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Market response to changes in the Swedish repo rate: A CapEx view of large cap companies

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Abstract: Previous research on the topic of equity prices and intrabank rates is extensive. However, no study has thus far been aimed to quantify the effect of changes to the Swedish repo rate conditional on the level of capital intensity of a firm. Drawing on previous literature by Ehrmann and Fratzscher among others, the study utilises data on investors' expectations on the repo rate to fit a fixed effects model with the aim of determining the conditional effect of the level of capital intensity. While the model indicated no significant effects of the level of capital intensity that would comply with the standard market view, it did yield significant results for firm's net debt coherent with the intuitive hypothesis.

Keywords: Repo rate, capex, stock returns

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1 Introduction

The Swedish central bank, Riksbanken, has the legal obligation to maintain price stability in Sweden according to the Sveriges Riskbank Act (riskbankslagen 1988:1385). The common definition of this obligation is to maintain a slow and stable rate of inflation – with the current target being 2%. The primary monetary policy instrument at disposal is the repo rate (reporäntan), which is the interest rate at which banks can borrow or deposit funds at Riksbanken for a period of 7 days (Sveriges Riksbank, 2019). This rate has direct implications on the rates offered in the credit markets (Cook and Hahn, 1989).

This study aims to understand the effect that changes in the repo rate has on the Swedish equity market, and specifically the response on companies conditional on their level of capital expenditures (CapEx). This would be of interest to policy makers to understand the implications of such policy changes on redistribution of capital in the market, especially since no such study has previously been done on the Swedish market. Furthermore, the Swedish intrabank credit market is of particular interest because of the longevity of the sub-zero interest rates.

The study will focus on the shocks created by announcements of repo rate changes and their implications on stock prices depending on the level of capital expenditures in said firms.

2 Research question

The following research question has been proposed for the thesis:

> What effect does a firm's level of capital expenditures play in the Swedish market's response to changes in the Swedish intrabank rate?

3 Motivation of study

Naturally, the previous research on the subject of equity prices and intrabank rates has been extensive throughout the years on global markets as well as on the Swedish market. For example, the Swedish central bank Riksbanken has conducted studies on certain aspects of the effect that the repo rate has on the equity market in the context of certain types of firms. However, no effort has thus far managed to quantify the effect of such changes directly related to the relative capital intensity of a firm.

This study aims to fill this gap in the literature by conducting an econometric analysis of the conditional impact of a relative capital expenditure ratio on the equity price. Furthermore, this study utilises the average expectation for the change in repo rate from players in the financial markets in order to determine the *unanticipated* change. The purpose of this transformation is to circumvent the otherwise prevalent problem of an efficient market; that any information available to the market is already priced into every available asset.

Apart from contributing by means of gap-filling, the result of this study can hopefully aid in the understanding of how certain groups of firms are affected by a change in the repo rate. While this is merely one small component conducted in a limited study, the same methodology could be used in future papers exploring firms on a different

distinguishing factor.

4 Previous research

This section aims to provide the reader with a brief understanding of previous research on related topics as well as some theory that will be used in the study.

4.1 Monetary policy, interest rates and surprises

In their article *The Effect of Changes in the Federal Funds Rate Target on Market Interest Rates in the 1970s*, Cook and Hahn conducted a study in order to investigate the dissonance between previous empirical literature and the standard view of market participants (Cook and Hahn, 1989). Reichenstein had two years earlier, in 1987, conducted an exhaustive study on previous empirical literature, pointing to the conclusion that a situation where Federal Reserve can influence interest rates finds little evidence - at least on the short term interest rates (Reichenstein, 1987).

The novel method that Cook and Hahn applied on the subject was to identify the Federal Reserve's statements and actions that signal a change in the federal funds rate, instead of simply regressing the funds rate on the short-term interest rates. Such a test would then provide a new statistical angle on the issue at hand. Results-wise, Cook and Hahn found that new information signaling a change in the federal funds rate had a close relationship with a movement in the short-term interest rates on the market in the same direction (Cook and Hahn, 1989). Contrary to previous studies, this result matches the standard market view of the tools of the Federal Reserve.

On the same subject, Kuttner published a paper in 2001 aimed to capture the unanticipated changes in the federal funds rate, instead of simply looking at the absolute change. In order to derive a consistent expectation of the funds rate, Kuttner utilized futures contracts on the rate, and derived the implied expectation from these instru-

ments. Kuttner could conclude that the market has a strong response on unanticipated changes in the rate, while anticipated changes were followed by a smaller response. (Kuttner, 2001)

4.2 Market response on equity prices

Bernanke and Kuttner performed a seminal study that analysed the impact of changes in monetary policies on equity prices in order to understand the average reaction of the US stock market as well as the economic sources of such a reaction. The study utilized an event study approach, where they isolate the unexpected change in the Federal funds rate by looking at futures contracts on this rate which should embody the market expectations of the Federal funds rate. This is consistent with the approach utilized by Kuttner (2001).

Bernanke and Kuttner calculated the market's response to a change (or lack of change) in the Federal funds rate on the day of the change through the CRSP value weighted return index. Through this approach, the authors find a negative relationship between the direction of a Federal funds rate change and the market return. Furthermore, and argumentative of their approach, when regressing on both the unanticipated and anticipated change in the Federal funds rate, the results were insignificant.

