Covid-19, quantitative easing, and the awakening of abnormal returns at the Swedish stock market

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ABSTRACT

This thesis aims to investigate to what extent the quantitative easing monetary policy tool, applied by the Riksbank, contributed to abnormal returns at the Swedish stock market during Covid-19. The chosen time period is 2007-2022, including the period before and after the implementation of quantitative easing in Sweden in 2015. Furthermore, the chosen time period includes two crises, the global financial crisis (GFC) and the Covid-19 crisis.

Two artificial portfolios are created, one representing a high-risk portfolio and the other representing a low-risk portfolio. The thesis applies the ADL error correction model to estimate a potential relationship amongst QE and the returns for each of the computed portfolios. Results show a short-run relationship for both the high-risk and the low-risk portfolio. From the long-run perspective, there is only a relationship found concerning the high-risk portfolio.

A modified CAPM-model is used as an interpretation when calculating abnormal returns, where the growth rate of industrial production reflects the expected return. Results show the presence of QE and abnormal returns for both portfolios during the time period of Covid-19, 2020-2022.

Keywords: Quantitative easing, Austrian business cycle Theory, Financial instability hypothesis, Speculative bubbles, Covid-19, Abnormal returns

SAMMANFATTNING

Denna uppsats syftar till att undersöka i vilken utsträckning Riksbankens kvantitativa lättnader bidrog till abnorm avkastning på den svenska aktiemarknaden under Covid-19. Den valda tidsperioden är 2007 – 2022, vilket inkluderar perioden före och efter genomförandet av kvantitativa lättnader i Sverige. Vidare inkluderar den valda tidsperioden två kriser, den globala finanskrisen samt Covid-19-krisen.

Två artificiella portföljer konstrueras, där en representerar en högriskportfölj och den andra representerar en lågriskportfölj. Studien tillämpar en ADL error correction modell för att undersöka huruvida det existerar ett samband mellan kvantitativa lättnader och avkastningen för var och en av portföljerna. Resultaten visar ett kortsiktigt förhållande för både högrisk- och lågriskportföljen. Ur det långsiktiga perspektivet hittades endast ett samband för högriskportföljen.

En modifierad CAPM-modell används vid beräkning av abnorm avkastning, där variabeln för den industriella produktionstillväxten reflekterar den förväntade avkastningen. Resultaten visar förekomsten av abnorm avkastning i samband de kvantitativa lättnader som genomfördes under Covid-19 för båda portföljerna under tidsperioden 2020–2022.

Nyckelord: Kvantitativa lättnader, Österrikiska konjunkturcykelteorin, Finansiella instabilitets hypotesen, Spekulativa bubblor, Covid-19, Abnorm avkastning.

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CONTENT

LIST OF ABBREVIATIONS

ABC	Austrian business cycle theory
APF	Asset purchase facility
APP	Asset purchase programme
ECB	European Central Bank
FIH	Financial instability hypothesis
PEPP	Pandemic emergency purchase programme
QE	Quantitative easing
TLTRO	Targeted longer-term refinancing operations
ZLB	Zero lower bound
GFC	Global financial crisis

1. INTRODUCTION

On March 11, 2020, The World Health Organization (WHO) declared the Covid-19 outbreak a global pandemic (WHO, 2020). The pandemic weakened the world economy as it did not only trigger a global health crisis but also a global economic crisis, causing labor supply shortages, reduced production through supply disruptions, and the closure of factories. Furthermore, the severe disruptions in the economy caused a rise in unemployment and revenue losses for businesses (Handoyo, 2020). According to Handayo (2020), uncertainty of the duration and intensity of the pandemic caused investors and consumers to reduce or delay investment and spending decisions. Moreover, the high uncertainty contributed to increased financial market volatility (Barro et al., 2020). The rapid spread of the virus across the world caused many countries to impose different restrictions e.g., lockdowns and travel bans, causing supply chain bottlenecks in the production structure which haltered major economic operations.

In order to lead economies to the path of recovery, restoring market stability and stimulating the economy, central banks have used unconventional monetary policy measures such as quantitative easing, henceforth QE (Fischer, 2021). The aim of QE operations is to reduce long-term interest rates by injecting liquidity through the purchases of securities e.g., government bonds and corporate bonds (Bernanke and Reinhart, 2004; Joyce et al., 2012). QE was first applied in Japan in 2001 as it dealt with deflationary pressures (Girardin and Moussa, 2011). After the global financial crisis, henceforth GFC, of 2008-09, the central banks of the US and the United Kingdom adopted QE measures to support the economic recovery (Joyce et al., 2012). In the Euro area and Sweden, QE programs were initially launched in 2015 with the aim of making monetary policy more expansionary and bring inflation back to its target level (De Rezende, 2017; Hartmann and Smets, 2018). Although several central banks have implemented QE programs, they exhibit different characteristics in terms of how they are implemented and combined with other unconventional monetary policy tools (Joyce et al., 2012). As for Sweden, the Swedish central bank, the Riksbank, launched its QE program with the main goal of avoiding appreciation of the Swedish krona and encourage banks to increase their lending. To achieve this, the asset purchases were concentrated in nominal government bonds (De Rezende, 2017). On February 1, 2020, the Swedish government classified Covid-19 as a threat to public health and a danger to society (Krisinformation, 2020). Due to the following turmoil on financial markets and the downturn in the economy, the Riksbank expanded their asset purchases to include treasury bills, covered bonds, municipal bonds and corporate debt

securities with the aim of facilitating the credit supply of the real part of the economy and increase the liquidity in the banking system (Sveriges Riksbank, 2020).

According to Sveriges Riksbank (2020), parallels can be drawn between the economic crisis in the wake of the Covid-19 pandemic and the GFC of 2008-09, however, major differences exist between the two crises. The GFC was a result of an endogenous shock that originated from within the financial system, i.e., the problem that arose in the real part of the economy were mainly indirect effects of the problems that arose in the financial sector. The Covid-19 crisis, however, emerged from an exogenous shock that originated from outside both the financial system and the economy, causing imbalances between supply and demand (Sveriges Riksbank, 2020). Thus, in comparison with the GFC, the Covid-19 crisis is not a monetary phenomenon per se. However, the consequences of the monetary response to Covid-19 can be viewed as a monetary phenomenon (Lane, 2022).

The injection of liquidity due to QE might lead to disequilibrium conditions in the economy (Gaffard et al., 2018). Furthermore, these imbalances might generate financial bubbles that could worsen the conditions in the economy (Echarte Fernández et al., 2021; Mulligan, 2021). According to the Austrian business cycle theory, henceforth the ABC theory (see e.g., Mises, [1924] 1980; Hayek, 1933; 1939; Huerta de Soto, 2006), unsustainable economic expansions are powered by policy-induced credit expansion, creating an investment boom through artificially low interest rates. However, according to the Financial instability hypothesis, hereafter the FIH (see Minsky 1986; 1992), economic expansion is unsustainable if it is driven by a process of an endogenous overoptimism and overleveraging. Mulligan (2013) and Mulligan et al. (2014) argue that the credit expansion that the ABC theory perceives as the cause of the business cycle is compatible with the overoptimism and overleveraging of the financial system described by the FIH. Thus, in terms of the FIH, credit expansion provides additional funds to finance overleveraging, creating malinvestment through the process of transforming hedge finance firms into speculative finance firms and Ponzi finance firms. As credit expansion increase the incentives for financial intermediaries to lend greater amounts at lower interest rates, making it cheaper to borrow, it intensifies the process of firms overleveraging themselves (Mulligan, 2013; Mulligan et al., 2014). However, as money is endogenous, the supply of credit must be matched by a corresponding demand (Gaffard et al., 2018). If there is a demand for credit, injecting liquidity due to QE will cause the process of malinvestment and financial instability described by Mulligan (2013) and Mulligan et al.

(2014). With a lack of demand, injecting liquidity will create an excessive amount of liquidity in the financial sector causing asset prices to rise (Gaffard et al., 2018). The boom type of asset price inflation reflects a scenario where asset prices accelerate at a faster speed than what they should have in a scenario of sound money in the economy. In terms of the boom type of asset price inflation, when asset prices exceed their fundamental value, the prices to not reflect the productivity growth, speculative bubbles and abnormal returns may occur (McQueen and Thorley, 1994; Brown, 2017).

1.1 Research aim and research question

The research question of interest is the following: *To what extent did quantitative easing (QE) contribute to abnormal returns at the Swedish stock market during Covid-19?*

To handle the economic crisis in the wake of the Covid-19 pandemic, the Riksbank launched its new QE program. QE is an unconventional monetary policy used by central banks as an attempt to increase liquidity in the economy. Therefore, this thesis aims at investigating whether unconventional monetary policy, in terms of QE, created abnormal returns at the Swedish stock market through the actions of the Riksbank during Covid-19. This thesis will contribute to the limited studies available on economics of Covid-19. In addition, this study acknowledges the differences and similarities between the GFC of 2008 - 09 and the Covid-19 pandemic when interpreting the results of the analysis.

1.2 Limitations

This thesis is limited to investigating the period of 2007-2022. The main period for analysis is 2020-2022, covering the Covid-19 pandemic years. During this period, the Riksbank launched its new QE program. However, to avoid research bias regarding the effect of QE on stocks, and to strengthen the results, it is of importance to include a time period before the outbreak of Covid-19. The time period of 2007-2015 includes the GFC and during this period, the Riksbank did not engage in QE. The time period of 2015-2020 includes the period when the Riksbank launched its first QE program.

Furthermore, this thesis is limited to investigating 40 Swedish companies, 20 large cap and 20 small cap, that have been listed on the Stockholm exchange during the whole time period, 2007-2022. The selection is limited to a total of 40 companies due to the narrow number of Swedish small cap companies listed during the whole time period. However, as the selected companies have survived both the GFC and the Covid-19 crisis, it is of importance to acknowledge the notion of selection bias. According to Hansen (2003), high market volatility might cause bankruptcies of companies, but since this thesis focuses on companies that have been listed during the whole period of 2007-2022, the appearance of bankruptcies caused by market volatility due to crises and macroeconomic imbalances are not captured. The motive behind choosing companies that have been listed during the whole time period of 2007-2022 is that it allows for the investigation of how the chosen companies behaved during the pre-pandemic period as well as during the pandemic.

2. BACKGROUND

2.1. Quantitative Easing

According to Joyce et al. (2012), the foundation that the central bank's monetary policy rested upon before the GFC of 2008-09 appeared secure and robust. The central banks used short-term interest rates as an instrument to achieve their objective of a low and stable inflation rate. By controlling the level of the short-term interest rate, the central banks could effectively manage the liquidity conditions in the money markets and pursue its primary objective. They argue that the operation of conventional monetary policy was a largely successful strategy for inflation targeting, but it did not prevent asset market bubbles from occurring. According to them, the GFC and its aftermath brought several challenges for monetary policy and central banks. Conventional monetary policy proved insufficient as it was constrained by the zero lower bound[1] (ZLB), putting the economy effectively in a liquidity trap[2]. The usual official rate did not impact market rates in the expected way and the usual monetary transmission

[1] The zero lower bound occurs when short-term nominal interest rates approach zero. As interest rates cannot become negative, conventional expansionary monetary policy cannot achieve much when the ZLB is at or near zero (Altavilla et al., 2019).

[2] A liquidity trap occurs when monetary policy becomes ineffective due to high savings rates and very low interest rates (Schmitt-Grohe and Uribe, 2014).

mechanism was not working. Consequently, central banks turned to unconventional monetary policies to aid the economy in its recovery.

The most common form of unconventional monetary policy has been QE which, unlike conventional monetary policy, aims to reduce long-term interest rates through purchases of securities by the central bank (Joyce et al., 2012). According to Bernanke and Reinhart (2004), the size of the central bank's balance sheet expands through the purchase of longer-term securities, affecting the supply of reserves and the money stock.[3] They argue that even with the interest rate at its ZLB, the central bank can increase the quantity of reserves through QE operations, encourage lending and investment, thus increasing the money stock. However, as pointed out by Gaffard et al. (2018), this increase of the money stock may not necessarily occur.

QE was first applied in Japan in 2001 as it dealt with deflationary pressures that followed the burst of the financial bubble in the 1990s (Girardin and Moussa, 2011). According to Girardin and Moussa (2011), the Bank of Japan, with the interest rate at its ZLB, aimed at providing ample liquidity using the current account balance as the main operating policy target. The hope was that by purchasing government securities from the banking sector and thereby boosting the level of cash reserves the banks held in the system, asset prices would eventually increase. After 2009, the Bank of Japan has introduced further QE programs to expand the monetary base and overcome deflationary pressures (Matsuki et al., 2015).

