eased the need for credit, thus reducing financial constraints.

The goal of my paper is to study the manager's practice in capital budgeting and investment planning. To bring new insight to the table, I have conducted a one-off business survey of the manufacturing industry in Norway. My hope is that the survey may shed light on the discussion about the lack of investment growth from a different perspective than traditional empirical analysis have given us.

Specifically, the paper discusses which methods are preferred by the managers to support the investment decision. I am particularly interested in studying to what extent their practices are consistent with, or goes against the textbook approach. Textbooks in corporate finance recommend firms to use the net present value method to calculate the expected profitability of an investment[1]. The hurdle rate used to discount the expected cash flow is supposed to take into account the riskiness of the project, but also the share of debt funding. With several projects, the internal rate of return could assist the management with the ranking of its projects, according to this theory. Lastly, the theory recommends that firms should analyze the sensitivity of the assumptions it made to calculate its expected cash flow. If firms follow those recommendations, they will behave as predicted by the Neoclassical investment models. If not, how should we think about modeling real investments?

I have tried to design the survey such that the answers can be used to rank the different

[1] An example of a corporate finance textbook is Brealy et al. (2017)

methods used by the managers for its investment planning. An additional motive has been to obtain insight about the underlying assumptions behind the Neoclassical investment models. To address these issues, the survey questionnaire contains questions about the firms' qualitative questions concerning its assumptions, such as how significant emphasis it puts to its calculated hurdle rate. I do not believe that I can validate or falsify the different theoretical models using the results from this survey. However, it will increase our insight into which perspective a practitioner is taking on in capital budgeting and investment planning, and by this increase our understanding of investment fluctuations. The findings from this survey have been essential to the results of paper 2 and 3 in this Ph.D. dissertation. The results from this paper helps us to put the empirical models of in the second paper in context, while the theoretical model in the last paper is motivated with on the insight from the survey.

The business survey was conducted during the winter 2012/2013 and is unique in the sense that the response rate is as high as 42 percent. Furthermore, being able to use the same respondents as in Business Tendency Survey (BTS) of Statistics Norway, the sample would be stratified. The sample is linked to administrative data and the Statistics Norways's quarterly Investment Survey which enables us to address more detailed research questions. The high response rate and the fact that the survey is representative of the whole population of manufacturing firms make it possible to study firm size effects using ordered logit model and two-way tables in a way few other studies have done.

My research shows that decision-making processes varies substantially between small and large firms. Small firms use different methods than large firms and pay less attention to the formal capital budgeting process. This implies that aggregate investments in countries with a relatively high share of large firms respond differently to shocks affecting firms' expectations than how a similar shock would affect investments in countries with a relatively high share of small firms. Hence, I argue that one has to take into account heterogeneity in the firm size distribution for different countries when modeling aggregate investments. Thus, this paper contributes to the literature on firm size heterogeneity and management practice. I have studied management practice in its use of investment and corporate finance theory and present empirical evidence showing that there is a different management practice between small, middle-sized, and large firms.

The paper starts with a brief literature review in the next section. Section 3 discuss the data and the business survey. The empirical and descriptive methods are explained in section 4, while the analysis is described in section 5. The analysis starts by going through the survey results briefly. This gives detailed coverage of the firms' practice and strategy. Then an econometric model is applied to analyze the business survey data together with administrative data to uncover what methods the firms choose for their capital budgeting process and which factors are best at describing their choices. Section 6 summarizes the paper. Detailed figures, a description of the survey, tables with statistical tests of the survey results, and further survey results not discussed in the paper are found in the appendix.

2 Literature

The study of management practice, and particularly the firms' choices related to its investment decision have been conducted in decades. A comprehensive study of the Chief Financial Officers' (CFO) practice of capital budgeting and investment planning is found in Graham and Harvey (2001). The survey is covering three distinct topics: Capital budgeting, cost of capital, and capital structure. The focus of Graham and Harvey (2001) is to identify whether the standard theory is backed up by empirical findings. One of the strengths of the paper is that the survey covers a large part of the theories discussed by the corporate finance literature. However, many countries are, in contrast to the US, less dominated by large firms and corporations and have a relatively large share of small firms. Graham and Harvey (2001) mainly focus their attention on large corporations, for good reasons. Brounen et al. (2006) extend the work of Graham and Harvey (2001) through their particular focus on capital structure policies. An important message from Brounen et al. (2006) is that capital structure policies differ substantially across countries. There is consequently a need to fold out different management practices since they also seem to differ widely between countries. A potential weakness with both Graham and Harvey (2001) and Brounen et al. (2006) is that both papers have a relatively low response rate. They report a response rate of nine percent and five percent, respectively. A low response rate may make it somewhat difficult to generalize the results. If the respondents are unfamiliar with the terms used in the questionnaire, they are more likely to drop out of the survey. If

there are selection effects present in the survey, this can bias the responses towards the use of more complicated methods, and away from more straightforward decision rules.

In a study of venture capitals (VC) Gompers et al. (2019) surprisingly find that few VC funds use the methods recommended by academic textbooks. Their finding goes against Graham and Harvey (2001) showing that only a small share of the funds use the NPV method to calculate the valuation of their investment and supports the view that gut feeling plays a large role in the investment decision. They do not find any firm size effect on the methods chosen by the VC fund to value the investment, but they find that small funds are more likely to rely on gut feeling when taking their decisions.

Bloom and Reenen (2010) surveys the management practice of plant managers at medium-sized firms around the world. Based on their survey, they find substantial differences in practice between countries, with the US rating highest. Their study highlights the importance of studying management practice and they also find that it is not sufficient to study management practice in a few counties. Kengatharan (2016) discusses the empirical research of corporate finance during the last 20 years and represent valuable insights into management practice.

Except for Gompers et al. (2019), none of the papers above focus mainly on how practice varies between small and large firms. However, firm size heterogeneity and management practice are discussed in several other studies. Gertler and Gilchrist (1994) study how firm size affects the firm's response to a monetary policy shock. They find empirical support for a more significant contraction in inventories, sales, and short-term debt in small firms relative to larger firms when the credit supply tightens. Calomiris and Hubbard (1990) have also highlighted the role of firm size heterogeneity. They discuss how firm heterogeneity caused by information asymmetry affects the capital structure and their access to credit. Runyon (1983) also studies investment practices in small US businesses. Runyon (1983) finds that small firms embrace more straightforward methods than Graham and Harvey (2001), but the paper does not compare the practice of small firms with middle-sized and large businesses. This makes it challenging to study relative differences of practice.

3 Data

3.1 The Norwegian Manufacturing Industry

The Norwegian manufacturing industry is characterized by having a relatively large share of small and middle-sized firms. The Norwegian offshore petroleum industry is sizeable, and because of this, the manufacturing industry has a relatively large share of the firms in the ship and rig building industry compared to other OECD countries. Furthermore, the manufacturing industry is prominent in the production of inputs and investment goods and characterized by few producers of consumer goods.

In OECD countries, the average number of employees per enterprise in the manufacturing industry were 17.4 in 2012.[2] The trio – US, Germany, and Switzerland had nearly twice as many employees per enterprise than the average OECD country. The South European countries: Greece, Italy, Portugal, and Spain are at the bottom of the scale with far fewer employees per enterprise than the average country. Norwegian enterprises are also below the average OECD with 13.2 employees per enterprise. If one does not take into account the firm size composition, then studies of corporate finance practice in the US, UK or the Germanic-speaking countries, will not be directly comparable to result from the studies of countries like France, Poland, Netherlands or Norway. All are countries with an average employee per enterprise of about 13. Hence, studying Norwegian data as a representative for countries with a larger share of smaller firms, might further increase our insight into firm behavior.

Recall that the purpose of the survey is to obtain data that can be applied to study which methods the firms prefer when evaluating investment projects. The survey questionnaire contains further questions that are useful for understanding their choice of methods. The business survey builds on the quarterly Business Tendency Survey (BTS) by the Division for Manufacturing Statistics at Statistics Norway. The BTS is a survey that is based on questioning the firms about the business' prospects and their investment budget, which I analyze in the second paper of this thesis. I sent the questionnaire to the same respondents as those that participate in the BTS. Hence, the respondents have experience in filling out business surveys. The respondents are, in most cases, the general manager or the chief

[2]Unweighted average; data source: OECD Productivity statistics; stats.oecd.org

Table 1: The distribution of firms and employment in the total population and the sample within each firm size category, all figures measured in 2013

	Firms			Employees		
Category	*N*	In pop.	In sample	*N*	In pop	In sample
Total manufacturing	13 518	100 %	745	188 954	100 %	92 845
Small manufacturing firms	12 640	93.5 %	34.0 %	49 281	26.1 %	7.2 %
Middle manufacturing firms	540	4.0 %	56.6 %	74 088	39.2 %	29.4 %
Large manufacturing firms	338	2.5 %	9.4 %	65 584	34.7 %	63.3 %

Notes: The table shows figures for number of firms and total employment in the population. The "In pop" and "In sample" figures shows the relative distribution of small, middle and large sized firms in the total population and in the sample respectively. Firms without employment are excluded from this summary table.

accountant. In the largest firms, the respondents are typically the Chief Financial Officers (CFO). The advantage of using the respondents of the BTS is three-folded.

Regarding data quality, the respondents in this survey are accustomed to answering questionnaires related to expectations and investment practices. Statistics Norway has strong confidence among businesses, which both enhance truthful answers and a high response rate. Second, the sampling procedure used by Statistics Norway secures that the sample is representative and unbiased both across firm size and across industries. Third, the respondents are linked to their firms' organization number, which makes it possible to link the survey data to administrative data from the Business and Enterprise Statistics and data from the quarterly Investment Survey, both from Statistics Norway. Linking survey data with administrative data enables us to cross-validate some of the responses given to the questionnaire with the administrative data. After I added the administrative data to the survey data, it was possible to study if there are any biases in average debt to asset ratio, investment level or the number of employees between the firms that responded to the survey and firms that did not respond.

Managers of manufacturing firms typically have a varied educational background. Table 2 shows the education of the respondents. The survey shows that a large share of the respondents has high education and that CFOs and CEOs of large firms are much more likely to have a decree within economics. It is also interesting to note that among smaller

Table 2: The education level of the respondents. In percent

	Lower 2nd	Upper 2nd. Pract.	Upper 2nd. General	Technological Ba or M.Sc	Economics Master	Economics Bachelor	Other University	Other studies
Small	1.8	5.4	8.1	15.3	20.7	19.8	27.0	1.8
Middle	0.0	6.7	5.2	7.4	31.9	28.2	18.5	2.2
Large	0.0	0.0	5.5	7.3	34.6	21.8	29.1	1.8
All firms	0.7	5.0	6.3	10.3	28.2	23.9	23.6	2.0

Table 3: Summary statistics for each employment category (no. of employees) of firms in the total population of Norwegian manufacturing industry. Average for the years **2011-2014**

	0 - 9	10-19	20-49	50-99	100-199	200+	All firms
Number of firms	15 663	1 759	1 381	514	271	159	19 747
Employees**	30 391	23 728	42 596	35 463	37 037	63 808	233 023
Value added*	15 787	14 902	28 943	26 273	34 930	71 812	192 646
Gross investments*	2 164	1 239	2 360	2 753	4 354	6 931	19 800

*Notes: *In million NOK, **Total employed within this category. Value added in market prices*

firms there is a large share of firms where the managers have a technical background, typically a bachelor's degree from a university college or a master of science from a university. Table 3 summarizes the administrative data of the firms participating in this survey.

Data is organized as a cross-section set. Because data is sampled once, one would expect that the business trends are affecting some of the answers in an unknown direction. If the perception of the firms' prospects varies with the business cycle, the level of uncertainty will also vary. Hence, one would expect that practice related to the investment decisions also varies with the business cycle. Even though the questions are formulated in a general way, an important concern was to conduct the survey when the Norwegian business climate was close to neutral, i.e., when investments increase with a rate close to the long-run growth rate. In such a climate the business managers are more likely to have a balanced view of the prospect of their firms'.[3]

[3]For a detailed description of real-time the business climate see Chart 1.10 in the Monetary Policy Report 1/2013, published by the Central Bank of Norway

The survey design is based on stratified sampling. The BTS divides the firms into four different strata, and the respondents are drawn randomly from each stratum. The probability of being drawn from the population increases with firm size. Also, all firms within the stratum of the largest firms are included in the sample. The population includes firms in the Norwegian mining and manufacturing sector with more than ten employees. The total number of respondents, drawn from the full population, is 745 firms. The mining and manufacturing industry in Norway consists of almost 20 000 firms, and slightly above 9 000 firms have no employees, and a further 6 500 have less than ten employees. Firms with none or few employees amount to a small fraction of the total employment and total investments in the manufacturing industry. Those firms were excluded from the population before the sampling. Details about the composition of the firms are shown in Table 20 in the appendix. The firms included in the sample add up to approximately 40 percent of the total employment in the manufacturing industry, while it covers 3.5 percent of the total number of firms in the industry.

After correcting for non-responses, 36.5 percent are small firms, 55.2 percent are middle firms, and 8.1 percent are large firms. I want to test whether there are any biases in firm size composition between the response and non-response groups. Using a t-test to test for differences in mean employment of the group with a response and the group with a non-response, I find that the difference in firm size distribution is insignificant between the two samples. Hence, it is possible to argue that there are no selection issues related to firm size between the respondents and the non-respondents in the sample.[4]

To achieve a high response rate, I reduced the number of questions in this survey compared to those occurring in Graham and Harvey (2001) and Brounen et al. (2006). Furthermore, for every question, the respondents could choose to answer that the question was "Not relevant for our firm". The motivation for including this response category was to encourage the respondents unfamiliar with the concepts questioned to respond. Finally, the information letter contained detailed information about the survey and it requested the

[4] A two-sided Welch t-test for the difference in mean employment between the group of response and non-response $\Pr(T > |t|) = 0.63$, i.e. I do not reject the H_0 : difference in means is zero. A test for difference in mean employment with the Wilcoxon rank-sum test gives a p-value of 0.37, i.e., one does not reject H_0: difference in means is zero. I do a similar test for difference in the debt to asset ratio, revenue, and total investments, and all indicate that there are small biases between firm responding and not to the survey.

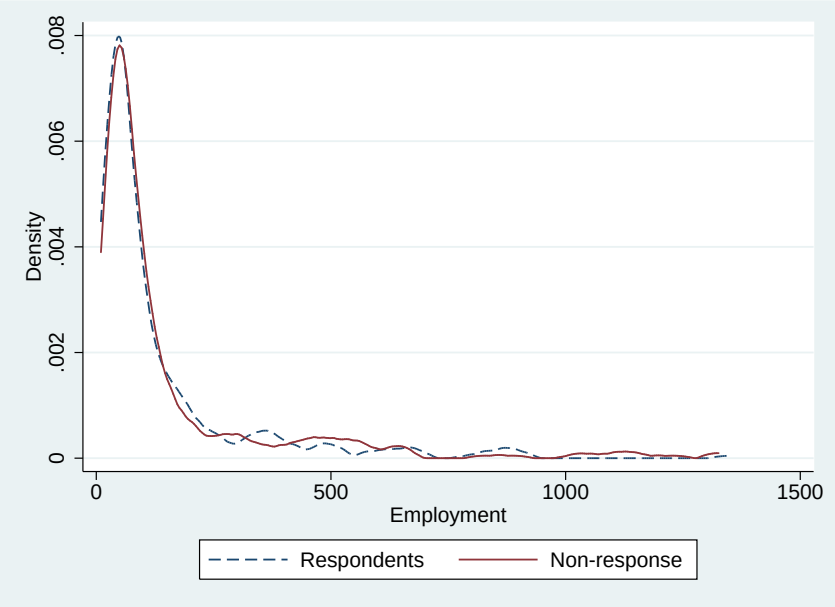


Figure 1: Kernel density distribution of firm employment. Non-response and respondents.

respondents not to hesitate to answer even if they were unfamiliar with the topic addressed in the question. This resulted in a high response rate from both from large as well as small firms, with a response rate of 42 percent.

The survey uses an Internet-based survey program called Enalyser. Respondents were contacted by e-mail, and they replied using an Internet questionnaire. All respondents are linked to their firms with an organization number. The organization's number makes it possible to link the survey results with firm data from administrative registers for Statistics Norway. The survey was initiated Medio November 2012, and a dunning letter was sent Medio December and ultimo January 2013, with a deadline 31st of January. The last questionnaire was received in February 2013.

