Norwegian School of Economics
Bergen, Autumn 2021

Determinants of Corporate Cash Holdings

An empirical analysis on the relationship between the key policy rate, firm characteristics & Swedish corporate cash holdings, 1994-2019

Johannes Jansen Heggebø & Sondre Nordby Sortland

Supervisor: Jørgen Haug

Master thesis, Economics and Business Administration

Major: Financial Economics

NORWEGIAN SCHOOL OF ECONOMICS

Acknowledgements

Ultimately, this thesis concludes our five years at the Norwegian School of Economics. We are grateful for the opportunity we have had, meeting wonderful people, and learning from some of the best in the field of economics and finance. Furthermore, these five years have been an integral part of our personal development, having challenged us both intellectually and personally, resulting in us being eager to take on the new challenges that lies ahead. Realising that our time at NHH is coming to an end brings up mixed emotions. In that regard, we consider this thesis to be an appropriate challenge to conclude this chapter.

Firstly, we would like to direct our unconditional gratitude to our supervisor, Associate Professor Jørgen Haug, for his valuable insights, guidance, and constructive feedback throughout the semester. His support and constructive feedback provided us with both personal encouragement and valuable contributions to the theoretical framework of this thesis.

Secondly, several other people deserve our gratitude. To begin with, we would like to thank our families and fellow students for their support throughout this project. Lastly, we would like to extend our gratitude to those who have contributed through rewarding discussions and valuable inputs, particularly Dr. Nils-Odd Tønnevold at Connectum Capital Management and lecturers at NHH.

Norwegian School of Economics

Bergen, December 2021

Johannes Jansen Heggebø

Sondre Nordby Sortland

Abstract

This thesis investigates the determinants of Swedish corporate cash holdings. We document a positive correlation between Swedish corporate cash holdings and the key policy rate for the period 1994-2019, in contrast to existing theory. On shorter five-year periods, the relationship between interest rate and cash holdings varies and is both positive and negatively correlated. The most pronounced impact from the interest rate on cash holdings is observable in periods when the interest rates are negative.

Additionally, we find that the development in certain firm characteristics drives the increase in Swedish corporate cash holdings during our sample period. The main drivers behind this increase are size, leverage, and cash flow volatility. This further indicates that the precautionary motive and the transaction motive for holding cash have become more and less prominent during the period. Conclusively, these insights provide corporate managers and government officials with information and additional insights with implications for monetary policy.

Keywords – Corporate Cash Holdings, Liquidity Management, Key Interest Rate, Firm Characteristics

Contents

List of Figures

List of Tables

1 Introduction

1.1 The Thesis

Liquid assets in the form of cash and short-term investments are at an all-time high for global corporate balance sheets, with the level now at $6.84 trillion USD, which is 45% higher than the average of the five previous years.[1] This development coincides with global interest rates being in a more or less continuous downward trend following the financial crisis in 2008 (Del Negro, Giannone, Giannoni & Tambalotti, 2018). This has led many company executives to state the need for alternative dispositions for cash, while government officials and economists claim the economy is losing out on valuable investment opportunities (Hirstensein, 2021).

This thesis is concerned with the determinants of Swedish companies' cash holdings, seeking to investigate both the impact of the key policy rate, as well as certain firm characteristics, to be able to determine the drivers for the observed growth. In the following analysis, we will use identified motives for holding liquid assets as a starting point for our investigation, while the backdrop for our analysis is illustrated in the figure below. The figure plots the evolution of Swedish corporate cash holdings and the key policy rate, each trending in different directions.[2]

[1] S&P Global, obtained from 2021Q2 earnings.

[2] Data are obtained from Compustat Global through Wharton Research Data Services, and from Sveriges Riksbank.

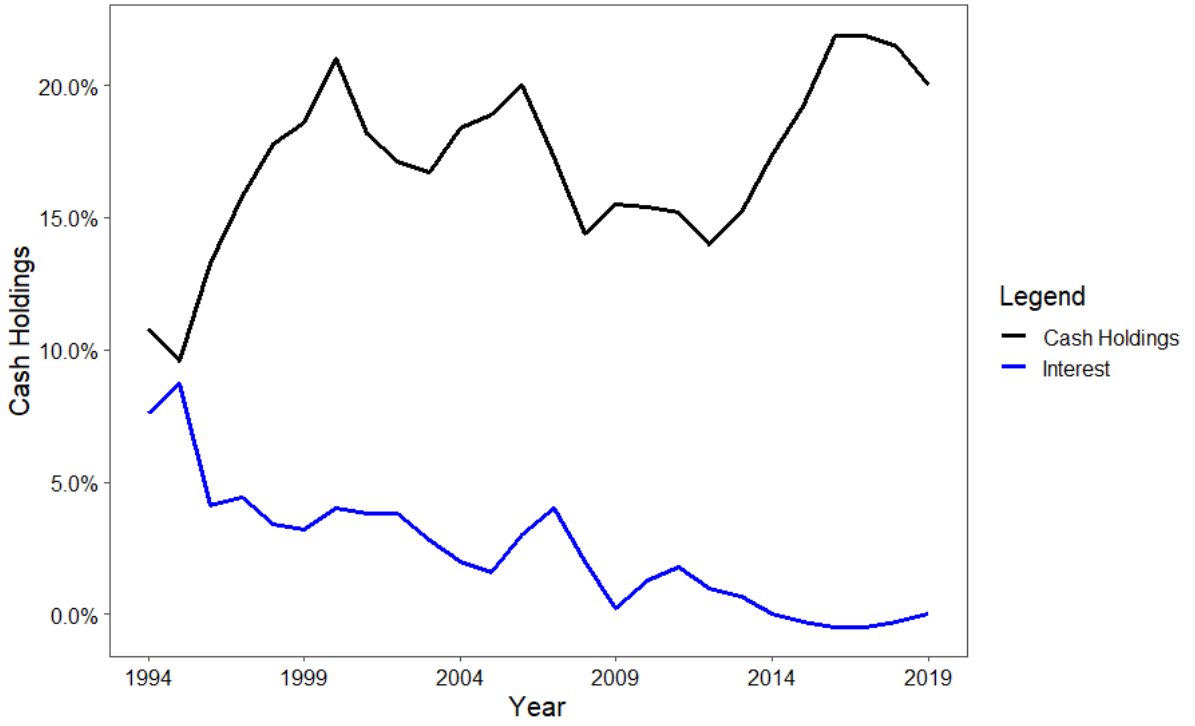

Figure 1.1: Key Policy Rate & Average Corporate Cash / Total Assets, 1994-2019

Figure 1.1 plots the development for the Swedish key policy rate and average cash holdings for public corporations in Sweden from 1994-2019.

1.2 Why Sweden?

Using the geographical market of Sweden for analysing corporate cash holdings is interesting for a number of reasons. Firstly, the Swedish investment universe is diverse, allowing for robust cross-industry analysis. Secondly, Sweden is known for stable political conditions and thus operating environment for its companies. In addition, Swedish companies experienced negative nominal interest rates in the period between 2015 and 2019. This makes it possible to conduct interesting sub-period analysis which allows us to see if the traditional mechanisms and motives apply in a climate with sub zero interest. The reason for starting our sample period in 1994 is to align the company financials with additional data for interest and GDP. Sweden changed specifics of their key policy rate in 1994, making this a natural starting point for our sample period. Lastly, according to the OECD (2021), the Swedish economy went trough six recessions between 1994-UTD, which provides us with the opportunity to analyse cash holdings for different stages of the economic cycle.

1.3 Theoretical Foundations and Research Questions

To study the determinants of corporate cash holdings, including the effect of the key policy rate, we draw on the works of Opler, Pinkowitz, Stulz & Williamson (1999), Bates, Kahle & Stulz (2009), and Gao, Whited & Zhang (2021). The aforementioned theoretical frameworks are all built on the transactions model of liquidity management, presented by Baumol (1952) and Tobin (1956), which will provide the theoretical foundation for the methodology of this thesis.

In the following analysis, we seek to empirically explain the reasons for the increase in Swedish corporate cash holdings which can be seen in Figure 1.1. Acknowledging that disposition of corporate resources and liquidity management are complex managerial decisions, we include firm characteristics to control for known motives for holding cash. Furthermore, the firm-exogenous variable for GDP growth is included in addition to the key policy rate. Believing that firm characteristics, exogenous factors and the general investment climate will influence firms' propensities to hold cash, we seek to estimate the directions each factor contributes.

Accordingly, the research questions for our thesis are as follows:

Research Question I: Does the key policy rate impact Swedish corporate cash holdings, and if so, in what direction?

Research Question II: Can firm characteristics and the development in these, be identified as drivers and determinants of Swedish corporate cash holding?

The results of our analysis on the relationship between the key interest rate and Swedish corporate cash holdings indicate a positive relationship for the entire sample period. However, the results are varying when looking at shorter sub-periods. This indicates that the relationship between corporate cash holdings and interest rates can vary when looking a shorter time periods. Moreover, the relationship for the last 15 years suggests that the interest rate could have contributed to the observed increase in Swedish cash holdings.

The second part of the analysis also identify clear links between specific firm characteristics and the propensity to hold cash on corporate balance sheets. The analysis further provide results suggesting that certain managerial and corporate motives for holding cash are

present and partly contributes to the increase in cash holdings. Lastly, we observe that firms with certain characteristics are more interest sensitive.

Through this thesis, we believe we have made several contributions to the existing research. Firstly, we have contributed to the already extensive base of research on the determinants of corporate cash holdings. The contributions relate firstly to the documentation of a positive relationship for Swedish companies from 1994-2019, and by analysing the effect of certain firm characteristics over the period. Secondly, we have added to this research base by providing an analysis of the relationship conditional on shorter periods, showing that the effect of the interest rate varies substantially over shorter periods.

Lastly, we have analysed the influence of managerial motives on Swedish corporate cash holdings, providing consistent findings indicating that Swedish companies follow patterns consistent with literature analysing other geographical markets. This thesis also offers support to the effect of monetary policy, estimating a strong response to changes in interest rates, with the effect being most pronounced when interest rates go below zero.[3]

An outline of the thesis is as follows: we review previous literature in Section II. This review will provide the foundations for the formulation of our hypothesis. Section III focuses on the data used in this thesis and the methodology used to create our econometric model. In Section IV we will present our analysis and empirical results with a brief discussion on the robustness of the analysis. In Section V we discuss our results, and provide guidance for topics suited for future research and the implication of our thesis. Finally, Section VI concludes our analysis.

[3]Implications of the findings of the thesis are further elaborated on in the discussion section.

2 Literature Review

Here we present literature related to our research questions, and we begin by presenting literature on the different motives for corporations to hold cash on their balance sheet. Then, we present literature on the link between interest rates and corporate cash holdings. Following this, we present literature on the different firm characteristics that influence the level of cash holdings.

2.1 Identified Motives for Corporate Cash Holdings

There are four main managerial motives for why firms hold cash; (1) *The Transaction Motive*, (2) *The Precautionary Motive*, (3) *The Tax Motive*, and (4) *The Agency Motive* (Bates, Kahle & Stulz, 2009).

In addition to these motives for holding cash, there is firm-exogenous factors that impacts the level of a firm's cash holdings. We argue that the most important factor out of these is the key policy rate. Thus, we add this to our motives for holding cash, and will present the reasoning behind this after the four motives mentioned above.

2.1.1 *The Transaction Motive*

Numerous earlier finance models revolve around the task of deriving firms' optimal demand for cash and liquid assets. Provided that firms incur transaction costs when converting non-cash financial assets into cash, early papers by Baumol (1952) and Miller & Orr (1966), derives the optimal demand for cash and liquid assets, and finds that there are economics of scale for cash holdings. Baumol further makes the argument that in accordance with the transaction motive, liquid asset holdings decrease with the cost of raising debt and hedging risk, as well as the ease of selling assets. Consistent with this finding, Mulligan (1997) provides additional arguments for the existence of these economics of scale by showing that larger firms generally hold less cash when adjusting for size.

2.1.2 *The Precautionary Motive*

In a world of capital market frictions, information asymmetries, and uncertain investment opportunities, holding liquid assets such as cash, enables firms to access means of payment without delay. This is a precautionary motive, regardless of whether the liquid assets are used for investments in projects or held to better cope with adverse shocks. Bates et al. (2009) see this motive in light of firms having a propensity to hold cash when access to capital markets is costly or limited. Adding to this perspective, Opler et al. (1999) find that firms with riskier or more volatile cash flows, longer cash conversion cycles and poor access to external financing, generally hold more cash.

Additionally, Opler et al.(1999) suggests that firms with higher opportunity costs in terms of better investment opportunities could hold more cash because of adverse shocks and financial distress become more costly. This opportunity costs are estimated by employing different proxies for firms' general investment opportunities, such as market-to-book ratios and R&D spending. Furthermore, by modeling the precautionary demand for cash, Almeida, Campello, & Weisbach (2004) postulate that financially constrained firms direct a more significant percentage of their cash flow to cash holdings than unconstrained firms.Lastly, Riddick & Whited (2009) finds a positive correlation between a firm's risk and its level of cash, even after adjusting for measurement error in Tobin's q.[4]

2.1.3 *The Tax Motive*

Research by Foley, Hartzell, Titman & Twite (2007) argue that U.S. corporations that would incur negative tax consequences of repatriation of foreign earnings, are more likely to hold larger amounts of corporate cash. The effect is particularly prominent for corporations for which the implied tax consequences are the highest for repatriation. Thus, Foley et al. conclude that multinational affiliates are more likely to accumulate cash than domestic ones. Corporate cash can be repatriated through for example dividends distributions, capital gains, upstream loans. Dividend distributions are subject to withholding tax (WTH), dividends are normally tax exempt for corporate shareholders under the participation exemption, and for Swedish corporations there are no tax on dividends if the controlled foreign company (CFC) are based within the European Economic Area (EEA) (OECD,

[4]Tobin's Q equals the market value of a company divided by its assets' replacement cost.