In the United States, QE programs were initially launched to support economic recovery after the federal funds rate reached the ZLB in 2008. To reduce long-term interest rates, the American central bank, Federal Reserve, completed three large-scale asset purchase programs (LSAP) by purchasing long-term treasuries and mortgage-backed securities (Eksi and Tas, 2017). In March 2020, the Federal Reserve established a new round of LSAP in response to the Covid-19 and announced that it would be purchasing $700 billion worth of treasuries and mortgage-backed securities to support the flow of credit to households and businesses (Federal Reserve, 2020).

To support the economic recovery after the GFC, the central banks of the United Kingdom and the European Monetary Union, Bank of England and European Central Bank (ECB),

[3] Note that, according to Gaffard et al. (2018), when the monetary base increases it does not directly imply a corresponding increase in the money supply.

respectively, have followed the Federal Reserve in adopting policies that have led to substantial increases in their balance sheets (Joyce et al., 2012). In the UK, the Bank of England began its Asset Purchase Facility (APF) as a measure to support the economy in the aftermath of the crisis. Through its QE operations, the Bank of England has overwhelmingly purchased UK government bonds from the non-bank private sector. In response to the shock of Covid-19, the Bank of England expanded its asset purchase program and announced several rounds of QE purchases totaling £896 billion (Bank of England, 2021).

In the Euro area, the ECB initially launched its Asset Purchase Program (APP) in 2015 with the aim to overcome the ZLB on interest rates in its attempt to bring inflation back to its target level (Hartmann and Smets, 2018). Under the APP, the ECB has overwhelmingly purchased government bonds, but also a range of other assets including corporate bonds, asset-backed securities and covered bonds (European Central Bank, 2022a). To counter the risks posed by Covid-19, the ECB announced the launching of the Pandemic Emergency Purchase Program (PEPP), which had an overall envelope of €1,850 billion (European Central Bank, 2022b). Furthermore, the ECB announced its third series of targeted longer-term refinancing operations (TLTRO)[4] to ensure favorable borrowing conditions and support the supply of credit during the pandemic. The intention was to increase the money supply as the monetary base increased through the PEPP (European Central Bank, 2022c).

According to De Rezende (2017) the Riksbank, just as the ECB, initially launched its QE program in 2015 with the aim of making monetary policy more expansionary. The main goal was to avoid a quick appreciation of the Swedish krona and encouraging banks to lend by lowering interest rates in various markets. To stimulate the economy and bring inflation to its 2 percent target, the asset purchases were concentrated in nominal government bonds with maturities ranging in the two- to eleven-year segment (De Rezende, 2017). Due to the downturn in the global economy and the significant turmoil on financial markets created by the Covid-19, the Riksbank announced on March 16, 2020, that they would extend and expand its asset purchases. Before the new purchase program began on March 18, 2020, the Riksbank had limited its asset purchases to government bonds in order to minimize risk. Furthermore, its holdings of government bonds amounted to approximately SEK 340 billion (Hansson and Birging, 2021). However, the Riksbank's QE measures to handle the economic crisis in the wake of the Covid-19 pandemic had a different focus than the QE measures taken from 2015.

[4] A first series of TLTRO was announced in 2014, and a second in 2016 (European Central Bank, 2022c).

The aim of the new QE measures was to facilitate the credit supply to the real part of the economy and increase the liquidity in the banking system. Furthermore, as several markets showed signs of deterioration in their functioning, the objective was to ensure that the market returned to a more normal functioning. Therefore, the Riksbank committed to purchase a broader type of securities (Sveriges Riksbank, 2022). Under the framework of the new purchase program, the Riksbank purchased government bonds, treasury bills, covered bonds, municipal bonds and corporate debt securities (Hansson and Birging, 2021). In December 2021, the Riksbank's holdings of securities amounted to approximately SEK 930 billion (Sveriges Riksbank, 2022).

2.2. Transmission mechanisms of QE and abnormal stock market returns

To shed light on the relationship between QE and the stock market in particular, it is necessary to recognize the transmission mechanisms through which QE may affect stock prices. According to Hildebrand (2006), the relationship between monetary policy and stock prices is complex since it can influence stock prices through several channels. First, if stocks are priced using the dividend discount model, the interest rate is used to discount future dividends. In addition, the value of domestic assets of a company may be affected by the interest rate while the value of its foreign assets and profits may be affected by the exchange rate. Hence, monetary policy affects stock prices via the interest rate as well as through its linkage to the exchange rate. Second, monetary policy influences the financing cost of a company and the availability of loans (Hildebrand, 2006). Moreover, Hildebrand (2006) argues that the effects monetary policy has on the real economy may influence the firm's profits as well as the commodity prices.

According to Alsterlind et al. (2015), there are mainly four transmission mechanisms through which QE measures can be expected to operate to reach sought market effects:

- **The signaling channel:** Purchases of government securities signal expansive monetary policy and low interest rate for a prolonged period of time. If the interest rate is hiked sharply before the purchased bonds have matured, the central bank will incur losses[5].

[5] When the Riksbank purchases securities, they deposit newly created electronic money in the commercial banks' account at the Riksbank and thus, the total surplus increases. Since the Riksbank pays interest on this surplus, they will incur a loss if the interest, on average, proves higher than the interest received on the security. (Alsterlind et al., 2015).

Thus, the credibility of a future low interest rate is strengthened causing a reduction in market uncertainty.

- **The premium channel:** When the central bank is purchasing a particular security e.g. long-term government bonds, the outstanding volume decreases in exchange for risk-free reserves. Given that a large share of investors is reluctant to purchase other asset classes, the premium on long-term bonds will decline, the prices will increase and hence, the interest rate will fall.
- **The portfolio balance channel:** As purchases of long-term government bonds influence premiums, it may cause contagion effects to prices of other assets. When the yield for long-term government bonds declines, it causes investors to seek higher returns from riskier assets. Investors will keep rebalancing their portfolios to counteract the decline in yields and hence, they increase the demand for riskier assets. This process will increase asset prices and reduce yields on the market, causing a broad decline in interest rates in the economy.
- **The liquidity channel:** Purchases of securities by the central bank causes the commercial banks to experience an increase in their reserve balances at the central bank. As the volume of liquidity in the banking system increases, the liquidity risk decreases[6]. Thus, the availability of bank credit might be improved.

Through these four channels, the effects of QE may be transmitted to the stock market. The signaling effect, the premium effect and the portfolio rebalancing effect would make long-term investment less attractive and create incentives for investors to seek higher returns in riskier assets (Alsterlind et al., 2015). This indicates that an increased monetary base does not necessarily lead to a corresponding increase in the money supply, which, consequently, causes disequilibrium conditions in the economy (Gaffard et al., 2018). When long-term investments are perceived as less attractive, it creates incentives for investors to weight their portfolios towards riskier assets e.g., stocks. This will increase the demand for stocks and, all else equal, stock prices. According to Alsterlind et al. (2015), it is, however, a necessary condition that different assets are not perceived as perfect substitutes. If the condition is met, however, it might lead to speculative bubbles and abnormal returns as stock prices continue to increase. McQueen and Thorley (1994) argue that speculative bubbles allow stock prices to deviate from their fundamental values, without assuming irrational investors. Hence, the rise of speculative

[6] The increased liquidity reduces the probability of banks to end up with an excessive deficit (Alsterlind et al., 2015).

bubbles, and thus abnormal returns, may occur as the stock prices exceed their fundamental value. Furthermore, investors realize that the stock prices exceed their fundamental values, but they are convinced that the over-valuation of stocks will continue, causing the bubble to expand further. Empirical characteristics of such bubbles include a long-run of positive abnormal returns that eventually will lead to a crash (McQueen and Thorley, 1994). In addition, Brown (2017) postulates that asset price inflation, in terms of abnormal returns, arises as a consequence of disequilibrium conditions that are caused by a monetary disorder. The boom type of asset price inflation is characterized by irrational exuberance and occurs in the context of good economic outcomes that includes accelerating productivity growth and flourishing investment opportunities. According to Brown (2017), yielding higher returns fuel the positive feedback loop that reinforces the credibility of speculative stories, which engender irrational exuberance that causes malinvestment. In the context of interest being below the natural level, good performance on risky investments will fuel the progressive over-optimism that underpin investment choices. Furthermore, boom type asset price inflation reflects a scenario where prices of goods and services grow at a faster speed than what they would in a scenario of sound money in the economy (Brown, 2017).

Moreover, the process of falling interest rates would lower the cost of borrowing and the liquidity effect may, if the liquidity channel is functioning successfully, simultaneously, promote an expansion of loans provided by commercial banks (Alsterlind et al., 2015). With a corresponding demand, this could encourage investment spending and create incentives for companies to borrow money in order to expand their business. As a business expansion may be perceived as a positive outlook on future demand, investors might be interested in buying stocks which would cause stock prices to rise.

3. PREVIOUS RESEARCH

3.1 QE and the real economy

The effects of unconventional monetary policies on the economy have been the subject for several studies through recent years. Gaffard et al. (2018) points out the limited impact QE has on the economic growth in European countries. They argue that the increased supply of credit has not been matched by a corresponding demand for credit. This is partly because of the low demand expectations of firms and households, and partly because of the increasing

financialization that causes both the share of financial activities by non-financial firms and the amount of liquidity remaining in the financial sector to increase. Perillo et al. (2018) also conclude that QE has had a small effect on the real economy. They point out that there has been a small increase in bank lending activity. Although, this increase has been due to increased bank loans to the Euro system and not due to increased lending activity addressed to the real economy.

Wullweber (2020) argues that the permanent unconventional measures taken by central banks since the global financial crisis of 2008-09 did not sustainably stabilize the financial system, though the measures managed to temporarily restore stability. Furthermore, the author argues that the financial system was highly prone to instabilities with strongly leveraged firms, and that a huge asset bubble had built up during the years before Covid-19. Thus, the global financial system was already in an unstable condition before the pandemic. Likewise, Echarte Fernández et al. (2021) argue that the world economy was stagnating before the Covid-19 pandemic appeared and that the outbreak of the Covid-19 pandemic triggered the crisis that was already brewing. Furthermore, the authors argue that the injection of liquidity, through QE measures, into markets that are suffering the consequences of the Covid-19, is largely hiding the risk of assets, causing long-term investment errors in the financial markets[7]. The authors conclude that the injection of liquidity perpetuates imbalances and generates financial bubbles that eventually will cause a crisis of greater severity and thus, the expansionary monetary policy should not be a long-term solution.

3.2 Monetary policy and stock markets

Lima et al. (2016) utilize an autoregressive distributed lag (ADL) approach to examine if QE, pursued by the central banks in the US, the UK and Japan, was effective to increase the market share after the subprime crisis[8]. The authors examine the long-run relationship among the variables through the ARDL-model and use the Pesaran et al. (2001) bounds test for cointegration to test the existence of long-term relationship amongst the variables. Their

[7] This statement agrees with the ABC theory and the FIH (see e.g., Mises [1924] 1980; Hayek 1933; 1939; Minsky 1986; 1992; Huerta de Soto 2006).
[8] The Subprime mortgage crisis of 2007-2010 was developed due to an earlier expansion of mortgage credit (Duca, 2013).

research finds that there are strong indications that the QE implemented had a positive impact on the stock market. Furthermore, the results shed some light on the conduction of monetary policy in times of crisis.

Cepni et al. (2021) analyze how conventional and unconventional monetary policy shocks affect the stock market in sentiment-based regimes, by using a panel vector autoregression (VAR) model. Furthermore, the authors control for the monetary policy shock in the model by applying both zero and sign restrictions. They conclude that an expansionary monetary policy shock would create a large diversity from the equilibrium prices when the sentiments are high, compared to low. Thus, the results add a behavioral channel through which monetary policy can influence equity prices. Furthermore, they conclude that bubbles are more likely to originate due to over-exuberance under higher investor sentiment, and therefore, in attempt to avoid bubbles, the policy authorities should consider the level of investor sentiment when defining monetary policy decisions that are likely to have an effect on the stock market.

Al-Jassar and Moosa (2018) analyze the impact of the QE policy tool on stock prices through a structural time series approach. They define QE as the growth and size of the Federal Reserve's balance sheet when acquiring securities bought in exchange for newly created money. They find that QE has a positive effect on stock prices, but these effects are not exclusively a contribution to the reaction of stock prices. Stock prices are in addition affected by missing variables in terms of secular trend representing long-term movements and periodic variation representing business cycles. Hence the performance of the stock market cannot be exclusively related to QE.