In the regression in the study, the authors address multiple potential problems with their approach. One of the major ones being the assumption of orthogonality of the error term to changes in the Federal funds rate. In other words, the authors assume that there is no correlation between the other factors affecting the stock return and the change in the Federal funds rate. They provide previous studies which illustrate that there are no clear examples where the FOMC cut rates as a result of a decline in the

equity market. Furthermore, the orthogonality condition would be violated if changes in the Federal funds rate would be thought to reveal otherwise unknown information regarding the state of the overall economy. (Kuttner, 2001)

4.3 Conditional response on equity prices

In the paper *Taking Stock: Monetary Policy Transmission to Equity Markets*, Ehrmann and Fratzcher analyse the effects of U.S. monetary policy to the equity market. They identify that the responses differ conditional on financial constraints in general and Tobin's Q in particular. This paper also utilized an event study approach, and again draws on the conclusions by Kuttner (2001) to motivate the use of unexpected rate changes. This is consistent with the efficient market hypothesis, i.e. that asset prices should at any given time represent all information available in the market. Instead of using futures prices (like Bernanke and Kuttner (2005)), the authors gather data from Reuters polls among market participants. The authors argue that this approach produces similar results to the Federal funds futures approach.

Regarding weaknesses in the analysis, the authors point out that the poll results might be misleading in the sense that there is a small time-window between the Federal funds rate change and the issuance of the poll.

The paper provides support for conditionality in the market's response to firms with varying levels of financial constraints. (Ehrmann and Fratzscher, 2004)

5 Theory and key concepts

This section aims to give the reader an understanding of the econometric theory and key concepts that will be used extensively in the study.

5.1 Capital Expenditures

Capital expenditures (CapEx) within a firm denotes the funds used by a firm to purchase, upgrade and maintain assets classified as property, plant or equipment (PP&E). These expenses do not appear directly on the income statement. Instead, they are recognised over time through means of depreciation expenses. (Berk and DeMarzo, 2017, p. 279)

5.2 Panel data

Panel data, or longitudinal data, is a means of creating a data set by following the same firms (or individuals, families etc.) across time. For the process of analysing panel data using econometric methods, one cannot assume that each observation of a firm is independently distributed across time. Instead, models such as fixed effects estimation (see section 2.7) have been developed in order to handle these dependencies. Such methods utilize e.g. time differencing and the removal of unobserved attributes of a subject. (Wooldridge, 2016, p. 403)

5.3 Fixed effects estimation

The method of fixed effects is an extension of multiple linear regression, applied to data with a panel structure. The model utilizes a transformation to remove some unobserved effect a_i, which represents any time-constant unobservable variable in the model.

For the simplest case, consider a single-variable model, and let a_i denote the time invariant fixed effect, and let u_i denote the idiosyncratic error. For $\forall i$:

$$y_{i,t} = \beta_1 x_{i,t} + a_i + u_{i,t} \quad t = 1, 2, ..., T \tag{5.1}$$

Then, for each i, the average equation (over time) is:

$$\bar{y}_i = \beta_1 \bar{x}_i + a_i + \bar{u}_i \tag{5.2}$$

Over the assumption that the a_is are time-invariant, we can write the time-demeaned equation as:

$$y_{i,t} - \bar{y}_i = \beta_i \ddot{x}_{i,t} + \ddot{u}_{i,t} = \ddot{y}_{i,t} \tag{5.3}$$

In this latter equation, the term of fixed effect, a_i, has been subtracted out of the equation, and left is a model most suitably estimated through pooled OLS. (Wooldridge, 2016, p. 420)

5.4 Heteroskedasticity

The term Heteroskedasticity, in the context of multiple linear regression, describes the phenomenon where the variance of the unobserved error term u conditional on the regressor variables is not constant. When the opposite is true, we have homoskedasticity, or homoskedastic error terms. This homoskedasticity is an assumption made on the data when fitting a multiple linear regression model. In brief, when the model exhibits heteroskedastic error terms, many of the regular test statistics fail. Crucial to this

paper, heteroskedasticity can also be present in panel models such as fixed effects regression. (Wooldridge, 2016, p. 243)

There are several remedies for heteroskedasticity, one of which is to construct robust standard errors in order to generate heteroskedasticity-robust t or f statistics (Wooldridge, 2016, p. 246).

Likewise, there is a set of tests that can be used in order to determine whether or not a model exhibits heteroskedasticity. One of these is the White Test. For a detailed explanation of this test, see (Wooldridge, 2016, pp. 252-254).

6 Data

6.1 Swedish equity data

The study is limited to panel data of 56 companies currently listed on the Stockholm Large Cap list. This list is comprised of publicly traded companies with a market capitalization of 10bn SEK or more, directly fetched through the Thomson Reuters EIKON database. The data stretches over 10 years (2008-2018) and consists of the following daily observational columns:

- Closing quote
- Latest reported CapEx
- Latest reported revenue
- Net debt

Note that all companies that are currently represented on the list have not been listed on the exchange during the entire period. These observations are thus excluded from the data set. Furthermore, some issues with reported CapEx being absent from a few companies are present. These will also have to be excluded.