PwC (2021)).

2.1.4 *The Agency Motive*

Jensen, (1986) states that ingrained managers could rather choose to retain earnings as corporate cash, than increase shareholder payouts when investment opportunities are poor, or as a mean to serve self-interest. (Jensen,1986). Dittmar, Mahrt-Smith & Servaes (2003) utilise cross-country analysis to build on this, providing evidence that for countries with poor shareholder protection, companies hold up to twice as much cash compared to companies in countries where agency problems are less prominent. Furthermore, Dittmar et al. suggests that when shareholder protection is poor, factors generally associated with the need for accumulation of cash holdings become of less importance. Nikolov & Whited (2014) estimates a dynamic model to test three mechanisms that misalign shareholder and managerial incentives; managerial perquisite consumption, limited managerial ownership of the firm, and compensation based on firm size. They find that managerial perquisite consumption critically affects the cash policy of the firm while finding little basis for significant effects for the latter mechanisms. In this thesis, the agency motive will not be directly controlled for, as we lack the necessary data to test specifically for agency motives and incentives.

2.2 Interest Rates and Corporate Cash Holdings

Findings on the relationship between interest rates and corporate cash holdings are divided. The topic has been approached with different methodologies and from different theoretical foundations, yielding inconsistent results. Some findings show a positive relationship (Stone, Lee & Gup, 2018), and some uncover an inverse relationship (Azar, Kagy & Schmaltz, (2016); Boileau & Moyen (2016); Graham & Leary (2018); Garcia-Teruel & Martinez-Solano (2009) Meltzer (1963)). Lastly, Gao et al. (2021) finds that the relationship between corporate cash holdings and interest rates could be non-linear or non-monotonic.

When investigating the the determinants of corporate cash holdings, one also acknowledges that how a company disposes its resources is, in fact largely a managerial decision, we investigate the key policy rates relative impact on the identified managerial motives for

holding cash (Glaser, Lopez-De-Silanes & Sautner, 2013).[5] We further seek to investigate the relative impact of the key policy rate on different samples of firms based on firm characteristics, to see if certain corporate cash holdings are more sensitive toward the interest rate than others.

2.3 Hypothesis Development

Based on the findings of existing literature in the research area of liquidity management, we recognise multiple motives that can impact cash holdings in different directions. A possible explanation for the observed development in cash holdings, as seen in table 1.1, is that the motives which increases cash holdings have become stronger during our sample period. One of the factors that contributes to higher cash holdings, according to the majority of existing literature, is decreasing interest rates. Our first hypothesis could therefore be formulated as follows:

Hypothesis I (H_1): The relationship between the Swedish key policy rate and Swedish corporate cash holdings is negative.

Following the first hypothesis, and given the negative development for the Swedish key policy rate, we expect it to have contributed positively to the observed increase for Swedish corporate cash holdings.

Furthermore, it reasonable to presume that managers deciding the level of corporate cash holding, and setting the policy for liquidity management, are taking these decisions based on more than the interest rate. Thus, we expect developments in the other motives for corporate cash holdings to also have contributed positively to the observed increase. More specifically, we believe that there are certain firm characteristic that lead firms to have different exposure towards these motives. Thus, our second hypothesis can be formulated as follows:

Hypothesis II (H_2): The impact of some known motives for holding cash has increased relative to others, which is likely to have contributed to the observed increase in cash holdings over our sample period.

[5]Stakeholders and government regulations could also influence decisions revolving around liquidity management. These are accounted for by the removal of industries facing capital requirements, as well as constructing models with variables of interest for stakeholders.

The development of the motives can be measured by the change of certain firm characteristics. Subject to the transaction motive, a general reduction of firm size should lead to an relative increase in cash holdings. To be able to explain the observed increase in Swedish cash holdings, we expect to find a negative relationship with other variables like CAPEX, acquisitions, and dividends. These variables are considered as direct substitutes for holding cash. Instead of keeping cash on the balance sheet, the cash is put to work.

Companies' total assets are also a variable we expect to be negatively linked to cash holdings negatively. One could argue that it is a fair assumption that larger and more asset-heavy companies do not need the same levels of cash, relative to its holdings of other assets, compared to smaller companies. This is due to the economics of scale for cash and assets, as well as the possibility to exchange these assets into other means of payment, assets, or deletion of debt. Lastly, we expect a positive correlation between multinational firms and cash holdings due to the tax motive explained earlier. As one can infer from the literature review, the motives for holding corporate cash and the link between interest rates and corporate cash holding are extensively researched in other geographical markets. Our thesis draw on insight from multiple sources, some applying different perspectives and theoretical models. In the following section, we present the data and methodology used in this thesis.

3 Data and Methodology

We will now present the data and the methodology used to analyse the research questions. First, we will present data and the variables we have used, followed by a presentation of the econometric models that we use in our analysis.

3.1 Data and Sample Selection

The data set on company financials is extracted from the Compustat Global database accessed through Wharton Research Data Services.[6] The extracted observations are annual accounting data from 1994 to 2019 for every company in the database, listed on the Nasdaq Stockholm AB in that period.[7] Additionally, we use the latest available GDP data that are not still being revised, which is the reason for ending our data set in 2019. Data for the Swedish key policy rate is extracted from Sveriges Riksbank (the Swedish Central Bank), and GDP data are obtained from Statistikmyndigheten SCB (Statistics Sweden).[8] [9]

All observations in our data set are adjusted for inflation and reported in 2019-prices. For this purpose, we have used inflation data from Statistikmyndigheten. Further, every numeric firm characteristic used in our regressions is winsorized at the 5% and 95% levels. We exclude companies within the financial sector (GICS code 40) due to the regulatory restrictions this sector has on cash holdings. We further require companies to have positive total assets and revenues, and to report in the local currency. When obtaining data from Compusutat Global, there are some variables with missing observations. These NA's are set are set to zero. The main variables of concern are R&D, acquisitions, CAPEX and dividends. Another possible way of handling missing values are imputation techniques. Having implemented one of these imputation techniques, we quickly discovered that such techniques did not produce good enough results for our data set. Thus, we found that the best way to deal with them was to set missing observations to zero. We argue that this is a good approach, because missing observations are likely to be caused by the lack of

[6] https://wrds-www.wharton.upenn.edu/
[7] The Nasdaq Stockholm AB is formerly known as the Stockholm Stock Exchange.
[8] https://www.riksbank.se/en-gb/
[9] https://www.scb.se/en/

reporting, primarily at the start of our data set. After these measures, our entire sample period from 1994 to 2019 leaves us with 9556 firm-year observations, including 894 unique firms.

3.2 Variable Definitions

We use variables from the accounting data from Compustat as the firm-specific variables in our analysis. We use cash holdings as our dependent variable, which consists of cash and short term investments[10]. The other firm specific variables we obtain are: total assets, CAPEX, leverage, dividends, acquisitions, net working capital (NWC), R&D, revenue, EBITDA, total tax, foreign exchange income and interest expense. For comparison purposes, all variables are scaled with total assets. The variable for dividend is turned into a dummy variable and that is also the case for the foreign exchange income. The latter variable is extracted to recognize if a firm have multinational operations or not, as argued by Gao et al. (2021). EBITDA, tax and interest expense are only extracted to make a cash flow variable. We control for firm size by taking the natural logarithm of the book value of total assets. It is desirable to control for firm size using market value of the firms, but Compustat does not have this variable in their global database. Extracting market values from other databases and merging them with our Compustat data set did not produce good enough results largely duo to inconsistency issues, thus this was not a valid option.[11]

Industry-specific effects are controlled for by an industry sigma like Bates et al. (2009) explains. The industry sigma is constructed by estimating the standard deviation of each firm's previous 10-year cash flow, demanding minimum three observations during that period. The standard deviation of each firm-year is then grouped into average standard deviations within industries. Further, we follow Gao et al. (2021), using the growth in GDP to control for the economic fluctuations during the period. This variable is included to serve as a proxy for the investment opportunities that firms face. By including a variable that controls for the general fluctuations of the business cycle, we are able to

[10]Cash and short-term investments are defined as assets that represents any immediately negotiable medium of exchange or any instruments normally accepted by banks for deposit and immediate credit to a customer's account.

[11]Bates et al. (2009) finds that the results do not change much when using market value of equity for scaling.

determine how our different firms react to a change in the investment climate in regards to liquidity management. A more comprehensive and detailed description of each variable is found in Table A1.1 in the Appendix.

3.3 Econometric Model

We examine our research questions by running a panel regression on our data sets on various sample periods from 1994-2019. The following OLS-model is implemented over firm-years (i, t):

$$Cash_{i,t} = \beta_0 + \beta_1 InterestRate_t + \beta_2 GDPgrowth_t + \beta_3 X_{i,t} + \epsilon_{i,t} \tag{3.1}$$

Cash is the ratio of cash and short term investments to total assets of firm i at time t. Interest rate is the Swedish key policy rate, GDP-growth is the annual percentage change in GDP-levels in Sweden, and X are the set of firm-specific characteristics discussed in section 3.2. The model consists of elements from the work of Opler et al. (1999), Bates et al. (2009), and Gao et al. (2021). In all of our regressions, we cluster our standard errors on firm level. Clustered standard errors allow for autocorrelation within the clusters. These standard errors are also robust for heteroskedasticity both within and across the entities (Stock & Watson, 2012). By clustering on firm level, we allow variables to correlate with themselves through time, within each firm. Clustered standard errors are generally larger than standard ones, and do not affect the coefficients in the model.

In addition to this main model, we run two similar regressions. The first of these models is constructed by taking the natural logarithm of the dependent variable, while everything else remains the same as in model 3.2. The second model is constructed by lagging the interest and GDP-variables by one year. This way we align the firm characteristic variables in a given year with the firm-exogenous variables from the past year. This can be reasonable as it takes some time for management to adjust their firm to exogenous factors. Everything else is equal to model 3.2. These models can be written like:

$$\ln(Cash_{i,t}) = \beta_0 + \beta_1 InterestRate_t + \beta_2 GDPgrowth_t + \beta_3 X_{i,t} + \epsilon_{i,t} \tag{3.2}$$

$$Cash_{i,t} = \beta_0 + \beta_1 InterestRate_{t-1} + \beta_2 GDPgrowth_{t-1} + \beta_3 X_{i,t} + \epsilon_{i,t} \tag{3.3}$$

The reason behind creating two additional models is to enhance the robustness of our findings. If we get similar results for all three models, it makes our findings more robust. Additionally, log-transforming the dependent variable can contribute to better the normality in the data, if this becomes an issue later on. The issues of robustness will be further elaborated in the upcoming analysis section.

4 Analysis

This section presents the results of the regression estimations performed to answer our research questions. First, we investigate research question 1 and the relationship between the key interest rate and corporate cash holdings. This is done by estimating models over the entire sample period and for five sub-periods. We investigate if there is any difference in the short and long-term effects of the key policy rate.

When investigating the second research question we also estimate long- and short-term models. Additionally, we estimate several models by dividing our sample firms into groups based on firm characteristics. For instance, we divide our firms into size groups to check if there is any difference for small vs. large firms. These types of analysis allow us to isolate the relative influence on cash holdings that these characteristics have.

4.1 The Effect of the Key Policy Rate on Corporate Cash Holdings

4.1.1 Investigating Research Question 1

Regression models, 1994-2019

The first step in our research is to investigate how the key interest rates affects corporate cash holdings for Swedish companies. We control for industry effects using the industry sigma variable, as discussed in the data chapter. Another possibility to account for industry effects, is to implement industry fixed effects. We have conducted regression models with fixed effects, but these models yielded similar results as our reported models. The model with industry fixed effects is reported in Table A2.2 in the Appendix.

Table 4.1: OLS Regression, 1994-2019

Table 4.1 presents the regression models estimated for the entire sample period from 1994-2019. The dependent variable in models 1 and 3 is the cash holdings level for Swedish corporations over the sample period. The dependent variable in model 2, is estimated using the logarithm of cash holdings. In model 3 the exogenous variables for interest and GDP growth are lagged to control for potential delays in the impact on cash holdings. Industry effects are controlled for with the inclusion of the Industry Sigma variable.

OLS Model			
	Dependent variable:		
	Cash Holdings	Ln(Cash Holdings)	Cash Holdings
	(1)	(2)	(3)
Interest	0.721***	6.293***	
	t = 4.095	t = 4.436	
GDP Growth (%)	0.472***	2.318***	
	t = 7.229	t = 5.328	
Lagged Interest			0.419**
			t = 2.408
Lagged GDP Growth			0.508***
			t = 7.342
ln(Total Assets)	-0.015***	-0.114***	-0.015***
	t = -8.730	t = -6.775	t = -8.274
Leverage	-0.371***	-2.242***	-0.380***
	t = -17.672	t = -13.862	t = -17.207
R&D	0.004***	0.014***	0.004***
	t = 2.859	t = 2.965	t = 2.835
NWC	-0.256***	-1.374***	-0.258***
	t = -12.230	t = -9.441	t = -11.566
CAPEX	-0.165***	-0.819***	-0.170***
	t = -4.446	t = -2.758	t = -4.109
Dividend	0.012	0.256***	0.014*
	t = 1.601	t = 4.970	t = 1.825
Industry Sigma	0.173**	1.507**	0.164**
	t = 2.156	t = 2.488	t = 1.981
Acquisition	-0.254***	-0.983***	-0.263***
	t = -8.435	t = -3.364	t = -8.313
Multinational Firm	0.016**	0.175***	0.013*
	t = 2.422	t = 2.948	t = 1.830
Constant	0.413***	-0.997***	0.419***
	t = 21.652	t = -8.205	t = 21.151
Observations	9,556	9,556	8,666
R^2	0.319	0.257	0.330
Adjusted R^2	0.319	0.256	0.329

Note:
*p<0.1; **p<0.05; ***p<0.01

The first column in the regression table presents the results when using cash holdings as the dependent variable. As can be seen from the table, interest rate turns out to be positive and significant at a 99%-level in our model. This is not in line with our initial hypothesis H_1 and the actual development for corporate cash holdings and interest rates, shown in figure 1.1. In isolation, this indicates that there is other factors causing the observed increase of corporate cash holdings. The interpretation of the coefficient is that for one unit increase in interest rate (1% point), cash holdings increase on average 0.721 units, corresponding to 721.000 SEK (2019 money) for our sample.