3.3 Summary of previous research

The research mentioned concludes that unconventional monetary policy affects the real economy, but to a certain degree, and that when pursuing a credit-driven expansion policy, the intention of increasing the supply of credit may not be met with a corresponding demand for credit (Gaffard et al., 2018; Perillo et al. 2018). Furthermore, the credit expansion during the Covid-19 crisis may cause the appearance of financial errors and malinvestments when liquidity injection is progressed towards markets suffering consequences of Covid-19, which hides the risks of asset, contributing to long-term investment errors in the financial markets (Echarte Fernández et al., 2021).

3.4. Research contribution

This thesis contributes to previous studies by applying the ABC theory and the FIH when studying the economy's response to unconventional monetary policies, such as QE, through the stock market, by using the ADL error correction model. The model selection process for the research is based on the assumptions presented in Lima et al. (2016), where the long-run relationship among the variables is examined through the ARDL model.[9] This thesis differs from similar studies through the limitations of Sweden and the Swedish stock market when incorporating, not only returns, but abnormal returns on the stock market of interest. In addition, the research contributes to studies of Covid-19 and economy. Thus, this thesis aims at investigating to what extent QE contributed to abnormal returns at the Swedish stock market during Covid-19.

4. THEORETICAL FRAMEWORK

4.1 Money creation and money endogeneity

According to Gaffard et al. (2018), money creation largely results from the process of expansion in banks' leveraging. Furthermore, banks' leveraging is constructed through financial interconnections and assets among banks and other financial institutions. This has consequences for the assets and liabilities of banks and hence for credit supply. In a financial system, the assets and liabilities of banks, their leverage, is interdependent and must jointly be determined (Gaffard et al., 2018). They argue that QE measures may affect this process by altering the liquidity conditions for the banks and the prices of financial assets. Furthermore, the central bank can affect the amount of credit supplied to the real economy through its influence on the shaping of banks' leveraging and deleveraging dynamics and thus, QE may be an effective tool to avoid the emergence of a financial crisis (Gaffard et al., 2018).

However, as the supply of credit must be matched by a corresponding demand for credit, the effectiveness of QE and its impact on the real economy does not solely depend on factors that the central bank can control. Furthermore, money endogeneity implies that the supply of money is dependent of the demand and thus, an expansion of the monetary base due to QE does not

[9] Optimally, an agent-based process analysis would have been used for this paper (see e.g., Leijonhufvud, 2006). However, considering the time frame, such analysis was not applied to this thesis.

strictly imply that the money supply increase. Endogenous money can be defined in the sense that credit makes deposits (Wicksell, [1906] 1966; Mises, [1924] 1980; Gaffard et al., 2018). According to the Post-Keynesian view, the money stock responds endogenously to changes in demand for credit, implying that the stock of money reacts to changes in the level of money wages (Moore, 1979). If investors observe that asset prices are high due to excess of liquidity, and not because of a growing real economy, they might expect a future decrease in prices and thus, they will be reluctant to invest in real assets (Kroll, 2018). With an existent reluctant to invest in real assets, QE will, consequently, cause an excessive amount of liquidity in the financial sector as the supply of credit is not matched by a corresponding demand for credit (Gaffard et al., 2018). Furthermore, if an increase in asset prices is a result of excess liquidity, it might create speculative bubbles and abnormal returns on the stock market due to the boom type of asset price inflation. The boom type of asset price inflation occurs when prices of goods and services grow at a faster speed than what they would in the scenario of sound money in the economy (Brown, 2017; Gaffard et al., 2018).

According to Wicksell ([1898] 1936), the definition of the natural rate of interest emphasizes the relationships between saving and consumption as well as investment and production of consumption goods. The natural rate of interest on loans is neutral in respect to commodity prices, reflecting a stable price level. However, when banks lend money with a lower interest rate than the natural rate, the equilibrium conditions of the economy will be disrupted. If the market rate of interest is lower than the natural rate, and prices remains unchanged, entrepreneurs will acquire a surplus profit above their real entrepreneurial profit. Consequently, the demand for services, raw materials and goods increases, causing commodity prices to rise (Wicksell [1898] 1936). When the market rate of interest is above the natural rate, Wicksell ([1898] 1936) argue that the opposite will appear. Thus, if prices remain unchanged, entrepreneurs will experience a loss of income and the demand of goods and services decreases relative to the supply, causing prices to fall. According to Wicksell ([1898] 1936), when market rate of interest reflects the natural rate of interest, there is an equilibrium condition meaning that savings are equal to investments and thus, the supply and demand in the market for goods and are equal as well. Furthermore, the money rate of interest would, according to Wicksell, reflect the rate of interest in the capital markets. The relationship of the money market and the capital market can be viewed through the actions of banks pursuing restrictive measurements regarding the quantity of means of payment, leading to a constraining effect on producers' demand for credit. The encourage saving behavior, would result in decreased prices (Wicksell,

[1898] 1936). According to Leijonhufvud (2000), it is difficult for policymakers and market participants to know the level of the natural rate of interest, causing the appearance of disequilibrium conditions. If the central bank stabilizes the interest rate by providing the banking system with the freedom to rediscount at the initial current interest rate, the sectors that should expand will do so rapidly causing other sectors and consumers to be directed towards a general boom. In the presence of a low market rate of interest, the natural rate of interest is probably low as well, causing a decrease in investments of industrial production in the economy. If the injection of liquidity due to QE creates an excessive amount of liquidity in the financial system, asset prices will rise above their fundamental values. When the returns from financial investments do not reflect the fundamentals of the economy, e.g., the industrial production, it can be interpreted as abnormal returns in terms of the boom type of asset price inflation (Leijonhufvud, 2000; Brown, 2017).

4.2 The Austrian business cycle and the financial instability hypothesis

The ABC theory perceives unsustainable economic expansion as a result from an exogenous credit expansion causing artificially low interest rates (Hayek, 1929). The FIH, however, perceives economic expansion as unsustainable if it is driven by a process of an endogenous overoptimism and overleveraging (Minsky, 1992). Mulligan (2013) and Mulligan et al. (2014) argue that the credit expansion of production that the ABC theory postulates as the cause of the business cycle is compatible with the overleveraging of the financial system and the practices of actors described by the FIH. The FIH describes a similar process as the ABC theory, where optimism rather than credit expansion causes firms to overleverage themselves and hence, they share a significant overlap. Furthermore, as the credit expansion lowers the cost of borrowing through artificially low interest rates, it intensifies and exacerbates the process of firms overleveraging themselves (Mulligan, 2013; Mulligan et al., 2014).

According to the FIH, the economy has both stable and unstable financial regimes, and prolonged periods of prosperity transform the economy from financial relations that make for a stable system to financial relations that make for an unstable system (Minsky, 1986). The FIH classifies heterogeneous firms into three categories based on a balance-sheet typology: hedge, speculative and Ponzi finance. This characterization reflects the capacity of firms to service their debt from their operating cash flows. Hedge finance firms are those which can service

both interest and principal with their cash flows from operations. Speculative finance firms cover interest on debt, but their cash flows from operations are not sufficient for repayment of the principal. Such firms must take on new loans in order to reduce the principal of existing loans. For Ponzi finance firms, the cash flows from operations are not sufficient to cover the interest on their debt or the repayment of principal. Such firms will have to increase their indebtedness by borrowing increasing amounts or to sell off assets in order to pay interest. Since more-leveraged firms expose the financial sector to greater risk, the mixture of hedge, speculative and Ponzi finance in an economy is a major determinant of its stability (Minsky, 1992).

In the view of the FIH, the capitalist economy endogenously becomes financially fragile as sufficiently long periods of economic expansion engender the optimism that causes borrowers and lenders to systematically underestimate the actual risk of financing activities (Minsky, 1986). Actors progressively underestimating risk, causing the process of firms overleveraging themselves and assets to be systematically over-valued, transforms the financial system from an initial robust system with hedge finance firms to a fragile system dominated by speculative and Ponzi finance firms (Minsky, 1986). As the economy becomes increasingly dominated by speculative and Ponzi finance firms, the risk-adjusted returns are lowered economy-wide (Mulligan et al., 2014). Further on, when asset prices stop rising beyond their real value, speculative and Ponzi finance firms are forced to sell off assets to meet interest payment demands, creating an oversupply of assets offered for sale. The resulting occurrence of debt deflation causes a liquidity shortage and financial crisis (Minsky, 1986).

As QE is a tool to spur economic growth by injecting liquidity in the banking system, the Riksbank presumes that it might cause commercial banks to increase their lending to households and companies (Sveriges Riksbank, 2020). As postulated by the FIH, when the demand of money is high, economic expansion creates too optimistic expectations of future profits, causing prices on assets to increase beyond their real value and households and companies to be overleveraged (Minsky, 1986). Thus, if QE measures taken by the Riksbank result in an excessive leveraging of households and companies, it might cause future problems of debt deflation and financial fragility as interest rates normalize and asset prices stop rising. However, as pointed out by Gaffard et al. (2018), since the demand for credit has been low, the injection of liquidity due to QE has resulted in companies being underleveraged relative to the monetary base.

In the view of the ABC theory, business cycles are caused by malinvestment powered by policy-induced credit expansion creating an investment boom through artificially low interest rates. Even in the absence of additional savings, credit expansion lowers the interest rate and increases the supply of loanable funds which encourages firms to borrow even greater amounts (Hayek, 1939). If the demand for credit is high, the injection of credit through expansionary monetary policy drives a wedge between saving and investment as it simultaneously, though unsustainably, increases both consumption and investment, causing resources from the middle stages of production to systematically transfer to earlier and later stages of production (Hayek, 1935; Mises, 1949). Credit expansion causes entrepreneurial planners to act as if saving has increased, even if it has not, through artificially low interest rates. When the market rate of interest is below the natural rate, it will encourage investments and discourage savings (Wicksell, [1898] 1936). As investments exceed savings, it will generate an entrepreneurial error causing a process of malinvestments, characterized by entrepreneurs shifting productive activity from short-term investment projects into predominantly long-term investment projects. Thus, the ABC theory postulates that injections of liquidity consequently engender unsustainable economic expansion by causing malinvestment and overconsumption.

The production structure fails to reflect actors time preferences and cannot sustainably transform the overly large volume of intermediate output from early stages of production, through the middle-stage productive activities, into the overlarge desired amount of late-stage consumable output and thus, it is unsustainable (Hayek, 1935; Mises, 1949). Credit expansion and the resulting transition to more capitalistic means of production causes business cycles as it creates a boom that will lead to a bust. As interest rates rise, it will create a massive abandonment of production plans causing a transition to less capitalistic means of production, reflecting the occurrence of a recession (Hayek, 1933; Mises, 1949).

According to Hayek (1945), no central planner can possess all available knowledge dispersed across society as efficiently as decentralized market participants coordinated by the price system. Thus, economic activity can be described as decentralized planning, reflecting the amount of relevant knowledge associated with the market participants (Hayek, 1945). According to Mulligan (2013), as a central bank engages in QE, difficulties arise for entrepreneurs in finding the optimal resource allocation when constructing their entrepreneurial plan. Through QE operations, the central bank expands the size of the balance sheet in order to provide commercial banks with more liquidity (Bernanke and Reinhart, 2004). In the view of

the ABC theory, credit expansion created through expansionary monetary policy e.g., QE, causes a disequilibrium condition engendered by malinvestment (Hayek, 1939).