In order to reduce the possibility that the first response category dominates the survey results, the ordering of the response categories in the questionnaire was rotated whenever it was possible and logical. To make the analysis relevant, I needed to ensure that the firms that responded to the questionnaire conducted investments regularly. Hence, I asked when they conducted their last investment. Two-thirds of the firms had made investments within a half year before they were surveyed, and only 5 percent had conducted their last investments more than two years before the survey. In addition, 2 percent of the firms said investing in real capital was not relevant for their firms. These firms was taken out of

Table 4: Correlation matrix, estimated using the polychoric transformation. Method for calculating profitability of investment project

	EAC	IRR	NPV	Payback	Several methods	No methods
EAC	1					
IRR	0.04	1				
NPV	-0.05	0.50	1			
Payback	-0.21	0.16	0.13	1		
Several models	-0.38	-0.33	-0.30	-0.50	1	
No model	.	.	-0.99	-0.78	-0.51	1

Table 5: Correlation matrix, estimated using the polychoric transformation. Funding source of investment project

	Equity	Bank loan	Bonds	Currency loan	New shares	Parent loan
Equity	1					
Bank loan	-0.50	1				
Bonds	-0.07	0.33	1			
Currency loan	-0.02	0.40	0.76	1		
New shares	-0.13	0.35	0.74	0.70	1	
Parent loan	-0.09	-0.12	0.32	0.31	0.38	1

the sample before the empirical analysis. There is a trade-off between asking all relevant questions and keeping the survey short. The longer the survey is, the lower is the response rate likely to be. It has been important for the quality of this survey to ensure a high response rate and to capture the heterogeneity among firms. Therefore, the information letter was carefully designed in order to achieve a high response rate. I put a great deal of attention in convincing the respondents not to be afraid of failing to know the concepts that are taken up by the questionnaire.

Table 4-6 shows the correlation matrix of the responses to the question about methods used by the firms. In this paper, all responses are ordered or binary. When the data series of interest is designed as categorical data, a standard correlation analysis, known as the Pearson correlation coefficient, will introduce bias. A polychoric correlation analysis is more suitable for ordinal and binary data. This method lets you find the correlation of a normally distributed latent variable that is represented with an ordinal variable, Kolenikov et al. (2004). The correlation analysis of the latent variables is estimated using maximum

Table 6: Correlation matrix, estimated using the tetrachoric transformation. Hurdle rate for calculating the profitability of investment projects

	Bank loan rate	Bond rate	FRA	WACC	CAPM	Several	Other
Bank loan rate	1						
Bond rate	-0.10	1					
FRA	-0.05	0.72	1				
WACC	-0.22	0.71	0.65	1			
CAPM	-0.10	0.79	0.65	0.81	1		
Several	-0.14	0.73	0.63	0.78	0.84	1	
Other	-0.29	0.69	0.56	0.65	0.67	0.72	1

likelihood. I have implemented the stata procedure - poloychoric - by Kolenikov et al. (2004). Note that the method is called tetrachoric if it is used on binary data. Obviously, the correlation is high between methods that are used by few and therefore have several zeros. The important result from the correlation analysis is that the correlation between popular methods is low.

4 Structural analysis of firms' preferences over different investment methods

The purpose of this section is to develop an econometric approach for analyzing the most preferred method the respective firms apply when evaluating potential investment projects. There is a reason to believe that firms apply different methods on different prospects and in addition, the preferred method may vary over time even for the same type of investment prospect. This may be due to the complexity of the projects, changes of stakeholders for the respective projects or changes in the manager's view about which is the preferred method. Also, other factors than purely economic ones may influence investment decisions. Thus, even under identical "external" choice conditions, a manager may use different methods at different points in time due to his inability to assess precise and definite values of the methods once and for all. This matter is discussed in the literature on decision making in organizations, see Simon (1979) and March (1991), and in the context of a normative decision-making model, see e.g. Schwartz and Howard (1981). Schwartz and

Howard (1981) highlights the effects of personal and social norms on decision making.

To obtain information about preferences, one possibility would be to ask each firm to rank order the different methods, or to ask which method is the most preferred one. However, a complication with this approach is that it might be difficult for the manager to decide which is the most preferred method unless one specifies details of the actual investment project. To make a precise description review of my approach, let V_{tij} be a latent index that represents the utility of method j at time t, as viewed by firm i. That is, the more often the firm uses method j, the higher is V_{tij}. Let $j = 0$ represent the response "No method" and assume that the latent popularity index has the structure

$$(1) \quad V_{tij} = \alpha_i + \beta_{j0} + X_i\beta_j + Z_{tij}\theta + \eta_{tij} \text{ with } V_{ti0} = \alpha_i + \varepsilon_{ti0}$$

where α_i is a fixed firm specific effect, β_{j0} is an alternative specific constant, X_i is a vector of observed explanatory variables that might depend on both the firm and the method, with the associated parameter vector β, Z_{tij} a variable that characterizes the potential investment project t considered by firm i for method j. Typical attributes that varies with the different investment projects are the size of the investment, what kind of real capital the firm currently invests in, the life span of the investment project, the level of uncertainty of future cash flow, etc. With no loss of generality, I assume that the mean value of Z_{tij} across time is zero. For later use, define $Z_{ti} = (Z_{ti1}, Z_{ti2}, ...)$. The terms η_{tij} and ε_{ti0} are IID random variables.

Under suitable distributional assumption about the stochastic error terms $\{\eta_{tij}\}$ one can derive the probability that firm i shall choose method j at time t, conditional on X_i and Z_{tij}, expressed formally as:

$$(2) \quad P_j(X_i, Z_{ti}) = P(V_{ij} = \max_r V_{tri} | X_i, Z_{ti})$$

For example, if the stochastic error terms are independent and standard Gumbel distributed the model in (2) becomes a multinomial logit model. To estimate the unknown parameter, one can obtain data from a traditional stated preference survey (SP). To design the questionnaire of SP, one needs to specify hypothetical values of $\{Z_{tij}\}$ in order to formulate precise survey questions, Kroes and Sheldon (1988). In the context of this paper, this may be difficult because there may be a variety of investment projects, and some of their attributes may be hard to quantify. However, since there is a variety of investment projects,

I am in this paper more interested in revealing the average choice behavior of the firms regarding the preferred method. More precisely, our ambition is not to obtain an estimate of $P_j(X_i, Z_{ti})$, but instead.

$$(3) \quad P_j(X_i) = P(V_{ij} = \max_r V_{ir} | X_i) = E_Z P_j(X_i, Z_{ti})$$

where E_Z denotes the expectation operator with respect to the temporal (investment project) variation in Z_{ti}. Thus, in the choice probability given in (3) the unobservable vector (unobservable in our case) is integrated. If panel data on realized choices among methods, including Z_{ti}, were available so that estimates of $P_j(X_i, Z_{ti})$ could then be obtained, and one could then calculate $P_j(X_i)$ as:

$$(4) \quad \frac{1}{T} \sum_{t=1}^{T} P_j(X_i, Z_{ti})$$

However, such data are not available in our case, and therefore, another alternative approach is called for. The alternative approach used in this paper consists of a two-stage procedure as follows. In the first stage, I analyze the intensity with which the respective methods are used by the firms. In other words, at this stage the purpose is to estimate a model of how often the respective methods are used by the firm. To this end, the ordered logit (or probit) modeling framework can be applied. In the second stage, the estimation results from the first stage are used to calculate choice probabilities of the most preferred method, as given in (3).

To obtain suitable data the survey questionnaire contains questions on how often firms use the respective evaluation methods, and which can be used for estimating the first stage model, namely the ordered logit model. The questions in the survey questionnaire that are appropriate to this end are questions like; is a given method always used, or often used, or rarely used, etc... Thus, these answers correspond to response categories, $k = 1, 2, ..., m$, those firms that are in category 1 are those who state that they always use a given method, those who are in category 2 are those who often use the method, etc. Let $\varepsilon_{1ij} = Z_{1ij} + \eta_{1ij}$ for $j > 0$. Recall that the distribution of Z_{1ij} is assumed to be independent of t. Since Z_{1ij} is unobservable, I model ε_{1ij}, similarly to η_{1ij} as a random variable (from the viewpoint of the researcher). Consequently, under specific distributional assumptions about $\{\varepsilon_{1ij}\}$ it is possible to calculate the choice probability given in (4). Let $P(Y(k)) = 1$ if firm i is

observed to be in response category k given method j and zero otherwise. Assume that $\varepsilon_{1ij},\ j=0,1,2,\ldots$ are IID and let $F(\cdot)$ be the c.d.f. of $\varepsilon_{1ij}-\varepsilon_{1i0}$. Hence, it follows that:

$$P(Y_{ij}(k)=1|X_i)=P(\gamma(k)<V_{1ij}-V_{1i0}<\gamma(k-1)|X_i) \tag{5}$$

$$=F(\gamma(k)-X_i\beta_j-\beta_{j0})-F(\gamma(k-1)-X_i\beta_j-\beta_{j0}) \tag{6}$$

where $\gamma(k)$ are unknown threshold values which are estimated jointly with the parameter vector β_j and β_{j0}. The reason why I consider $V_{1ij}-V_{1i0}$ instead of V_{1ij} is because I wish to get rid of the fixed effect while retaining a reasonable interpretation, Ferrer-i Carbonell and Frijters (2004). Thus, V_{1i0} represents an "anchoring" effect that makes the evaluation scales comparable across firms.

The threshold parameters $\{\gamma(k)\}$ are implicitly representing the average of the firm's interpretation of the response categories, such as "often" or "rarely", for example. Note that here it is assumed that $\{\gamma(k)\}$ do not depend on the method j. It seems reasonable that the threshold levels do not depend on the evaluation methods. It follows from the above expression that I can rewrite (6):

$$P(Y_{ij}(k)=1|X_i)=F(\tilde{\gamma}_j(k)-X_i\beta_j)-F(\tilde{\gamma}_j(k-1)-X_i\beta_j) \tag{7}$$

where $\tilde{\gamma}_j(k)=\gamma(k)-\beta_{j0}$. Hence, I obtain $\tilde{\gamma}_j(k)$ by taking the respective mean across the threshold levels $\gamma(k)$, $k=1,2,..,m$ such that $\bar{\tilde{\gamma}}_j(k)=\bar{\gamma}(k)-\beta_{j0}$. Note that although I cannot identify the unknown parameter β_{j0}, but because it is a constant it cancels in utility comparisons and therefore is irrelevant in this context. Figure 2 illustrates the relationship between the threshold parameters, $\gamma(k)$ and the k ordered response categories

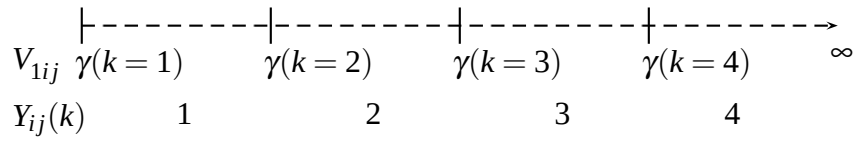


Figure 2: Relationship between threshold values, $\gamma(k)$ with the corresponding preference level, V_{ij} and the response categories of the endogenous variable, $Y_{ji}(k)$. Firms that prefer a given method as high as it can, will have a value of $V_{ij}>\gamma(k=4)$

In the following, I shall assume that $\varepsilon_{1ji},\ j=1,2,3,...$ are independent Gumbel distributed. Which, implies that that the c.d.f. of the error is given by $\exp(-e^{(-x)})$. Then it is

well known that $F(\cdot)$ becomes a logistic distribution function so that the model in (6) and (8) becomes an ordered logistic model which can readily be estimated by the method of maximum likelihood. The model parameters are estimated separately for each method:

$$(8) \quad P(Y_i(k)=1|X_i) = F(\tilde{\gamma}_j(k) - X_i\beta) - F(\tilde{\gamma}_j(k-1) - X_i\beta)$$

Consider next how the results above can be used to obtain the probability of the most preferred evaluation method, given that the parameters of the utility function have been estimated. Under the assumption of IID Gumbel distributed error terms, independent across methods, it follows that the probability that evaluation method j is the most preferred method, as view by firm i, is equal to

$$(9) \quad P(V_{ij} = max_r V_{ir}|X_i) = \frac{\exp(X_i\hat{\beta}_j - \bar{\tilde{\gamma}}_j)}{\sum_{r=1}^{m}\exp(X_i\hat{\beta}_r - \bar{\tilde{\gamma}}_r)}$$

The empirical counterpart of the choice probability in (9) is the fraction of time firm i would choose method j, given the explanatory variables. Note that the multinomial model given in (9) depends crucially on $Corr(\varepsilon_{1ji}, \varepsilon_{1ki})$ being independent of j and k for $j \neq k$. This assumption could in principle be tested by estimating a multivariate ordered logit model in the first stage, but that is not done in this paper. The average probability of choosing method j is calculated as

$$(10) \quad \frac{1}{N}\sum_{i=1}^{N} P(V_{ij} = max_r V_{ir}|X_i) = \frac{1}{N}\sum_{i=1}^{N}\left(\frac{\exp(X_i\hat{\beta}_j - \bar{\tilde{\gamma}}_j)}{\sum_{r=1}^{m}\exp(X_i\hat{\beta}_r - \bar{\tilde{\gamma}}_r)}\right)$$

The empirical model is estimated by using the maximum likelihood using STATA with the *oglm* and *glm* packages. The calculation of the predictions and the calculated probabilities of the preferred method is done in Python with the *numpy* and *pandas* libraries.

4.1 Descriptive methods

To verify the business survey using administrative data and study if there are any differences in how the choice of the method the firm uses or how often the firm apply different measures varies between small and large firms. I test for differences in means between the respective groups and between response categories. To do this, I apply two types of tests. I use the t-test and the Wilcoxon Rank Sum test for comparing the results in two

sub-samples, and I use the Kruskal-Wallis and ANOVA to compare both between groups and blocks.

The above-mentioned tests may all be used to test whether I can reject or not the hypothesis of differences in the mean between groups and/or between blocks. However, neither the ANOVA nor the Kruskal-Wallis test can pinpoint exactly which response category that is significantly different from the other. For this, I employ Dunn's test, which can account for multiple pairwise comparisons of the Kruskal-Wallis rank test or the Tuckey-Kramer pairwise comparison for the two-way ANOVA. Applying the full apparatus of tests, I find that there are significant differences in firms' decision rules. Detailed results and explanations of the methods are reported in the appendix.

5 Empirical Analysis

Neoclassical investment models have been, and still are, the standard framework for analyzing investment decisions both in corporate finance and in economics in general. The net present value (NPV) model and the Q-model both highlight the importance of the net discounted profit for the investment decision. This section analyses the results from the business survey and sheds light on how business managers choose methods to support their investment decision process. I start each subsection with a description of the methods and a brief overview of earlier findings. Then I continue with a descriptive analysis of the survey results and round off each subsection with a description of the results from the empirical study.

5.1 How do firms calculate their hurdle rate?

In capital budgeting, it is important to have a view of the firm-specific risk. This is because it is a crucial part of the cost of capital. The traditional view is that the risk-free interest rate normally equals the interest rate on long term government bonds, like Treasury bonds, see e.g. Huang and Huang (2012). Hence, the firm-specific interest rate, r_j, can then be expressed as the risk-free rate, r_F, plus the firm-specific risk premium, θ_j:

$$r_j = r_F + \theta_j \tag{11}$$

What kind of method the firm uses to specify the company or project risk varies between companies. A textbook approach for finding the θ_j is based on the use of the capital asset price model (CAPM), see Lintner (1965). By estimating the stock return, σ_j, relative to the market return, σ_M, called the β, one finds the firm's risk premium: $\theta_j = \frac{\sigma_j}{\sigma_M}(r_m - r_F) = \beta(r_m - r_F)$, where r_m is the market return.

Following this approach, when calculating the minimum acceptable rate of return (hurdle rate), one assumes that the project risk premium equals the average firm risk premium. For investment projects, it is not always the average company cost of capital, but the risk and cost of the specific project that is relevant. To obtain identification of the project risk might be demanding. An approach suggested by Brealy et al. (2017) when it is difficult to calculate the internal project risk is to identify firms with homogeneous project portfolios that match your investments project and estimate their θ_j based on the CAPM.

The CAPM excludes the cost of debt when estimating the firm-specific hurdle rate. By calculating the weighted-average cost of capital (WACC), the cost of debt is taken into account. An alternative to the CAPM is to use the difference between the cost of debt and riskless debt instruments as the market valuation of the firms' risk, unless there are provisions or restrictions reducing the value of debt, Merton (1974). This will be a less demanding approach and reduce the time spent on investment analysis.

A particular focus of this paper is the effect of firm size heterogeneity on firms' investment decision making. When analyzing the firm size heterogeneity I divide the firms into small, middle, and large firms based on their number of employees. Compared to the volatility of the firms' employment figures, the volatility of the sales figures varies significantly. Therefor, employment is the preferred measure for splitting the sample into firm size categories. Small firms include firms with less than 50 employees, middle firms include firms with 50 or more, but less than 500 employees, and large firms include firms with 500 or more employees. Out of the total sample: 34 percent of the firms are small firms, 57 percent are middle firms, and 9 percent are large firms.

The survey questionnaire contains questions about which hurdle rate the firm normally uses when doing its profitability analysis. Table 7 shows the result for the share of the firms that answers that it always uses the different hurdle rate calculations. It turns out that more than half of the firms (51.7 percent) use their bank loan rate as their hurdle rate. This

Table 7: Questions about firms' choice of hurdle rate

Methods used by firms to calculate the hurdle rate, percentage answered: Methods that always are used by the firm. In percent[a)]				
	All firms	Small firms	Middle-sized firms	Large firms
Bank rate*	51.7	68.3	45.1	15.0
Bond rate*	0.6	0.0	1.0	0.0
FRA	11.5	7.5	13.1	16.7
WACC*	15.9	3.1	21.2	30.0
CAPM	4.5	1.5	6.2	6.7
Several*[1]	5.4	0.0	8.7	6.3
Other*[2]	20.5	13.3	21.7	42.1
The firms' appraisal of its calculated hurdle rate, by firm size. In percent[b)]				
Great	28.0	30.8	27.2	25.2
Moderate	41.9	57.7	42.9	41.2
Small	17.2	11.5	16.9	17.7
No	5.4	.	4.2	3.4
Not relevant	7.5	.	8.8	12.6

*Firm size differences are significant using the Kruskal-Wallis equality-of-population rank test.