Model 2 estimates a similar model as model 1, but with a log transformed dependent variable for cash holdings. The coefficient for interest is still positive and statistical significant on a 99%-level. The interpretation is however different now that the dependent variable is log transformed. Over our sample period, interest rates fall from 7.6% to a negative 0.0357%. According to this model, and based only on interest rates, corporate cash holdings should then decrease by 38.15% over the period.[12] We note that the signs in front of the coefficients are similar for this model as in model 1, with the exception for the constant coefficient.

In our third model, the dependent variable used is regular cash holdings, as in model 1. The difference is that interest rate and the growth in GDP are lagged by a year. This way, the firm management has had time to adjust their operations to last year's interest rate and GDP growth. Interestingly, the key interest rate for the previous period seem to influence the level of cash holdings less than the interest rate of the current period - as the coefficient here is lower. This might suggest that firm management need less than a year to adjust their business to the change in interest rates. We observe that model 3 has the same signs in front of the coefficients as model 1, and the coefficients are very similar.

We see a value for adjusted R^2 of about 31-33% for models 1 and 3, with model 2 reporting a substantially lower value of 25.7%, indicating that models 1 and 3 explains the variation in corporate cash holdings much better. Since model 2 has a more difficult interpretation and a lower R^2 than the others, and that model 3 is similar to model 1 but with fewer observations due to the lag, we choose to only use model 1 in our further analysis. This model now serves as our base model and is used for every regression output that we

[12]The estimated effect of the reduction in the key policy rate according to model 2 reported in Table 4.1, on equation form: (exp(-0.076357*6.293)-1)= -38.15%

present further in this paper. For the entire sample period, the models above estimates a positive relationship between interest rates and cash holdings. Next, we will conduct estimations on shorter time periods to investigate if this relationship holds.

Regression models for five sub-periods

We estimate five models, dividing our sample period into five-year sub-periods. Our sample period spans over 26 years, so we add an extra year to our first sub-period. This is done to add more observations to the first sub-period, given that the start of the time period contains the least number of observations.

Table 4.2: Regression Models for Five Sub-periods

Table 4.2 presents the regression models estimated to analyse Swedish corporate cash holdings for five subsequent periods between 1994-2019. The first model includes the six years from 1994-1999, while the following four models are estimated over five-year periods. The econometric model used to estimate all five periods is model 1, as reported in Table 4.1.

Regressions for Five Sub-periods					
	Dependent variable: Cash Holdings				
	1994-1999	2000-2004	2005-2009	2010-2014	2015-2019
	(1)	(2)	(3)	(4)	(5)
Interest	0.038	3.051***	-1.235***	-1.072**	-5.526***
	t = 0.159	t = 4.806	t = -3.132	t = -2.046	t = -3.115
GDP Growth (%)	-0.362	1.091***	1.083***	0.215*	-0.494*
	t = -0.826	t = 5.160	t = 6.111	t = 1.881	t = -1.731
ln(Total Assets)	-0.029***	-0.013***	-0.016***	-0.015***	-0.018***
	t = -8.843	t = -4.264	t = -5.295	t = -6.365	t = -7.196
Leverage	-0.486***	-0.459***	-0.365***	-0.251***	-0.380***
	t = -10.161	t = -11.766	t = -11.821	t = -10.103	t = -13.331
R&D	0.004	0.001***	0.007	0.011***	0.005***
	t = 0.873	t = 3.319	t = 1.379	t = 4.715	t = 3.448
NWC	-0.407***	-0.278***	-0.282***	-0.128***	-0.283***
	t = -10.072 t	t = -8.462	t = -7.415	t = -4.958	t = -9.280
CAPEX	-0.432***	-0.360***	-0.173***	-0.071	-0.166**
	t = -6.302	t = -3.897	t = -3.088	t = -1.304	t = -2.039
Dividend	-0.013	0.011	0.042***	0.030***	-0.001
	t = -0.916	t = 0.770	t = 3.531	t = 2.589	t = -0.083
Industry Sigma	0.692	0.413**	0.158	0.367**	0.411***
	t = 1.065	t = 2.447	t = 1.350	t = 2.560	t = 2.770
Acquisition	-0.232**	-0.345***	-0.286***	-0.165***	-0.261***
	t = -2.482	t = -5.809	t = -6.024	t = -3.606	t = -4.887
Multinational	0.005	0.009	0.018	0.020**	0.033***
	t = 0.391	t = 0.804	t = 1.585	t = 1.984	t = 2.915
Constant	0.693***	0.366***	0.432***	0.309***	0.413***
	t = 15.295	t = 8.045	t = 14.240	t = 11.087	t = 12.411
Observations	901	1,499	1,932	2,344	2,880
R^2	0.572	0.441	0.314	0.232	0.353
Adjusted R^2	0.567	0.437	0.310	0.228	0.351
Note:	*p<0.1; **p<0.05; ***p<0.01				

The estimated models reported in Table 4.2 highlight the difference in the impact of the interest rate throughout our sample period. We see that the interest rate's effect on cash holdings varies between the sub-periods. In the first period, interest has a positive and non-significant coefficient. The coefficient is positive and statistically significant for the second period at a 99%-level. In the third period, the interest coefficient becomes negative and statistically significant at a 99%-level. The negative coefficient holds for the subsequent periods, coming out significant at 95% and 99%-level, respectively. For the last sub-period, the Swedish key interest rate has been constantly below zero, making this period particularly interesting to investigate. Notably, this coefficient is much larger than for all previous periods. This may indicate that once the interest rates stay below zero, it has a higher impact on cash holdings.

Interestingly, interest is negatively linked with cash holdings for three sub-periods, even though the coefficient is positive on the regression for the whole period. These negative coefficients are more in line with our initial hypothesis of a negative relationship between interest rates and cash holdings (H_1). In addition, the negative coefficients are more coinciding with the observed increase of corporate cash holdings. The results for the sub-periods indicates that interest rates can have both negative and positive impact on cash holdings in the short term. It also indicates that when interest rates are below zero, its impact on cash holdings increases substantially.

We also note that R^2 changes over the sub-periods. This indicates that there are time effects present, making the model's explanatory power differ through time. One such effect is related to interest rate, which may have a greater impact around certain interest rate thresholds, thus a model estimated around such a threshold may explain more of the variation in cash holdings. As argued in the paragraph above, the increase in R^2 for the last period may cohere with interest rates falling below zero. However, it is difficult to pinpoint the changes in R^2 only by taking one variable into account. Thus, we can not conclude that this is one of the main reasons for the observed change, although it has a plausible economic explanation.

4.2 Analysis on the Firm Specific Variables

4.2.1 Investigating Research Question 2

In this section we investigate our second research question, seeking to find out which firm characteristics that influences companies level of cash holdings. We also comment on the second exogenous variable in the model, GDP growth. The firm specific variables will be presented chronologically by their order in the regression outputs. Before the analysis of every variable, we present the historical development for each variable. This is presented in Table 4.3 below, which shows the average value of each variable on a yearly basis. Change in firm characteristic can be a driver for the observed increase in cash holdings, thus possibly providing some explanation to the observed increased Swedish cash holdings. Hence, we may refer to this table when figuring out if one of the variables has contributed to the observed increase in cash holdings over our sample period (Figure 1.1).

Table 4.3: Development in Firm Characteristics Over the Sample Period

Year	N	Cash	Ln(Assets)	Div.	R&D	Lev	CF Vol.	MNE	CAPEX	AQ	NWC
1994	60	0.108	9.235	0.817	0.009	0.614	0.022	0.500	0.028	0.005	0.029
1995	65	0.096	9.060	0.815	0.008	0.599	0.025	0.492	0.031	0.008	0.027
1996	118	0.133	8.068	0.602	0.012	0.564	0.025	0.398	0.048	0.010	0.076
1997	182	0.158	7.256	0.538	0.026	0.546	0.028	0.385	0.069	0.013	0.086
1998	222	0.178	6.854	0.482	0.025	0.539	0.031	0.369	0.069	0.015	0.081
1999	264	0.186	6.519	0.443	0.034	0.528	0.036	0.326	0.059	0.015	0.070
2000	279	0.210	6.694	0.423	0.032	0.478	0.038	0.351	0.055	0.023	0.084
2001	289	0.182	6.451	0.356	0.042	0.513	0.055	0.360	0.047	0.016	0.065
2002	297	0.171	6.233	0.347	0.040	0.530	0.067	0.465	0.036	0.014	0.048
2003	307	0.167	6.041	0.362	0.038	0.543	0.088	0.544	0.031	0.014	0.021
2004	327	0.184	5.903	0.382	0.039	0.521	0.093	0.532	0.035	0.013	0.025
2005	359	0.189	5.863	0.401	0.029	0.514	0.096	0.521	0.033	0.021	0.023
2006	369	0.200	5.835	0.398	0.032	0.502	0.108	0.520	0.041	0.023	0.008
2007	393	0.173	5.886	0.379	0.030	0.499	0.106	0.529	0.040	0.030	0.018
2008	398	0.144	5.707	0.314	0.332	0.528	0.112	0.530	0.038	0.020	-0.009
2009	413	0.155	5.618	0.329	0.043	0.493	0.115	0.516	0.028	0.010	-0.002
2010	437	0.154	5.496	0.348	0.040	0.491	0.114	0.478	0.027	0.015	0.001
2011	444	0.152	5.474	0.349	0.037	0.505	0.110	0.500	0.029	0.015	0.007
2012	450	0.140	5.431	0.349	0.042	0.517	0.107	0.540	0.029	0.016	0.000
2013	487	0.152	5.330	0.329	0.039	0.508	0.109	0.517	0.022	0.011	0.005
2014	526	0.174	5.246	0.333	0.031	0.496	0.109	0.506	0.024	0.013	-0.006
2015	549	0.192	5.287	0.346	0.036	0.496	0.111	0.539	0.022	0.019	-0.022
2016	582	0.219	5.400	0.325	0.026	0.482	0.121	0.521	0.023	0.026	-0.012
2017	595	0.219	5.503	0.316	0.031	0.465	0.126	0.553	0.023	0.018	-0.016
2018	585	0.215	5.587	0.326	0.046	0.468	0.131	0.571	0.026	0.020	-0.020
2019	569	0.200	5.684	0.105	0.053	0.493	0.138	0.576	0.025	0.016	-0.034

Table 4.3 shows the development for firm characteristics for publicly listed Swedish corporations in our Compustat data set from 1994-2019. N represents the number of firms included in the index for the given year. MNE is an abbreviation for Multinational Firms. CF Vol is an abbreviation for Industry Sigma. Dividend and MNE are dummy variables. AQ are and abbreviation for acquisition.

4.2.2 Firm Size

The coefficient for assets is negative and significant on a 99% level in the models estimated for both the entire period, and the sub-periods (Table 4.1 and 4.2). The negative coefficient is further consistent with both the transaction motive as well as the precautionary motive identified in the literature review. The motives argue that a negative relationship occurs partly as a consequence of economics of scale for cash, and the fact that some assets are easily to sell. Assets could thus provides firms with an option for liquidity if needed. From Table 4.3 it is clear that average firm size, measured by assets, has decreased over our sample period. Given its negative relationship with cash holdings, this decrease in size would have contributed to the increase in Swedish cash holdings, ceteris paribus. Investigating further into size, we divide our data set into quintiles on size, to see if there

is any systematic differences between the different quintiles. The figure below displays the average cash holdings during the sample period for the different quintiles on size (book value of total assets). The quintiles are ascending, where the smallest firms are found in quintile 1. The quintiles are updated every year.