According to Mulligan (2013) and Mulligan et al. (2014), the FIH describes the dynamics of the malinvestment and unsustainable expansion phase of the business cycle. In terms of the FIH, credit expansion provides additional funds to finance overleveraging, creating malinvestment through the process of transforming hedge finance firms into speculative finance firms and Ponzi finance firms. Simultaneously, it creates incentives for the financial sector to lend greater amounts at lower interest rates, making it cheaper to borrow. As QE increases the liquidity in the banking system, it also increases the amount of credit available for borrowers (Sveriges Riksbank, 2020). However, investments depend on expected profit opportunities. As pointed out by Gaffard et al. (2018), increased supply of credit must be matched by a corresponding demand for credit, otherwise it will cause an excessive amount of liquidity in the financial sector. Furthermore, excess liquidity implies that the process of overleveraging and malinvestment will not occur. With a corresponding demand of credit, injecting liquidity to recover from the Covid-19 recession may create speculative bubbles as it will fuel the progressive overoptimism. Furthermore, when the market rate of interest is below the natural rate, investors will want to borrow more money than savers are willing to save, causing disequilibrium conditions in the economy (Wicksell, [1898] 1936). As central banks utilize QE measures, commercial banks can accommodate the excess demand by increasing the supply of credit, causing demand, and thus prices, to increase. This could substitute a new unsustainable expansion for a sustainable recovery with hedge finance firms being displaced by speculative and Ponzi finance firms. According to Mulligan et al. (2014), lending to speculative and Ponzi finance firms imposes a greater risk on the financial system and therefore it becomes increasingly difficult to coordinate interdependent entrepreneurial plans. Entrepreneurial planners' ability to coordinate production will eventually be overwhelmed by the external risk[10], causing the production structure to collapse (Mulligan et al., 2014). However, this presumes that the supply of credit is matched by a corresponding demand for credit, causing the leveraging to increase relative to the monetary base, as pointed out by Gaffard et al. (2018). Thus, if money is endogenous, it is of importance to consider the demand for credit. When there is a demand for credit, injecting liquidity through QE measures will cause malinvestment and financial instability. Furthermore, this might cause speculative

[10] According to the ABC theory, the risk is a product of exogenous credit expansion, while for the FIH, it is endogenous (Mulligan et al., 2014).

bubbles through the process of overleveraging and overoptimism (Mulligan, 2013; Mulligan et al., 2014). With a lack of demand, injecting liquidity will create an excessive amount of liquidity in the financial sector, which implies that the process of overleveraging and malinvestment will not occur. The excess liquidity will, however, create higher asset prices that might, in turn, cause speculative bubbles in terms of the boom type of asset inflation (Brown, 2017; Gaffard et al., 2018).

5. HYPOTHESIS

If money is endogenous, that is, money supply is determined by the demand for money, a demand for money will lead to an increase of the monetary base due to QE. However, if this demand for money does not exist, there will be no credit expansion through QE. Furthermore, if there is an increased demand for money, the credit creation through QE will lead to malinvestment and financial instability. With a lack of demand for money, it will cause excess liquidity and asset prices will increase through the boom type of asset price inflation, but the amount of malinvestment and financial instability in the economy will decrease. Thus, investors will be underleveraged because of the low ratio of debt capital to equity capital, but they will also be in a situation where they might gain abnormal returns through the boom type of asset price inflation.

Hence, the hypothesis states that *when the Riksbank pursued with the new QE program during Covid-19, depending on the demand for credit, it caused abnormal returns through the boom type of asset price inflation.*

6. DATA

6.1. Financial data

The financial data consist of historical closing prices, returns and trade volumes for each share selected for the thesis. The data is of weekly frequency and covers the period January 5, 2007, to February 4, 2022, and was provided from the financial software Refinitiv. The selected shares consist of 20 large cap shares and 20 small cap shares, constituting two artificial

portfolios constructed for the thesis. In accordance with Minsky's (1992) classification of heterogeneous firms, one portfolio, the low-risk portfolio, consist of large cap firms that are expected to exhibit lower risk of becoming speculative or Ponzi finance firms, and the other portfolio, the high-risk portfolio, consist of small cap firms that are expected to exhibit higher risk of becoming speculative or Ponzi finance firms. Thus, a higher degree of malinvestment and financial instability are expected to have appeared in the firms that constitute the high-risk portfolio when the Riksbank expanded its balance sheet through QE measures during the Covid-19 pandemic.

Both portfolios are equally weighted, meaning that the same weight, or importance, is assigned to each share in the portfolio. The reasoning for using equally weighted portfolios instead of value weighted portfolios is to give the same weight to each share, instead of giving a greater weight to larger shares. Furthermore, as the time frame is long, value weighted portfolios would have required continuous rebalancing as the share values change over time. As the portfolios are not rebalanced during the time frame of the thesis, the firms that constitute the portfolios have been listed on the Stockholm Exchange since 2007. Thus, the selection of shares has been limited. Furthermore, the portfolios have been diversified among a variety of sectors to reduce risk of market volatility that could arise within one specific sector. For information about selected shares and sectors for each portfolio, respectively, see Appendix table A.

6.2. Macroeconomic indicators

QE is measured as the size of the Riksbank's balance sheet. Data with historical information about the size of the Riksbank's balance sheet is retrieved from the Riksbank's weekly reports and thus, the data is of weekly frequency and covers the time frame of the thesis. As QE is expected to lower the long-term government bond yield, affecting interest rates and credit supply, it is an important indicator of the functioning of QE. Data with information about the Swedish ten-year government bond yield is provided by the Riksbank.

The industrial production index is an indicator of growth in production and is a measure of the fundamentals of the economy. Data with information about the industrial production index is retrieved from Statistics Sweden. The index is adjusted for calendar and seasonal effect and covers the time frame of the thesis. The index is presented in monthly percentage changes. As

the index is expected to have a stable growth over time, the monthly data is transformed into weekly data. Thus, the percentage changes are held constant during the months.

Lending to households and non-financial companies is an indicator of the leverage of households and non-financial corporations. Data with information about the growth rate of lending to households and companies is retrieved from Statistics Sweden. The data is presented in monthly percentage changes. The data is transformed into weekly frequency.

7. METHODOLOGY

7.1. Time series analysis

The aim of this thesis is to analyze to what extent QE has contributed to abnormal returns during Covid-19. The first step is to investigate whether QE has an effect on stock returns, specifically by studying the size of the Riksbank's balance sheet and two artificially constructed portfolios representing, based on the theoretical framework, low-risk and high-risk, respectively. As the attempt is to measure how the size of the balance sheet has affected the portfolio returns for some given time periods of interest, the appropriate approach is regression through a time-series model with autoregressive characteristics. Therefore, the autoregressive distributed lag (ADL) model will be used, as it provides a method to empirically investigate the causal relationship between the size of the Riksbank's balance sheet and the returns on the two portfolios. The portfolios are treated separately, as two different time series, but include the same explanatory variables. Furthermore, the time series are divided into three time periods. The main period covers the pandemic years, January 10, 2020, to February 4, 2022. The first pre-pandemic period covers the years January 5, 2007, to January 2, 2015. During this period, the Riksbank did not utilize QE as an expansionary monetary policy tool. The second pre-pandemic period covers the years January 9, 2015, to January 3, 2020. During this Period, the Riksbank initially launched QE and started to expand its balance sheet through purchases of longer-term government bonds.

7.2 Stationarity and the Augmented Dicky-Fuller test

When analyzing time series data, there is generally a stationary requirement for the variables in the data set, meaning that their mean and variance do not vary over time. From a probabilistic point of view, stationarity requires the future to resemble the past (Stock and Watson, 2020; Shrestha and Bhatta, 2018). Concerning autoregressive models, probability distribution needs to be the same regardless of the time period, which can be viewed in the expression below:

$$E(Y_t) = E(Y_{t-s}) = \mu, for\ some\ s > 0$$

$$Var(Y_t) = Var(Y_{t-s}) = \sigma y^2\ and$$

$$Cov(Y_t, Y_{t-s}) = \gamma_s \tag{1}$$

Where $E(Y_t)$ is the expected value of Y at period t, Var is the variance representing the variation of spread of Υ_t from $E(\Upsilon_t)$, Cov is the covariance representing the joint variation of Υ_t, and Υ_{t-s} and Υ_{t-s} is the lag of Y up to period $t-s$.

Υ_t is stationary if the above conditions are met. If the criteria do not hold, the time series is nonstationary, meaning that it has trends, or seasonality, that will yield misleading results due to spurious regressions. Non-stationarity implies that there is a random walk with or without a drift, or a stochastic trend, in the time series. This can be eliminated by differencing the series. To test whether a time series variable is non-stationary, the Augmented Dickey-Fuller (ADF) test can be performed to test for unit-roots (Shrestha and Bhatta, 2018; Stock and Watson 2020).[11] The ADF test and its hypothesis are presented below:

$$\Delta y_t = \mu + \delta Y_{t-1} + \sum_{i=1}^{k} \beta_i \Delta y_{t-i} + e_t$$

$$H_0: \delta = 0, Y_t\ is\ not\ stationary$$

$$H_a: \delta < 0, Y_t\ is\ stationary \tag{2}$$

[11] See Dickey-Fuller test presented in Dickey & Fuller (1979).

Where μ is the constant term, e_t is the error term, k is the number of lags, $\Delta Y_t$is the first difference of y_t, i.e. $y_t - y_{t-1}$, and δ is $\alpha - 1$ where α is the coefficient of $y_t - 1$.

7.3. Optimal lag order selection

The ADL model uses lagged versions of both dependent and explanatory variables. Selecting the optimal lags for each variable is important as the number of lags poses a risk of missing out on crucial information. To estimate the optimal number of lags for each variable in the model, the Akaika information criterion (AIC) will be used. The AIC is expressed as follows (Stock and Watson, 2020):

$$AIC(p) = \ln\left[\frac{SSR_{(p)}}{T}\right] + (p+1)\frac{2}{T} \tag{3}$$

Where p represents the number of lags that minimizes the AIC value. $SSR_{(p)}$ is the sum of squared residuals of the estimated autoregression with p lags, and T represents the number of time periods, which could be in the form of quarters or months (Stock and Watson, 2020).

7.4. ADL, Bounds cointegration test, and the ECM

As mentioned, the stationarity requirement of time series data is essential in order to achieve reliable estimations. If variables are stationary at different levels, meaning that they are integrated of different orders, limitations may arise regarding the usage of certain time series models, e.g., the vector autoregression model (VAR). However, the ADL cointegration techniques would be desirable to apply in such a case as it has the advantage of being able to combine both variables that are stationary at level state I(0) and variables that are stationary at first difference level I(1) (Nkoro and Uko, 2016). An additional advantage with the ADL model is that the sample size does not have to be large in order for the model to produce reliable results when testing for cointegration. The bounds test for cointegration is useful to test the presence of the long-run relationship between the variables (Pesaran et al., 2001). If the results show that there is cointegration, i.e., there is a long-run relationship, the ADL model can be

reparametrized to include an error correction term, which is referred to as an error correction model (ECM) (Engle & Granger, 1987; Nkoro and Uko, 2016).

Conclusively, the ADL (p,q,...,q) model is expressed as:

$$Y_t = C_0 + \sum_{i=1}^{p} \alpha_i Y_{t-i} + \sum_{i=0}^{q_1} \beta'_{1,i} X_{1,t-i} + \ldots + \sum_{i=0}^{q_4} \beta'_{4,i} X_{4,t-i} + \epsilon_t \quad (4)$$

If the bounds test of cointegration show that there is a long-run relationship, the ADL model is reparametrized to include an error correction term. The ECM model through the inclusion of an error term:

$$\Delta Y_t = c_0 + \theta(Y_{t-1} - \emptyset X_{k,t-1} - \ldots - \emptyset X_{k,t-1}) + \sum_{i=1}^{p-1} \gamma_i \Delta Y_{t-i} + \sum_{i=0}^{q_1-1} \varphi'_{1,i} \Delta X_{1,t-i} + \ldots + \sum_{i=0}^{q_4-1} \varphi'_{4,i} \Delta X_{4,t-i} + \varepsilon_t \quad (5)$$

Where c_0 is the constant term, p is the optimal lags for the dependent variable, k is the number of independent predictors, $q_k$is the optimal lags for the independent variable k, ΔY is the first difference of the dependent variable in time t, $\Delta X_{k,t-i}$ is the first difference of independent variable k in time $t - i$, γ is the coefficient for the dependent variable, φ_k is the coefficient for the independent variables k, $\emptyset = \frac{\sum_{j=0}^{k} \varphi_j}{\theta}$ is the long-run coefficients for k independent predictors, and $\theta = 1 - \alpha$ is the speed of adjustment.

Furthermore, the ECM investigates the long-run relationship between variables and the short-run dynamics. In equation 5, the square brackets represent the long-term variables, and the first differences of the variables are for the short-run.

In table 1, the variables included in the model are described.