Regarding the data points *latest reported CapEx* as well as *latest reported revenue*, the database gave unsatisfying results when querying quarterly report data. Thus, only yearly data was used for the CapEx and revenue parameters. This makes for an unfortunate worst-case scenario of a one year time lag between the data point used and the repo rate change, as opposed to a 3 month maximum for quarterly data.

6.2 Swedish monetary policy data & expectations

To conduct the study in the suggested manner, the data needed is the dates for the announcements of changes in the repo rate. This data is collected from press releases from the Swedish national bank, Riksbanken, and is consolidated into a time series with columns for date, current repo rate and announced rate.

One way to see the unexpected changes in the interest rate is proposed by Kuttner (2001), and involves looking at the futures of the rate. While such instruments exist on the Swedish market (so called RIBA futures), they are seemingly only traded on the OTC market, and prices are thus not publicly accessible. Instead, the study will look at the surveyed responses of industry professionals to determine the expectations of the repo rate change. This method of data collection has been used in previous research on related topics by (Ehrmann and Fratzscher, 2004).

The data for the expectations is collected from Kantar Sifo, a leading insights and statistics company commissioned by the Swedish national bank to perform this study. The study is conducted on a monthly basis from 2010 and onwards, and was previously conducted four times a year.

7 Method

Due to the nature of the data set being on panel form, the choice of method of analysis was directly limited to econometric models suited for this type of data. The scope of models available is, as described, limited to ones which are suited to capture the dependencies within observations in the data (Wooldridge, 2016).

7.1 Choice of model

In order to be able to answer the research question, the method of analysis in the study must aim to evaluate whether there exists some relationship between the Swedish Riksbank's announcements to alter the repo rate and the prices of equity in the market. Furthermore, the model must be able to distinguish between the different firms, time periods and the firms' capital expenditures. While a standard multiple linear regression would be a straightforward approach for this case, the model fails to capture the individual effects of certain companies that might cause a bias in the estimation. Instead, a fixed effects regression model is proposed for the task, as it is well suited for data of the panel type in this study (Wooldridge, 2016). Such a model has also been used in similar studies, e.g. Bernanke and Kuttner (2005) and Cook and Hahn (1989).

7.2 Model specification

The first fixed effects regression model was structured as below:

$$r_{i,t} = \beta_0 + \beta_1 uc_t + \boldsymbol{\beta}_2^T CapEx_{i,t} + \boldsymbol{\beta}_3^T \left(uc_t \times CapEx_{i,t}\right) \tag{7.1}$$

$$\text{where } \boldsymbol{\beta}_2 = \begin{bmatrix} \beta_{2,high} \\ \beta_{2,mid} \end{bmatrix} \boldsymbol{\beta}_3 = \begin{bmatrix} \beta_{3,high} \\ \beta_{3,mid} \end{bmatrix} CapEx_{i,t} = \begin{bmatrix} high_{i,t} \\ mid_{i,t} \end{bmatrix} \tag{7.2}$$

where $r_{i,t}$ denotes the percentage return of stock i at time t, uc_t denotes the unexpected change of the repo rate at time t, $CapEx_{i,t}$ denotes the CapEx ratio level of firm i at reported at the latest time before t and $uc_t \times CapEx_{t,i}$ is the interaction terms of the unexpected change in the repo rate and the CapEx ratio level.

The choice of using the unanticipated change in the repo rate as opposed to simply the announced change is motivated by the efficient market hypothesis. Consider a the scenario where some arbitrary indicator or information, accessible to the entire market, points to an upcoming increase by 25 points in the repo rate. The efficient market hypothesis then states that the market will use this information when setting the prices of equities in the market. Assuming this indicator or information is correct, the official announcement of a repo rate increase by the same 25 points will, in theory, have no effect on the equity prices. However, regressing on the unanticipated change in the repo rate will provide a basis for analysis on the implications of the Swedish monetary policy (Ehrmann and Fratzscher, 2004).

It shall be noted here that the use of a CapEx ratio, instead of the absolute measure of CapEx, is motivated on the basis of inadvertent biases. The $CapEx_{i,t}$ is defined as company i's latest reported CapEx before time t divided by the latest reported figure for revenue for company i before time t. This transformation is applied as to not accidentally capturing the firm size directly in the error term, causing structural bias in the estimation.

The interaction term is aimed to capture the additional effect that that the CapEx ratio level has when the uc_t regressor is changed, making β_3 the main coefficient of interest in the model. A quick mathematical argument can be laid out:

Consider the model in equation 7.1. Without the interaction term (label this reduced

equation $\tilde{r}_{i,t}$), differentiating w.r.t. $CapEx_{i,t}$ gives:

$$\frac{\partial \tilde{r}_{i,t}}{\partial CapEx_{i,t}} = \beta_2 \tag{7.3}$$

However, when utilizing the interaction term, we get:

$$\frac{\partial r_{i,t}}{\partial CapEx_{i,t}} = \beta_2 + \beta_3 uc_t \tag{7.4}$$

Then, if we can say that $\beta_3 \neq 0$ at some significance level α, then β_3 is interpreted as follows:

> Holding all else constant, the additional effect on the return on day t of having a the CapEx ratio increase by 100% is $\beta_2 + \beta_3 uc_t$.