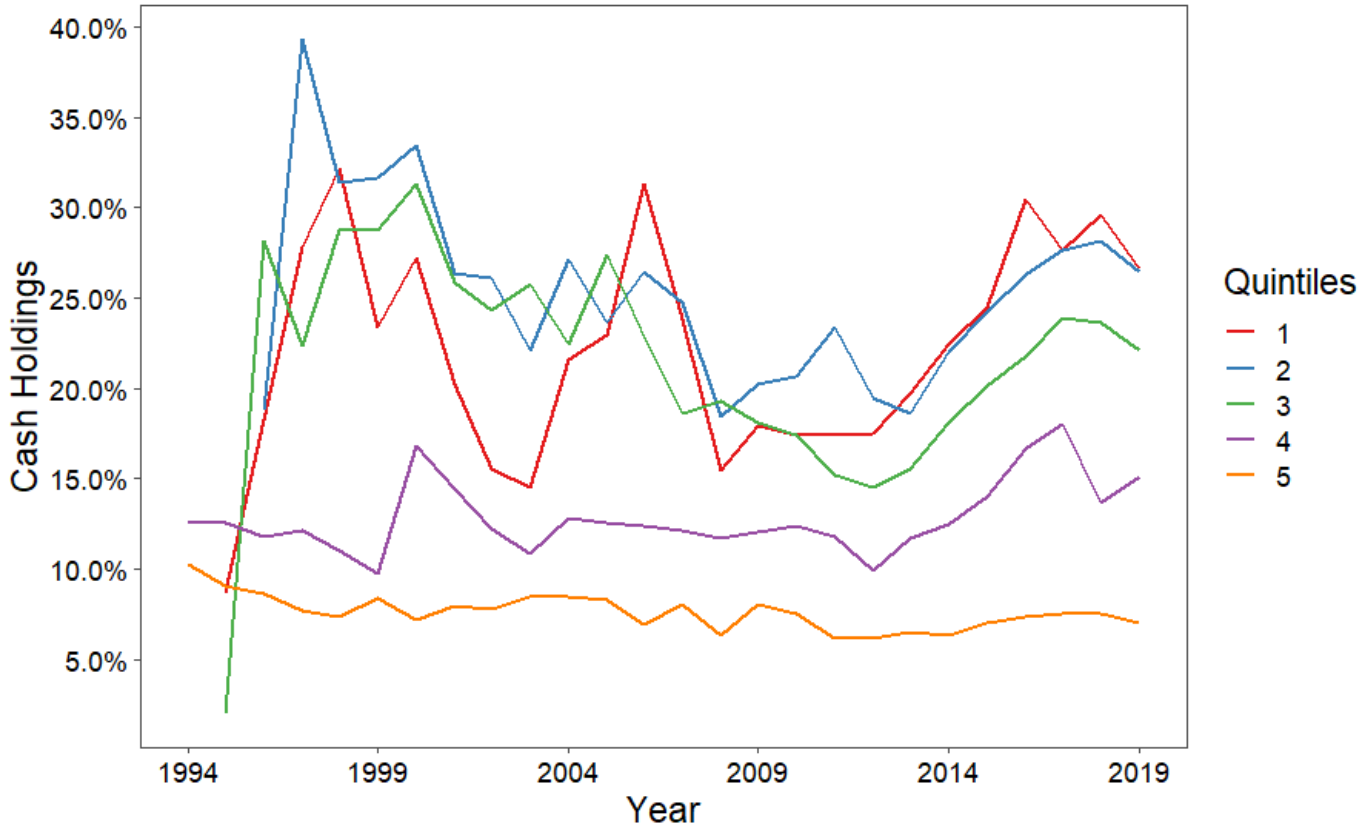

Figure 4.1: Cash Holdings by Size Quintiles

Figure 4.1 plots the development of average cash holdings for Swedish corporations grouped in size quintiles, for the time period 1994-2019.

Evident from Figure 4.1, smaller firms hold relatively more cash than bigger firms. Quintile 5, representing the top 20% of the index, is the only quintile which has experienced a downward trend in cash holdings based on the first and last observation. The three bottom quintiles experience a surge in cash holdings in the late nineties, before declining the next couple of years. This surge and following decline could be due to the Dot-com bubble, which affected IT-firms the most, typically firms with low book value of assets. After the financial crisis, we see a clear pattern of increasing cash holdings for every quintile but the largest one. The fact that larger firms holds less cash is in line with the negative size coefficients obtained from the regressions presented in Table 4.1 and Table 4.2.

Since the differences between the size quintiles is so clear, we want to investigate the size effect further. To do this, we run our base regression model from Table 4.1 on the size quintiles. This allows us to isolate the size effects and observe its influence on other firm characteristics besides cash holdings. The regression is conducted on the entire sample period. The results can be found in Table 4.4.

From this table we see that the largest firms are the least influenced by the exogenous variables interest and GDP growth. This is evident both from smaller coefficients and less significance. Given that these companies are the largest in our index, they are more robust and therefore this finding could be expected. Moreover, we see that the industry sigma is significant only for the smallest firms. According to our model, cash flow volatility has the strongest impact on the smallest firms. This can contributed to the precautionary motive of holding cash. Smaller firms are prone to exogenous shocks that often increase the demand for cash. This is likely to be enhanced further if their cash flow is volatile.

Another noteworthy finding is in regards of the R&D coefficient. We see that the coefficient for the quintile with the largest firms is much higher than the other quintiles. The acquisition coefficient on the other hand, is the only one which is not significant on the 99% level for the largest quintile. Thus, the impact of these two variables seems to be respectively enhanced and reduced for the biggest firms in our data set.

Lastly, we see that the estimated models for the first and fifth quintile explain less of the variance in cash holdings than the other quintiles. This is likely influenced by the fact that the biggest outliers can be found in these quintiles.

Table 4.4: OLS Regression for Size Quintiles

Table 4.4 presents the regression models estimated to analyse Swedish corporate cash holdings for firms of different size. The table reports five estimated models, one for each size quintile. The econometric model used to estimate all five models is model 1, as reported in Table 4.1.

Dependent variable: Cash Holdings					
	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5
Interest	-0.911*	1.280***	2.014***	0.479*	0.192
	t = -1.713	t = 2.607	t = 4.544	t = 1.852	t = 1.299
GDP Growth (%)	0.807***	0.666***	0.342**	0.323**	0.032
	t = 4.433	t = 3.811	t = 2.248	t = 2.474	t = 0.556
Leverage	-0.304***	-0.442***	-0.480***	-0.343***	-0.097*
	t = -12.894	t = -10.883	t = -11.540 t	t = -7.772	t = -1.897
R&D	0.005**	0.006***	0.003**	0.010***	0.339***
	t = 2.015	t = 3.014	t = 2.137	t = 4.888	t = 3.021
NWC	-0.198***	-0.307***	-0.373***	-0.220***	-0.178**
	t = -7.465	t = -7.668	t = -9.144	t = -5.319	t = -2.005
CAPEX	-0.052	-0.237***	-0.275***	-0.157**	-0.014
	t = -0.625	t = -3.653	t = -2.633	t = -2.211	t = -0.158
Dividend	0.126***	0.080***	0.023*	-0.003	-0.016*
	t = 4.000	t = 4.521	t = 1.669	t = -0.294	t = -1.737
Industry Sigma	0.322**	0.070	0.091	0.176	-0.058
	t = 2.006	t = 0.391	t = 0.602	t = 1.224	t = -0.623
Acquisition	-0.230***	-0.356***	-0.388***	-0.150***	-0.068
	t = -3.228	t = -6.443	t = -6.101	t = -3.323	t = -1.420
Multinational	0.031**	0.023	0.014	0.005	-0.007
	t = 2.027	t = 1.640	t = 1.047	t = 0.532	t = -0.569
Constant	0.303***	0.387***	0.402***	0.298***	0.153***
	t = 10.943	t = 11.137	t = 11.880	t = 8.088	t = 3.347
Observations	1,914	1,913	1,913	1,906	1,910
R^2	0.174	0.297	0.363	0.334	0.149
Adjusted R^2	0.170	0.293	0.360	0.330	0.144
Note:	*p<0.1; **p<0.05; ***p<0.01				

4.2.3 Industry Effects

In our regressions we account for industry effects with the industry sigma. This variable is positively and significant at a 90% level in our base model reported in Table 4.1. In the sub-period regression it is significant in three out of five sub-periods. This indicates that firms within industries that experience more volatile cash flows, hold more cash. This makes economically sense and are in line with the precautionary motive described earlier. Furthermore, the industry sigma has the highest positive correlation with with cash holdings, with a correlation of 19.4% reported in the correlation matrix found in Table A1.2 in the Appendix. This further indicates that cash flow volatility has a relatively big impact on corporate cash holdings, strengthening the precautionary motive for holding cash.

Looking at Table 4.3, we see that average cash flow volatility has increased from 2.2% to 13.8% during our sample period. Since industry sigma has a positive impact on cash holdings, this increase has contributed to the observed increase in cash holdings. In our regression on size quintiles (Table 4.4), the industry sigma is only significant for the lowest size-quintile. Thus, cash flow volatility mainly affects the smallest firms. Considering the precautionary motive this makes economic sense, given that smaller firms have less assets for collateral, and resources to draw from when facing downturns.

There are other industry-specific factors present than only cash flow volatility. To investigate this, we visualize the difference in cash holdings for every industry. The figure below illustrates the average cash holding each year within every industry.

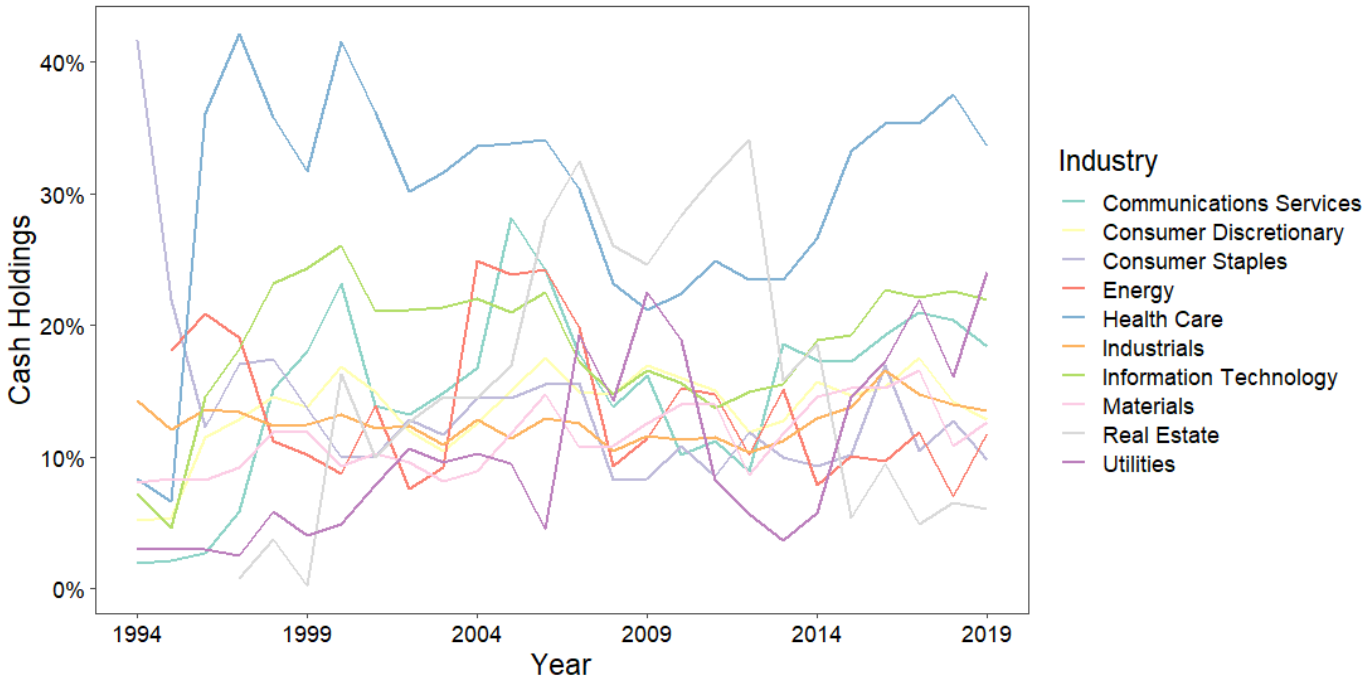

Figure 4.2: Average Cash Holdings Sorted by Industry

Figure 4.2 plots the development for the average cash holdings for our sample of public corporations in Sweden from 1994-2019. The firms are grouped and reported on industry sector level, as defined by The Global Industry Classification Standard (GICS).

The figure illustrates that most of the industries are quite similar in regards of cash holdings, most of them ranging around 10%-20% in cash holdings throughout the period. Health care is the industry with the highest peak, and is also the only industry which holds more than 30% cash for a substantial period of time. When we run our regression with industry fixed effects, health care is the only industry that has a positive and significant relationship with cash holdings (Table A2.1). If the health care sector increases in size over the period, more firms are having a significant and positive relation with cash holdings. This could possibly explain parts of the increase in cash holdings over the sample period.

To see if there is any trend in the index composition over the sample period, we plot the number of firms within each sector per year in the graph below.

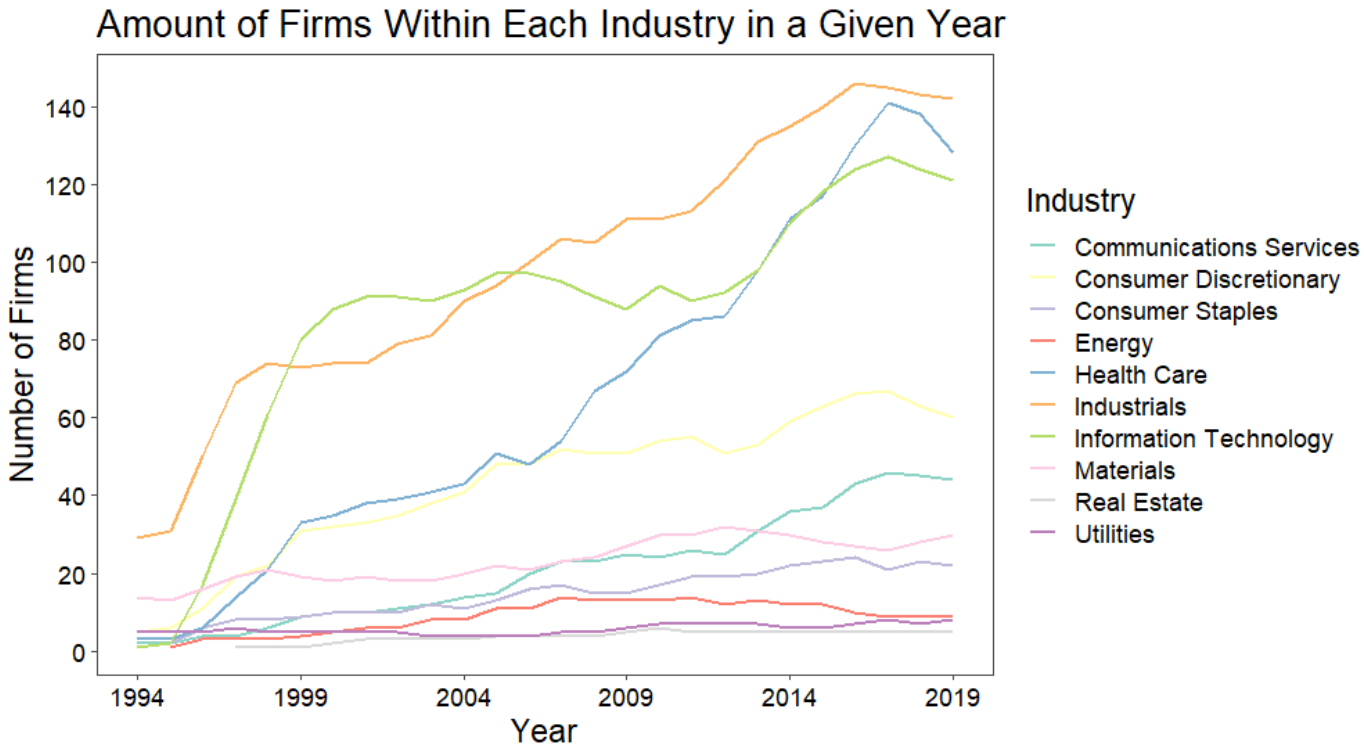

Figure 4.3: Historical Index Composition in Sweden, 1994-2019

Figure 4.3 plots the historical development for the number of index constituents in Sweden that makes up our dataset per industry from 1994-2019.