Table 1: Descriptions of variables

Variable	Variable type	Description
LRreturn	Dependent	The equally weighted low-risk portfolio returns. The portfolio represents firms with lower risk of being speculative or Ponzi finance firms. For information about included shares, see Appendix table A.
HRreturn	Dependent	The equally weighted high-risk portfolio returns. The portfolio represents firms with higher risk of being speculative or Ponzi finance firms. For information about included shares, see Appendix table A.
logBalanceSheet	Explanatory	The Riksbank's balance sheet. The size of the balance sheet is a measurement for QE. The variable has been logarithmically transformed.
SEgvb10y	Explanatory	The Swedish ten-year government bond yield. The yield influences interest rates, and thus the stock market. As QE lowers the yield, it is an important indicator to include.
IPI	Explanatory	Industrial production index. The index is adjusted for calendar and seasonal effects. The index is presented in monthly percentage changes. The variable has been transformed into weekly data.
logLRtradevolume	Explanatory	The sum of the trade volumes for all shares that constitutes the low-risk portfolio. The variable is included as it might reflect investors sentiment and expected future earnings. The variable has been logarithmically transformed.
logHRtradevolume	Explanatory	The sum of the trade volumes for all shares that constitutes the high-risk portfolio. The variable is included as it might reflect investors sentiment and expected future earnings. The variable has been logarithmically transformed.

7.5. The modified CAPM

The CAPM estimates the expected return on an investment given its systematic risk and provides a benchmark rate of return for evaluating investments. The model assumes that investors are single period planners who agree on an identical input list to identify an efficient, i.e., mean-variance optimal, risky portfolio. The CAPM equation is expressed as (Bodie et al., 2021):

$$(r_i) = E(r_z) + \beta_i[E(r_M) - E(r_z)] \tag{6}$$

Where $E(r_i)$ is the expected return $E(r_z)$ is the risk-free rate, β_i is the market risk, and $E(r_M)$ is the expected market return.

As the aim of this thesis is to investigate to what extent QE contributed to abnormal returns at the Swedish stock market during Covid-19, on the basis of the theoretical framework specified in section 4, a modified version of the CAPM is applied, inspired by Sechrest (2006). Sechrest applies the modified CAPM to the ABC theory of malinvestments, and thus examines disequilibrium processes through an equilibrium model. The growth rate of the industrial production in Sweden will reflect the fundamentals of the economy and thus, the expected return of the portfolios. To examine whether the returns are normal or abnormal, the growth rate of the industrial production is subtracted from the portfolios' returns and the calculated differences are compared to a benchmark estimated by the standard deviation, representing the normality.

8. RESULTS

8.1 Descriptive statistics

In table 2, descriptive statistics for the variables used in the analysis are presented for the period January 10, 2020, to February 4, 2022. The mean, standard deviation, minimum, maximum, median, variance, skewness, and kurtosis for each of the variables are presented. The return variable has the approximate mean value of 0.4 for the low-risk portfolio and the approximate mean value of 0.6 for the high-risk portfolio, which indicates that the return for the high-risk portfolio has, on average, been higher than the return for the low-risk portfolio. In addition, concerning the return variable, the deviations from the mean value are measured through the

standard deviation, where the low-risk portfolio has a standard deviation of approximately 2.9 and the high-risk portfolio has a standard deviation of approximately 3.2. Thus, both the mean and dispersion around the mean are higher for the high-risk portfolio compared to the low-risk portfolio. Furthermore, the mean value of the return variable, for both portfolios, respectively, is less than the median value, confirming the negatively skewed results. This implies that for the return variable in both portfolios, there is an asymmetry that deviates from the normal distribution. In addition, the kurtosis for both portfolios of the return variable is positive with a value over three, indicating that the kurtosis is leptokurtic, thus it produces more outliers than the normal distribution and is more heavy-tailed compared to the normal distribution (Stock and Watson, 2020).

Table 2: Descriptive statistics, 2020-2022

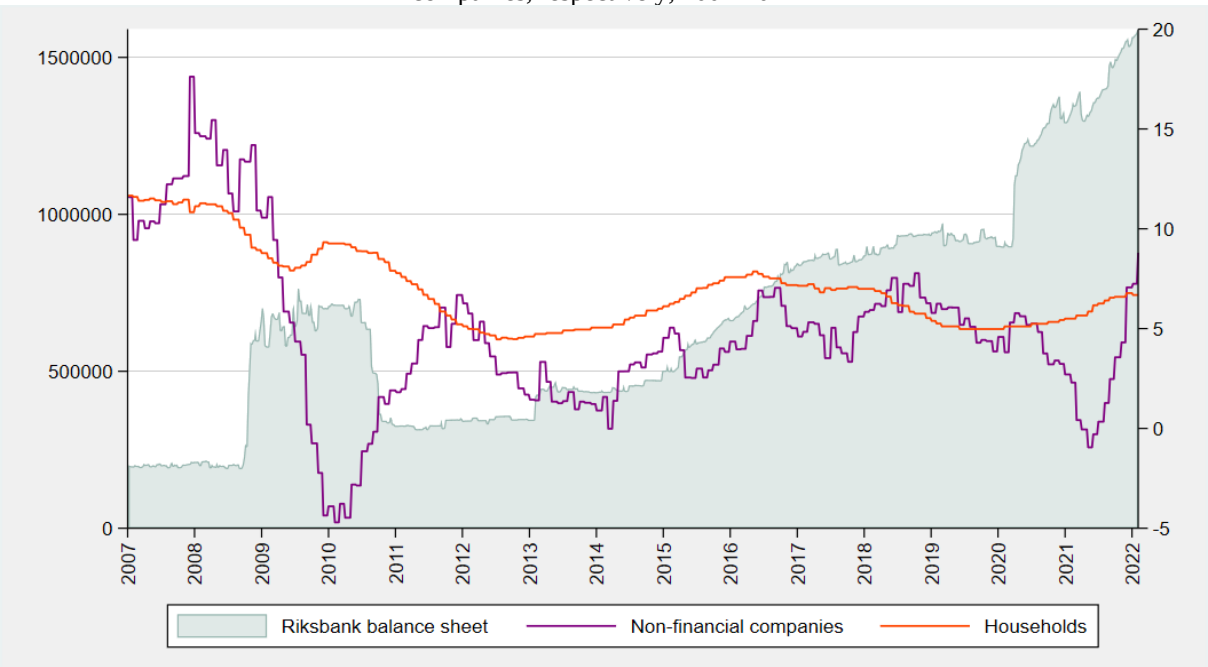
Variable	Obs.	Mean	Std. Deviation	Min	Max	Median	Variance	Skewness	Kurstosis
LRclose	109	198.724	23.346	137.649	243.958	190.235	642.414	-0.026	2.109
LRreturn	109	0.369	2.893	-17.64	6.659	0.563	8.373	-2.616	17.403
LRtradevolume	109	2.33e+08	8.89e+07	8.28e+07	6.63e+08	2.22e+08	7.90e+15	2.125	10.624
HRclose	109	43.979	10.553	23.976	63.481	41.547	111.371	0.024	1.757
HRreturn	109	0.598	3.178	-13.763	11.157	0.66	10.102	-1.217	8.195
HRtradevolume	109	1.41e+07	1.24e+07	3815007	7.86e+07	9787042	1.55e+14	2.904	14.124
SEgvb10y	109	0.127	0.192	-0.358	0.486	0.092	0.037	0.099	2.026
Balancesheet	109	1311236	177840	897699	1589969	1330676	3.16e+10	-0.837	3.509
IPI	109	0.386	2.369	-8.56	5.123	0.318	5.616	-1.615	8.575

Source: Authors' rendering of data from Refinitiv, Riksbank and Statistics Sweden.

In figure 1, the Riksbank's balance sheet and the growth rate of lending to households and non-financial companies in Sweden, respectively, are illustrated for the entire sample period, 2007-2022. Historically, the growth rate of lending to non-financial companies has fluctuated more than the growth rate of lending to households. Furthermore, it is illustrated that lending to companies increased during the periods when the size of the Riksbank's balance sheet expanded, which indicates that the leverage of companies increased during these periods. Viewing 2009-2011, the size of the balance sheet expanded significantly and during the same period, lending to companies increased significantly as well. During this period, however, the Riksbank did not expand its balance sheet by purchasing securities through QE. The Riksbank initially launched its QE program in 2015, which was followed by an increase in lending to companies. Moreover, lending to companies sharply increased approximately one year after the

Riksbank began its new QE program in 2020. The figure also implies that companies have responded to QE by taking on more debt. However, the responses have not occurred directly, but rather some time afterward the two QE programs began. Thus, this indicates that it might have been a lack of demand for credit at the time the programs were implemented, causing some amount of excess liquidity. Furthermore, the illustration implies that the leverage of households has been more moderate than that of companies. This might be due to expectations about future profits created by QE, causing companies to finance new investments by taking on more debt. These findings suggest that there has been a demand for credit, which created a higher risk of malinvestment and financial instability through the injection of liquidity due to QE, as postulated by Mulligan (2013) and Mulligan et al. (2014). Nevertheless, as companies might not have absorbed the total amount of liquidity that has been injected, QE could have created an excessive amount of liquidity in the financial system, as pointed out by Gaffard et al. (2018). Lending to companies increased approximately one year after the new QE program began, indicating that excess liquidity was present during Covid-19. Thus, the excess liquidity might have mitigated the risk of malinvestment and financial instability. In addition, it might have caused higher asset prices and a boom type of asset inflation.

Figure 1: The Riksbank's balance sheet vs. the growth rate of lending to households and non-financial companies, respectively, 2007-2022



Note: The left y-axis represents the size of the balance sheet, and the right y-axis represents the growth rate of lending.

Source: Authors' rendering of data from Riksbank and Statistics Sweden.

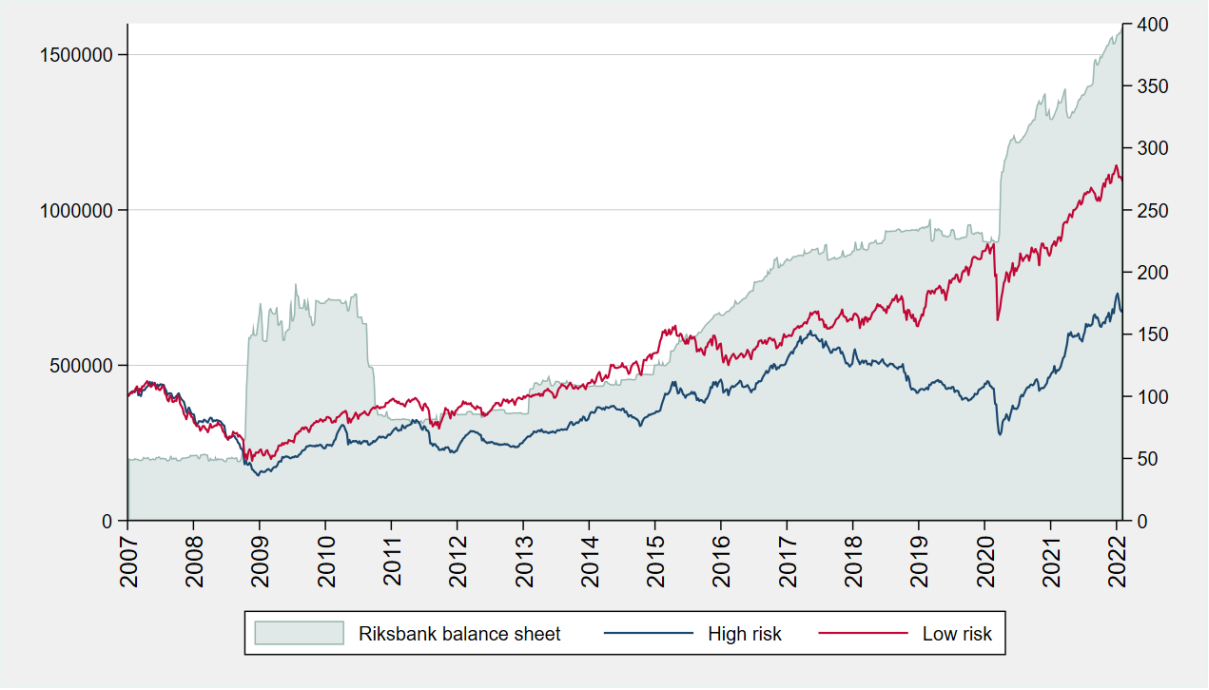
In figure 2, the Riksbank's balance sheet and the portfolios' historical price movements are illustrated for the entire sample period, 2007-2022. January 5, 2007, is the base date from which the changes in prices are measured. The base date has index prices equal to 100, and the two graphical lines represent the percent changes in prices for the high-risk portfolio and the low-risk portfolio, respectively. Historically, the low-risk portfolio has outperformed the high-risk portfolio, which is illustrated in the figure. As of February 4, 2022, the low-risk portfolio had increased by 173 percent while the high-risk portfolio had increased by 70 percent. The low-risk portfolio started to perform better than the high-risk portfolio during the financial crisis of 2008-09, and thereafter the portfolios exhibited a similar upward trend until the mid of 2017. As the financial crisis was a result of an endogenous shock that originated from within the financial system, the differences regarding the performance of the portfolios might be explained by their different characteristics. As the low-risk portfolio is characterized by a lower risk for malinvestment and financial fragility compared to the high-risk portfolio, the low-risk companies might not have been as overleveraged and financial fragile as the high-risk in the wake of the financial crisis. Thus, the low-risk companies might have had the characteristics of hedge finance firms, while the high-risk companies might have had the characteristics of speculative or Ponzi finance firms. During 2017-2020, the high-risk portfolio deviated from the low-risk portfolio as it had a downward trend.