1, 2) Several = Several different models and Other = Other models.

a) The rows do not sum to 100 percent since the firms might use more than one calculation method.

b) In order to motivate the respondents to answer, the firms could answer either *"No"* or *"This question is not relevant to our firm"*

Table 8: Factors affecting firms' choice of hurdle rate

	Bank loan rate	Bond rate	FRA	WACC	CAPM	Other models
Small firms	0.558*	-0.175	-0.199	-0.351	-0.162	-0.005
	(1.73)	(-0.51)	(-0.66)	(-1.11)	(-0.49)	(-0.02)
Large firms	-0.651*	0.266	0.199	0.111	0.869**	0.878**
	(-1.83)	(0.58)	(0.49)	(0.26)	(2.00)	(2.08)
Subsidiary	-0.237	1.013***	1.138***	0.987***	1.034***	0.862***
	(-0.86)	(3.12)	(3.92)	(3.28)	(3.31)	(3.01)
Funding investments w/equity	0.156	-0.222	0.687	-0.363	-0.058	0.257
	(0.43)	(-0.44)	(1.45)	(-0.81)	(-0.12)	(0.57)
Funding investments w/debt	0.634**	0.281	0.603**	0.416	0.690**	-0.008
	(2.17)	(0.83)	(1.98)	(1.33)	(2.12)	(-0.03)
Sensitivity analysis	-0.704***	0.787**	0.614*	1.511***	0.868**	0.549*
	(-2.62)	(2.18)	(1.94)	(4.41)	(2.54)	(1.68)
Threshold 1	-1.248	2.570***	2.448***	2.206***	2.754***	2.542***
	(-1.58)	(2.83)	(3.03)	(2.68)	(3.14)	(3.04)
Threshold 2	-0.290	6.486***	3.890***	4.052***	5.196***	3.548***
	(-0.38)	(5.93)	(4.67)	(4.73)	(5.57)	(4.15)
Threshold 3	0.522		5.416***	4.797***	6.646***	4.748***
	(0.68)		(6.18)	(5.46)	(6.52)	(5.39)
Controls	✓	✓	✓	✓	✓	✓
No. of observations	228	228	228	228	228	228
Log-likelihood	-261.75	-139.67	-232.90	-206.65	-181.08	-238.47
χ^2- test, p-value	0.000	0.000	0.000	0.000	0.000	0.000
Pseudu R^2	0.065	0.115	0.075	0.124	0.125	0.078

Notes: The empirical model for the probability that the firm chose a given method to calculate its hurdle rate is estimated using a ordered logit model: $Y_i = F(\tilde{\gamma}(k) - X_i\beta) - F(\tilde{\gamma}(k-1) - X_i\beta)$, where $\tilde{\gamma}$ is the thresholds parameters, X_i is the firm specific variables, and $F()$ is the logit function. Control variables include administrative data on firm level such as debt to asset ratio, profit ratio, last year investments. Standard errors are bootstrapped, with the significance levels of the z-test represented with stars: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

The category "Several different models" represent the **baseline method**, noted as V_{ti0} in the section above.

is especially true for small firms, while large firms to a lesser degree use bank loan rates as a substitute for calculating their own hurdle rate. Looking into the figures, it turns out that 73 percent of the firms that are financing their investments with bank loans answer that they use bank loan rate for calculating profitability. Still, 53 percent of the firms not funding their investment with bank loans use bank lending rates as their hurdle rate. Since profitability depends on the expected prices and volumes, it is the expected interest rate that should be used in calculations. Interest rates from the forward rate agreements (FRA) market reflect market expectations. Hence, it should be more suited for profitability calculations than bank loan rates. A decent share of the firms is using interest rates from the FRA market, and on average, it is chosen by 11.5 percent of the firms. It is also relevant to note that 12 percent of the firms respond "No" or "Not relevant" for all models.

As explained in section 4, the way I will study firms' preferred methods is by the

two-step procedure. To find which method the firms prefer to use to calculate its hurdle rate, I will be using a combination of the ordered logit model and the multinomial logit model. The results from the empirical model, shown in table 8, show that firm size is also important for explaining how the firms calculate their hurdle rate. Large firms are less likely to use the bank loan rate as their hurdle rate, but large firms have a higher probability of choosing advanced methods to calculate its hurdle rate than middle-sized and small firms do. The effect of being a subsidiary does also affect the calculation of the hurdle rate. Hence, strengthening the evidence that there is a spill-over-effect regarding how capital budgeting is done within corporations.

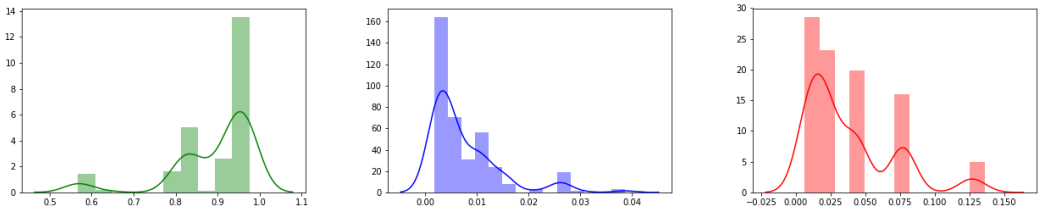
Interestingly, firms with debt funding have a higher probability of calculating their hurdle rates than firms with predominantly other funding sources. I question the firms about their use of sensitivity analysis to shed light on the uncertainty of investments, and if the firm respond that they use sensitivity analysis often, then it is a higher probability that they are using sophisticated methods for calculating the hurdle rate, while it reduces the probability of using bank loan rates as their hurdle rate. To see if the emphasis the firms put on the estimated hurdle rate affects which method they chose, I ran models where this variable was included. How strong emphasis the firms put on its hurdle rate did not affect which method is preferred, with one exception and that was the method "Other models". I control for the financial situation of the firm by adding debt to asset ratio and the profit margin, defined as earnings before interest and tax (EBIT) relative to total revenues. Neither variables have an effect on the choice of what method the firm prefers.

Note that the threshold values or cut points, as they also are called, are estimated constants that help us categorize the predicted values. I use γ to label the threshold values in the discussion of the econometric methods in section 4. See figure 2 in the same section for a visual explanation of the cut points.

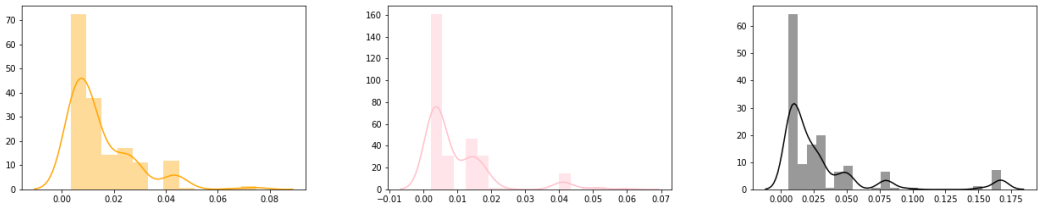
Step two of the calculation of the most preferred method includes the use of the multinomial probability model. I insert for the estimated parameters from the ordered logit model, as shown in section 4. The response category "Several models" is used as the reference category. Table 16 summarize the results, with the predicted mean, which is our estimate of the share of firms that prefer this method in front of the other methods to

Table 9: Multinomial probabilities for the different investment profitability calculation methods

	Bank loan rate	Bond rate	FRA	WACC	CAPM	Other models
mean	0.8974	0.0076	0.0385	0.0150	0.0098	0.0316
std	0.0979	0.0071	0.0324	0.0134	0.0110	0.0396
min	0.5836	0.0017	0.0063	0.0034	0.0021	0.0056
P25	0.8440	0.0025	0.0109	0.0057	0.0028	0.0106
P50	0.9383	0.0050	0.0226	0.0100	0.0045	0.0176
P75	0.9686	0.0109	0.0473	0.0246	0.0141	0.0327
max	0.9771	0.0399	0.1402	0.0774	0.0626	0.1720



(a) Bank loan rate **(b)** Bond rate **(c)** FRA



(d) WACC **(e)** CAPM **(f)** Other models

Figure 3: Distribution of estimated multinomial probabilities for the most preferred method. Histogram and kernel density estimator

calculate its hurdle rate. The results show that the majority of firms prefer to use the bank loan rate. A small share of firms prefer the FRA or to use "Other models", while the other methods are estimated to be the preferred one by nearly none of the firms. To visualize the distribution of the different firms' most preferred method, I show the distribution of the predicted probabilities for preferring the given method in Figure 3.

5.2 Investment criteria

The firms' choice of investment criteria to its capital budgeting process is an intensively studied topic in applied corporate finance. The textbook methods presented in Brealy et al. (2017) for calculating investment projects are the Net present value (NPV), Internal rate of return (IRR), Payback method, Book of return, and profitability analysis. Boye and Koekebakker (2006), a popular book among Norwegian business schools, also includes the Equivalent annual cost (EAC) as a recommended method. Brealy et al. (2017) present the NPV method as the benchmark model for calculating investment projects. Equivalent annual cost (EAC) is an extension of the NPV method. In contrast to the NPV, it adjusts the estimated NPV for differences within the lifespan of projects, making projects with a longer lifespan less worth.

Even though the NPV is assumed to give the most accurate assessment of a project's profitability, Graham and Harvey (2001) find that the internal rate of return is slightly more common among CFOs. Brealy et al. (2017) argue that one reason for the popularity of the IRR might be due to the fact that financial officers need to convince their executives or its owners to get the project approval. The reason is that the IRR might be chosen because it is easier to grasp than the NPV. The Payback method, Book of return and Profitability analysis are all less common than the NPV and IRR, but 57 percent of CFOs use the payback method occasionally, see Graham and Harvey (2001). Kengatharan (2016) conclude as in Graham and Harvey (2001) that discounted cash flow (DCF) methods are most common.

My findings differ from those found in Graham and Harvey (2001). When questioned which method executives use when calculating the profitability of projects, my analysis shows that the most common method is the payback method. The figures in Table 10 shows the proportion of firms using the different methods *often* or *now and then*. The survey results show that a total of 37 percent of the respondents said they normally use

Table 10: Investment criteria used to calculated profitability of investment projects. Percentage of firms responding that the method is used by the firm

	All Firms	Small	Medium	Large
EAC	9.52	7.5	10.1	14.8
IRR*	28.6	14.2	33.9	55.6
NPV*	35.4	19.2	40.7	70.4
Payback period	37.2	31.7	40.7	37.0
Other methods	15.5	20.8	12.2	14.8
No method*	19.0	25.8	17.5	0

*) Firm size differences are significant using the Kruskal-Wallis equality-of-population rank test.

a) The rows do not sum to unity since the firms might use more than one calculation method.

b) In order to motivate the respondents to answer, the firms could answer either *"No"* or *"This question is not relevant to our firm"*.

Table 11: How often the firm cannot give a good estimate of the expected cash flow. In percent

	All firms	Small firms	Middle-sized firms	Large firms
Always	2.4	5.0	1.1	.
Often	28.2	24.0	31.2	26.9
Now and then	47.2	50.4	45.7	42.3
Rarely	19.2	18.2	18.3	30.8
Never	3.0	2.5	3.8	.

the payback method, while 35 percent use the NPV method and slightly fewer firms, 29 percent, use the IRR method.[5] This is surprising given the results in Graham and Harvey (2001). Furthermore, I find that the Equivalent annual cost method is less common, with only 10 percent of the respondents using this method. More interestingly, 20 percent of the respondents said that they do not use any formal method at all, and 15 percent have a model, but not one of the methods listed in Table 10.

To explain how firm size and other factors explain the firms' choice of method for

[5]The difference in the response rate between NPV and payback is not significantly different at a 5 % significance level.

calculation of profitability, I use a simpler version of the ordered logit model that contains only two response categories, namely “often” or “never”. In contrast to the ordered logit model presented in section 4 there is now only one threshold. Otherwise, the interpretation is unchanged, and I use the same two-step model to predict the preferred method. After I have modeled the ordered logit model, I do as earlier and calculate the most popular method given the explanatory factors using the multinomial logit choice probability. Table 12 summarize the estimation results from the simple ordered logit model while table 16 shows the multinomial choice probabilities. The empirical analysis from the simple ordered logit model shows that the importance of firm size varies heavily between the different methods. There is a strong positive firm size effect for the probability of the firm using IRR or NPV. Both methods, and particularly the NPV, is used predominantly by large firms, and less by small firms. This result holds even if I control for the education level of the manager. It is the most educated managers that use NPV and IRR, while education counts negative for firms that respond that they are not using a model for calculating the profitability. This is a result backed up by Brounen et al. (2004). For the other methods, I find that the probability is slightly higher for larger and smaller firms than middle-sized. The empirical results show that whether the firm is a subsidiary or not is important for explaining if the firm uses a known calculation method. I find that firms that are subsidiaries are more likely to use formal calculation methods, such as IRR and Payback indicating that there is some transfer of knowledge and practice within the corporations, which smaller firms benefit from. Funding sources also affect which method is preferred. If the firm funds it selves with equity, the probability of using one of the methods described above increases compared to firms funding their investments with a bank loan.

To avoid that any random composition affects the results, I create several new variables. Those variables are: Firm investments in machines relative to buildings; this variable is 1 if the ratio is greater than 1, maintenance and repair, a variable that is 1 if the respondent that the motive of their last investment was in the category maintenance and repair, real investments relative to employment, debt to asset ratio and profitability. Since this is not the variables of interest, I have not added them to the results shown in table 12.

To find the most commonly used model, I calculate the multinomial logit probabili-

Table 12: Factors affecting firms' choice of investment criteria

	EAC	IRR	NPV	Payback	No model
Small cap	0.047	-0.142	-1.152***	-0.183	0.544
	(0.08)	(-0.34)	(-2.62)	(-0.51)	(1.03)
Large cap	0.426	1.265***	0.956**	0.292	.
	(0.72)	(2.96)	(2.26)	(0.77)	.
Higher education	0.282	0.626*	0.857**	0.259	-1.046**
	(0.54)	(1.68)	(2.26)	(0.82)	(-1.99)
Subsidiary	0.588	0.583*	-0.217	0.465	-1.009
	(1.21)	(1.70)	(-0.62)	(1.52)	(-1.63)
Freq. of EquityFunding	0.459	0.244	-0.565**	0.287	-0.538
	(1.09)	(0.96)	(-2.15)	(1.29)	(-1.36)
Freq. of DebtFunding	-0.288	0.064	-0.522***	0.201	-0.013
	(-1.20)	(0.38)	(-3.06)	(1.36)	(-0.05)
Sensitivity analysis	-0.251	1.348***	1.167***	0.274	.
	(-0.45)	(3.80)	(3.14)	(0.81)	.
Imp. of HurdleRate	1.637	2.404***	2.054***	0.943**	-3.212***
	(1.54)	(2.95)	(3.24)	(2.02)	(-5.31)
Threshold	-4.752***	-5.333***	-1.166	-3.637***	3.143**
	(-2.72)	(-4.30)	(-1.15)	(-3.96)	(2.24)
Controls	✓	✓	✓	✓	✓
No. of observations	236	236	236	236	146
Log-likelihood	-66.57	-113.61	-113.10	-139.86	-56.67
χ^2-test, p-value	0.448	0.000	0.000	0.004	0.000
Pseudu R^2	0.086	0.249	0.281	0.103	0.324

Notes: The empirical model for the probability that the firm is using the current method for calculating its profitability is estimated using a logit model: $logit(Y_i) = X_i\beta + \varepsilon_i$, where X_i is the firm specific variables. Control variables include administrative data on firm level such as debt to asset ratio, profit ratio, last year investments. Standard errors are bootstrapped, with the significance levels based on the z-values represented with stars: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

The category "Other models" represent the **baseline method**, noted as V_{ti0} in the section above.