The figure illustrates that the health care, industrial and the IT sector experience a large increase in the number of firms throughout the period. Numerically, the relative number of health care firms scaled by the total number of firms in the index, increase by 17.5% from 1994 to 2019. However, conducting the same exercise based on total assets instead of number of firms, there is an actual decline of 0.5%. The same is evident if we measure with revenues instead of total assets.

The only industry with a substantial higher cash holding than the others do not increase in relative size during the period. Based on this, we can not conclude that the change in the industry composition can explain the observed increase in cash holdings.

4.2.4 Leveraged Firms

In all our estimated models, the coefficient for leverage indicates a negative relationship with cash holdings. This is also significant at a 99% level, with the only exception being for quintile 5 on size. Given the negative relationship, combined with a gradual reduction

of debt over time (Table 4.4), leverage has contributed to the increase in Swedish corporate cash holdings during our sample period. The economic intuition behind the negative relationship for leverage and cash holdings, is that if debt is sufficiently constraining, firms will use cash to reduce the leverage (Bates et al. 2009).

Like we did for size, we also want to further investigate the relationship that leverage has on the other variables in our model. Hence, we regress our base model on the quintiles of leverage. As for size, the quintiles are ascending, where quintile 1 represents the least levered firms in our data set for a given year. The quintiles are updated every year. The results for this regression can be found in Table A2.1 in the Appendix. We see that the exogenous variables, interest and GDP, effect the low levered firm the most. According to our model, the more levered the firm is, the less impact exogenous factors have on the corporate cash holdings. Another noteworthy variable is the industry sigma. This is only significant for the highest levered firms. The highest levered firms which experience higher cash flow volatility will hold more cash.

4.2.5 Capital Expenditures

The estimated regression models in Table 4.1 and 4.2 both return negative coefficients for CAPEX. All coefficients in these models are significant on a 99% level, with one exception for the sub-period regression for 2010-2014. When we regress our model on the size quintiles, we see that the CAPEX variable is only significant for the three middle quintiles.

A negative relationship for CAPEX and cash holdings is in line with what we could expect beforehand, as CAPEX is a capital outflow and thus an alternative to holding cash on the balance sheet. As can be seen in Table 4.3, CAPEX stays around the same level during our sample period. This give reason to believe that the CAPEX variable has not contributed considerably to the observed increase for corporate cash holdings in Sweden.

4.2.6 Net Working Capital

In our estimated models reported in Table 4.1 and 4.2, net working capital has a significant and negative relationship with cash holdings. The estimated relationship is further found to hold for every size quintile, although the significance drops for the largest quintile. The

negative relation is in line with what we could have expected beforehand, as the assets that makes up net working capital are substitutes for cash.

Table 4.3 shows the development in average NWC (net of cash) for our index over the sample period. From 1994 to 2019 the average NWC drops 6.5 percentage points. Since an increase in NWC has a negative impact to corporate cash holdings, the observed decrease has had a positive impact for the development in the Swedish corporate cash holdings.

4.2.7 Dividend firms vs. Non-Dividend Firms

As mentioned, dividends can be seen as a substitute for holding cash. Thus, dividend presumably has a negative relationship with cash holdings. Dividends can also be viewed as a proxy for larger firms, which also should have a negative impact on cash holdings.

However, dividends are positively related to cash holdings according to our model for the entire sample period. This is not in line with that we expected, but we also note that dividend are the only variable without any significance at all in our model. In the sub-period regression in Table 4.2, the same positive relation can be found for three of the five year periods. Two of them with significance at the 99% level. For the first and last period the coefficient is negative, but not statistically significant. Dividend is the only firm specific variable that changes sign between the sub-periods. It is also one of the variables that reports the weakest amount of significance over the five sub-periods. Thus, the finding that dividend is positively related to cash holdings does not seem to be as robust as the other findings.

Since the dividend findings are both ambiguous and unexpected we want to examine it further. From the regression models on size quintiles in Table 4.4, we see that dividend fluctuates from positive in the first three quintiles to negative for the two last quintiles. The expected negative effect is present for the largest firms, but not the smallest ones. For this reason, it is possible that the size effect is higher than the effect of dividends, possibly influencing the dividend coefficient.[13] Another way of examining the impact of dividends, is to split up the data set between dividend paying firms and non-dividend paying firms. The figure below does that and illustrates the average corporate cash holdings for these

[13]The dividend paying firms are found to be over three times the size of the non-dividend paying firms on average. With the group of firms measuring 9515,151 MSEK and 3049,398 MSEK, respectively.

two groups.

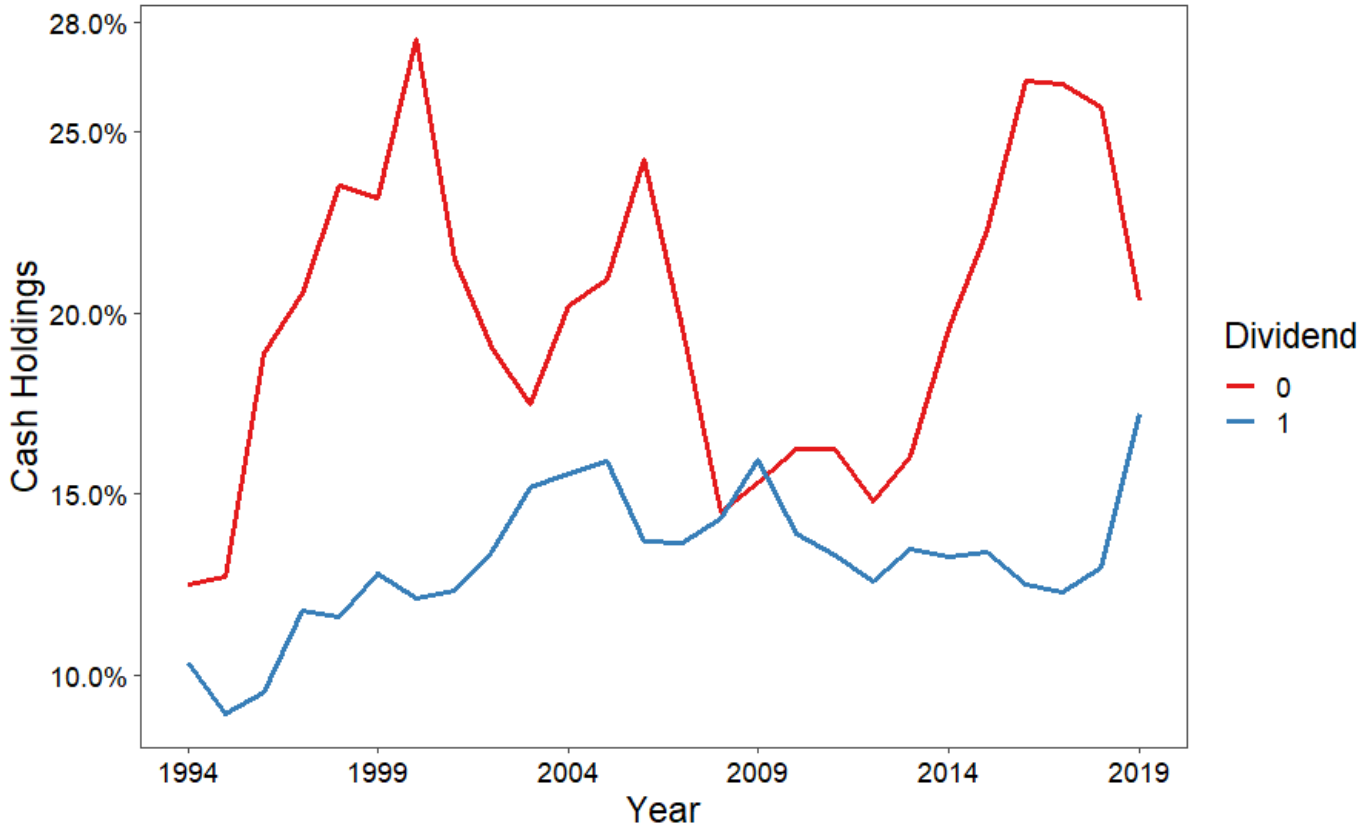

Figure 4.4: Corporate Cash Holdings for Dividend-paying and Non-paying Firms

Figure 4.4 plots the development for the average level of cash holding for the Swedish corporations that pay dividend and those who do not, from 1994-2019.

In line with expectations, but not our regressions, dividend paying firms hold less cash on average than non-dividend paying firms. The volatility in corporate cash holdings is also substantially higher for non-dividend paying firms. This is consistent with the expectation that larger firms operate under more stable conditions than smaller firms, and that larger firms pays dividends. Once again, there is a possibility that the size effect plays a vital part for the result.

Table 4.3 shows that the amount of dividend paying firms has decreased substantially. The increase in non-dividend paying firms, which on average holds more cash than dividend-paying firms per Figure 4.4, could be a part of the explanation of why corporate cash holdings has surged through our sample period. While this makes sense, it is not consistent with the positive coefficient for dividends in our estimated regression for the whole period. Another evidence for a negative relationship between cash holdings and dividend can

be found in the correlation matrix reported in Table A1.2 in the Appendix. This shows that dividend is negatively related to cash holdings, and only leverage and debt are more negatively correlated.

The dividend variable thus provides conflicting results, both within our regressions and between the regressions and the further analysis. We conduct a final analysis trying to see if there is any systematic differences between dividend paying firms and non-dividend paying firms. If that is the case, then other firm characteristics that cohere with dividend may influence the results. For this, we run the model 1 regression from Table 4.1 on dividend paying firms and non-dividend paying firms. The result is reported in the Appendix, as the first two models in Table A2.3.

We observe that there are some key differences between the two groups. GDP growth is largely positive and highly significant for non-dividend paying firms, while it is negative and non-significant for dividend-paying firms. This could indicate that when firms reach the stage of dividend payouts, their cash holdings do not seem largely affected by the general investment climate. Another variable that changes sign between the two groups are the multinational variable. This coefficient is positive and significant for the non-dividend paying firms, while it is non-significant and negative for the dividend paying firms. This follows the same pattern as the small and large companies had on this variable. Hence, there is reason to believe that the other characteristics of dividend paying firms has an impact of our results. Likely, the size effect are dominating this variable since dividend paying firms on average is over three times the size.

4.2.8 National vs. Multinational firms

Multinational firms could have tax motives to keep their cash on the balance sheet. Thus, we expect multinational firms to keep more cash than national firms. For the estimated models in Table 4.1 we observe the expected positive relationship. However, for the subsequent regression on sub-periods, we only get significant relationships for the last two periods.

Figure 4.5 illustrates average cash holdings splitting firms into multinational and national firms.