During the first quarter of 2020, following the developments of the Covid-19 pandemic, there was a large drop in the portfolios' prices. However, the drop was followed by a quick recovery and an accelerating trend of rising prices for both portfolios. As illustrated, the recovery took place around the same time as the Riksbank started to expand its balance sheet by purchasing securities through its new QE program. This indicates that the new QE measures taken by the Riksbank supported the significantly upward trend. Since lending to companies started to increase approximately one year after the new QE program began and the portfolios' prices started to rise, it indicates that there was a lack of demand for credit during the first year, causing an excessive amount of liquidity in the financial sector, as described by Gaffard et al. (2018). Thus, the accelerating trend of rising prices might have been caused by excess liquidity. In that case, the prices might reflect the boom type of asset price inflation. However, the sharp increase in lending to companies during the mid of 2021 reflects an increasing demand for credit and with the injection of liquidity due to QE, this might have created higher risk of malinvestment and financial instability, as argued by Mulligan (2013) and Mulligan et al. (2014). In that case, the recovery from Covid-19 can be interpreted as an unsustainable expansion. However, as

mentioned earlier, the higher risk of malinvestment and financial instability might have been mitigated by the excess liquidity.

Moreover, the effect of QE might also be observed by viewing the first two quarters of 2015. The Riksbank initially launched its QE program in 2015, and during the same time, the portfolios exhibited a slight upward movement in prices. This implies that QE might have influenced these changes. The price movements, however, were not as significant as during Covid-19 which might be explained by the difference in circumstances, or the characterization of the new QE measures taken during Covid-19. As for the demand for credit, it is illustrated in figure 1 that lending to companies increased some time afterwards QE was implemented. The demand for credit, and the absence of noteworthy price increases, indicate that QE might not have caused a larger amount of excess liquidity during this period.

Figure 2: The Riksbank's balance sheet vs low-risk portfolio and high-risk portfolio, 2007-2022.

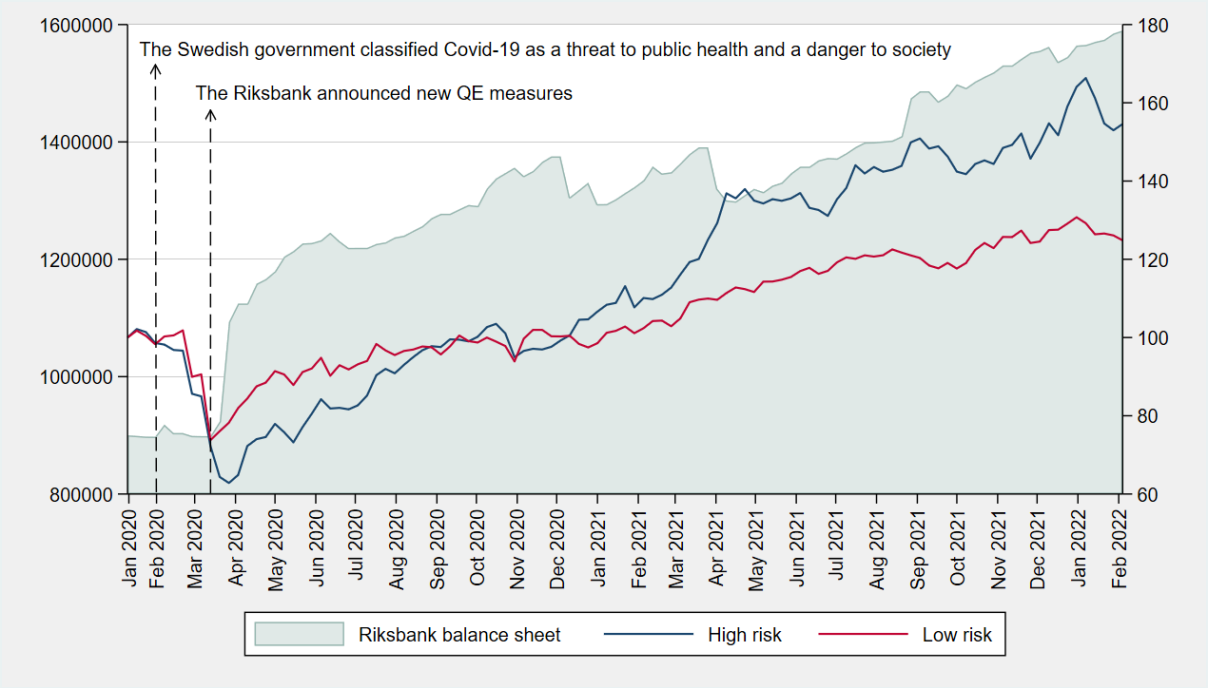


Note: The left y-axis represents the size of the balance sheet, and the right y-axis represents the price index.
Source: Authors' rendering of data from Riksbank and Refinitiv.

In figure 3, the Riksbank's balance sheet and the portfolios' historical price movements are illustrated for the period during the Covid-19 pandemic, 2020-2022, where January 10, 2020, is the base date from which the changes in prices are measured. As illustrated, the high-risk

portfolio outperformed the low-risk portfolio during this period. As of February 4, 2022, the high-risk portfolio had increased by 55 percent while the low-risk portfolio had increased by 25 percent. The prices started to drop as the Swedish government classified Covid-19 as a threat to public health and a danger to society. When the low-risk portfolio and the high-risk portfolio hit their pandemic low, the prices had dropped 35 percent and 22 percent, respectively. Even though the outbreak of Covid-19 had a larger impact on the high-risk portfolio, the accelerating trend of rising prices was higher for the high-risk portfolio than for the low-risk portfolio. This indicates that the QE measures taken by the Riksbank had a greater effect on companies that have a higher risk of becoming speculative or Ponzi finance firms. Thus, the potential presence of excess liquidity might have had a greater effect on high-risk companies, causing their prices to increase at a higher rate. Furthermore, as lending for companies increased in the mid of 2021, it implies that the high-risk companies might have absorbed a larger share of the injected liquidity relative to the low-risk companies and thus, they might have had a higher risk for malinvestment and of financial instability. This indicates that the high-risk behavior of agents is associated with the expansion of the monetary base. Moreover, the higher prices of the high-risk portfolio might also be explained by investors weighting their portfolios towards riskier stocks, causing their prices to increase.

Figure 3: The Riksbank's balance sheet vs low-risk portfolio and high-risk portfolio, 2020-2022.



Note: The left y-axis represents the size of the balance sheet, and the right y-axis represents the price index.

Source: Authors' rendering of data from Riksbank and Refinitiv.

8.2. Testing for stationarity

The ADL model has a stationarity requirement, as mentioned in section 7.4. To test for stationarity, ADF tests for the variables were performed for both portfolios. In table 3, the results from the ADF tests for the main ADL model, covering the Covid-19 pandemic period 2020-2022, are presented.

The results from the initial ADF tests concluded that all variables except *SEgvb10y* were stationary in their level state I(0). For the variable *SEgvb10y*, differencing the data by one order solved the problem of non-stationarity and thus, the variable was stationary at its first difference level I(1). Since the variables are integrated of different orders, the ADL model is suitable to use, as described in section 7.4.

Table 3: ADF test for unit root, ADL model 2020-2022.

Pre-transformation			**Post-transformation**		
Variable	**P-value**	**Stationary I(0)**	**Variable**	**P-value**	**Stationary I(1)**
HRreturn	-8.008***	Yes	-	-	-
logBalancesheet	-2.289**	Yes	-	-	-
logHRtradevolume	-3.224**	Yes	-	-	-
IPI	-3.799***	Yes	-	-	-
SEgvb10y	-1.224	No	ΔSEgbv10y	-9.79***	Yes
LRreturn	-10.004***	Yes	-	-	-
logLRtradevolume	-4.517***	Yes	-	-	-

*** p<0.01, ** p<0.05, * p<0.1

8.3 ADL error correction model, 2020–2022

In table 4, the results from the ADL error correction models are presented. In the first model (1), the results for the high-risk portfolio are presented and in the second model (2), the results for the low-risk portfolio are presented. Both models utilize a timeframe spanning from January 10, 2020, to February 4, 2022. To find the optimal number of lags, the Akaike information criterion (AIC) was used, in accordance with section 7.3. Based on the AIC, the first model (1) is ADL (1, 3, 2, 2, 1) and the second model (2) is ADL (4, 3, 2, 3, 3). To assure the existence of a long-run relationship, the bounds test for cointegration was performed for both models, as described in section 7.4. The F-statistic was higher than all I(1) critical values for the regressors,

which implies that the variables are bound together in the long-run. See Appendix table B for the F-bound statistics and the critical values. Furthermore, the error correction term is negative and significant for both models, which further supports the long-run relationship.

For the high-risk portfolio, the size of the Riksbank's balance sheet has a positive effect on the portfolio returns, and the estimated coefficient is highly statistically significant with a *p*-value less than 0,01, both in the short-run and long-run. The ten-year government bond yield and the industrial production index have significant negative effects on the portfolio return in the short-run. Furthermore, the trade volume has a significant positive effect on the portfolio returns in the short-run. Thus, the size of the balance sheet is the only variable with a significant long-run effect on the portfolio returns.

For the low-risk portfolio, the size of the Riksbank's balance sheet has a positive effect on the portfolio returns in the short-run, and the estimated coefficient is highly statistically significant with a *p*-value less than 0,01. In the long-run, however, the coefficient is insignificant which indicates that there is no evidence that the size of the balance sheet affects the portfolio returns in the long-run. The ten-year government yield, the industrial production index and the trade volume have significant negative effects on the portfolio returns in the short-run. In the long-run, however, the industrial production index has a significant positive effect on the portfolio returns.

Table 4: ADL error correction model, results for high-risk portfolio and low-risk portfolio, respectively, 2020-2022.

Model	(1)	(2)
Portfolio	High-risk	Low-risk
ADJ		
Return *t-1*	-0.8182232***	-0.948813***
	(0.0932231)	(0.2148711)
Long-run		
logBalanceSheet	8.975122***	5.652786*
	(2.968971)	(2.864455)
ΔSEgvb10y	3.689789	13.61544
	(10.36435)	(8.893237)
IPI	0.2841104	0.4185871**
	(0.1789738)	(0.1803492)
logTradevolume	-1.055572*	1.181812
	(0.5750906)	(1.341863)
Short-run		
ΔReturn *t-1*		-0.0825395
		(0.1879479)
ΔReturn *t-2*		-0.0308826
		(0.1590652)
ΔReturn *t-3*		-0.2111358
		(0.114524)
ΔlogBalanceSheet	19.15612	36.71283**
	(16.54234)	(17.38695)
ΔlogBalanceSheet *t-1*	-16.49067	-5.672145
	(16.60031)	(16.80268)
ΔlogBalanceSheet *t-2*	50.20216***	41.73998***
	(15.08244)	(15.30836)
ΔSEgvb10y	-4.319663	-13.32718**
	(6.878787)	(6.08297)
ΔSEgvb10y *t-1*	-11.88523**	-9.467832**
	(5.194519)	(4.549986)
ΔIPI	0.0173981	0.1457927
	(0.1837846)	(0.17405)
ΔIPI *t-1*	-0.4206064**	-0.4497161**
	(0.1838916)	(0.1775463)
ΔIPI *t-2*		-0.4649706***
		(0.1644737)
ΔlogTradevolume	1.485284**	-4.53172***
	(0.708096)	(1.217159)
ΔlogTradevolume *t-1*		-2.213509*
		(1.165358)
ΔlogTradevolume *t-2*		-3.168399***
		(1.092551)
Intercept	-89.32997***	-97.39916*
	(33.36979)	(55.78028)
R-squared	0.5793	0.7229
Adjusted R-squared	0.5192	0.6602
Residual standard error	2.7465	2.3849
Observations	105	105

Standard errors are in paranthesis. *** p<0.01, ** p<0.05, * p<0.1

When examining the results, it is observed that the size of the Riksbank's balance sheet, the measurement of QE, has a positive short-term effect on both portfolios' returns, and a positive long-term effect on the high-risk portfolio returns. As lending to companies increased approximately one year after the new QE program began, these findings suggest that the short-run effect of QE, observed for both the high-risk portfolio and the low-risk portfolio, might reflect the presence of excess liquidity due to a lack of demand for credit. This causes asset prices, and thus returns, to increase, as postulated by Gaffard et al. (2018) and Brown (2017). When observing the high-risk portfolio, long-run effect of QE indicates that the returns might have been fueled by an unsustainable credit expansion due to a higher demand for credit, which is a threat to financial stability, as described by Mulligan (2013) and Mulligan et al. (2014). As the results show evidence for a long-term effect on the high-risk portfolio, but not the low-risk portfolio, it implies that the QE measures taken by the Riksbank during Covid-19 might have created malinvestment due to the market rate of interest being below the natural rate, encouraging companies to take on debts to finance new investments. Considering money as endogenous, the results further indicate that high-risk companies might have had a higher demand for credit compared to low-risk firms, indicating that they might have absorbed a larger share of the injected liquidity. Furthermore, the ten-year government bond yield has a negative effect on both portfolios' returns in the short-run, which implies that investors are rebalancing their portfolios towards riskier assets as the interest rates decline, causing their prices to increase, as described in section 2.2. Hence, the high-risk behavior of agents is associated with QE.