Table 13: Multinomial probabilities for the different investment profitability calculation methods

	EAC	IRR	NPV	Payback
mean	0.1605	0.7996	0.0004	0.0394
std	0.1146	0.1349	0.0005	0.0349
min	0.0105	0.4022	0.0000	0.0033
P25	0.0687	0.7219	0.0001	0.0153
P50	0.1389	0.8266	0.0003	0.0314
P75	0.2363	0.9148	0.0006	0.0451
max	0.5170	0.9830	0.0046	0.1752

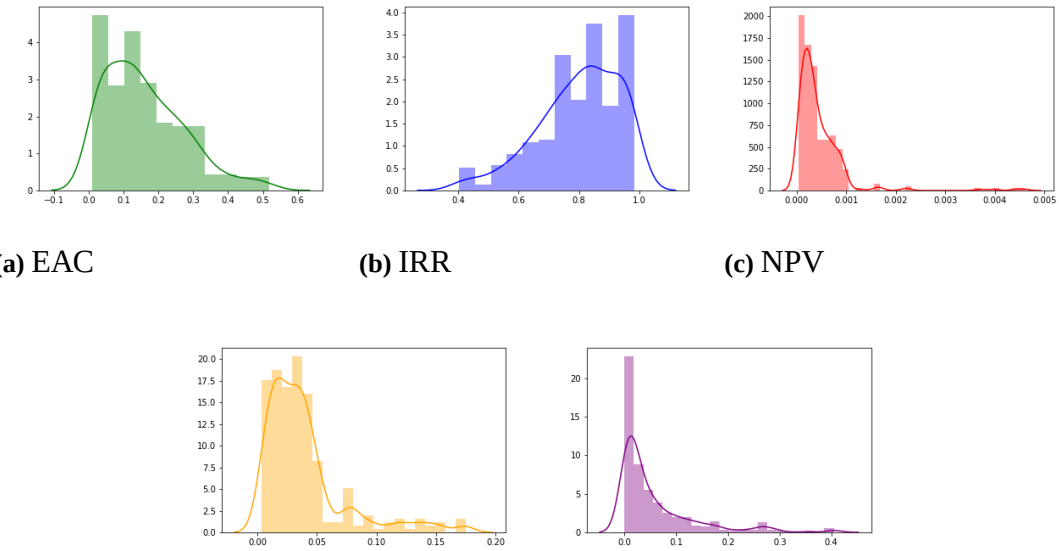
ties, as shown above. The results show that the Internal rate of return is the most preferred method to calculate the profitability of an investment. The firms are divided into two. While most firms are estimated to prefer the IRR, about a quarter of the firms prefer the EAC. The multinomial probability model predicts practically zero probabilities of choosing the NPV and the Payback-model. Based on the responses, the model estimate that the firms that are using the NPV or the payback together with the IRR, prefer the IRR before one of these two models.

5.3 Investment funding

To get an understanding of how funding source affects investment behavior, the survey questionnaire contains questions on how the firms finance their investments. The theory of corporate finance is not clear on what is the best strategy. Bessler et al. (2011) summarize capital structure theory by highlighting three theories:

1. Trade-off theories discuss how firms adjust their debt. There is a trade-off between higher tax-deductibility (in the case of tax non-neutrality), and financial distress, such as the increased risk of bankruptcy as the debt rises

2. Pecking order theories describe how asymmetric information affects the financing



(a) EAC **(b)** IRR **(c)** NPV

(d) Payback **(e)** Several models

Figure 4: Distribution of estimated multinomial probabilities for firms' preferred method for calculating the profitability. Histogram and kernel density estimator

structure. Because of the information advantage the manager has above the market, the firms will strive to increase its debt ratio rather than issuing equity when the firms' market value is below the managers' estimation of the firm value

3. Market timing theories tell a story where the firm raises equity capital preferably when the stock market conditions are good. One measure for market conditions could be the market to book values, and a policy could be to issue equity when this ratio is relatively high

These three groups of theories may give insight into how companies finance their investments.

The importance of funding is addressed in several papers. Two recent studies of the importance of funding show that access to liquid funds and funding is important for investment decisions. The debt-equity ratio is studied by Lewis and Tan (2016), by exploiting the variation in R&D investment, they are able to show how the funding affects profits. Using a natural experiment Rauh (2006), finds that there are strong cash flow effects on investments. I have a somewhat different approach to the funding decision. I want to find

Table 14: Investment funding source, by firm size. Average response, response categories 1 to 3

Firm size	Equity*	Bank Loan*	Bonds	Currency loan	New shares	Parent loan*
Small	2.30	2.17	1.03	1.09	1.01	1.38
Middle†	2.53	1.92	1.00	1.07	1.03	1.74
Large†	2.37	1.58	1.08	1.13	1.00	1.68
All firms	2.43	1.98	1.02	1.08	1.02	1.61

Note: Response categories: 3: Yes, almost always; 2: Now and then; 1: No, almost never. The reported results are average responses, the higher the figure, the larger is the share of the firms responding that they use the specific financing source. *Firm size is significant at the 5 percent level using a Kruskall-Wallis rank test. †Difference in mean between the different response categories are significant for large and middle-sized firms using two-way ANOVA with the Tuckey-Kramer multiple pairwise comparison test.

the most common source of funding, and with a hypothesis that this will make it easier to understand what limits new investment projects. Note that this paper does not intend to test the capital structure theories explicitly, but rather identify some qualitative characteristics about factors affecting firms' funding decisions. Hence, sufficient liquid funds are a necessity for investments and having knowledge about where the company gets its funding from is necessary for understanding what might restrict the access to liquidity. Without equity capital, the firm needs external funding, either from banks, in the form of bank loans, or from the credit market, in the form of issued bonds or shares.

Titman (2002) summarizes his paper with a hypothesis about the bond market in the EU before and after the introduction of the Euro. He suggests that firms with their main activity in small countries might find it more profitable to raise funding in the bond market after the Euro was implemented. This is because the single currency decreases the risk premiums on bonds in small countries with illiquid markets because the common currency reduces the exchange rate risk. Hence, the gap between the observed cost of issuing bonds and shares are reduced. If this is correct, I should find that Norwegian firms are to a little degree exposed to the bond market. An interesting finding in Harford and Uysal (2014) shows that unrated firms are less likely to get bond financing. Knowing that small and middle-sized firms to a less degree take the cost of being rated, one would expect that fewer of them finance investments with bonds.

Table 15: Factors affecting the choice of funding source

	Equity	Bank Loan	Parent Loan
Middle sized firms	0.221	-0.315	0.464*
	(0.26)	(0.25)	(0.26)
Large firms	0.722*	-1.112***	1.010***
	(0.38)	(0.33)	(0.34)
Debt to asset ratio	-1.983***	1.600***	0.385
	(0.65)	(0.60)	(0.60)
Net profit to book value	0.025**	-0.014	0.003
	(0.01)	(0.01)	(0.01)
Paid dividends	-0.112	0.703***	-0.767***
	(0.30)	(0.27)	(0.29)
Importance of cash for investments	-0.384	1.005***	0.084
	(0.27)	(0.26)	(0.26)
Threshold 1	-5.164***	0.100	0.616
Threshold 2	-3.200***	0.710	1.283**
Threshold 3	-0.904*	2.488***	2.977***
Controls	✓	✓	✓
No. of observations	281	281	281
Log-likelihood	-252.067	-345.799	-325.104
χ^2-test, p-value	0.000	0.000	0.001
Pseudu R^2	0.056	0.067	0.041

Notes: The empirical model for the probability that the firm fund its investments with Equity, Bank loan or Parent loan is estimated using a ordered logit model: $Y_i = F(\tilde{\gamma}(k) - X_i\beta) - F(\tilde{\gamma}(k-1) - X_i\beta)$, where $\tilde{\gamma}$ is the thresholds parameters, X_i is the firm specific variables, and $F()$ is the logit function. Control variables include administrative data on firm level such as debt to asset ratio, profit ratio, last year investments. Standard errors are bootstrapped, with the significance levels of the z-test represented with stars: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

The results from the survey responses regarding firms' funding sources are summarized in Table 14. I find that more than half of the firms use equity and retained earnings to finance all its new projects. Furthermore, the results show that there are significant differences between small, middle, and large-sized firms in how they finance their investments. Nearly a third of the firms answered that they finance their investments with a loan from banks, and 15 percent get financing through its parent company. None of the firms uses currency loans; bonds or issues new shares to finance its project on a regular basis, but a few firms use one those three funding sources now and then.

To extend the study of what affects the firms' choice of funding source, I estimate an ordered logit model to explain factors affecting which funding source they prefer. The ordered logit model exploits the ranking of the responses in the questionnaire and uses

both administrative data and the survey responses to explain the funding choice. I present estimation results for three models in Table 15, one for the probability that the firm is funding its investment with equity, one for funding investment with a bank loan and one model for funding investments with parent loan. The other funding sources are used by too few firms that I can make a valid model for them. The explanatory variables are the response to the question of whether access to cash is limiting firm investments, firm size dummies, and firm-level administrative data.

The analysis shows that firms with high profitability are more likely to fund themselves with equity, while profitability has no effect on firms choosing debt funding. Firms that respond that their investments are limited by its availability to liquid funds do have a higher likelihood of funding themselves with bank loans, than firms which report not to be limited by access to cash. Large firms have a reduced likelihood to fund their investments with bank loans relative to small and middle-sized firms, showing that small firms are most likely to fund their investments with bank loans. Studying firms that are funding their investments with equity, I find that things are turned around. The results show that large firms are more likely to fund their investments with equity than small firms are. Controlling for the financial situation of the firm, I find that firms with a high debt to asset ratio are more likely to fund their investments with bank loans relative to firms with low debt ratios, which are more likely to fund their investments with equity.

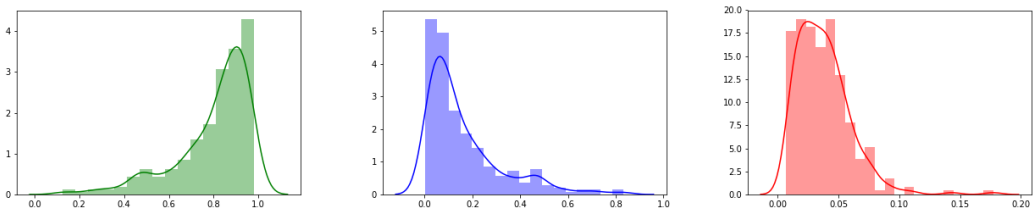
Not surprising, as shown in Table 16, more than 3/4 of the firms prefer funding its investments with equity, while 16 percent prefer a bank loan. A few firms are found to prefer funding from its parent company. Based on the survey results, I know that most of the subsidiaries finance investments with retained earning, explaining the low figure of firms preferring parent loans as funding. Figure 5 shows the distribution of the estimated probabilities for the three funding sources.

5.4 Leaning towards model results or gut feeling?

A capital budgeting process might start with an analytical approach, where the firm calculates its cost of capital and then the profitability of the investment project. However, figures showing the profitability are of no use if the investment decision does not hinge on the calculated profitability. I was curious about how the firms anticipated the results from

Table 16: Multinomial probabilities for the funding choice

	Equity funding	Bank loan funding	Parent loan
mean	0.80044	0.16169	0.03785
std	0.16678	0.16026	0.0221
min	0.12658	0.00329	0.00707
P25	0.72857	0.05009	0.02159
P50	0.85789	0.09926	0.03487
P75	0.92320	0.21396	0.04914
max	0.98169	0.83331	0.17705



(a) Equity funding **(b)** Bank loan funding **(c)** Parent loan

Figure 5: Distribution of estimated multinomial probabilities for the preferred funding source. Histogram and kernel density estimator

their calculations, so I included a few questions in the questionnaire regarding how they considered the results and how the firms in the business survey handled the uncertainty of their projects.

The questionnaire contains questions on whether the calculated hurdle rate is important for the decision of implementing the investment project. Table 7 showed that 27 percent of the respondents put great emphasis on the calculated hurdle rate, and close to half of the firms put moderate emphasis on the calculations. Looking at the firms putting no or only some emphasis on the hurdle rate, one could wonder why they bother calculating it. 16 percent of the firms put only some emphasis on the calculation and 4 percent no emphasis. 9 percent answered that calculating the hurdle rate is not relevant for their firms. Keeping in mind that 20 percent of the firms said they did no profitability analysis; this figure is not surprising.

There are several uncertain elements the firm has to take an decision on when they are calculating the hurdle rate or the expected profitability. The inputs used by the methods depend on market prospects, entry or exit of firms, etc. It is not obvious how to estimate the inputs for the calculations. The firm has to ask themselves whether there are any reasons to believe that the forecasted future income stream or cost is biased, or their inputs are reasonable. If firms find it difficult to forecast the input variables to the profitability analysis, one would expect that the firm would put less emphasis on the analysis. The survey questionnaire continues to question how often firms cannot give a good estimate of the expected project cash flow. Table 7 shows that one out of three respondents answered that high uncertainty often or always made it close to impossible to calculate the cash-flow of the project. Almost half of the firms said that they *now and then* experienced such uncertainty. Only a fifth of the respondents said that they *rarely* or *never* experienced such uncertainty. Given the response, it is obvious that formal capital budgeting methods play a smaller role in the investment decision than the impression one gets from textbooks on corporate finance.

To study which factors that explain which firms put higher than the average emphasis on the calculation of the hurdle rate, I employ the ordered logit model. The empirical results are shown in Table 17. In the case where the firm put high weight on the profitability analysis when taking its investment decision, one expects that the firm put effort to calcu-

Table 17: Factors explaining the level of emphasis the firms' put in its calculated hurdle rate

Uncertain cash flow estimates	-0.769**
	(0.35)
Using theory-close methods	0.504**
	(0.26)
Subsidiary	0.622**
	(0.28)
Using sensitivity analysis	1.315***
	(0.35)
Threshold 1	-2.444***
Threshold 2	-1.888***
Threshold 3	-0.509
Threshold 4	1.836***
Controls	✓
No. of observations	189
Log-likelihood	-231.38
χ^2-test, p-value	0.000
Pseudu R^2	0.084

Notes: The model is estimated using a ordered logit model: $Y_i = F(\tilde{\gamma}(k) - X_i\beta) - F(\tilde{\gamma}(k-1) - X_i\beta)$, where $\tilde{\gamma}$ is the thresholds, X_i is the firm specific variables, and $F()$ is the logit function. Control variables include administrative data on firm level such as debt to asset ratio, profit ratio, last year investments. Standard errors are bootstrapped, with the significance levels of the z-test represented with stars: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 18: Survey responses, by firm size. In percent

Percentage of firms conducting sensitivity analysis as a part of its investment planning				
	Small	Middle	Large	All firms
Always	5.8	9.7	15.4	8.7
Often	8.3	22.0	30.8	17.7
Now and then	19.8	20.4	23.1	20.4
Rare	19.0	23.7	26.9	22.2
Never	47.1	24.2	3.9	30.9
Percentage of firms considering the opportunity cost of capital, by firm size				
	Small	Middle	Large	All firms
Always	24.8	19.6	34.6	22.7
Often	12.4	9.2	11.5	10.6
Now and then	20.7	27.7	26.9	25.1
Rare	14.9	19.0	15.4	17.2
Never	27.3	24.5	11.5	24.5

a Because of the way the data is organized, in this case the Kruskal-Wallis equality-of-populations rank test show whether the average response differ.

b The differences in firm size are significant at the 5 percent level using the Kruskal-Wallis test.

late the hurdle rate. I find that it is a higher likelihood that the firm puts a high emphasis on the hurdle rate if it is a subsidiary. Interestingly there is no effect on the manager's education nor firm size. However, firms that use the methods preferred by theory such as the WACC or FRA to calculate the hurdle rate or the IRR and NPV to calculate profitability puts a higher weight on the hurdle rate than firms that employ simpler methods.

5.5 Project analysis

A sensitivity analysis is a good way of illustrating the risk of a project. Classic sensitivity analysis identifies which part of the project where the possible losses or gains can come from. One might also use such an analysis to estimate the success-rate for an investment project. A break-even analysis is another type of sensitivity analysis that can illustrate the

uncertainty of a project. This method has the advantage that it calculates the number of sold products, the product price or the average costs needed to get a positive NPV, and by this illustrates key target values for the investment project. More advanced methods might include analyzing the sensitivity of a project with a Monte Carlo simulation of the investment calculations. By building an economic model and then test it by running a Monte Carlo simulation, one might get a better and more accurate description of the risk involved in a specific project. In order to get an overview of this topic, the firms were questioned whether they used sensitivity analysis to shed light on the project uncertainty. If so, I question the firm if they had any knowledge about real options modeling or Monte-Carlo simulations.

Table 18 shows that approximately 26 percent of the firms answered that they always or often conduct a sensitivity analysis before an investment project is initiated, while 43 percent of the firms say they do it now and then. Even though they consider the uncertainty related to future costs and income to be large, nearly 31 percent of the firms do not conduct any sort of sensitivity analysis. Table 18 shows how the response differs when I sort the firms by size. While the small firms to a lesser degree do sensitivity analysis, this is rather common among large firms.

Results from an ordered logit model, see Table 19, shows that there are several factors that explain which firms that are using sensitivity analysis actively to understand the risk of a project. Here I define that a firm conducts sensitivity analysis if it answers if it is conducted “Now and then” or more often. The empirical results show that firms that use theory preferred methods to calculate the hurdle rate or profitability are more like to conduct a sensitivity analysis than firms that use different methods.

Large firms have a higher probability of conducting a sensitivity analysis than small and middle-sized firms. Subsidiaries are more likely to conduct a sensitivity analysis, backing up the findings I earlier have shown that subsidiaries are more likely to chose the textbook methods in investment planning. The effect is so strong that it cancels the effect of being a small firm.