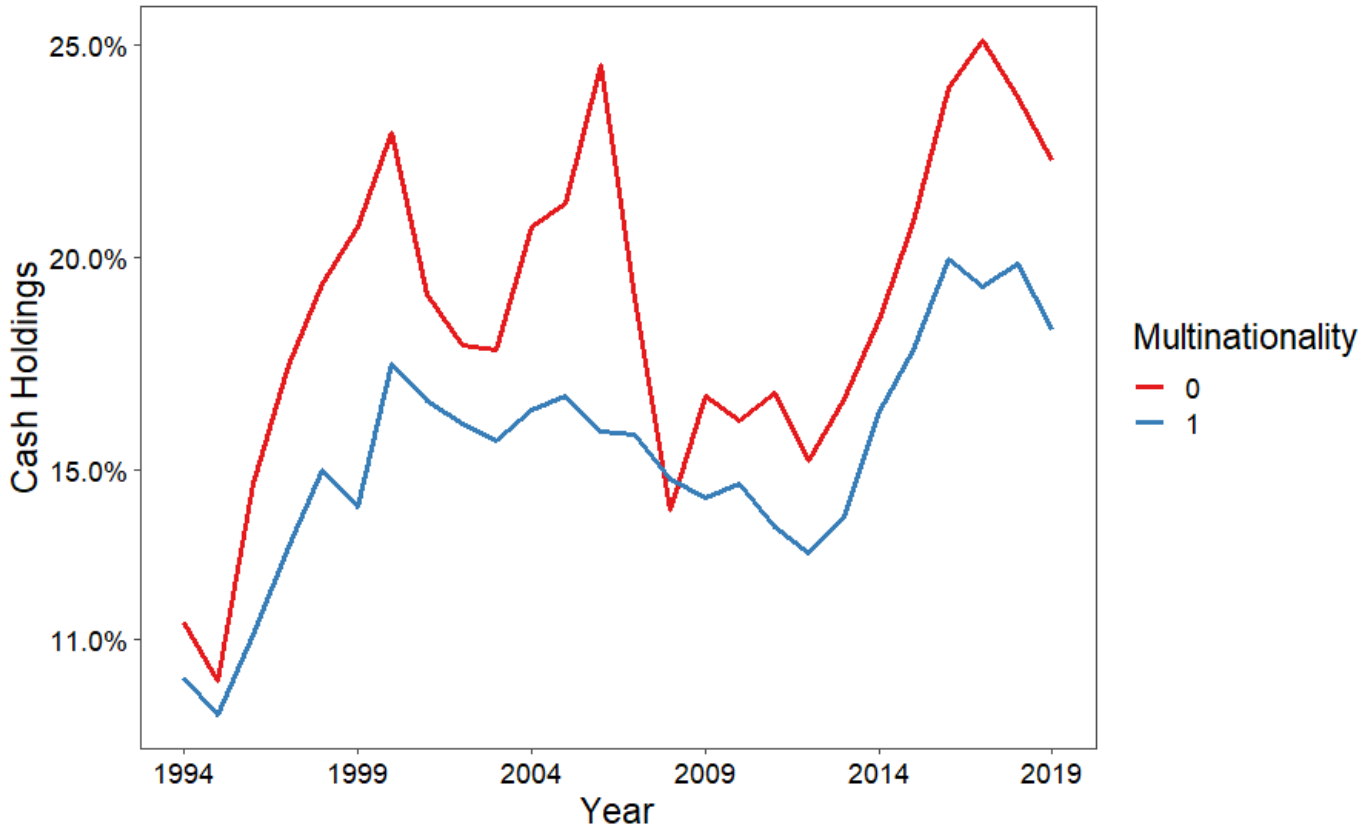

Figure 4.5: Corporate Cash Holdings for Multinational vs. Domestic Firms

Figure 4.5 plots the development for the average level of cash holding for the Swedish corporations with multinational business and purely domestic firms, from 1994-2019.

The plotted result from the figure is not what we expected to see, as multinational firms have lower cash holdings on average than national firms in our data set. We also note a similar pattern with the dividend figure, that multinational firms have lower volatility in their cash holdings. This is probably due to the fact that multinational firms is also larger and more mature on average than national firms. This can be the reason why we see the result from this figure when we only split up the firms in national and multinational firms. Hence, it might be possible that multinationality has a positive effect on cash holdings, but that firm size could have an even bigger impact. We further regress our model on the two separate groups. The regression model is model 3 and 4 reported in Table A2.3 in the Appendix. Evident from these estimated models, we observe that exogenous variables for interest and GDP Growth, are significant at a 99%-level, with the largest coefficient being reported for the national firms. Thus, indicating that national firms are generally more sensitive towards changes in the Swedish key policy rate.

4.2.9 Acquisitions

Acquisitions represents a cash outflow, and can thus also be seen as a substitute for holding cash. For this reason we expect a negative relationship with cash holdings, and our estimated models in Table 4.1 and 4.2 confirm this expectation. Table 4.3 shows an average increase in the firms reporting acquisitions over our sample period. This trend coupled with the negative relationship would then have a negative impact on cash holdings. However, evident from Table 4.3 one can see that the acquisition variable has among the lowest assets-ratios of our included variables for every year. It is therefore reason to believe that this effect is somewhat smaller the other variables which have a higher ratio-to-assets.

4.2.10 R&D

R&D is a short term cash outflow for the firm, but it also serves as a proxy for the organic growth opportunities. This is because firms take on R&D expenses to gain something in future, as argued by Titman and Wessels (1988). Thus, whether or not R&D should have a positive or negative relation with cash holdings are ambiguous. In our estimated base models for the entire sample period (Table 4.1), the relationship is slightly positive and significant on a 99% level. The positive relation holds for every estimated sub-period as well, although the significance varies between the non-significance to significance on the 99% level. From Table 4.3 we see that the average expense on R&D has increased substantially throughout the sample period. Thus, R&D has contributed to the observed increase in Swedish cash holdings. From Table 4.4, we see that the impact from R&D varies with firm size. For all size quintiles the R&D coefficient is positive and significant, but for the largest firms the coefficient is way higher.

4.2.11 GDP Growth

When including GDP growth in our estimated models, we observe a positive coefficient, for all of the estimated models reported in Table 4.1. We also note that the level of GDP has nearly doubled from 1994-2019, with 2647914 MSEK and 4947642 MSEK respectively.[14] The results regarding the impact of GDP growth differs when estimating the sub-period

[14]Deflated to 2019-prices.

regressions, with the coefficients coming out positively significant at a 99% and 90% levels, for the periods 2000-2004, 2005-2009 and 2010-2014, respectively. For the first and the last period however the coefficient comes out negative, but only the last period reports a significant relationship on the 90%-level.

When investigating further, looking at how GDP growth effects companies varying in size, we find that the effect of GDP seemingly affects the smallest companies the most (Table 4.4). Further, in the regression on the leverage quintiles reported in Table A2.1 Appendix, we find that only the two most leveraged quintiles of firm, reports a significant relationship for GDP growth and their cash holdings.

4.3 Overall Results of the Analysis

Related to our first research question, we find that the key policy rate have had a positive relationship with Swedish corporate cash holdings for the sample period 1994-2019. Further, when estimating models for five sub-periods, this relationship party changes, reporting a significant negative relationship for the last 15 years of our sample period (2005-2019), with only the the estimated coefficient for the 2000-2004 coming out positive and statistically significant. In conclusion we find that the overall effect of the key policy rate are likely not contributed to the increase in Swedish cash holdings, while the results from the sub-period regressions indicate that the key policy rate have contributed to the increase the at the end of our period. The last finding is further pointing towards the effect being more significant when interest rates go below zero.

For the analysis investigating our second research question, we find clear indication of negative size effects for firms and cash holding, finding larger companies to hold less cash than smaller ones. In addition, when analysing firms of different size, we find that the effect of other firm characteristics vary greatly for different size quintiles. Our estimated models also uncovers a potential for the presence of industry effects through increased cash flow volatility, that could have contributed to the increase in cash holdings. Lastly, our analysis find significant relationships for Swedish cash holdings and all firm characteristics, except for dividends.

4.4 Methodology Concerns and Robustness Tests

In our methodology and data set, there are some main concerns which can influence our results. First, we cover the concepts of heteroskedasticity, autocorrelation and multicollinearity. Then we comment on time-invariant effects and the most common issues of endogeneity, before finishing this section with data limitations.

4.4.1 Heteroskedasticity and Autocorrelation

A common problem with panel data is the occurrence of heteroskedasticity. The presence of heteroskedasticity will not effect the model coefficients, but it will effect the standard errors and thus reduce the efficiency of our models (Stock & Watson, 2012). This can lead to wrong interpretation for the significance of the coefficients. We formally test for heteroskedasticity in our models by a Breusch-Pagan test. For all regression models, we reject the null hypothesis for this test. Thus, we conclude that there is heteroskedasticity present in our models. To correct for this, we use clustered standard errors which are also robust to heteroskedasticity. The clustered standard errors also corrects for the autocorrelation that occurs through time within each firm.

4.4.2 Multicollinearity

Multicollinearity occurs when two independent variable are highly correlated. This makes it difficult to tell which variable are actually of interest. The correlation matrix shows that the highest levels of correlation between the independent variables are for size and dividends which are positively correlated by 54%. There are also some other variables within the range of 40%-50% correlation. To formally test if this is multicollinearity, we perform VIF-tests on our regression.[15] If a VIF-test for a variable returns a value above 10, it is considered to be multicollinearity present in the model (Stock et al. 2012). In our regressions there is no variable above 2, and we conclude that multicollinearity is not large a problem for our model.

[15] Variance Inflation Factor

4.4.3 Time-invariant Effects and Endogeneity Concerns

One of the main concerns with panel data specifically is the possibility of time-invariant effects present that could mislead our findings. In our data set with a lot of firms in different industries, the results are most likely impacted by time-invariant factors like culture and leadership that varies across firms and industries. To control for such factors we run regressions with industry-fixed effects. These regressions yielded similar results like the ones without industry fixed effects. Based on this, it does not seem that this is a issue for our model.

One of the more serious problems with regressions like this is endogeneity. This occurs when one of the independent variables are correlated with the error term, or that an independent variable is influenced by the dependent variable. Such cases are called omitted variable bias and reverse causality respectively. Reverse causality may specifically be a concern for the dividend variable. Large cash holdings can cause investor pressure in order to make firms pay dividend. Following Bellamare, Masaki & Pepinsky (2017), we control for this by lagging the dividend variable one year. Doing this does not produce any different results. This indicates that there is no severe problems with reverse causality for this variable.

The last endogeneity concern is omitted variable bias. Most notably, we tried to extract market values for each firm. We did not succeed in doing this, and market value can possibly explain variation in cash holdings better than book assets. Firms within asset-light sectors can be highly valued by the market, while their total assets is relatively low. Measuring size with total assets can in these cases give the wrong results. There is also other factors that could possibly explain cash holdings which are not included in the model, either because it is hard to measure or that we could not obtain good enough data for it. Lastly, while we have take measures to ensure unbiased estimators, we cannot rule out the possibility of the presence of endogeneity in our models.

4.4.4 Data Limitations

There are some more general concerns regarding the quality of our data set. As evident from Figure 4.3, we see that the industry composition is not as diverse as we believed a

Swedish index would be. For some of the industries, the number of firms present are below ten during the entire sample period. One of these industries are real estate, where some of the largest firms in this sector are not included in our data set. This might influence our results.

Also, some of the variables extracted have a lot of missing values. For dividends and R&D, the number of NA's are just above 5 000. Over half of the data set is then missing. It may be due to the fact that these variables are not reported when they are zero. This reason is also a part of the reason why we set NA's to zero. There is also the possibility that firms have paid out dividend or spent money on R&D, but that our database has not managed to provide this info. If that is the case, this is also a concern for our model.

5 Discussion

We will now discuss the main results from our analysis in light of the financial theory presented in Section II. As we did in the analysis section, we will first investigate our first research question before proceeding with our second research question. Then we will outline the theoretical and some practical implications of the findings of our thesis. At the end of the section there are a few proposals for future research based on the subject from this thesis.

5.1 Key Policy Rate and Corporate Cash Holdings, RQ1

5.1.1 The Long-Term Impact of the Key Policy Rate

According to Baumol (1952) and Tobin (1956), firms will hold more cash when interest rates fall due to lower opportunity costs. This theory coincides with the development of the key policy rate and corporate cash holdings for Swedish firms over our sample period. Our analysis indicates that this theory does not hold in the Swedish market from 1994 - 2019. We find that interest rates positively relate to cash holdings when regressing our model on the entire sample period. The difference in findings could be the results of many things. Firstly, we estimate our models on firms in another geographical market, and we estimate slightly different models than previous literature by including the industry sigma and the variable for GDP. However, finding a positive relationship between the key policy rate and Swedish corporate cash holdings, we conclude that other factors than the key policy rate are likely to have influenced Swedish cash holdings more and been the driver for the increase in cash holdings from 1994-2019.

5.1.2 The Short-Term Impact of the Key Policy Rate

When we conduct our analysis on shorter periods, we find that the impact of the interest rate on cash holdings fluctuates between our five-year sub-periods. In contrast to the long-term findings, three out of the last sub-periods return a negative relationship between interest rates and cash holdings. For the last sub-period, the negative relation is also

robust. Since the interest rate for that period has been below zero, this finding could indicate a threshold for cash holdings when interest rates go below zero. The threshold could indicate that the key policy rate's effect on cash holdings appears abruptly greater at zero-percent-level. Such a finding is in line with Gao et al.(2021), which estimates the money demand for different interest levels, where the money demand schedule implies a satiation level of cash holdings at zero interest rates. In our estimated models, we do not test explicitly for the money demand but rather observe a sizeable negative coefficient for the period with zero interest rates, and the model captures a larger percentage of the variation in corporate cash holdings. The negative relation in these periods is also in line with the opportunity cost theory from Baumol and Tobin.

For the first two sub-periods, the interest is positively related to cash, in line with the result for the entire sample and in contrast to the last periods. Given the fluctuation in the interest rate's impact on the short term, this could indicate a difference in short- and long-term liquidity management mechanisms. A possible explanation for this is that managers might find themselves able to optimize their capital allocation for the long-term while for shorter periods operating under constraints that make them more responsive to a change in interest rate.

5.1.3 The Impact of the Key Policy Rate on Different Firm Characteristics

On our analysis of different firm characteristics, we find that the interest rate have a different impact on firms based on certain characteristics. The main findings in this regard is related to size, leverage and multinational firms. For size, we find that just the smallest quintile of firms experience a negative relationship between interest rate and cash holdings over the entire time series. The relationship is positive for every other size quintile. A possible reason for this could be that larger firms are likely to hold proportionally less cash in the first place due to the transaction motive. Hence, they experience a smaller increase in opportunity cost once the interest rate fall. The opposite applies to smaller companies, thus they are more sensitive to a change in interest rate. Another reason for this finding could be that smaller firms are more sensitive to changes in the key policy rate since the cost of inflation is greater for them than for larger firms, or that they can

react more decisively than larger firms due to having a leaner organisation

Interest rates also hit multinational firms and national firms different. According to our models national firms are much more related to the interest rate than multinational firms (Table A2.5). Intuitively this makes sense, as the multinational firms got several interest rates to take into account, while the national firms only got to relate to the Swedish interest rate.