8.4. Diagnostic tests

To investigate the stability of the ADL error correction models, it is appropriate to conduct diagnostic tests. Therefore, the models have been tested by the diagnostic tests for serial correlation and heteroscedasticity. To test for serial correlation, the Breusch-Godfrey LM test for autocorrelation was performed. The null hypothesis for the test is no serial correlation. To test for heteroscedasticity, the White's test for heteroscedasticity was performed. The null hypothesis for the test is homoscedasticity. As seen in table 5, the null hypotheses for the tests cannot be rejected and thus, the results from the ADL error correction models are not biased by serial correlation or heteroskedasticity.

Table 5: Diagnostic test results

Model	**(1) High-risk**	**(2) Low-risk**
Statistic	*Prob > chi2*	*Prob > chi2*
Breusch-Godfrey LM	0.8397	0.5523
White's	0.4698	0.4539

8.5 ADL error correction models, pre-pandemic period

To ensure that the statistically significant effects of the Riksbank's balance sheet, used as a measurement of QE, on the portfolios' returns are isolated to the Covid-19 pandemic period, it is necessary to investigate the pre-pandemic period. Therefore, two ADL error correction models are used, covering two different periods. The first model covers the period January 5, 2007, to January 2, 2015, and the result is presented in Appendix table C. During this period, the Riksbank did not utilize QE as an expansionary monetary policy tool. Thus, if the results indicate that the size of the Riksbank's balance sheet has a statistically significant effect on the portfolios' returns, the effect cannot be due to QE. The second model covers the period January 9, 2015, to January 3, 2020, and the result is presented in Appendix table D. As the Riksbank initially launched its QE program in 2015, results that reveal that the size of the Riksbank's balance sheet has a statistically significant effect on the portfolios' returns indicate that the effect in the main model, covering period 2020-2022, cannot be isolated to the new QE measures taken by the Riksbank during the Covid-19 pandemic.

As in the main model, ADF tests for the variables were performed to test for stationarity. The ADF tests covering the period 2007-2015, concluded that all variables except *logBalanceSheet* and *SEgvb10y* were stationary in their level form I(0), while *logBalanceSheet* and *SEgvb10y* were stationary in their first difference level I(1). See Appendix table E for test results. The ADF tests covering the period 2015-2020, concluded that all variables except *SEgvb10y* were stationary in their level form I(0), while *SEgvb10y* was stationary in its first difference level I(1). See Appendix table F for test results. To assure the existence of a long-run relationship, the bounds test for cointegration was performed for each model. Se Appendix table G and table H for test results.

For the low-risk portfolio in the period 2007-2015, the size of the Riksbank's balance sheet has a significant positive effect on the returns in the short-run. Viewing figure 2 in section 8.1, it illustrates that the size of the Riksbank's balance sheet increased significantly during 2009-2011. It can also be distinguished that the low-risk portfolio had a small upward movement during the same period. Hence, the effect is not unexpected. However, the size of the coefficient indicates that the effect is considerably smaller than the effect retrieved from the main model. Furthermore, as illustrated in figure 2 in section 8.1, the expansion of the balance sheet in 2020 was followed by a significantly larger increase in the low-risk portfolio price, compared to 2009. Thus, the difference might be explained by QE and its effects on the real economy.

For the period 2015-2020, there is no significant effect of the size of the Riksbank's balance sheet on the portfolios' returns. This indicates that the observed effects in the main model can be isolated to the new QE measurements taken by the Riksbank during Covid-19. The new QE program that began in 2020 had a different aim than the QE program that began in 2015, and the different characteristics of these programs might explain the retrieved results. Furthermore, the Riksbanks' balance sheet grew considerable larger due to the new QE program compared to when QE was initially launched in 2015, which reflects the provision of liquidity.

However, as the theoretical framework postulates, QE increases the amount of credit available for borrowers, but it is only with a corresponding demand for credit that it transforms the financial system to a fragile system engendered by the over-optimism that causes actors to progressively underestimate risk. With a lack of demand, the injection of liquidity due to QE will create and excessive amount of liquidity in the financial sector, causing asset prices, and thus returns, to increase. As there is no significant effect of QE on the portfolios' returns during 2015-2020, these findings imply that the demand for credit might have been higher relative the supply of credit during 2015-2020, which might have caused an unsustainable expansion.

8.6 Analysis of QE and abnormal returns

In figure 4 and 5, the abnormal returns are illustrated for the low-risk portfolio and the high-risk portfolio, respectively, for the entire sample period, 2007-2022. See section 7.5. for the interpretation of abnormal returns. The reference lines, for which abnormality is measured, in both figures represent 1.5 standard deviations for the low-risk portfolio. As the low-risk

portfolio consists of larger and more stable firms, with lower risk of becoming speculative or Ponzi finance firms, it seems logical to use the low-risk portfolio's standard deviation as a benchmark to interpret normality and abnormality for the high-risk portfolio as well. Historically, before the Covid-19 outbreak, the difference between the industrial production index and the returns of both portfolios, respectively, has fluctuated within the interval (-5, 5) percentage points, except for during the financial crisis of 2008-09. As one standard deviation is 3.247, it seems reasonable to use 1.5 standard deviations (4.871), as a benchmark for abnormality. With one standard deviation, both portfolios would exhibit predominance of abnormal returns during the entire period and thus, it would be difficult to interpret it as abnormality.

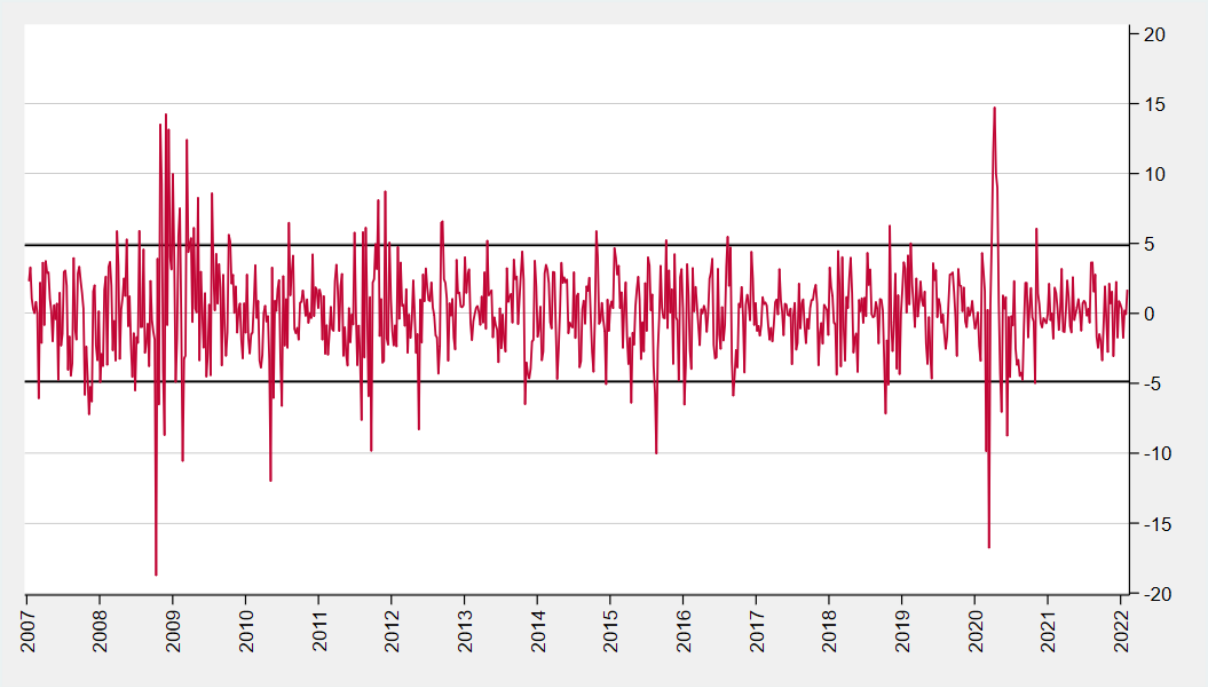
The difference between the industrial production index and the returns of both portfolios should fluctuate around zero. For both portfolios, however, it is illustrated that there are some periods where the difference fluctuates above zero, reflecting periods of higher returns. This can be interpreted as shares being overvalued caused by over-optimistic future profitability. Periods of higher returns can also be due to a lack of demand for credit in the presence of a credit injection due to QE, creating excess liquidity in the economy. With excess liquidity, speculative bubbles can arise due to Browns' (2017) boom type of asset price inflation and thus, abnormal returns might occur.

Viewing the period of Covid-19, there are major fluctuations that significantly deviate from the benchmark corridor and thus, can be interpreted as abnormal returns. For the low-risk portfolio, illustrated in figure 4, the difference between the industrial production index and the return peaked at 15 percent in April 2020. For the high-risk portfolio, illustrated in figure 5, the peak was 20 percent. Hence, in both portfolios, the peak occurred within the first month after the Riksbank launched its new QE measures. This indicates that the higher returns do not reflect the fundamentals of the economy, as they cannot be explained by the industrial production and thus, they are positively abnormally high. Furthermore, it indicates that supply of credit is were not met by a corresponding demand for credit and thus, the injection of liquidity created excess liquidity that might have fueled asset prices. This in turn, might have caused speculative bubbles and giving rise to abnormal returns, as argued by Brown (2017). From the mid 2020-2022, the returns are relatively stable, for both portfolios, as they remain within, or close to, the corridor[12] reflecting the fundamental value. This implicates that the demand for credit was

[12] Note: 1.5 standard deviations, positive and negative, constitutes the corridors upper and lower boundaries.