In other words, β_3 captures the additional effect that the CapEx ratio has on the percentage return when there is an unexpected change in the repo rate (Wooldridge, 2016).

7.3 Data preparation

After collecting the relevant data some consolidation and transformations had to be done, and will be presented below.

Unexpected change in the repo rate

The data was manually collected from the PDF reports published on Kantar Sifo's website and consolidated in an Excel spreadsheet. The data points included:

- Latest date of reply to survey

- Average expectation of the repo rate in the coming 3 months for the money market participants

These data points were then joined with the data from Riksbanken, which was also manually collected from their press releases, by the date of the announced rate change. From this, the difference between the money market participants' expectations and the actual new repo rate was noted in the data set which was to be used in the regression.

Stock returns

The stock returns were calculated as the percentage yield from d days before the repo rate change. That is:

$$r_{i,t} = \frac{p_t - p_{t-d}}{p_{t-d}} \tag{7.5}$$

where p_t denotes the price of stock i at time t, and p_{t-d} denotes the price of stock i d days before time t.

In the context of this study, the variable d will take on three different values such that $d \in \{1, 7, 14\}$. The rationale for not simply looking at the one-day return is described section 8.4.

Normalisation

In order to not inadvertently include the effect of a firm's size in the model, both the CapEx ratio and the net debt ratio were normalised to the revenue of the firm in ques-

tion. Formally, the transformations were done as follows:

$$CapExratio_{i,t} = \frac{CapEx_{i,t-1}}{revenue_{i,t-1}} \quad \text{(i)}$$

$$netdebtratio_{i,t} = \frac{netdebt_{i,t-1}}{revenue_{i,t-1}} \quad \text{(ii)}$$

Where $t-1$ here refers to the latest reported number before time t, i.e. the year before.

Cleaning the data

The data was cleaned of outliers and unfeasible data points. A critical point to look for is whether the CapEx ratio is negative or over 1.

Recall the definition of the CapEx ratio from equation i above. Thus, a CapEx ratio above 1 indicates that the firm invests more cash into PP&E that year than the revenue that the firm's operations generate. This is clearly an unsustainable practice, and does not give an indication of the true level of capital intensity in the firm. As such, these data points have been excluded.

Conversely, a firm's CapEx ratio might be negative due to the nature of how the item in the cash flow statement is calculated. Since essentially any firm must invest in its properties, plants and equipment in some form, these data points are considered abnormal as well, and are removed from the data set.

Furthermore, the case of extremely abnormal returns was considered. For example, Eniro AB had one-day returns of close to 100% during a period in 2009. It is unlikely that returns of this magnitude are dependent on an unexpected change in the repo rate. Since there is no explicit control for stock price volatility in the model, such outliers have been removed as well.

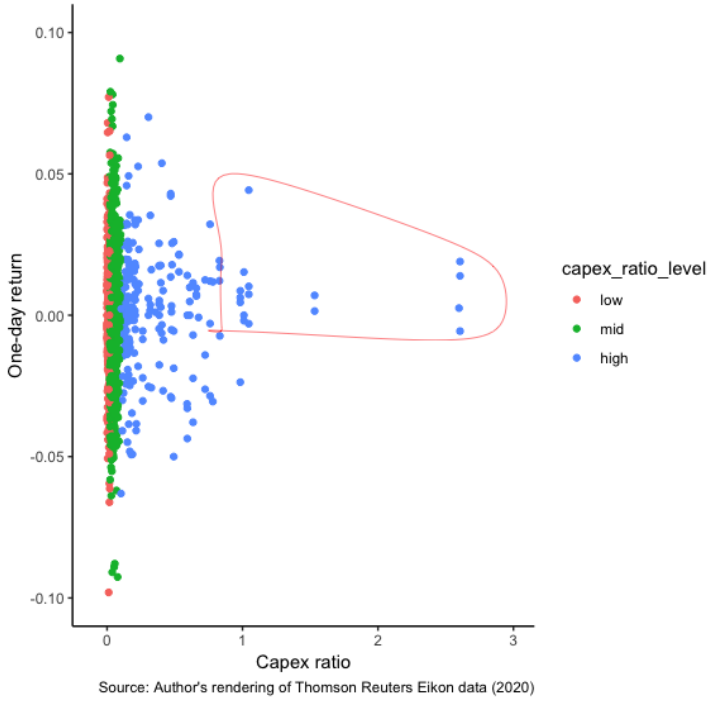

Figure 1: Illustration of removed points from the data set

Grouping the data

At this stage, the data set of firm fundamentals contains the desired information. However, since the model estimates linear coefficients for the regressor variables, it is likely that the regression will not capture non-linear effects of the CapEx ratio.

Relating to the motivation in section 3, the study aims to explore how unexpected changes to the repo rate impact different groups of companies. Therefore, the companies have been grouped into three groups based on the *level* of the CapEx ratio. The

grouping was done by quantiles:

$$low = \{k\} \text{ where } CapExratio_k \in quantile[0, 0.25]$$
$$mid = \{k\} \text{ where } CapExratio_k \in quantile(0.25, 0.75]$$
$$high = \{k\} \text{ where } CapExratio_k \in quantile(0.75, 1]$$

Consolidating the data

When the necessary transformations were done, all the data was joined into a panel data format in the statistics software package R in order to accommodate the requirements in the software STATA. Thus, each row of data contained two indices: firm ticker and date, as well as the data points corresponding to those indices. The final data frame contained 1417 observations of 56 firms.