The survey question on how strong emphasis the firm put on the calculated hurdle rate. Including this response to the empirical model, I find that firms that put a moderate or high emphasis on its hurdle rate have a higher probability of making a sensitivity analysis

Table 19: Factors explaining the use of sensitivity analysis

Middle sized firms	0.516*
	(0.29)
Large firms	1.658***
	(0.40)
Higher education	-0.044
	(0.27)
Using theory-close methods	1.259***
	(0.29)
Subsidiary	0.498*
	(0.27)
Importance of hurdle rate	0.804*
	(0.45)
Threshold 1	0.493
Threshold 2	1.888***
Threshold 3	3.215***
Threshold 4	4.838***
Controls	✓
No. of observations	224
Log-likelihood	-295.09
χ^2-test, p-value	0.000
Pseudu R^2	0.134

Notes: The model is estimated using a ordered logit model: $Y_i = F(\tilde{\gamma}(k) - X_i\beta) - F(\tilde{\gamma}(k-1) - X_i\beta)$, where $\tilde{\gamma}$ is the thresholds, X_i is the firm specific variables, and $F()$ is the logit function. Control variables include administrative data on firm level such as debt to asset ratio, profit ratio, last year investments. Standard errors are bootstrapped, with the significance levels of the z-test represented with stars: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

before the firm puts its investments decision into action.

6 Final remarks

This paper highlights some of the differences and similarities between corporate finance theory and practice. By analyzing data from a survey among firms in the Norwegian manufacturing industry, I have obtained further evidence on the practitioner's decision-making strategy. I have shown that a significant share of firms struggles with handling uncertainty and risk. The executives' lack of information makes small and middle-sized firms reluctant to analyze the profitability of their projects in-depth using textbook methods. When the executives' express high uncertainty about their profitability analysis one should expect that this increases the use of sensitivity analyses to shed light on the uncertainty, but the survey results show that only a small fraction of the executives do this. Even such basic recommended methods in investment decision making; namely calculation of the NPV or the IRR is not common among executives in small firms. Surprisingly, I also find that executives in middle-sized firms calculate NPV or IRR more rarely than earlier research on international corporations has indicated. The effect of uncertainty is extensively discussed in the literature, but more important than measuring the effect of uncertainty is that the reluctance of using recommended capital budgeting models implies that standard investment models will struggle to explain the actual behavior.

I have shown that while a large share of the investment theory is supported by respondents' answers to the survey questionnaire, a significant share is the theoretical models are not supported by data from this survey.

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Investments and Capital Budgeting Practice: Is there a difference between small and large firms?*†

Joakim Blix Prestmo[a, b]

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[a,]The Norwegian University of Science and Technology (NTNU), Department of Economics, N-7491 Trondheim, Norway, e-mail: Joakim.Prestmo@ntnu.no

[b]Statistics Norway, Reserch Department,P.O. Box 8131 Dep., N-0033 Oslo, Norway

Abstract

To increase our understanding of how business executives plan their investment budget, this paper analyses the results from the business survey that was sent out to a representative sample of firms in the manufacturing industry in Norway. The business survey was conducted in cooperation with The Business Tendency Survey of Statistics Norway. This linking to the Business tendency survey leads to a far higher response rate compared with similar studies, and it covers a representative share of the firms in the Norwegian manufacturing sector. I find, as many papers have shown before, that there are mismatches between theory and practice, but in contrast to earlier work, there seems to be a considerable mismatch. There is substantial firm size heterogeneity in capital budgeting: Smaller firms embrace simple methods for these calculations, and the results show that small firms have less sophisticated decision rules. Finally, a surprisingly large share of small and middle-sized firms do not put significant weight on their calculated investment criteria. If firms do not put weight on their calculations, this helps us in explaining why firms use gut feeling rather than thorough calculations to decide which investment project they start. Interestingly, being a subsidiary cancels the firm size effect. Indicating that there exists a sharing of best practices across larger corporations.

Keywords: Business Survey, Discount Rates, Capital Budgeting, Firm Size Heterogeneity

1 Introduction

Aggregate investments have been low in most OECD countries in the years following the financial crises, Banerjee et al. (2015). There is no agreement on what caused the investment level not to pick up to the pre-crisis levels. Some analysts have pointed to low expected demand as a possible cause, while others look to the over-capacity caused by larger than sustainable investment levels before the Financial crisis. Difficulties in getting credit is another cause for low investments. In recent years there has been an increased amount of studies analyzing the effect of credit and economic activity on, see e.g. Gertler and Gilchrist (2018) or Borio (2017). In the build-up to the Financial crisis, there was an accumulation of cash holdings in many firms, Bates et al. (2009). The increased cash holdings should have eased the need for credit, thus reducing financial constraints.

The goal of my paper is to study the manager's practice in capital budgeting and investment planning. To bring new insight to the table, I have conducted a one-off business survey of the manufacturing industry in Norway. My hope is that the survey may shed light on the discussion about the lack of investment growth from a different perspective than traditional empirical analysis have given us.

Specifically, the paper discusses which methods are preferred by the managers to support the investment decision. I am particularly interested in studying to what extent their practices are consistent with, or goes against the textbook approach. Textbooks in corporate finance recommend firms to use the net present value method to calculate the expected profitability of an investment[1]. The hurdle rate used to discount the expected cash flow is supposed to take into account the riskiness of the project, but also the share of debt funding. With several projects, the internal rate of return could assist the management with the ranking of its projects, according to this theory. Lastly, the theory recommends that firms should analyze the sensitivity of the assumptions it made to calculate its expected cash flow. If firms follow those recommendations, they will behave as predicted by the Neoclassical investment models. If not, how should we think about modeling real investments?

I have tried to design the survey such that the answers can be used to rank the different

[1] An example of a corporate finance textbook is Brealy et al. (2017)

methods used by the managers for its investment planning. An additional motive has been to obtain insight about the underlying assumptions behind the Neoclassical investment models. To address these issues, the survey questionnaire contains questions about the firms' qualitative questions concerning its assumptions, such as how significant emphasis it puts to its calculated hurdle rate. I do not believe that I can validate or falsify the different theoretical models using the results from this survey. However, it will increase our insight into which perspective a practitioner is taking on in capital budgeting and investment planning, and by this increase our understanding of investment fluctuations. The findings from this survey have been essential to the results of paper 2 and 3 in this Ph.D. dissertation. The results from this paper helps us to put the empirical models of in the second paper in context, while the theoretical model in the last paper is motivated with on the insight from the survey.

The business survey was conducted during the winter 2012/2013 and is unique in the sense that the response rate is as high as 42 percent. Furthermore, being able to use the same respondents as in Business Tendency Survey (BTS) of Statistics Norway, the sample would be stratified. The sample is linked to administrative data and the Statistics Norways's quarterly Investment Survey which enables us to address more detailed research questions. The high response rate and the fact that the survey is representative of the whole population of manufacturing firms make it possible to study firm size effects using ordered logit model and two-way tables in a way few other studies have done.

My research shows that decision-making processes varies substantially between small and large firms. Small firms use different methods than large firms and pay less attention to the formal capital budgeting process. This implies that aggregate investments in countries with a relatively high share of large firms respond differently to shocks affecting firms' expectations than how a similar shock would affect investments in countries with a relatively high share of small firms. Hence, I argue that one has to take into account heterogeneity in the firm size distribution for different countries when modeling aggregate investments. Thus, this paper contributes to the literature on firm size heterogeneity and management practice. I have studied management practice in its use of investment and corporate finance theory and present empirical evidence showing that there is a different management practice between small, middle-sized, and large firms.

The paper starts with a brief literature review in the next section. Section 3 discuss the data and the business survey. The empirical and descriptive methods are explained in section 4, while the analysis is described in section 5. The analysis starts by going through the survey results briefly. This gives detailed coverage of the firms' practice and strategy. Then an econometric model is applied to analyze the business survey data together with administrative data to uncover what methods the firms choose for their capital budgeting process and which factors are best at describing their choices. Section 6 summarizes the paper. Detailed figures, a description of the survey, tables with statistical tests of the survey results, and further survey results not discussed in the paper are found in the appendix.

2 Literature

The study of management practice, and particularly the firms' choices related to its investment decision have been conducted in decades. A comprehensive study of the Chief Financial Officers' (CFO) practice of capital budgeting and investment planning is found in Graham and Harvey (2001). The survey is covering three distinct topics: Capital budgeting, cost of capital, and capital structure. The focus of Graham and Harvey (2001) is to identify whether the standard theory is backed up by empirical findings. One of the strengths of the paper is that the survey covers a large part of the theories discussed by the corporate finance literature. However, many countries are, in contrast to the US, less dominated by large firms and corporations and have a relatively large share of small firms. Graham and Harvey (2001) mainly focus their attention on large corporations, for good reasons. Brounen et al. (2006) extend the work of Graham and Harvey (2001) through their particular focus on capital structure policies. An important message from Brounen et al. (2006) is that capital structure policies differ substantially across countries. There is consequently a need to fold out different management practices since they also seem to differ widely between countries. A potential weakness with both Graham and Harvey (2001) and Brounen et al. (2006) is that both papers have a relatively low response rate. They report a response rate of nine percent and five percent, respectively. A low response rate may make it somewhat difficult to generalize the results. If the respondents are unfamiliar with the terms used in the questionnaire, they are more likely to drop out of the survey. If

there are selection effects present in the survey, this can bias the responses towards the use of more complicated methods, and away from more straightforward decision rules.

In a study of venture capitals (VC) Gompers et al. (2019) surprisingly find that few VC funds use the methods recommended by academic textbooks. Their finding goes against Graham and Harvey (2001) showing that only a small share of the funds use the NPV method to calculate the valuation of their investment and supports the view that gut feeling plays a large role in the investment decision. They do not find any firm size effect on the methods chosen by the VC fund to value the investment, but they find that small funds are more likely to rely on gut feeling when taking their decisions.

Bloom and Reenen (2010) surveys the management practice of plant managers at medium-sized firms around the world. Based on their survey, they find substantial differences in practice between countries, with the US rating highest. Their study highlights the importance of studying management practice and they also find that it is not sufficient to study management practice in a few counties. Kengatharan (2016) discusses the empirical research of corporate finance during the last 20 years and represent valuable insights into management practice.

Except for Gompers et al. (2019), none of the papers above focus mainly on how practice varies between small and large firms. However, firm size heterogeneity and management practice are discussed in several other studies. Gertler and Gilchrist (1994) study how firm size affects the firm's response to a monetary policy shock. They find empirical support for a more significant contraction in inventories, sales, and short-term debt in small firms relative to larger firms when the credit supply tightens. Calomiris and Hubbard (1990) have also highlighted the role of firm size heterogeneity. They discuss how firm heterogeneity caused by information asymmetry affects the capital structure and their access to credit. Runyon (1983) also studies investment practices in small US businesses. Runyon (1983) finds that small firms embrace more straightforward methods than Graham and Harvey (2001), but the paper does not compare the practice of small firms with middle-sized and large businesses. This makes it challenging to study relative differences of practice.

3 Data

3.1 The Norwegian Manufacturing Industry

The Norwegian manufacturing industry is characterized by having a relatively large share of small and middle-sized firms. The Norwegian offshore petroleum industry is sizeable, and because of this, the manufacturing industry has a relatively large share of the firms in the ship and rig building industry compared to other OECD countries. Furthermore, the manufacturing industry is prominent in the production of inputs and investment goods and characterized by few producers of consumer goods.

In OECD countries, the average number of employees per enterprise in the manufacturing industry were 17.4 in 2012.[2] The trio – US, Germany, and Switzerland had nearly twice as many employees per enterprise than the average OECD country. The South European countries: Greece, Italy, Portugal, and Spain are at the bottom of the scale with far fewer employees per enterprise than the average country. Norwegian enterprises are also below the average OECD with 13.2 employees per enterprise. If one does not take into account the firm size composition, then studies of corporate finance practice in the US, UK or the Germanic-speaking countries, will not be directly comparable to result from the studies of countries like France, Poland, Netherlands or Norway. All are countries with an average employee per enterprise of about 13. Hence, studying Norwegian data as a representative for countries with a larger share of smaller firms, might further increase our insight into firm behavior.

Recall that the purpose of the survey is to obtain data that can be applied to study which methods the firms prefer when evaluating investment projects. The survey questionnaire contains further questions that are useful for understanding their choice of methods. The business survey builds on the quarterly Business Tendency Survey (BTS) by the Division for Manufacturing Statistics at Statistics Norway. The BTS is a survey that is based on questioning the firms about the business' prospects and their investment budget, which I analyze in the second paper of this thesis. I sent the questionnaire to the same respondents as those that participate in the BTS. Hence, the respondents have experience in filling out business surveys. The respondents are, in most cases, the general manager or the chief

[2]Unweighted average; data source: OECD Productivity statistics; stats.oecd.org

Table 1: The distribution of firms and employment in the total population and the sample within each firm size category, all figures measured in 2013

	Firms			Employees		
Category	*N*	In pop.	In sample	*N*	In pop	In sample
Total manufacturing	13 518	100 %	745	188 954	100 %	92 845
Small manufacturing firms	12 640	93.5 %	34.0 %	49 281	26.1 %	7.2 %
Middle manufacturing firms	540	4.0 %	56.6 %	74 088	39.2 %	29.4 %
Large manufacturing firms	338	2.5 %	9.4 %	65 584	34.7 %	63.3 %

Notes: The table shows figures for number of firms and total employment in the population. The "In pop" and "In sample" figures shows the relative distribution of small, middle and large sized firms in the total population and in the sample respectively. Firms without employment are excluded from this summary table.

accountant. In the largest firms, the respondents are typically the Chief Financial Officers (CFO). The advantage of using the respondents of the BTS is three-folded.

Regarding data quality, the respondents in this survey are accustomed to answering questionnaires related to expectations and investment practices. Statistics Norway has strong confidence among businesses, which both enhance truthful answers and a high response rate. Second, the sampling procedure used by Statistics Norway secures that the sample is representative and unbiased both across firm size and across industries. Third, the respondents are linked to their firms' organization number, which makes it possible to link the survey data to administrative data from the Business and Enterprise Statistics and data from the quarterly Investment Survey, both from Statistics Norway. Linking survey data with administrative data enables us to cross-validate some of the responses given to the questionnaire with the administrative data. After I added the administrative data to the survey data, it was possible to study if there are any biases in average debt to asset ratio, investment level or the number of employees between the firms that responded to the survey and firms that did not respond.

Managers of manufacturing firms typically have a varied educational background. Table 2 shows the education of the respondents. The survey shows that a large share of the respondents has high education and that CFOs and CEOs of large firms are much more likely to have a decree within economics. It is also interesting to note that among smaller

Table 2: The education level of the respondents. In percent

	Lower 2nd	Upper 2nd. Pract.	Upper 2nd. General	Technological Ba or M.Sc	Economics Master	Economics Bachelor	Other University	Other studies
Small	1.8	5.4	8.1	15.3	20.7	19.8	27.0	1.8
Middle	0.0	6.7	5.2	7.4	31.9	28.2	18.5	2.2
Large	0.0	0.0	5.5	7.3	34.6	21.8	29.1	1.8
All firms	0.7	5.0	6.3	10.3	28.2	23.9	23.6	2.0

Table 3: Summary statistics for each employment category (no. of employees) of firms in the total population of Norwegian manufacturing industry. Average for the years **2011-2014**

	0 - 9	10-19	20-49	50-99	100-199	200+	All firms
Number of firms	15 663	1 759	1 381	514	271	159	19 747
Employees**	30 391	23 728	42 596	35 463	37 037	63 808	233 023
Value added*	15 787	14 902	28 943	26 273	34 930	71 812	192 646
Gross investments*	2 164	1 239	2 360	2 753	4 354	6 931	19 800

*Notes: *In million NOK, **Total employed within this category. Value added in market prices*

firms there is a large share of firms where the managers have a technical background, typically a bachelor's degree from a university college or a master of science from a university. Table 3 summarizes the administrative data of the firms participating in this survey.

Data is organized as a cross-section set. Because data is sampled once, one would expect that the business trends are affecting some of the answers in an unknown direction. If the perception of the firms' prospects varies with the business cycle, the level of uncertainty will also vary. Hence, one would expect that practice related to the investment decisions also varies with the business cycle. Even though the questions are formulated in a general way, an important concern was to conduct the survey when the Norwegian business climate was close to neutral, i.e., when investments increase with a rate close to the long-run growth rate. In such a climate the business managers are more likely to have a balanced view of the prospect of their firms'.[3]

[3]For a detailed description of real-time the business climate see Chart 1.10 in the Monetary Policy Report 1/2013, published by the Central Bank of Norway

The survey design is based on stratified sampling. The BTS divides the firms into four different strata, and the respondents are drawn randomly from each stratum. The probability of being drawn from the population increases with firm size. Also, all firms within the stratum of the largest firms are included in the sample. The population includes firms in the Norwegian mining and manufacturing sector with more than ten employees. The total number of respondents, drawn from the full population, is 745 firms. The mining and manufacturing industry in Norway consists of almost 20 000 firms, and slightly above 9 000 firms have no employees, and a further 6 500 have less than ten employees. Firms with none or few employees amount to a small fraction of the total employment and total investments in the manufacturing industry. Those firms were excluded from the population before the sampling. Details about the composition of the firms are shown in Table 20 in the appendix. The firms included in the sample add up to approximately 40 percent of the total employment in the manufacturing industry, while it covers 3.5 percent of the total number of firms in the industry.