The interest rate's impact on leveraged firms also change dependent on the degree of leverage. According to our model, the interest rate's impact on firms are declining with higher leverage. The cash holdings for the firms with lowest degree of leverage, are more affected by changes in the interest rate than the high levered firms (Table A2.5). One might presume that it would be the most leveraged firms that would be the most proactive towards a change of the key policy rate, but our findings suggest that they could be more restricted financially to make changes in their capital allocation.

Based on the findings that the key policy rate affect firms with certain firm characteristics differently, it is interesting to see which development each characteristics has experienced through our sample period (Table A2.5). Multinational firms has increased with around 8% in our sample period, while both leverage and size decreasing substantially during this period. Since multinational firms are less affected by the key policy rate, this development indicates that the interest rate overall declines in importance. However, both the decline in size and leverage contributes to higher importance of the interest rates, as both the lowest quintiles on size and leverage are the most affected by the interest rate. Whether the impact of the interest rate on cash holdings has declined or inclined in our sample is ambiguous, but it is interesting to note that the importance of the interest rate may vary in the future based on the development of the firm characteristics.

5.1.4 Firm Characteristics and Corporate Cash Holdings, RQ2

In this part, we address research question 2. As discussed in the last part, the interest rate positively affects cash holdings for the long term. Therefore, the decrease in interest rates can not explain the increase in cash holdings over our sample period. We now look at how firm characteristics impact cash holdings and if this can explain the increased development of cash holdings during our sample period.

In our model for the entire sample period, there were five variables negatively related to cash holdings: size, leverage, NWC, CAPEX and Acquisitions. R&D, industry sigma, and multinational firms were the only positive related firm characteristics, while the dividend variable were the only one returning a non-significant relationship with cash holdings for the entire sample period. These results were also consistent for the sub-periods regression, barring only dividend which fluctuated from negative to positive between the sub-periods. In order to explain the increase of cash holdings during our period, the negatively related firm characteristics have to decrease, while the positively related ones have to increase.

For the eight significant firm characteristics in our long-term model, seven out of these have had a development which contributes to an increase in cash holdings. Only the negatively related acquisition has increased during the period and thus contributed to a decline in cash holdings. The development in some of these characteristics has been drastic in terms of percentage points, R&D and cash flow volatility (industry sigma) being the most notable.

The last variable impacting cash holdings in our model is GDP growth. GDP levels in Sweden has nearly doubled in the period we are looking at, and the growth in GDP has been positive for the majority of years. This increase in combination with the positive coefficient obtained in our long-term regression shows that GDP growth has contributed to the increase in cash holdings. Thus, out of ten significant variables in our models, eight of these have had a development over our period which contributes to an increase in corporate cash holdings. It is the change in firm characteristics that drives the increase in cash holdings for our period, not the change in the key policy rate.

5.1.5 The Development in Managerial Motives for Holding Cash

Through this paper we have found that Swedish corporate cash holdings have increased mainly due to change in firm characteristics. This also indicates that some of the motives for holding cash has become more or less prominent during this period. The transaction motive of holding cash indicates that bigger firms hold less cash due to the economics of scale present. Given the underlying, declining development in average firm size, the subsequent reduced economics of scale, is likely to have contributed to the increase in cash holdings over our sample period.

In contrast, our findings indicates that the precautionary motive has become more prominent. According to this motive, firms hold more cash if cash flows are risky or volatile. We have seen that cash flow volatility has increased substantially, which is one of the main reasons why the precautionary motive has strengthened. The other main reason is that firms with better investment opportunities holds more cash because financial distress for such firms becomes more costly. Investment opportunities in organic growth, is usually proxied by R&D, which has increased a lot over the period. Both these reasons contributes to strengthen the precautionary motive for holding cash.

Lastly, our estimated models and the observed trends of our data set do not indicate that the tax motive has contributed to the increase in Swedish cash holdings. The development of increased multinationality of Swedish firms, could provide the opportunity for increased cash holding, but the regulatory developments led by the EU and others are seemingly counteracting this development for controlled foreign companies.

5.2 Model Implications

This section elaborates briefly on some broader implications of the identified cash-interest relationship, besides those already discussed above.

5.2.1 Monetary Policy

A central bank's main task is to hinder economic downturns' most significant negative outcomes. Centrally, for stable monetary economics is the monetary policy's transmission mechanism, which states that the central bank essentially cares about two parameters: (1) the production gap, measured as the general economic activity compared to the potential, and (2) that inflation is close to its target (Røisland & Sveen, 2005). Thus, the relationship for how the key policy rate affects Swedish corporations' decisions for how to utilize its available cash has important implications for these issues.

Our estimated model for the entire sample period suggest that as a result of a lowered key policy rate and subsequently borrowing cost, firms decrease their cash holdings.[16] How firms utilizes this increased financial leeway is not formally tested, but it is likely that it could be directed towards internal and external investment, which is in line with intentions of the central bank. This presumption is mainly based on the observed development for R&D, CAPEX and Acquisitions in Table 4.3. These findings for a period with low interest rates support the theory behind two channels through which monetary policy stimulates the real economy: the interest rate channel and the balance sheet channel. The central bank seeks to increase the economy's output through the channels by increasing lending and raising investment. Our analysis thus offers support for the practices of monetary policy, showing that Sveriges Riksbank is succeeding in its efforts to stimulate the Swedish economy through the interest channel.

[16] Assuming that bank's and lenders reduce borrowing cost proportionally to the reduction of the key policy rate.

5.3 Proposals for Future Research

Since our research is the first to identify determinants for Swedish corporate cash holdings, we believe a broad approach to the subject was needed. Thus, having provided general information, future researchers are encouraged to investigate the implications of our findings and take a more narrow approach by investigating the determinants for cash holdings of specific types of firms or industries. The results of this thesis indicate that the health care industry could be a good starting point for such analysis. Further, by acknowledging that liquidity management is a managerial decision, further research could also seek to tie the findings of this thesis by taking more of a strategic approach to the subject of liquidity management. Lastly, one could further investigate the relationship between the interest rate and corporate cash holdings by taking a more macroeconomic view and untangling the full implications for monetary policy.

6 Conclusion

The purpose of this thesis has been to decompose the drivers of the observed growth for Swedish corporate cash holdings by looking at known determinants and motives for holding cash. Liquidity management is an integral part of every firm, and the substantial increase in corporate cash holdings in Sweden from 1994 to 2019 has been an interesting backdrop for this thesis. We have looked at the different factors which contribute to firms propensity to hold cash, how strong the respective factor's influence is, and how these factors have developed throughout the sample period. Based on the theory on liquidity management, we have investigated the determinants of cash holdings by looking at four different motives to hold cash, as well as the impact from the key policy rate and the general business cycle. We have further based our analysis upon two research questions which we will answer with this conclusion.

6.0.1 Research Question 1

The first research question is in regards to whether or not the key policy rate has had an impact on cash holdings, and if so, precisely how it affects cash holding. In contrast to the existing theory, we find that the key policy rate has been positively related to corporate cash holdings in our sample period. Therefore, it is not the key policy rate that is the reason for the increase in corporate cash holdings. For shorter periods, we find that the key policy rate can be both positively and negatively linked with cash holdings. We also find that it seems to be an interest threshold once the interest rate goes below zero, as the impact dramatically increases once this happens. The last finding for the key policy rate is that its impact varies for different firms based on certain characteristics.

6.0.2 Research Question 2

Our second research question span around the impact firm characteristics have on cash holdings. Our analysis finds that cash holdings have negative relationships with size, leverage, NWC, CAPEX, and acquisitions. Other than the key policy rate, we find a positive link with cash holdings for GDP growth, R&D, multinational firms, and cash flow volatility. Furthermore, we find that the underlying development in eighth out of

ten investigated characteristics contributes to higher cash holdings. Thus, we identify the development in these characteristics as the main drivers behind the increase in Swedish corporate cash holdings. When calculating the net contribution of the different firm characteristics and their respective developments, we find that the main contributors have been size, leverage, cash flow volatility (industry sigma).

Linking the firm characteristics to the different motives for cash holdings, we find that the precautionary motive has become more prominent over the investigated period. Firms hold more cash as a precautionary measure since their cash flow volatility has increased, and that firms with good investment opportunities know that financial distress will be more costly for them. On the other side, the transaction motive has become less prominent because of a lesser degree of the economics of scale since firms on average are smaller based on total assets. In conclusion we find that the precautionary and the transaction motive have contributed to the increase for Swedish corporate cash holdings, while finding little or no indication that the trend in corporate cash holding is driven by either a tax or agency motive.

References

Almeida, H., Campello, M., and Weisbach, M. S. (2004). The cash flow sensitivity of cash. *The Journal of Finance*, 59(4):1777–1804.

Azar, J. A., Kagy, J.-F., and Schmalz, M. C. (2016). Can changes in the cost of carry explain the dynamics of corporate "cash" holdings? *The Review of Financial Studies*, 29(8):2194–2240.

Bates, T. W., Kahle, K. M., and Stulz, R. M. (2009). Why do us firms hold so much more cash than they used to? *The Journal of Finance*, 64(5):1985–2021.

Baumol, W. J. (1952). The transactions demand for cash: An inventory theoretic approach. *The Quarterly Journal of Economics*, pages 545–556.

Bellemare, M. F., Masaki, T., and Pepinsky, T. B. (2017). Lagged explanatory variables and the estimation of causal effect. *The Journal of Politics*, 79(3):949–963.

Boileau, M. and Moyen, N. (2016). Corporate cash holdings and credit line usage. *International Economic Review*, 57(4):1481–1506.

Dittmar, A., Mahrt-Smith, J., and Servaes, H. (2003). International corporate governance and corporate cash holdings. *Journal of Financial and Quantitative analysis*, 38(1):111–133.

Foley, C. F., Hartzell, J. C., Titman, S., and Twite, G. (2007). Why do firms hold so much cash? a tax-based explanation. *Journal of Financial Economics*, 86(3):579–607.

Gao, X., Whited, T. M., and Zhang, N. (2021). Corporate money demand. *The Review of Financial Studies*, 34(4):1834–1866.

García-Teruel, P. J., Martínez-Solano, P., and Sánchez-Ballesta, J. P. (2009). Accruals quality and corporate cash holdings. *Accounting & Finance*, 49(1):95–115.

Glaser, M., Lopez-De-Silanes, F., and Sautner, Z. (2013). Opening the black box: Internal capital markets and managerial power. *The Journal of Finance*, 68(4):1577–1631.

Graham, J. R. and Leary, M. T. (2018). The evolution of corporate cash. *The Review of Financial Studies*, 31(11):4288–4344.

Hirstensein, A. (2021). Companies hold tight to their piles of cash. *The Wall Street Journal*.

Jensen, M. C. (1986). Agency costs of free cash flow, corporate finance, and takeovers. *The American Economic Review*, 76(2):323–329.

Meltzer, A. H. (1963). The demand for money: the evidence from the time series. *Journal of political Economy*, 71(3):219–246.

Miller, M. H. and Orr, D. (1966). A model of the demand for money by firms. *The Quarterly Journal of Economics*, 80(3):413–435.

Mulligan, C. B. (1997). Scale economies, the value of time, and the demand for money: Longitudinal evidence from firms. *Journal of Political Economy*, 105(5):1061–1079.

Negro, M. D., Giannone, D., Giannoni, M., and Tambalotti, A. (2018). Global Trends in Interest Rates. Working Papers 1812, Federal Reserve Bank of Dallas.

Nikolov, B. and Whited, T. M. (2014). Agency conflicts and cash: Estimates from a dynamic model. *The Journal of Finance*, 69(5):1883–1921.

OECD (2021). *OECD Composite Leading Indicators: Reference Turning Points and Component Series*.

Opler, T., Pinkowitz, L., Stulz, R., and Williamson, R. (1999). The determinants and implications of corporate cash holdings. *Journal of Financial Economics*, 52(1):3–46.

PwC (2021). Sweden: Corporate - income determination.

Riddick, L. A. and Whited, T. M. (2009). The corporate propensity to save. *The Journal of Finance*, 64(4):1729–1766.

Røisland, and Sveen, T. (2005). Pengepolitikk under et inflasjonsmål. *Norsk Økonomisk Tidsskrift*, 119:16–38.

Stock, J. H., Watson, M. W., et al. (2012). *Introduction to Econometrics*, volume 3. Pearson New York.

Stone, A.-L., Gup, B. E., and Lee, J. (2018). New insights about the relationship between corporate cash holdings and interest rates. *Journal of Economics and Finance*, 42(1):33–65.

Titman, S. and Wessels, R. (1988). The determinants of capital structure choice. *The Journal of Finance*, 43(1):1–19.

Tobin, J. (1956). The interest-elasticity of transactions demand for cash. *The review of Economics and Statistics*, pages 241–247.

Appendix

A1 Variable Definitions & Correlations

In this subsection we present the definitions for the obtained and constructed variables, as well as the correlation between them.