7.4 Estimating the model coefficients

While the data consolidation and transformation was done in R, the actual model estimation was done in STATA. The motivation behind this choice is the native support for fixed effects regression within the `xtreg` command and the `fe` parameter.

8 Results

8.1 Regressor definitions

Table 1 presents and explains the dependent and independent variables of the regressions in this section.

Regressor variable	Definition
X-day return	The return on the stock price from x days before the date t
repo_change_unex	The unexpected change inte the repo rate (see section 7.3)
high	Group dummy variable for high level CapEx ratio
mid	Group dummy variable for mid level CapEx ratio
low	Group dummy variable for low level CapEx ratio
netratio	The ratio of net debt to revenue (see section 7.3)

Table 1: Regression definition table

8.2 Initial results

The results of the first regression, as specified in equation 7.1 are presented in Table 2.

From the regression output, it is clear that the model is sub-optimal. The following standard hypothesis test was also conducted:

$$H_0 : \beta_j = 0 \; \forall j \quad H_1 : \beta_j \neq 0 \text{ for some } j$$

With a value of 1.15 on the F-statistic, the null hypothesis cannot be rejected.

8.3 Revised model

The result from section 8.2 indicate that the model needs to be revised. One likely issue with the model is that it falls subject to omitted variable bias. A possible remedy is to

	(1)	
	One-day return	
repo_change_unex	-0.00354	(0.0103)
high	-0.00729	(0.00437)
low	0	(.)
mid	0.000176	(0.00267)
high × repo_change_unex	-0.00128	(0.0164)
low × repo_change_unex	0	(.)
mid × repo_change_unex	0.0128	(0.0121)
Constant	0.00194	(0.00212)
Observations	1438	

Standard errors in parentheses

$^{*}\ p < 0.05, ^{**}\ p < 0.01, ^{***}\ p < 0.001$

Table 2: Regression table for inital model

control for the firms' net debt. The reason is that it would capture the firms' ability to pay off any existing debt in the event that it should be required. A company which is able to pay off their debt to a high degree would likely be less impacted by a raise in the repo rate and should thus be accounted for in the model.

Performing a similar regression with the addition of the net debt ratio (see section 7.3) yielded the results in Table 3

In this case, the t-statistic is even lower at 0.82.

8.4 The time aspect

There might be several reasons to explain the inaccuracy of the model. Firstly, there might still be omitted variable bias in the model, where it does not currently account for factors impacting the equity price.

Furthermore, the change in the repo rate is widely anticipated by the market some time

	(1)	
	One-day return	
repo_change_unex	-0.00317	(0.758)
netratio	0.000496	(0.657)
high × netratio	0.000692	(0.579)
low × netratio	0	(.)
mid × netratio	0.000606	(0.812)
high	-0.00884	(0.069)
low	0	(.)
mid	-0.000165	(0.952)
high × repo_change_unex	-0.000855	(0.959)
low × repo_change_unex	0	(.)
mid × repo_change_unex	0.0123	(0.308)
Constant	0.00174	(0.422)
Observations	1438	

p-values in parentheses

$^{*}\ p < 0.05$, $^{**}\ p < 0.01$, $^{***}\ p < 0.001$

Table 3: Regression table for revised model

before the announcement with big certainty. This is not captured in the expectations. See section 9 for a discussion on this topic.

An attempted remedy for this issue in the model is to capture equity returns on a wider time frame. Table 4 presents regressions with different time frames for the return vector.

8.5 Adjusting for heteroskedasticity

At this stage, testing for heteroskedasticity is an option to see if the assumptions of the fixed effects model hold. A hypothesis test for heteroskedasticity was performed, with the interpretation H_0 : Homoskedastic error terms, H_1 : Heteroskedastic error terms. This yielded a p-value < 0.001. One can thus be confident in the fact that heteroskedasticity is prevalent in the model. Accounting for this with robust standard errors for the statistics, we get the final fixed effects model described in Table 5

	(1) One-day return	(2) 7-day return	(3) 14-day return
netratio	0.000908	0.000808	0.00353
	(0.318)	(0.723)	(0.296)
netratio × repo_change_unex	-0.000388	0.0141	0.0234
	(0.914)	(0.118)	(0.082)
repo_change_unex	0.00930	-0.109***	-0.0179
	(0.146)	(0.000)	(0.451)
high	-0.00800*	-0.00900	-0.0189
	(0.045)	(0.368)	(0.203)
low	-0.0000146	-0.00648	-0.0111
	(0.996)	(0.336)	(0.266)
mid	0	0	0
	(.)	(.)	(.)
high × repo_change_unex	-0.0132	-0.0291	-0.0803
	(0.409)	(0.466)	(0.177)
low × repo_change_unex	-0.0141	0.00989	0.0113
	(0.250)	(0.747)	(0.804)
mid × repo_change_unex	0	0	0
	(.)	(.)	(.)
Constant	0.00150	0.00718*	0.0107*
	(0.230)	(0.022)	(0.022)
Observations	1417	1417	1417

p-values in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 4: Regression table for model including time aspect