After correcting for non-responses, 36.5 percent are small firms, 55.2 percent are middle firms, and 8.1 percent are large firms. I want to test whether there are any biases in firm size composition between the response and non-response groups. Using a t-test to test for differences in mean employment of the group with a response and the group with a non-response, I find that the difference in firm size distribution is insignificant between the two samples. Hence, it is possible to argue that there are no selection issues related to firm size between the respondents and the non-respondents in the sample.[4]

To achieve a high response rate, I reduced the number of questions in this survey compared to those occurring in Graham and Harvey (2001) and Brounen et al. (2006). Furthermore, for every question, the respondents could choose to answer that the question was "Not relevant for our firm". The motivation for including this response category was to encourage the respondents unfamiliar with the concepts questioned to respond. Finally, the information letter contained detailed information about the survey and it requested the

[4] A two-sided Welch t-test for the difference in mean employment between the group of response and non-response $\Pr(T > |t|) = 0.63$, i.e. I do not reject the H_0 : difference in means is zero. A test for difference in mean employment with the Wilcoxon rank-sum test gives a p-value of 0.37, i.e., one does not reject H_0: difference in means is zero. I do a similar test for difference in the debt to asset ratio, revenue, and total investments, and all indicate that there are small biases between firm responding and not to the survey.

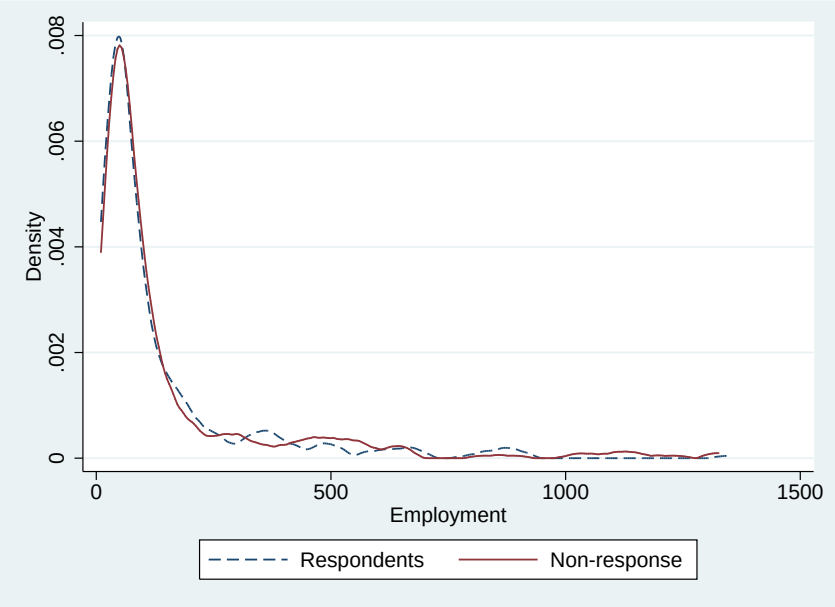


Figure 1: Kernel density distribution of firm employment. Non-response and respondents.

respondents not to hesitate to answer even if they were unfamiliar with the topic addressed in the question. This resulted in a high response rate from both from large as well as small firms, with a response rate of 42 percent.

The survey uses an Internet-based survey program called Enalyser. Respondents were contacted by e-mail, and they replied using an Internet questionnaire. All respondents are linked to their firms with an organization number. The organization's number makes it possible to link the survey results with firm data from administrative registers for Statistics Norway. The survey was initiated Medio November 2012, and a dunning letter was sent Medio December and ultimo January 2013, with a deadline 31st of January. The last questionnaire was received in February 2013.

In order to reduce the possibility that the first response category dominates the survey results, the ordering of the response categories in the questionnaire was rotated whenever it was possible and logical. To make the analysis relevant, I needed to ensure that the firms that responded to the questionnaire conducted investments regularly. Hence, I asked when they conducted their last investment. Two-thirds of the firms had made investments within a half year before they were surveyed, and only 5 percent had conducted their last investments more than two years before the survey. In addition, 2 percent of the firms said investing in real capital was not relevant for their firms. These firms was taken out of

Table 4: Correlation matrix, estimated using the polychoric transformation. Method for calculating profitability of investment project

	EAC	IRR	NPV	Payback	Several methods	No methods
EAC	1					
IRR	0.04	1				
NPV	-0.05	0.50	1			
Payback	-0.21	0.16	0.13	1		
Several models	-0.38	-0.33	-0.30	-0.50	1	
No model	.	.	-0.99	-0.78	-0.51	1

Table 5: Correlation matrix, estimated using the polychoric transformation. Funding source of investment project

	Equity	Bank loan	Bonds	Currency loan	New shares	Parent loan
Equity	1					
Bank loan	-0.50	1				
Bonds	-0.07	0.33	1			
Currency loan	-0.02	0.40	0.76	1		
New shares	-0.13	0.35	0.74	0.70	1	
Parent loan	-0.09	-0.12	0.32	0.31	0.38	1

the sample before the empirical analysis. There is a trade-off between asking all relevant questions and keeping the survey short. The longer the survey is, the lower is the response rate likely to be. It has been important for the quality of this survey to ensure a high response rate and to capture the heterogeneity among firms. Therefore, the information letter was carefully designed in order to achieve a high response rate. I put a great deal of attention in convincing the respondents not to be afraid of failing to know the concepts that are taken up by the questionnaire.

Table 4-6 shows the correlation matrix of the responses to the question about methods used by the firms. In this paper, all responses are ordered or binary. When the data series of interest is designed as categorical data, a standard correlation analysis, known as the Pearson correlation coefficient, will introduce bias. A polychoric correlation analysis is more suitable for ordinal and binary data. This method lets you find the correlation of a normally distributed latent variable that is represented with an ordinal variable, Kolenikov et al. (2004). The correlation analysis of the latent variables is estimated using maximum

Table 6: Correlation matrix, estimated using the tetrachoric transformation. Hurdle rate for calculating the profitability of investment projects

	Bank loan rate	Bond rate	FRA	WACC	CAPM	Several	Other
Bank loan rate	1						
Bond rate	-0.10	1					
FRA	-0.05	0.72	1				
WACC	-0.22	0.71	0.65	1			
CAPM	-0.10	0.79	0.65	0.81	1		
Several	-0.14	0.73	0.63	0.78	0.84	1	
Other	-0.29	0.69	0.56	0.65	0.67	0.72	1

likelihood. I have implemented the stata procedure - poloychoric - by Kolenikov et al. (2004). Note that the method is called tetrachoric if it is used on binary data. Obviously, the correlation is high between methods that are used by few and therefore have several zeros. The important result from the correlation analysis is that the correlation between popular methods is low.

4 Structural analysis of firms' preferences over different investment methods

The purpose of this section is to develop an econometric approach for analyzing the most preferred method the respective firms apply when evaluating potential investment projects. There is a reason to believe that firms apply different methods on different prospects and in addition, the preferred method may vary over time even for the same type of investment prospect. This may be due to the complexity of the projects, changes of stakeholders for the respective projects or changes in the manager's view about which is the preferred method. Also, other factors than purely economic ones may influence investment decisions. Thus, even under identical "external" choice conditions, a manager may use different methods at different points in time due to his inability to assess precise and definite values of the methods once and for all. This matter is discussed in the literature on decision making in organizations, see Simon (1979) and March (1991), and in the context of a normative decision-making model, see e.g. Schwartz and Howard (1981). Schwartz and

Howard (1981) highlights the effects of personal and social norms on decision making.

To obtain information about preferences, one possibility would be to ask each firm to rank order the different methods, or to ask which method is the most preferred one. However, a complication with this approach is that it might be difficult for the manager to decide which is the most preferred method unless one specifies details of the actual investment project. To make a precise description review of my approach, let V_{tij} be a latent index that represents the utility of method j at time t, as viewed by firm i. That is, the more often the firm uses method j, the higher is V_{tij}. Let $j = 0$ represent the response "No method" and assume that the latent popularity index has the structure

$$(1) \quad V_{tij} = \alpha_i + \beta_{j0} + X_i\beta_j + Z_{tij}\theta + \eta_{tij} \text{ with } V_{ti0} = \alpha_i + \varepsilon_{ti0}$$

where α_i is a fixed firm specific effect, β_{j0} is an alternative specific constant, X_i is a vector of observed explanatory variables that might depend on both the firm and the method, with the associated parameter vector β, Z_{tij} a variable that characterizes the potential investment project t considered by firm i for method j. Typical attributes that varies with the different investment projects are the size of the investment, what kind of real capital the firm currently invests in, the life span of the investment project, the level of uncertainty of future cash flow, etc. With no loss of generality, I assume that the mean value of Z_{tij} across time is zero. For later use, define $Z_{ti} = (Z_{ti1}, Z_{ti2}, ...)$. The terms η_{tij} and ε_{ti0} are IID random variables.

Under suitable distributional assumption about the stochastic error terms $\{\eta_{tij}\}$ one can derive the probability that firm i shall choose method j at time t, conditional on X_i and Z_{tij}, expressed formally as:

$$(2) \quad P_j(X_i, Z_{ti}) = P(V_{ij} = \max_r V_{tri} | X_i, Z_{ti})$$

For example, if the stochastic error terms are independent and standard Gumbel distributed the model in (2) becomes a multinomial logit model. To estimate the unknown parameter, one can obtain data from a traditional stated preference survey (SP). To design the questionnaire of SP, one needs to specify hypothetical values of $\{Z_{tij}\}$ in order to formulate precise survey questions, Kroes and Sheldon (1988). In the context of this paper, this may be difficult because there may be a variety of investment projects, and some of their attributes may be hard to quantify. However, since there is a variety of investment projects,

I am in this paper more interested in revealing the average choice behavior of the firms regarding the preferred method. More precisely, our ambition is not to obtain an estimate of $P_j(X_i, Z_{ti})$, but instead.

$$(3) \quad P_j(X_i) = P(V_{ij} = \max_r V_{ir} | X_i) = E_Z P_j(X_i, Z_{ti})$$

where E_Z denotes the expectation operator with respect to the temporal (investment project) variation in Z_{ti}. Thus, in the choice probability given in (3) the unobservable vector (unobservable in our case) is integrated. If panel data on realized choices among methods, including Z_{ti}, were available so that estimates of $P_j(X_i, Z_{ti})$ could then be obtained, and one could then calculate $P_j(X_i)$ as:

$$(4) \quad \frac{1}{T} \sum_{t=1}^{T} P_j(X_i, Z_{ti})$$

However, such data are not available in our case, and therefore, another alternative approach is called for. The alternative approach used in this paper consists of a two-stage procedure as follows. In the first stage, I analyze the intensity with which the respective methods are used by the firms. In other words, at this stage the purpose is to estimate a model of how often the respective methods are used by the firm. To this end, the ordered logit (or probit) modeling framework can be applied. In the second stage, the estimation results from the first stage are used to calculate choice probabilities of the most preferred method, as given in (3).

To obtain suitable data the survey questionnaire contains questions on how often firms use the respective evaluation methods, and which can be used for estimating the first stage model, namely the ordered logit model. The questions in the survey questionnaire that are appropriate to this end are questions like; is a given method always used, or often used, or rarely used, etc... Thus, these answers correspond to response categories, $k = 1, 2, ..., m$, those firms that are in category 1 are those who state that they always use a given method, those who are in category 2 are those who often use the method, etc. Let $\varepsilon_{1ij} = Z_{1ij} + \eta_{1ij}$ for $j > 0$. Recall that the distribution of Z_{1ij} is assumed to be independent of t. Since Z_{1ij} is unobservable, I model ε_{1ij}, similarly to η_{1ij} as a random variable (from the viewpoint of the researcher). Consequently, under specific distributional assumptions about $\{\varepsilon_{1ij}\}$ it is possible to calculate the choice probability given in (4). Let $P(Y(k)) = 1$ if firm i is

observed to be in response category k given method j and zero otherwise. Assume that $\varepsilon_{1ij},\ j=0,1,2,\ldots$ are IID and let $F(\cdot)$ be the c.d.f. of $\varepsilon_{1ij}-\varepsilon_{1i0}$. Hence, it follows that:

$$P(Y_{ij}(k)=1|X_i)=P(\gamma(k)<V_{1ij}-V_{1i0}<\gamma(k-1)|X_i) \tag{5}$$

$$=F(\gamma(k)-X_i\beta_j-\beta_{j0})-F(\gamma(k-1)-X_i\beta_j-\beta_{j0}) \tag{6}$$

where $\gamma(k)$ are unknown threshold values which are estimated jointly with the parameter vector β_j and β_{j0}. The reason why I consider $V_{1ij}-V_{1i0}$ instead of V_{1ij} is because I wish to get rid of the fixed effect while retaining a reasonable interpretation, Ferrer-i Carbonell and Frijters (2004). Thus, V_{1i0} represents an "anchoring" effect that makes the evaluation scales comparable across firms.

The threshold parameters $\{\gamma(k)\}$ are implicitly representing the average of the firm's interpretation of the response categories, such as "often" or "rarely", for example. Note that here it is assumed that $\{\gamma(k)\}$ do not depend on the method j. It seems reasonable that the threshold levels do not depend on the evaluation methods. It follows from the above expression that I can rewrite (6):

$$P(Y_{ij}(k)=1|X_i)=F(\tilde{\gamma}_j(k)-X_i\beta_j)-F(\tilde{\gamma}_j(k-1)-X_i\beta_j) \tag{7}$$

where $\tilde{\gamma}_j(k)=\gamma(k)-\beta_{j0}$. Hence, I obtain $\tilde{\gamma}_j(k)$ by taking the respective mean across the threshold levels $\gamma(k)$, $k=1,2,..,m$ such that $\bar{\tilde{\gamma}}_j(k)=\bar{\gamma}(k)-\beta_{j0}$. Note that although I cannot identify the unknown parameter β_{j0}, but because it is a constant it cancels in utility comparisons and therefore is irrelevant in this context. Figure 2 illustrates the relationship between the threshold parameters, $\gamma(k)$ and the k ordered response categories

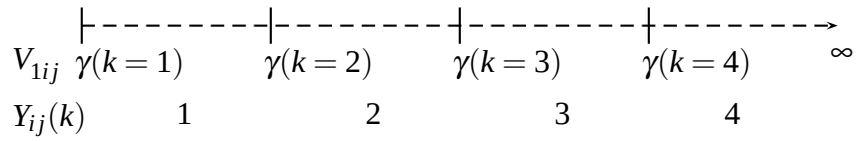


Figure 2: Relationship between threshold values, $\gamma(k)$ with the corresponding preference level, V_{ij} and the response categories of the endogenous variable, $Y_{ji}(k)$. Firms that prefer a given method as high as it can, will have a value of $V_{ij}>\gamma(k=4)$

In the following, I shall assume that $\varepsilon_{1ji},\ j=1,2,3,...$ are independent Gumbel distributed. Which, implies that that the c.d.f. of the error is given by $\exp(-e^{(-x)})$. Then it is

well known that $F(\cdot)$ becomes a logistic distribution function so that the model in (6) and (8) becomes an ordered logistic model which can readily be estimated by the method of maximum likelihood. The model parameters are estimated separately for each method:

$$(8) \quad P(Y_i(k)=1|X_i) = F(\tilde{\gamma}_j(k) - X_i\beta) - F(\tilde{\gamma}_j(k-1) - X_i\beta)$$

Consider next how the results above can be used to obtain the probability of the most preferred evaluation method, given that the parameters of the utility function have been estimated. Under the assumption of IID Gumbel distributed error terms, independent across methods, it follows that the probability that evaluation method j is the most preferred method, as view by firm i, is equal to

$$(9) \quad P(V_{ij} = max_r V_{ir}|X_i) = \frac{\exp(X_i\hat{\beta}_j - \bar{\tilde{\gamma}}_j)}{\sum_{r=1}^{m}\exp(X_i\hat{\beta}_r - \bar{\tilde{\gamma}}_r)}$$

The empirical counterpart of the choice probability in (9) is the fraction of time firm i would choose method j, given the explanatory variables. Note that the multinomial model given in (9) depends crucially on $Corr(\varepsilon_{1ji}, \varepsilon_{1ki})$ being independent of j and k for $j \neq k$. This assumption could in principle be tested by estimating a multivariate ordered logit model in the first stage, but that is not done in this paper. The average probability of choosing method j is calculated as

$$(10) \quad \frac{1}{N}\sum_{i=1}^{N} P(V_{ij} = max_r V_{ir}|X_i) = \frac{1}{N}\sum_{i=1}^{N}\left(\frac{\exp(X_i\hat{\beta}_j - \bar{\tilde{\gamma}}_j)}{\sum_{r=1}^{m}\exp(X_i\hat{\beta}_r - \bar{\tilde{\gamma}}_r)}\right)$$

The empirical model is estimated by using the maximum likelihood using STATA with the *oglm* and *glm* packages. The calculation of the predictions and the calculated probabilities of the preferred method is done in Python with the *numpy* and *pandas* libraries.