Table A1.1: Variable Definitions

Variable name	Compustat	Explanation
Company name	CONM	Identifies the company or index for which data is presented.
Capital Expenditures	CAPX	Cash outflow or the funds used for additions to the company's property, plant and equipment.
GICS Sectors	GSECTOR	Identifies the GICS-sector representative for the company.
ISO Currency Code	CURCD	Identifies the currency for a company's reported financial data.
Fiscal Year	FYEAR	The fiscal year of the current fiscal year-end month.
Acquisitions	AQC	Cash outflow of funds used for and costs relating to acquisition of a company in the current year or effects of an acquisition in a prior year carried over to the current year.
Total Assets	AT	Total value of assets as reported on a company's balance sheet.
Cash and ST-Investments	CHE	Represents cash and all securities readily transferable to cash as listed in the Current Asset section.
Dividends	DVT	Total amount of dividends, other than stock dividends, declared on all equity capital of the company.
EBIT	EBIT	Sum of Sales - COGS - (Selling, General & Admin. Expense) - Depreciation and Amortisation.
EBITDA	EBITDA	Sum of Sales - COGS - (Selling, General & Admin. Expense).
Total Liabilities	LT	Represents current liabilities, long-term debt, other noncurrent liabilities, inc. deferred taxes and investment tax credit.
Revenue	REVT	Represents Sales/Turnover plus Operating Revenues.
Income Taxes	TXT	Income taxes imposed by federal, state and foreign governments.
Working Capital	WCAP	Total current assets minus total current liabilities.
Interest and Related Expense	XINT	The periodic expense of securing short- and long-term debt.
R&D Expense	XRD	Costs incurred during the year related to development of new products or services.
Foreign Exchange Income	FCA	Income from countries other than home. Used to create dummy for multinational firm.
Multinational Firm		Constructed dummy-variable for multinationality, (1)=Multinational, (0)=Domestic.
Industry Sigma		The standard deviation of each firm's previous 10-year cash flow, grouped on industry. Min.observations for 3-years to include.
Cash Flow		EBITDA minus tax and interest expense.
Dividend Dummy		Constructed dummy-variable for dividend, (1)=Dividend, (0)=No-Dividend.
NWC		Net working capital. Compustat variable WCAP, minus Cash.
Inflation Factor	Source: SCB	The inflation factor used to adjust historical data for inflation.
Key Interest Rate, SWE	Source: SWE.CB	The key interest rate of Sweden, reported by Sveriges Riksbank.
GDP Growth	Source: SCB	The yearly % GDP growth for the Swedish economy.

Table A1.1 displays the variable definitions for Compustat variables, as well as additional variables used in the estimated regression models. All constructed variables are scaled with Total Assets when used in the econometric models of this thesis.

Table A1.2: Correlation Matrix

	Cash	**Interest**	**GDP Growth**	**CAPEX**	**Leverage**	**Dividend**
Cash	1	-0,06004	0,03828	-0,09780	-0,42835	-0,17216
Interest	-0,06004	1	0,24788	0,13911	0,06826	0,13714
GDP Growth	0,03828	0,24788	1	0,04059	-0,00041	0,04957
CAPEX	-0,09780	0,13911	0,04059	1	0,10211	0,03793
Leverage	-0,42835	0,06826	-0,00041	0,10211	1	0,08189
Dividend	-0,17216	0,13714	0,04957	0,03793	0,08189	1
Acquisition	-0,12198	-0,00352	0,02295	-0,03333	0,07546	0,07294
NWC	-0,09907	0,12158	0,03439	-0,06157	-0,40330	0,21143
R&D	0,15394	-0,01943	-0,00971	-0,02593	-0,06958	-0,05933
Ind. Sigma	0,19422	-0,50278	-0,13983	-0,18210	-0,15538	-0,24383
MNE	-0,08304	-0,07880	-0,03111	-0,00383	0,05524	0,20670
ln(Tot.Assets)	-0,30644	0,21888	0,04452	0,08746	0,18871	0,54075

	Acquisition	**NWC**	**R&D**	**Ind. Sigma**	**MNE**	**ln(Tot.Assets)**
Cash	-0,12198	-0,09907	0,15394	0,19422	-0,08304	-0,30644
Interest	-0,00352	0,12158	-0,01943	-0,50278	-0,07880	0,21888
GDP Growth	0,02295	0,03439	-0,00971	-0,13983	-0,03111	0,04452
CAPEX	-0,03333	-0,06157	-0,02593	-0,18210	-0,00383	0,08746
Leverage	0,07546	-0,40330	-0,06958	-0,15538	0,05524	0,18871
Dividend	0,07294	0,21143	-0,05933	-0,24383	0,20670	0,54075
Acquisition	1	-0,00689	-0,02266	-0,00010	0,06158	0,11032
NWC	-0,00689	1	-0,05330	-0,15891	0,07077	0,18275
R&D	-0,02266	-0,05330	1	0,06055	0,01252	-0,03331
Ind. Sigma	-0,00010	-0,15891	0,06055	1	0,02660	-0,33115
MNE	0,06158	0,07077	0,01252	0,02660	1	0,41299
ln(Tot.Assets)	0,11032	0,18275	-0,03331	-0,33115	0,41299	1

Table A1.2 show the correlation matrix between the independent variables used for all the reported models.

A2 Additional Regressions

Under this subsection we present the additional regressions, used to control for findings from the reported models in Section IV - Analysis. The backdrop for the estimated models are presented in the respective parts of the analysis, and all models are equipped with table text, explaining basis for the reported models.

Table A2.1: OLS Regression for Leverage Quintiles

Table A2.2 presents the regression models estimated to analyse Swedish corporate cash holdings for firms based on degree of leverage. Firms are grouped based on leverage and based on this we estimate five models for leverage quintiles. The most indebted firms are quintile 5, with the least indebted firms are reported in quintile 1.

Base Model Regression on Quintiles of Leverage					
	Dependent variable:				
	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5
Interest	1.589**	1.032**	0.563**	0.315**	0.308
	t = 2.341	t = 2.474	t = 2.467	t = 2.080	t = 1.262
GDP Growth (%)	1.151***	0.504***	0.103	0.136	0.186
	t = 5.409	t = 3.443	t = 0.759	t = 1.445	t = 1.443
ln(Total Assets)	-0.021***	-0.018***	-0.024***	-0.012***	-0.004**
	t = -2.622	t = -4.766	t = -10.393	t = -7.145	t = -2.049
R&D	0.003**	0.034***	0.007***	0.007***	0.007
	t = 2.300	t = 4.568	t = 2.854	t = 5.882	t = 1.606
NWC	-0.363***	-0.195***	-0.209***	-0.206***	-0.081***
	t = -6.558	t = -4.927	t = -6.878	t = -6.439	t = -3.820
CAPEX	-0.404***	-0.175***	-0.126**	-0.110**	-0.083***
	t = -3.599	t = -3.033	t = -2.441	t = -2.219	t = -2.723
Dividend	-0.004	0.053***	0.038***	0.020***	0.018**
	t = -0.142	t = 2.983	t = 4.043	t = 3.009	t = 2.084
Industry Sigma	0.393	0.009	-0.003	0.077	0.250**
	t = 1.610	t = 0.069	t = -0.023	t = 0.973	t = 2.211
Acquisition	-0.605***	-0.255***	-0.258***	-0.154***	-0.060**
	t = -7.204	t = -3.717	t = -7.550	t = -4.418	t = -2.149
Multinational Firm	0.035*	0.011	0.010	0.002	0.005
	t = 1.805	t = -7.204	t = 1.184	t = 0.264	t = 0.653
Constant	0.391***	0.252***	0.263***	0.172***	0.076***
	t = 7.842	t = 9.999	t = 11.659	t = 10.758	t = 4.207
Observations	1,914	1,911	1,913	1,909	1,909
R2	0.107	0.116	0.230	0.243	0.099
Adjusted R2	0.102	0.112	0.226	0.239	0.094
Note:	*p<0.1; **p<0.05; ***p<0.01				

Table A2.2: Expanded Base Models

Expanded Regression Models with industry fixed effects, estimated for the entire sample period, 1994-2019. The model is an expanded version of the base models reported in Table 4.1

OLS Models, incl. GISC Industries			
	Dependent variable:		
	Cash holdings	Ln(Cash holdings	Lagged Model
	(1)	(2)	(3)
Interest	0.604***	5.321***	
	t = 3.588	t = 4.026	
GDP Growth (%)	0.429***	2.072***	
	t = 6.489	t = 3.804	
Lagged Interest			0.335**
			t = 2.002
Lagged GDP Growth			0.462***
			t = 6.562
ln(Total Assets)	-0.014***	-0.065***	-0.014***
	t = -7.703	t = -3.786	t = -7.109
Leverage	-0.337***	-2.278***	-0.343***
	t = -13.332	t = -10.406	t = -14.579
R&D	0.0003**	0.001***	0.0002**
	t = 2.385	t = 3.038	t = 2.100
NWC	-0.262***	-1.501***	-0.262***
	t = -13.119	t = -8.402	t = -12.695
CAPEX	-0.135***	-0.478	-0.140***
	t = -3.786	t = -1.423	t = -3.547
Dividend	0.016**	0.269***	0.017**
	t = 2.265	t = 4.851	t = 2.399
Consumer Discretionary	0.013	0.040	0.014
	t = 0.758	t = 0.250	t = 0.857
Consumer Staples	-0.015	-0.275	-0.011
	t = -0.596	t = -1.116	t = -0.425
Energy	-0.068**	-0.476**	-0.065**
	t = -2.440	t = -2.218	t = -2.273
Health Care	0.072***	0.212	0.073***
	t = 3.533	t = 1.370	t = 3.627
Industrials	0.003	-0.039	0.005
	t = 0.161	t = -0.260	t = 0.319
Information Technology	0.014	0.059	0.015
	t = 0.820	t = 0.399	t = 0.935
Materials	-0.046**	-0.530**	-0.044**
	t = -2.361	t = -2.552	t = -2.288
Real Estate	0.011	-0.378	0.014
	t = 0.182	t = -0.932	t = 0.229
Utilities	-0.001	-1.585	0.001
	t = -0.019	t = -1.579	t = 0.026
Acquisition	-0.281***	-1.296***	-0.278***
	t = -9.138	t = -4.924	t = -8.830
Multinational	0.011	0.161***	0.008
	t = 1.585	t = 2.862	t = 1.056
Constant	0.408***	-1.091***	0.407***
	t = 19.736	t = -6.149	t = 20.240
Observations	9,566	9,566	8,672
R2	0.329	0.220	0.333
Adjusted R2	0.328	0.218	0.331

Table A2.3: OLS Regression: Dividends & Multinationality

Table A2.3 presents the regression models estimated to analyse Swedish corporate cash holdings for firms based on dividend policy and geographical business structure, between 1994-2019. Model 1 and 2 are estimated for firms that are paying dividends and those who are not paying dividends.

Base Model Regression on Dividends and Multinationality				
	Dependent variable: Cash Holdings			
	Dividend: Non-Paying	Dividend: Paying	National Firms	Multinational Firms
	(1)	(2)	(3)	(4)
Interest	0.639**	0.766***	0.824***	0.444**
	t = 2.424	t = 4.505	t = 3.180	t = 2.229
GDP Growth (%)	0.729***	-0.001	0.655***	0.264***
	t = 7.839	t = -0.012	t = 6.199	t = 3.079
ln(Total Assets)	-0.009***	-0.028***	-0.013***	-0.018***
	t = -4.092	t = -12.430	t = -5.101	t = -8.884
Leverage	-0.388***	-0.301***	-0.378***	-0.370***
	t = -16.730	t = -7.330	t = -17.048	t = -12.037
R&D	0.004***	-0.003**	0.007***	0.003**
	t = 2.749	t = -2.235	t = 3.166	t = 2.562
NWC	-0.275***	-0.264***	-0.219***	-0.300***
	t = -11.331	t = -8.418	t = -9.799	t = -10.113
CAPEX	-0.154***	-0.345***	-0.185***	-0.124**
	t = -3.888	t = -5.193	t = -3.691	t = -2.451
Dividend			0.031***	0.001
			t = 3.026	t = 0.162
Industry Sigma	0.118	0.162	0.140	0.177
	t = 1.212	t = 1.566	t = 1.399	t = 1.624
Acquisition	-0.259***	-0.328***	-0.226***	-0.277***
	t = -7.004	t = -7.663	t = -5.062	t = -8.151
Multinational Firm	0.024***	-0.004		
	t = 2.818	t = -0.502		
Constant	0.387***	0.522***	0.397***	0.465***
	t = 18.126	t = 15.660	t = 17.601	t = 16.512
Observations	6,189	3,367	4,739	4,817
R2	0.285	0.448	0.284	0.372
Adjusted R2	0.283	0.446	0.283	0.370
Note:	*p<0.1; **p<0.05; ***p<0.01			

A3 Statistical Tests

In order to investigate whether the average cash holdings for two groups are significantly different from each other, we apply Welch's two sample T-tests. We test for differences in the level of cash holding for both size quintiles 1 & 2 compared to 4 & 5, as well as for dividend paying firms and non-dividend paying firms. The alternative hypothesis is that the true difference in means in not equal to 0, and for both test we get a P-value of less than 5% for both test, thus we reject the null hypothesis and conclude that the true differences in mean is not equal to 0.

Table A3.1: T-Test for Difference between Quintile 1 & 2 vs. 4 & 5

Welch's Two Sample T-test	
data: Cash Holdings by Quintiles	
t = 10.854, df = 26.151, p-value = 3.492e-11	
Alternative hypothesis: true difference in means is not equal to 0	
95 percent confidence interval:	
0.1491933 0.2188756	
Sample estimates:	
Mean in group 1 & 2	Mean in group 4 & 5
0.3496106	0.1655762

Table A3.1 presents the statistical output from Welch's two sample T-test tested on the cash holding for size quintiles 1-2 and 4-5. The null hypotesis is rejected, and the test concludes that the average cash holdings for the two groups are significantly different.

Table A3.2: T-Test for Cash Difference for Dividend vs. Non-Dividend Paying Firms

Welch's Two Sample T-test	
data: Cash by Dividend	
t = 7.2528, df = 34.543, p-value = 1.952e-08	
alternative hypothesis: true difference in means is not equal to 0	
95 percent confidence interval:	
0.04800885; 0.08535648	
Sample estimates:	
Mean in group 0	Mean in group 1
0.1982297	0.1315471

Table A3.2 presents the statistical output from Welch's two sample T-test tested on the cash holding for dividend paying and non-paying firms. The null hypotesis is rejected, and the test concludes that the average cash holdings for the two groups are significantly different.