	(1) One-day return	(2) 7-day return	(3) 14-day return
netratio	0.000908	0.000808	0.00353
	(0.197)	(0.623)	(0.247)
netratio × repo_change_unex	-0.000388	0.0141**	0.0234**
	(0.887)	(0.009)	(0.001)
repo_change_unex	0.00930	-0.109***	-0.0179
	(0.132)	(0.000)	(0.416)
high	-0.00800**	-0.00900	-0.0189
	(0.007)	(0.391)	(0.271)
low	-0.0000146	-0.00648	-0.0111
	(0.995)	(0.361)	(0.197)
mid	0	0	0
	(.)	(.)	(.)
high × repo_change_unex	-0.0132	-0.0291	-0.0803
	(0.366)	(0.479)	(0.140)
low × repo_change_unex	-0.0141	0.00989	0.0113
	(0.276)	(0.757)	(0.813)
mid × repo_change_unex	0	0	0
	(.)	(.)	(.)
Constant	0.00150	0.00718*	0.0107*
	(0.076)	(0.016)	(0.014)
Observations	1417	1417	1417

p-values in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 5: Regression table for final model, adjusted for heteroskedasticity

9 Discussion

This section is divided into three parts, discussing different elements of the paper. Firstly, the possible interpretations of the model coefficients and its validity is addressed. Secondly, the issue of the market assumptions about the repo rate is discussed. Finally, an effort is made to discuss the potential problems of the data set and the collection of data.

9.1 Model interpretation

This section will primarily discuss the model output described in Table 5, as it is the latest in the series of regressions performed.

Relating to the aim of the study, the main coefficients of interest are the following:

- $high \times repo\_change\_unex$
- $mid \times repo\_change\_unex$
- $low \times repo\_change\_unex$

Due to the nature of dummy variables in the regression, the base case has been constructed as the mid level of capital intensity, and no coefficient is estimated for this case. These coefficients describe the interaction term between the relative level of CapEx in a firm and the unexpected change in the repo rate. The coefficient can be interpreted as the additional effect that the unexpected change in the repo rate has on the stock price conditional on which level of capital intensity the firm has.

However, in all three regressions from Table 5, these coefficients are non-significant on any reasonable level of significance. In other words, the results give no indication that the hypothesis that the coefficients individually equal zero can be rejected. Leaving the

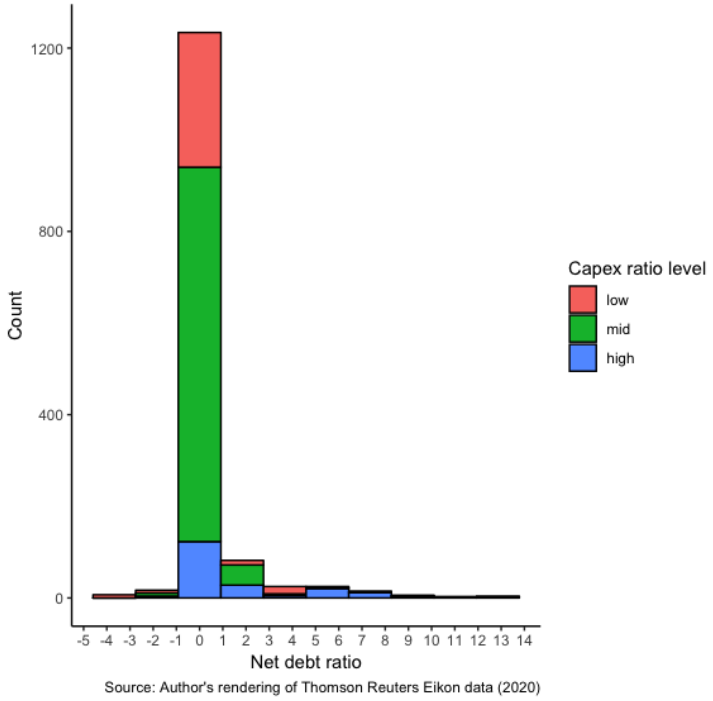

Figure 2: Full histogram of net debt ratio

discussion on the validity of assumptions of the model to the below sections, this result would indeed indicate that there is no conditional effect of the unexpected change in the repo rate on the stock price of a firm given its level of capital intensity.

Focusing on the coefficients which did see statistical significance, the one-day return model gives an indication that a firm with a high level of capital intensity on average respond negatively on the stock market on days of announcements. Note, however, that this does not in any way take into consideration which way the repo rate actually moves in relation to the market's expectations.