4.1 Descriptive methods

To verify the business survey using administrative data and study if there are any differences in how the choice of the method the firm uses or how often the firm apply different measures varies between small and large firms. I test for differences in means between the respective groups and between response categories. To do this, I apply two types of tests. I use the t-test and the Wilcoxon Rank Sum test for comparing the results in two

sub-samples, and I use the Kruskal-Wallis and ANOVA to compare both between groups and blocks.

The above-mentioned tests may all be used to test whether I can reject or not the hypothesis of differences in the mean between groups and/or between blocks. However, neither the ANOVA nor the Kruskal-Wallis test can pinpoint exactly which response category that is significantly different from the other. For this, I employ Dunn's test, which can account for multiple pairwise comparisons of the Kruskal-Wallis rank test or the Tuckey-Kramer pairwise comparison for the two-way ANOVA. Applying the full apparatus of tests, I find that there are significant differences in firms' decision rules. Detailed results and explanations of the methods are reported in the appendix.

5 Empirical Analysis

Neoclassical investment models have been, and still are, the standard framework for analyzing investment decisions both in corporate finance and in economics in general. The net present value (NPV) model and the Q-model both highlight the importance of the net discounted profit for the investment decision. This section analyses the results from the business survey and sheds light on how business managers choose methods to support their investment decision process. I start each subsection with a description of the methods and a brief overview of earlier findings. Then I continue with a descriptive analysis of the survey results and round off each subsection with a description of the results from the empirical study.

5.1 How do firms calculate their hurdle rate?

In capital budgeting, it is important to have a view of the firm-specific risk. This is because it is a crucial part of the cost of capital. The traditional view is that the risk-free interest rate normally equals the interest rate on long term government bonds, like Treasury bonds, see e.g. Huang and Huang (2012). Hence, the firm-specific interest rate, r_j, can then be expressed as the risk-free rate, r_F, plus the firm-specific risk premium, θ_j:

$$r_j = r_F + \theta_j \tag{11}$$

What kind of method the firm uses to specify the company or project risk varies between companies. A textbook approach for finding the θ_j is based on the use of the capital asset price model (CAPM), see Lintner (1965). By estimating the stock return, σ_j, relative to the market return, σ_M, called the β, one finds the firm's risk premium: $\theta_j = \frac{\sigma_j}{\sigma_M}(r_m - r_F) = \beta(r_m - r_F)$, where r_m is the market return.

Following this approach, when calculating the minimum acceptable rate of return (hurdle rate), one assumes that the project risk premium equals the average firm risk premium. For investment projects, it is not always the average company cost of capital, but the risk and cost of the specific project that is relevant. To obtain identification of the project risk might be demanding. An approach suggested by Brealy et al. (2017) when it is difficult to calculate the internal project risk is to identify firms with homogeneous project portfolios that match your investments project and estimate their θ_j based on the CAPM.

The CAPM excludes the cost of debt when estimating the firm-specific hurdle rate. By calculating the weighted-average cost of capital (WACC), the cost of debt is taken into account. An alternative to the CAPM is to use the difference between the cost of debt and riskless debt instruments as the market valuation of the firms' risk, unless there are provisions or restrictions reducing the value of debt, Merton (1974). This will be a less demanding approach and reduce the time spent on investment analysis.

A particular focus of this paper is the effect of firm size heterogeneity on firms' investment decision making. When analyzing the firm size heterogeneity I divide the firms into small, middle, and large firms based on their number of employees. Compared to the volatility of the firms' employment figures, the volatility of the sales figures varies significantly. Therefor, employment is the preferred measure for splitting the sample into firm size categories. Small firms include firms with less than 50 employees, middle firms include firms with 50 or more, but less than 500 employees, and large firms include firms with 500 or more employees. Out of the total sample: 34 percent of the firms are small firms, 57 percent are middle firms, and 9 percent are large firms.

The survey questionnaire contains questions about which hurdle rate the firm normally uses when doing its profitability analysis. Table 7 shows the result for the share of the firms that answers that it always uses the different hurdle rate calculations. It turns out that more than half of the firms (51.7 percent) use their bank loan rate as their hurdle rate. This

Table 7: Questions about firms' choice of hurdle rate

Methods used by firms to calculate the hurdle rate, percentage answered: Methods that always are used by the firm. In percent[a)]				
	All firms	Small firms	Middle-sized firms	Large firms
Bank rate*	51.7	68.3	45.1	15.0
Bond rate*	0.6	0.0	1.0	0.0
FRA	11.5	7.5	13.1	16.7
WACC*	15.9	3.1	21.2	30.0
CAPM	4.5	1.5	6.2	6.7
Several*[1]	5.4	0.0	8.7	6.3
Other*[2]	20.5	13.3	21.7	42.1
The firms' appraisal of its calculated hurdle rate, by firm size. In percent[b)]				
Great	28.0	30.8	27.2	25.2
Moderate	41.9	57.7	42.9	41.2
Small	17.2	11.5	16.9	17.7
No	5.4	.	4.2	3.4
Not relevant	7.5	.	8.8	12.6

*Firm size differences are significant using the Kruskal-Wallis equality-of-population rank test.

1, 2) Several = Several different models and Other = Other models.

a) The rows do not sum to 100 percent since the firms might use more than one calculation method.

b) In order to motivate the respondents to answer, the firms could answer either *"No"* or *"This question is not relevant to our firm"*

Table 8: Factors affecting firms' choice of hurdle rate

	Bank loan rate	Bond rate	FRA	WACC	CAPM	Other models
Small firms	0.558*	-0.175	-0.199	-0.351	-0.162	-0.005
	(1.73)	(-0.51)	(-0.66)	(-1.11)	(-0.49)	(-0.02)
Large firms	-0.651*	0.266	0.199	0.111	0.869**	0.878**
	(-1.83)	(0.58)	(0.49)	(0.26)	(2.00)	(2.08)
Subsidiary	-0.237	1.013***	1.138***	0.987***	1.034***	0.862***
	(-0.86)	(3.12)	(3.92)	(3.28)	(3.31)	(3.01)
Funding investments w/equity	0.156	-0.222	0.687	-0.363	-0.058	0.257
	(0.43)	(-0.44)	(1.45)	(-0.81)	(-0.12)	(0.57)
Funding investments w/debt	0.634**	0.281	0.603**	0.416	0.690**	-0.008
	(2.17)	(0.83)	(1.98)	(1.33)	(2.12)	(-0.03)
Sensitivity analysis	-0.704***	0.787**	0.614*	1.511***	0.868**	0.549*
	(-2.62)	(2.18)	(1.94)	(4.41)	(2.54)	(1.68)
Threshold 1	-1.248	2.570***	2.448***	2.206***	2.754***	2.542***
	(-1.58)	(2.83)	(3.03)	(2.68)	(3.14)	(3.04)
Threshold 2	-0.290	6.486***	3.890***	4.052***	5.196***	3.548***
	(-0.38)	(5.93)	(4.67)	(4.73)	(5.57)	(4.15)
Threshold 3	0.522		5.416***	4.797***	6.646***	4.748***
	(0.68)		(6.18)	(5.46)	(6.52)	(5.39)
Controls	✓	✓	✓	✓	✓	✓
No. of observations	228	228	228	228	228	228
Log-likelihood	-261.75	-139.67	-232.90	-206.65	-181.08	-238.47
χ^2- test, p-value	0.000	0.000	0.000	0.000	0.000	0.000
Pseudu R^2	0.065	0.115	0.075	0.124	0.125	0.078

Notes: The empirical model for the probability that the firm chose a given method to calculate its hurdle rate is estimated using a ordered logit model: $Y_i = F(\tilde{\gamma}(k) - X_i\beta) - F(\tilde{\gamma}(k-1) - X_i\beta)$, where $\tilde{\gamma}$ is the thresholds parameters, X_i is the firm specific variables, and $F()$ is the logit function. Control variables include administrative data on firm level such as debt to asset ratio, profit ratio, last year investments. Standard errors are bootstrapped, with the significance levels of the z-test represented with stars: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

The category "Several different models" represent the **baseline method**, noted as V_{ti0} in the section above.

is especially true for small firms, while large firms to a lesser degree use bank loan rates as a substitute for calculating their own hurdle rate. Looking into the figures, it turns out that 73 percent of the firms that are financing their investments with bank loans answer that they use bank loan rate for calculating profitability. Still, 53 percent of the firms not funding their investment with bank loans use bank lending rates as their hurdle rate. Since profitability depends on the expected prices and volumes, it is the expected interest rate that should be used in calculations. Interest rates from the forward rate agreements (FRA) market reflect market expectations. Hence, it should be more suited for profitability calculations than bank loan rates. A decent share of the firms is using interest rates from the FRA market, and on average, it is chosen by 11.5 percent of the firms. It is also relevant to note that 12 percent of the firms respond "No" or "Not relevant" for all models.

As explained in section 4, the way I will study firms' preferred methods is by the

two-step procedure. To find which method the firms prefer to use to calculate its hurdle rate, I will be using a combination of the ordered logit model and the multinomial logit model. The results from the empirical model, shown in table 8, show that firm size is also important for explaining how the firms calculate their hurdle rate. Large firms are less likely to use the bank loan rate as their hurdle rate, but large firms have a higher probability of choosing advanced methods to calculate its hurdle rate than middle-sized and small firms do. The effect of being a subsidiary does also affect the calculation of the hurdle rate. Hence, strengthening the evidence that there is a spill-over-effect regarding how capital budgeting is done within corporations.

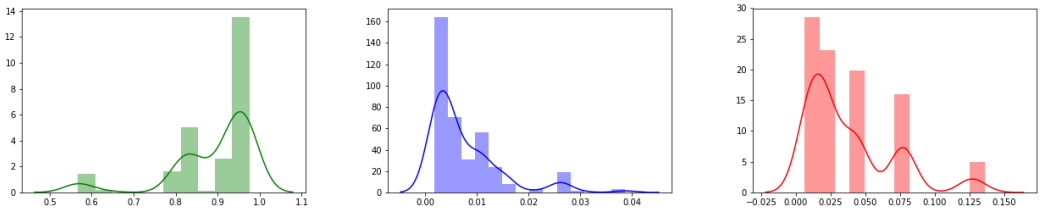
Interestingly, firms with debt funding have a higher probability of calculating their hurdle rates than firms with predominantly other funding sources. I question the firms about their use of sensitivity analysis to shed light on the uncertainty of investments, and if the firm respond that they use sensitivity analysis often, then it is a higher probability that they are using sophisticated methods for calculating the hurdle rate, while it reduces the probability of using bank loan rates as their hurdle rate. To see if the emphasis the firms put on the estimated hurdle rate affects which method they chose, I ran models where this variable was included. How strong emphasis the firms put on its hurdle rate did not affect which method is preferred, with one exception and that was the method "Other models". I control for the financial situation of the firm by adding debt to asset ratio and the profit margin, defined as earnings before interest and tax (EBIT) relative to total revenues. Neither variables have an effect on the choice of what method the firm prefers.

Note that the threshold values or cut points, as they also are called, are estimated constants that help us categorize the predicted values. I use γ to label the threshold values in the discussion of the econometric methods in section 4. See figure 2 in the same section for a visual explanation of the cut points.

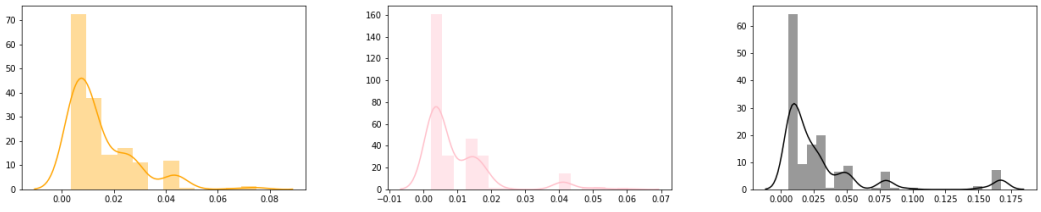
Step two of the calculation of the most preferred method includes the use of the multinomial probability model. I insert for the estimated parameters from the ordered logit model, as shown in section 4. The response category "Several models" is used as the reference category. Table 16 summarize the results, with the predicted mean, which is our estimate of the share of firms that prefer this method in front of the other methods to

Table 9: Multinomial probabilities for the different investment profitability calculation methods

	Bank loan rate	Bond rate	FRA	WACC	CAPM	Other models
mean	0.8974	0.0076	0.0385	0.0150	0.0098	0.0316
std	0.0979	0.0071	0.0324	0.0134	0.0110	0.0396
min	0.5836	0.0017	0.0063	0.0034	0.0021	0.0056
P25	0.8440	0.0025	0.0109	0.0057	0.0028	0.0106
P50	0.9383	0.0050	0.0226	0.0100	0.0045	0.0176
P75	0.9686	0.0109	0.0473	0.0246	0.0141	0.0327
max	0.9771	0.0399	0.1402	0.0774	0.0626	0.1720



(a) Bank loan rate **(b)** Bond rate **(c)** FRA



(d) WACC **(e)** CAPM **(f)** Other models

Figure 3: Distribution of estimated multinomial probabilities for the most preferred method. Histogram and kernel density estimator

calculate its hurdle rate. The results show that the majority of firms prefer to use the bank loan rate. A small share of firms prefer the FRA or to use "Other models", while the other methods are estimated to be the preferred one by nearly none of the firms. To visualize the distribution of the different firms' most preferred method, I show the distribution of the predicted probabilities for preferring the given method in Figure 3.

5.2 Investment criteria

The firms' choice of investment criteria to its capital budgeting process is an intensively studied topic in applied corporate finance. The textbook methods presented in Brealy et al. (2017) for calculating investment projects are the Net present value (NPV), Internal rate of return (IRR), Payback method, Book of return, and profitability analysis. Boye and Koekebakker (2006), a popular book among Norwegian business schools, also includes the Equivalent annual cost (EAC) as a recommended method. Brealy et al. (2017) present the NPV method as the benchmark model for calculating investment projects. Equivalent annual cost (EAC) is an extension of the NPV method. In contrast to the NPV, it adjusts the estimated NPV for differences within the lifespan of projects, making projects with a longer lifespan less worth.

Even though the NPV is assumed to give the most accurate assessment of a project's profitability, Graham and Harvey (2001) find that the internal rate of return is slightly more common among CFOs. Brealy et al. (2017) argue that one reason for the popularity of the IRR might be due to the fact that financial officers need to convince their executives or its owners to get the project approval. The reason is that the IRR might be chosen because it is easier to grasp than the NPV. The Payback method, Book of return and Profitability analysis are all less common than the NPV and IRR, but 57 percent of CFOs use the payback method occasionally, see Graham and Harvey (2001). Kengatharan (2016) conclude as in Graham and Harvey (2001) that discounted cash flow (DCF) methods are most common.

My findings differ from those found in Graham and Harvey (2001). When questioned which method executives use when calculating the profitability of projects, my analysis shows that the most common method is the payback method. The figures in Table 10 shows the proportion of firms using the different methods *often* or *now and then*. The survey results show that a total of 37 percent of the respondents said they normally use

Table 10: Investment criteria used to calculated profitability of investment projects. Percentage of firms responding that the method is used by the firm

	All Firms	Small	Medium	Large
EAC	9.52	7.5	10.1	14.8
IRR*	28.6	14.2	33.9	55.6
NPV*	35.4	19.2	40.7	70.4
Payback period	37.2	31.7	40.7	37.0
Other methods	15.5	20.8	12.2	14.8
No method*	19.0	25.8	17.5	0

*) Firm size differences are significant using the Kruskal-Wallis equality-of-population rank test.

a) The rows do not sum to unity since the firms might use more than one calculation method.

b) In order to motivate the respondents to answer, the firms could answer either *"No"* or *"This question is not relevant to our firm"*.

Table 11: How often the firm cannot give a good estimate of the expected cash flow. In percent

	All firms	Small firms	Middle-sized firms	Large firms
Always	2.4	5.0	1.1	.
Often	28.2	24.0	31.2	26.9
Now and then	47.2	50.4	45.7	42.3
Rarely	19.2	18.2	18.3	30.8
Never	3.0	2.5	3.8	.

the payback method, while 35 percent use the NPV method and slightly fewer firms, 29 percent, use the IRR method.[5] This is surprising given the results in Graham and Harvey (2001). Furthermore, I find that the Equivalent annual cost method is less common, with only 10 percent of the respondents using this method. More interestingly, 20 percent of the respondents said that they do not use any formal method at all, and 15 percent have a model, but not one of the methods listed in Table 10.

To explain how firm size and other factors explain the firms' choice of method for

[5]The difference in the response rate between NPV and payback is not significantly different at a 5 % significance level.

calculation of profitability, I use a simpler version of the ordered logit model that contains only two response categories, namely “often” or “never”. In contrast to the ordered logit model presented in section 4 there is now only one threshold. Otherwise, the interpretation is unchanged, and I use the same two-step model to predict the preferred method. After I have modeled the ordered logit model, I do as earlier and calculate the most popular method given the explanatory factors using the multinomial logit choice probability. Table 12 summarize the estimation results from the simple ordered logit model while table 16 shows the multinomial choice probabilities. The empirical analysis from the simple ordered logit model shows that the importance of firm size varies heavily between the different methods. There is a strong positive firm size effect for the probability of the firm using IRR or NPV. Both methods, and particularly the NPV, is used predominantly by large firms, and less by small firms. This result holds even if I control for the education level of the manager. It is the most educated managers that use NPV and IRR, while education counts negative for firms that respond that they are not using a model for calculating the profitability. This is a result backed up by Brounen et al. (2004). For the other methods, I find that the probability is slightly higher for larger and smaller firms than middle-sized. The empirical results show that whether the firm is a subsidiary or not is important for explaining if the firm uses a known calculation method. I find that firms that are subsidiaries are more likely to use formal calculation methods, such as IRR and Payback indicating that there is some transfer of knowledge and practice within the corporations, which smaller firms benefit from. Funding sources also affect which method is preferred. If the firm funds it selves with equity, the probability of using one of the methods described above increases compared to firms funding their investments with a bank loan.

To avoid that any random composition affects the results, I create several new variables. Those variables are: Firm investments in machines relative to buildings; this variable is 1 if the ratio is greater than 1, maintenance and repair, a variable that is 1 if the respondent that the motive of their last investment was in the category maintenance and repair, real investments relative to employment, debt to asset ratio and profitability. Since this is not the variables of interest, I have not added them to the results shown in table 12.

To find the most commonly used model, I calculate the multinomial logit probabili-

Table 12: Factors affecting firms' choice of investment criteria

	EAC	IRR	NPV	Payback	No model
Small cap	0.047	-0.142	-1.152***	-0.183	0.544
	(0.08)	(-0.34)	(-2.62)	(-0.51)	(1.03)
Large cap	0.426	1.265***	0.956**	0.292	.
	(0.72)	(2.96)	(2.26)	(0.77)	.
Higher education	0.282	0.626*	0.857**	0.259	-1.046**
	(0.54)	(1.68)	(2.26)	(0.82)	(-1.99)
Subsidiary	0.588	0.583*	-0.217	0.465	-1.009
	(1.21)	(1.70)	(-0.62)	(1.52)	(-1.63)
Freq. of EquityFunding	0.459	0.244	-0.565**	0.287	-0.538
	(1.09)	(0.96)	(-2.15)	(1.29)	(-1.36)
Freq. of DebtFunding	-0.288	0.064	-0.522***	0.201	-0.013
	(-1.20)	(0.38)	(-3.06)	(1.36)	(-0.05)
Sensitivity analysis	-0.251	1.348***	1.167***	0.274	.
	(-0.45)	(3.80)	(3.14)	(0.81)	.
Imp. of HurdleRate	1.637	2.404***	2.054***	0.943**	-3.212***
	(1.54)	(2.95)	(3.24)	(2.02)	(-5.31)
Threshold	-4.752***	-5.333***	-1.166	-3.637***	3.143**
	(-2.72)	(-4.30)	(-1.15)	(-3.96)	(2.24)
Controls	✓	✓	✓	✓	✓
No. of observations	236	236	236	236	146
Log-likelihood	-66.57	-113.61	-113.10	-139.86	-56.67
χ^2-test, p-value	0.448	0.000	0.000	0.004	0.000
Pseudu R^2	0.086	0.249	0.281	0.103	0.324

Notes: The empirical model for the probability that the firm is using the current method for calculating its profitability is estimated using a logit model: $logit(Y_i) = X_i\beta + \varepsilon_i$, where X_i is the firm specific variables. Control variables include administrative data on firm level such as debt to asset ratio, profit ratio, last year investments. Standard errors are bootstrapped, with the significance levels based on the z-values represented with stars: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

The category "Other models" represent the **baseline method**, noted as V_{ti0} in the section above.

Table 13: Multinomial probabilities for the different investment profitability calculation methods

	EAC	IRR	NPV	Payback
mean	0.1605	0.7996	0.0004	0.0394
std	0.1146	0.1349	0.0005	0.0349
min	0.0105	0.4022	0.0000	0.0033
P25	0.0687	0.7219	0.0001	0.0153
P50	0.1389	0.8266	0.0003	0.0314
P75	0.2363	0.9148	0.0006	0.0451
max	0.5170	0.9830	0.0046	0.1752

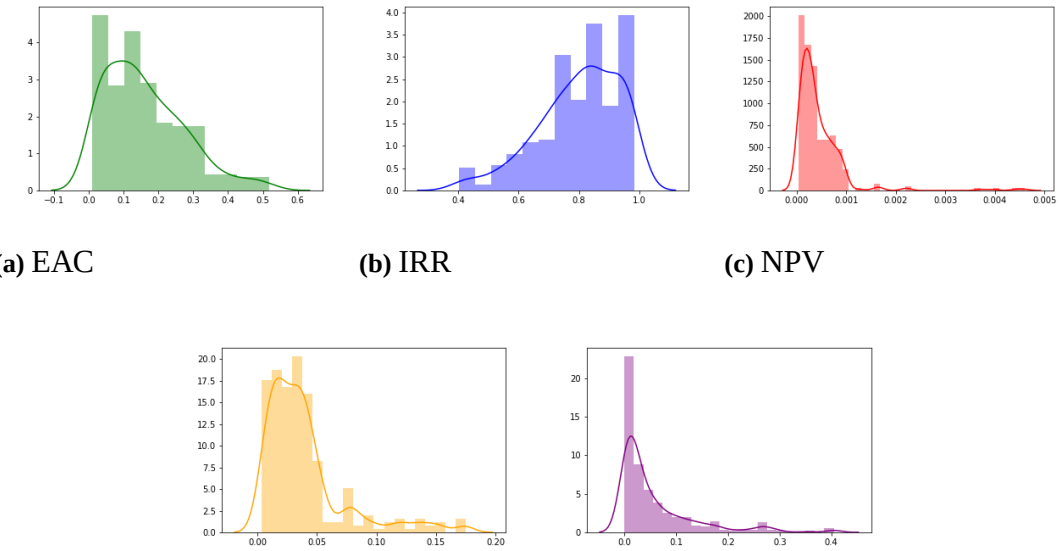
ties, as shown above. The results show that the Internal rate of return is the most preferred method to calculate the profitability of an investment. The firms are divided into two. While most firms are estimated to prefer the IRR, about a quarter of the firms prefer the EAC. The multinomial probability model predicts practically zero probabilities of choosing the NPV and the Payback-model. Based on the responses, the model estimate that the firms that are using the NPV or the payback together with the IRR, prefer the IRR before one of these two models.

5.3 Investment funding

To get an understanding of how funding source affects investment behavior, the survey questionnaire contains questions on how the firms finance their investments. The theory of corporate finance is not clear on what is the best strategy. Bessler et al. (2011) summarize capital structure theory by highlighting three theories:

1. Trade-off theories discuss how firms adjust their debt. There is a trade-off between higher tax-deductibility (in the case of tax non-neutrality), and financial distress, such as the increased risk of bankruptcy as the debt rises

2. Pecking order theories describe how asymmetric information affects the financing



(a) EAC **(b)** IRR **(c)** NPV

(d) Payback **(e)** Several models

Figure 4: Distribution of estimated multinomial probabilities for firms' preferred method for calculating the profitability. Histogram and kernel density estimator

structure. Because of the information advantage the manager has above the market, the firms will strive to increase its debt ratio rather than issuing equity when the firms' market value is below the managers' estimation of the firm value

3. Market timing theories tell a story where the firm raises equity capital preferably when the stock market conditions are good. One measure for market conditions could be the market to book values, and a policy could be to issue equity when this ratio is relatively high

These three groups of theories may give insight into how companies finance their investments.

The importance of funding is addressed in several papers. Two recent studies of the importance of funding show that access to liquid funds and funding is important for investment decisions. The debt-equity ratio is studied by Lewis and Tan (2016), by exploiting the variation in R&D investment, they are able to show how the funding affects profits. Using a natural experiment Rauh (2006), finds that there are strong cash flow effects on investments. I have a somewhat different approach to the funding decision. I want to find

Table 14: Investment funding source, by firm size. Average response, response categories 1 to 3

Firm size	Equity*	Bank Loan*	Bonds	Currency loan	New shares	Parent loan*
Small	2.30	2.17	1.03	1.09	1.01	1.38
Middle†	2.53	1.92	1.00	1.07	1.03	1.74
Large†	2.37	1.58	1.08	1.13	1.00	1.68
All firms	2.43	1.98	1.02	1.08	1.02	1.61

Note: Response categories: 3: Yes, almost always; 2: Now and then; 1: No, almost never. The reported results are average responses, the higher the figure, the larger is the share of the firms responding that they use the specific financing source. *Firm size is significant at the 5 percent level using a Kruskall-Wallis rank test. †Difference in mean between the different response categories are significant for large and middle-sized firms using two-way ANOVA with the Tuckey-Kramer multiple pairwise comparison test.

the most common source of funding, and with a hypothesis that this will make it easier to understand what limits new investment projects. Note that this paper does not intend to test the capital structure theories explicitly, but rather identify some qualitative characteristics about factors affecting firms' funding decisions. Hence, sufficient liquid funds are a necessity for investments and having knowledge about where the company gets its funding from is necessary for understanding what might restrict the access to liquidity. Without equity capital, the firm needs external funding, either from banks, in the form of bank loans, or from the credit market, in the form of issued bonds or shares.

Titman (2002) summarizes his paper with a hypothesis about the bond market in the EU before and after the introduction of the Euro. He suggests that firms with their main activity in small countries might find it more profitable to raise funding in the bond market after the Euro was implemented. This is because the single currency decreases the risk premiums on bonds in small countries with illiquid markets because the common currency reduces the exchange rate risk. Hence, the gap between the observed cost of issuing bonds and shares are reduced. If this is correct, I should find that Norwegian firms are to a little degree exposed to the bond market. An interesting finding in Harford and Uysal (2014) shows that unrated firms are less likely to get bond financing. Knowing that small and middle-sized firms to a less degree take the cost of being rated, one would expect that fewer of them finance investments with bonds.

Table 15: Factors affecting the choice of funding source

	Equity	Bank Loan	Parent Loan
Middle sized firms	0.221	-0.315	0.464*
	(0.26)	(0.25)	(0.26)
Large firms	0.722*	-1.112***	1.010***
	(0.38)	(0.33)	(0.34)
Debt to asset ratio	-1.983***	1.600***	0.385
	(0.65)	(0.60)	(0.60)
Net profit to book value	0.025**	-0.014	0.003
	(0.01)	(0.01)	(0.01)
Paid dividends	-0.112	0.703***	-0.767***
	(0.30)	(0.27)	(0.29)
Importance of cash for investments	-0.384	1.005***	0.084
	(0.27)	(0.26)	(0.26)
Threshold 1	-5.164***	0.100	0.616
Threshold 2	-3.200***	0.710	1.283**
Threshold 3	-0.904*	2.488***	2.977***
Controls	✓	✓	✓
No. of observations	281	281	281
Log-likelihood	-252.067	-345.799	-325.104
χ^2-test, p-value	0.000	0.000	0.001
Pseudu R^2	0.056	0.067	0.041

Notes: The empirical model for the probability that the firm fund its investments with Equity, Bank loan or Parent loan is estimated using a ordered logit model: $Y_i = F(\tilde{\gamma}(k) - X_i\beta) - F(\tilde{\gamma}(k-1) - X_i\beta)$, where $\tilde{\gamma}$ is the thresholds parameters, X_i is the firm specific variables, and $F()$ is the logit function. Control variables include administrative data on firm level such as debt to asset ratio, profit ratio, last year investments. Standard errors are bootstrapped, with the significance levels of the z-test represented with stars: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

The results from the survey responses regarding firms' funding sources are summarized in Table 14. I find that more than half of the firms use equity and retained earnings to finance all its new projects. Furthermore, the results show that there are significant differences between small, middle, and large-sized firms in how they finance their investments. Nearly a third of the firms answered that they finance their investments with a loan from banks, and 15 percent get financing through its parent company. None of the firms uses currency loans; bonds or issues new shares to finance its project on a regular basis, but a few firms use one those three funding sources now and then.

To extend the study of what affects the firms' choice of funding source, I estimate an ordered logit model to explain factors affecting which funding source they prefer. The ordered logit model exploits the ranking of the responses in the questionnaire and uses

both administrative data and the survey responses to explain the funding choice. I present estimation results for three models in Table 15, one for the probability that the firm is funding its investment with equity, one for funding investment with a bank loan and one model for funding investments with parent loan. The other funding sources are used by too few firms that I can make a valid model for them. The explanatory variables are the response to the question of whether access to cash is limiting firm investments, firm size dummies, and firm-level administrative data.

The analysis shows that firms with high profitability are more likely to fund themselves with equity, while profitability has no effect on firms choosing debt funding. Firms that respond that their investments are limited by its availability to liquid funds do have a higher likelihood of funding themselves with bank loans, than firms which report not to be limited by access to cash. Large firms have a reduced likelihood to fund their investments with bank loans relative to small and middle-sized firms, showing that small firms are most likely to fund their investments with bank loans. Studying firms that are funding their investments with equity, I find that things are turned around. The results show that large firms are more likely to fund their investments with equity than small firms are. Controlling for the financial situation of the firm, I find that firms with a high debt to asset ratio are more likely to fund their investments with bank loans relative to firms with low debt ratios, which are more likely to fund their investments with equity.

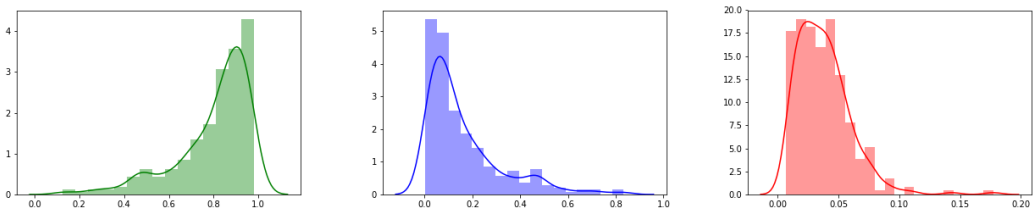
Not surprising, as shown in Table 16, more than 3/4 of the firms prefer funding its investments with equity, while 16 percent prefer a bank loan. A few firms are found to prefer funding from its parent company. Based on the survey results, I know that most of the subsidiaries finance investments with retained earning, explaining the low figure of firms preferring parent loans as funding. Figure 5 shows the distribution of the estimated probabilities for the three funding sources.

5.4 Leaning towards model results or gut feeling?

A capital budgeting process might start with an analytical approach, where the firm calculates its cost of capital and then the profitability of the investment project. However, figures showing the profitability are of no use if the investment decision does not hinge on the calculated profitability. I was curious about how the firms anticipated the results from

Table 16: Multinomial probabilities for the funding choice

	Equity funding	Bank loan funding	Parent loan
mean	0.80044	0.16169	0.03785
std	0.16678	0.16026	0.0221
min	0.12658	0.00329	0.00707
P25	0.72857	0.05009	0.02159
P50	0.85789	0.09926	0.03487
P75	0.92320	0.21396	0.04914
max	0.98169	0.83331	0.17705



(a) Equity funding **(b)** Bank loan funding **(c)** Parent loan

Figure 5: Distribution of estimated multinomial probabilities for the preferred funding source. Histogram and kernel density estimator

their calculations, so I included a few questions in the questionnaire regarding how they considered the results and how the firms in the business survey handled the uncertainty of their projects.

The questionnaire contains questions on whether the calculated hurdle rate is important for the decision of implementing the investment project. Table 7 showed that 27 percent of the respondents put great emphasis on the calculated hurdle rate, and close to half of the firms put moderate emphasis on the calculations. Looking at the firms putting no or only some emphasis on the hurdle rate, one could wonder why they bother calculating it. 16 percent of the firms put only some emphasis on the calculation and 4 percent no emphasis. 9 percent answered that calculating the hurdle rate is not relevant for their firms. Keeping in mind that 20 percent of the firms said they did no profitability analysis; this figure is not surprising.

There are several uncertain elements the firm has to take an decision on when they are calculating the hurdle rate or the expected profitability. The inputs used by the methods depend on market prospects, entry or exit of firms, etc. It is not obvious how to estimate the inputs for the calculations. The firm has to ask themselves whether there are any reasons to believe that the forecasted future income stream or cost is biased, or their inputs are reasonable. If firms find it difficult to forecast the input variables to the profitability analysis, one would expect that the firm would put less emphasis on the analysis. The survey questionnaire continues to question how often firms cannot give a good estimate of the expected project cash flow. Table 7 shows that one out of three respondents answered that high uncertainty often or always made it close to impossible to calculate the cash-flow of the project. Almost half of the firms said that they *now and then* experienced such uncertainty. Only a fifth of the respondents said that they *rarely* or *never* experienced such uncertainty. Given the response, it is obvious that formal capital budgeting methods play a smaller role in the investment decision than the impression one gets from textbooks on corporate finance.

To study which factors that explain which firms put higher than the average emphasis on the calculation of the hurdle rate, I employ the ordered logit model. The empirical results are shown in Table 17. In the case where the firm put high weight on the profitability analysis when taking its investment decision, one expects that the firm put effort to calcu-