In the 7-day return model, two coefficients were significant (excluding the constant term): the interaction coefficient between net debt ratio and the unexpected change

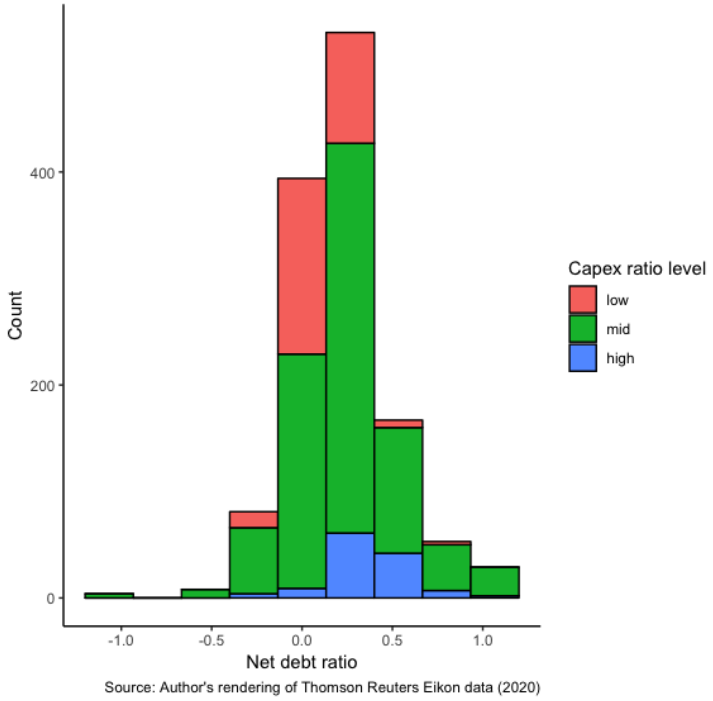

Figure 3: Zoomed histogram of net debt ratio

in the repo rate as well as the coefficient of the unexpected repo rate change. The latter would indicate that given a firm's net debt ratio, an unexpected one percentage point change in the repo rate would, on average, increase the stock price of a company by $0.0141 \times netratio_{i,t}$, where $netratio_{i,t}$ is the net debt ratio of firm i at time t. Looking at Figures 2 and 3, it is clear that an overwhelming majority of net debt ratios in the data set are between -1 and 1, and commonly close to 0. The overall indication from this regression is that firms with a positive net debt ratio on average respond positively to an unexpected increase in the repo rate over a seven day period before and at the day of the announcement. This coefficient was also significant in the 14-day model, with a significantly higher value. This is natural considering that the time frame is doubled, but could also indicate that the market has already set their common expectation on

the repo rate as far back as 14 days.

The coefficient for the unexpected change in the repo rate was only significant in the 7-day model. This coefficient should be interpreted as the average change in stock value for any company in sample during a 7-day period before and on the day of the announcement. Concretely, the coefficient on -0.109 would indicate that for an unexpected one percentage point increase in the repo rate, the average stock price is falls by 10.9% on this time period. This result is indeed interesting. In the 7-day case, it seems like the unexpected change in the repo rate has a significant impact on the stock market, but these changes are unrelated to the level of capital intensity in the firms, and is instead related to the level of net debt - which is of course intuitively sensible.

9.2 The market's relationship with the repo rate

In the process of trying to understand and interpret the results of the regressions, it should be noted that the Swedish central bank Riksbanken is, compared to e.g. the US Federal Reserve, rather transparent with its reasoning regarding the repo rate. This could lead to close to certain assumptions on the rate several days before the official announcement, which will get priced into the asset long before the change is made. This is exemplified in numerous articles in e.g. Dagens Industri (a leading daily business newspaper in Sweden).

While the method for this paper specifically aimed to account for these assumptions, there are two main problems that persist. Firstly, the expectations on the repo rate change was gathered from surveys from Kantar Sifo as described in section 6.2. These surveys were, however, not structurally executed at a certain time before an announcement by Riksbanken. Secondly, the nature of these surveys is that they only serve as an

approximation of the general market expectations. Now, would both of these points would have been remedied if one had access to the OTC pricing of RIBA futures? While these contracts could be used in order to derive an exact expectation on the repo rate, the answer is likely no. Since the instrument is only being traded on the OTC market, the contract is unavailable to the bulk of investors in Sweden. This means that while it would likely be a better approximation than the method used in this paper, it would not lie in the realms of the efficient market and would thus not be as precise a measurement as an equivalent futures contract in the U.S.

In the econometric analysis in this paper, an attempt to deal with the source of uncertainty with regards to the early expectations of the market is made. This rather trivial transformation of return vectors from one-day returns to 7- and 14-day returns was made to capture the event that investors might align their expectations towards the actual change right before the announcement. The final regression performed in section 8.5 revealed only one significant coefficient for the one-day return model, which was unrelated to the rate change. However, both the 7-day and 14-day returns had significant coefficients. This seems to indicate that the factor of a rate change is not present on the day of the announcement, likely due to what has been discussed thus far.

9.3 Implications of the data and sample

While the problem of the repo rate expectations data has been discussed in detail in section 9.2, some other aspects of the data are worth discussing. In any regression, it is desirable to capture variation in the regressors. Not only is the repo rate announced by Riksbanken predictable, but the marginal change at each announcement is in general small - with the exception of the reactive change after the financial crisis in the late 00s (see Figure 4). Furthermore, the repo rate has been exceptionally low for the majority

of the time that is in scope of the study. This could also have lead to non-responsiveness in general and on capital intensity in particular.

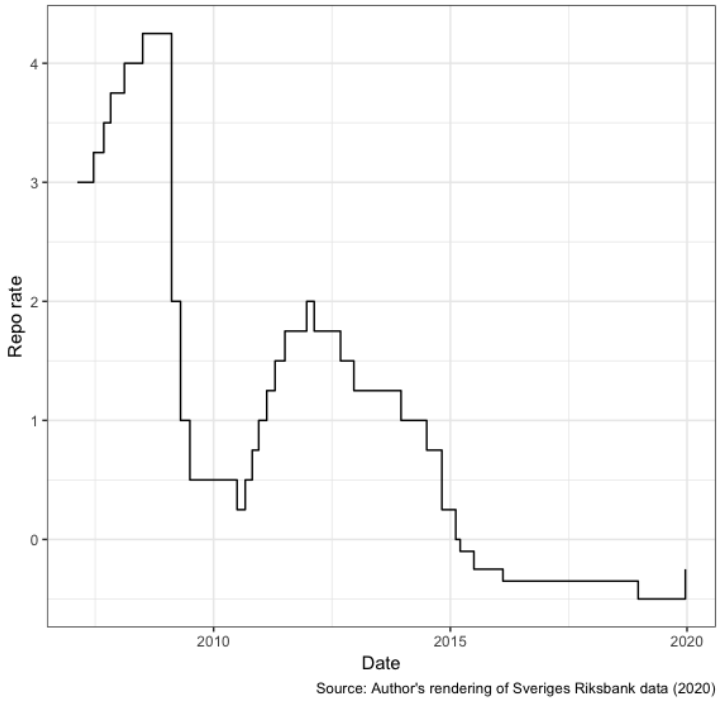

Figure 4: Time series of the Swedish repo rate

On the note of time frame, this study encompasses data from the beginning of 2008 through the end 2018. This has the obvious implication that the financial crisis is indeed within the scope of the paper. As my data set was limited, no there was no option to control for general volatility in the market which could have helped with these data points. Controlling for endogenous volatility could also have helped with some of the observations as previously mentioned.

Regarding sample of firms, this study has been limited to only the largest companies in Sweden. This choice was made partly because of the rich data that the Thomson

Reuters Eikon database could provide on these stocks, whereas smaller companies had a more limited supply of posts from the balance sheet and cash flow statement. The implication of this is that, of course, the result only holds for large companies. Furthermore, it could be argued that the effect of the repo rate might be lower on large-cap companies than on others. These companies are generally (always) well established on the market they operate in, with superior (and likely long-term) terms for any credit. A marginal change in the repo rate could thus have a smaller effect on these types of companies.

A final note on this topic is that even though the companies were separated into three groups for the analysis, there is a large homogeneity in the CapEx ratio as seen in Figure 1. This could be a limitation from the sampling of firms. To further illustrate this point, a density plot is provided in Figure 5.

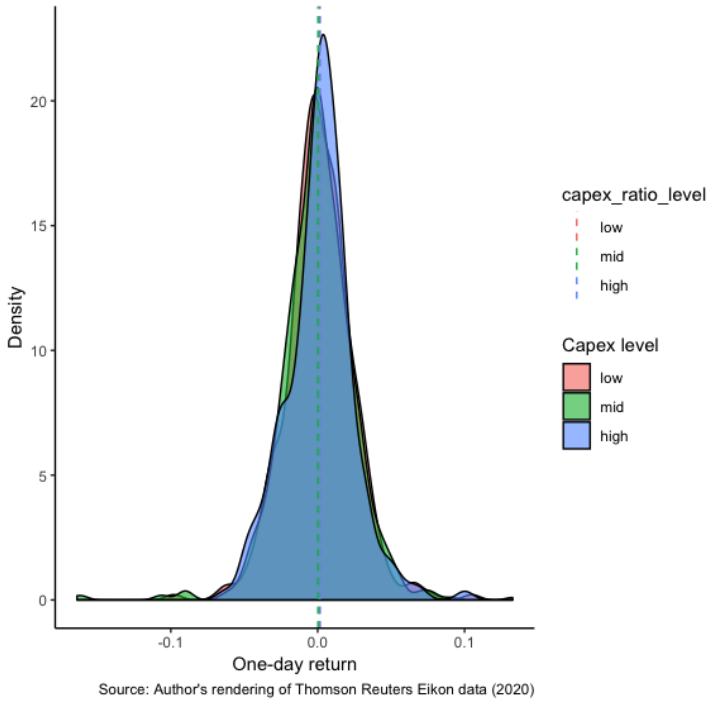

Figure 5: Density plot of the different CapEx level groups

10 Conclusion

With the aim of examining the market response on equity prices given levels of capital expenditures to unanticipated changes to the Swedish repo rate, this study failed to find any statistical significance in the relevant model coefficients. The study did, however, find significance in the response of the unanticipated change conditional on the net debt ratio of the firms on both a 7-day and 14-day horizon with results that are coherent with the intuitive market view of the phenomenon.

While the choice of a fixed effects regression model is likely well suited to the research question and data in hand, there exists an opportunity to perform a similar study with a different econometric framework. One suggestion would be to use the framework proposed in e.g. Fama et al. (1969). There is, however, no apparent way to remedy the issue of the market expectations of the repo rate, as the utopian option of using rate futures contracts comes with the difficulty that it does not represent the entire market. However, this type of data would likely still be an improvement from the data set generated in this study through Kantar Sifo surveys.

Lastly, while there are some concerns of validity of the data especially, care should be taken when interpreting the non-significant coefficients as an indication that the level of capital intensity in a firm does not cause any response from the market conditional on unanticipated changes in the repo rate.

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