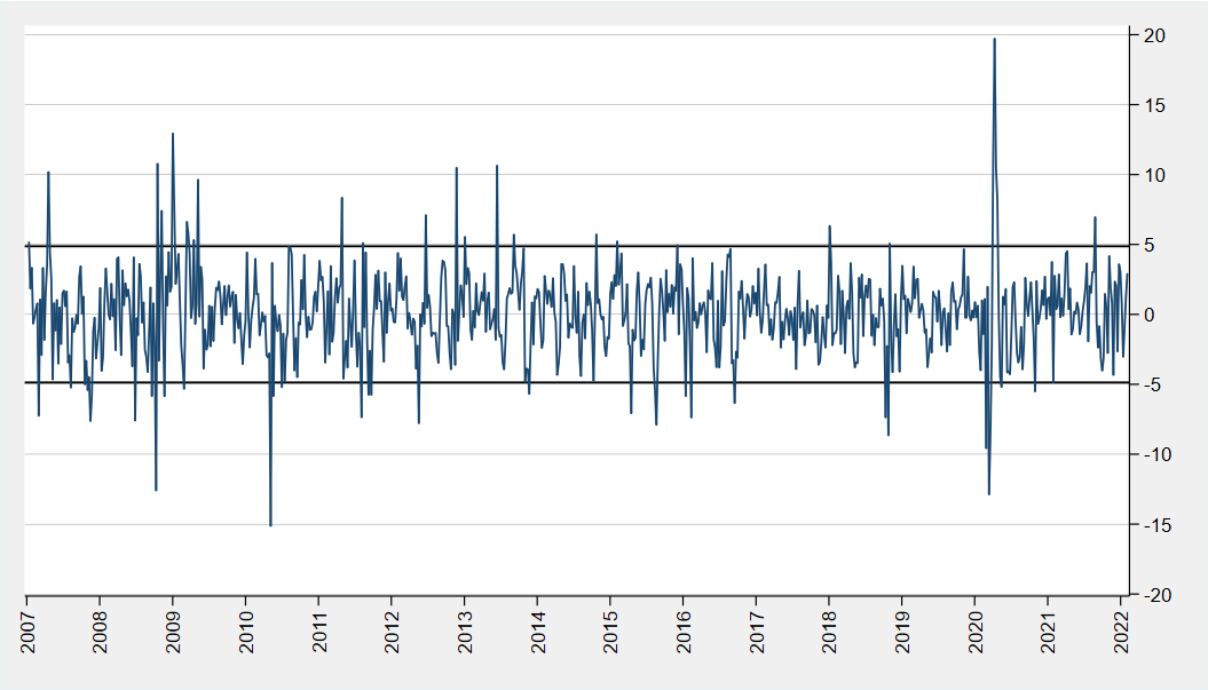
higher relative the supply of credit and hence, created a smaller amount of excess liquidity. However, for the high-risk portfolio it can be distinguished that there is a fluctuational trend higher above zero, compared to the low-risk portfolio. Thus, the high-risk portfolio returns deviate more from the industrial production index. This might be due to high-risk companies absorbing a larger share of the excess liquidity, or it might be due to the high-risk behavior of investors as they reconstruct their portfolios to riskier assets and increasing their prices.

Figure 4: Abnormal returns, low-risk portfolio, 2007-2022.



Source: Authors' rendering of data from Statistics Sweden and Refinitiv.

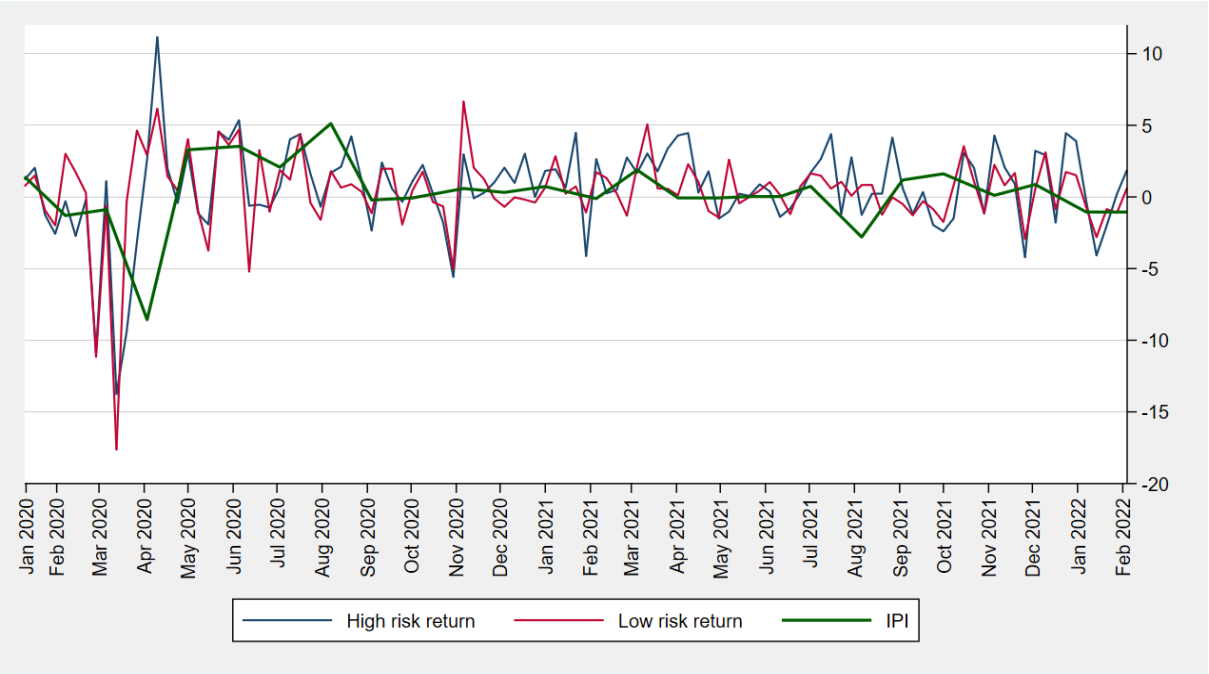
Figure 5: Abnormal returns, high-risk portfolio, 2007-2022.



Source: Authors' rendering of data from Statistics Sweden and Refinitiv.

In figure 6, the industrial production index and the portfolios' returns are illustrated for the period during the Covid-19 pandemic, 2020-2022. During 2020, the portfolios' returns fluctuated remarkably above and below the industrial production index. Thereafter, however, the returns were relatively stable around the index. Viewing the changes in the industrial production index, a sharp decline can be distinguished during the first two quarters of 2020. This illustrates that there were bottlenecks in the production, caused by the effects of Covid-19. Furthermore, the portfolios' returns peaked during the same time period. Therefore, it is distinct that the higher returns cannot be explained by industrial production growth. Thus, they are abnormal, which is in accordance with the boom type of asset inflation and might have been caused by excess liquidity due to QE. Moreover, the high-risk portfolio returns fluctuated more than the low-risk portfolio returns and as illustrated, the high-risk portfolio returns exhibited a higher degree of abnormality. Since the firms that constitute the high-risk portfolio have a higher risk of becoming speculative or Ponzi finance firms, these results indicate a higher risk of financial instability engendered by the new QE measures that were implemented during Covid-19. As excess liquidity increases asset prices, the higher returns of the high-risk portfolio relative the industrial production might have been due to speculative behavior in terms of over-optimistic expectations for future profits. In addition, this increases the probability that a speculative bubble might have developed during Covid-19.

Figure 6: Swedish industrial production index vs portfolio returns, 2020-2022.



Source: Authors' rendering of data from Statistics Sweden and Refinitiv.

9. CONCLUSION

The aim of this thesis was to investigate to what extent QE contributed to abnormal returns at the Swedish stock market during Covid-19. Two artificial portfolios were constructed, based on Minsky's (1992) classification of heterogeneous firms, representing low-risk and high-risk, respectively. The low-risk portfolio contained large cap companies, representing a lower risk of becoming speculative and Ponzi finance firms, and thus exhibits a lower risk of malinvestment and financial instability. The high-risk portfolio contained small cap companies, representing a higher risk of becoming speculative and Ponzi finance firms and thus, exhibits a higher risk of malinvestment and financial instability.

First, the ADL error correction model covering the pandemic years, 2020-2022, was used to investigate whether QE has influenced stock returns, specifically by studying the effect of the size of the Riksbank's balance sheet on the returns of the two portfolios, respectively. The results show that QE had a positive short-term effect on both portfolios' returns. As lending to companies started to increase approximately one year after the Riksbank began its new QE program, the short-run effect of QE might reflect the presence of excess liquidity due to a lack

of demand for credit. Hence, the excess liquidity in the economy might have created speculative bubbles due to asset price inflation. Concerning the long-term effects, the results only show a positive long-term effect on the returns of the high-risk portfolio. This implies that the returns for the portfolio might have been fueled by an unsustainable credit expansion due to a higher demand for credit, causing disruptions in the financial stability of the economy and enabling the presence of malinvestments. Considering money as endogenous, the results further indicate that high-risk companies might have had a higher demand for credit compared to low-risk firms and thus, they might have absorbed a larger share of the injected liquidity. Furthermore, the ten-year government bond yield had a negative effect on both portfolios' returns in the short-run, which implies that investors are rebalancing their portfolios towards riskier assets as the interest rates decline.

To ensure that the observed results are isolated to the pandemic period, ADL error correction models were used for the pre-pandemic period. For the period 2007-2015, the results show that the size of the Riksbank's balance sheet had a short-run effect on both portfolios' returns, however, this is not due to QE. Furthermore, the effects were smaller compared to the effects observed in the main model, covering the pandemic years. This might be explained by QE and its effect on the real economy. For the period 2015-2020, the results show no significant effects. Thus, this indicates that the observed effects in the main model can be isolated to the new QE program.

Second, a modified CAPM by Sechrest (2006) was performed and graphical interpretations were made to analyze abnormal returns. The Swedish industrial production index, reflecting the fundamentals of the economy, was used as a measure for the expected returns of the assets in accordance with Brown (2017). The illustration implies that the implementation of the new QE program in 2020 affected the returns of both portfolios as they deviated from their fundamental values in various degrees. During the first quarter of the pandemic period, a sharp decline was observed for the industrial production, confirming the presence of bottlenecks in the production. The returns of the portfolios did not exhibit a corresponding decline, indicating that the boom type of asset price inflation, created by excess liquidity in the economy, might have been present. Hence, over-optimistic expectations for future profits might have been engendered by injecting liquidity due to QE, causing higher returns of the portfolios relative to their fundamental value, causing the rise of abnormal returns according to the thesis theoretical framework.

In summary, abnormal returns were detected in both portfolios during the Covid-19 outbreak. Furthermore, the results from the ADL error correction model indicate that there is an effect of QE on the returns of the high-risk portfolio in both the long-run and short-run. For the low-risk portfolio, the effect is solely significant in the short-run. However, as the selection of stocks for this thesis were not properly randomized, it is of importance to acknowledge the presence of selection bias when interpreting the presented results. The selected companies have been listed during the whole time period of 2007-2022 and thus, survived both the GFC and the Covid-19 crisis. Therefore, it implies that each of the companies have been strong enough to both survive and recover from the crises. The appearance of bankruptcies caused by market volatility due to crises and macroeconomic imbalances has not been captured within this thesis and thus, the sample of companies does not account for the characteristics of different types of companies that have been listed on the Stockholm Exchange. Therefore, there are limitations concerning the interpretations of the results presented in this thesis. However, to account for some differences in characteristics among companies, the companies have been selected from a variety of sectors. Furthermore, the number of companies chosen for this thesis was limited to 40 companies, 20 small cap and 20 large cap, and they are not, necessarily, representative for the entire Swedish stock market. Hence, the results presented in this thesis are built upon the limitations and assumptions made in this thesis and do not reflect the stance of the entire Swedish stock market. With a larger number of companies and the inclusion of delisted companies, and allowing for rebalancing of the portfolios, the selection bias might have been avoided to some degree and thus, the generalizability, i.e., external validity, of the presented results could have been improved. This would be recommended for future research.

Conclusively, a recommendation based on the findings of this thesis is that the Riksbank have to consider the demand for money before pursuing unconventional policy tools such as QE. When excluding the demand for money and pursuing QE, the economy may suffer the consequence of excess liquidity, giving rise to further issue. In addition, the efficiency of using QE might increase when combining the unconventional monetary policy with fiscal policy. However, based on the research question of interest, this thesis has been limited to the investigate the unconventional monetary policy. Therefore, it would be interesting for future research to investigate fiscal policy as well.

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APPENDIX

Table A: Shares used for high-risk portfolio and low-risk portfolio.

High-risk	Sector	Low-risk	Sector
BERGS TIMBER B, (SE0000101297)	Basic Materials	ATLAS COPCO B, (SE0011166628)	Industrial
BJÖRN BORG, (SE0015811807)	Consumer Discretionary	SCA B, (SE0000112724)	Basic Materials
DORO, (SE0000215493)	Telecommunications	HUSQVARNA B, (SE0001662230)	Consumer Discretionary
FORMPIPE SOFTWARE, (SE0001338039)	Technology	BOLIDEN, (SE0015811559)	Basic Materials
WISE GROUP, (SE0007277876)	Industrial	LAGERCRANTZ GROUP B, (SE0014990966)	Technology
ELECTRA GRUPPEN, (SE0001572520)	Consumer Discretionary	VOLVO B, (SE0000115446)	Industrial
KABE GROUP B, (SE0000107724)	Consumer Discretionary	ERICSSON B, (SE0000108656)	Telecommunications
PROFILGRUPPEN B, (SE0000393860)	Basic Materials	AXFOOD, (SE0006993770)	Consumer Staples
DUROC B (SE0000331266)	Basic Materials	AAK, (SE0011337708)	Consumer Staples
NET INSIGHT B, (SE0000366098)	Telecommunications	SEB A, (SE0000148884)	Financials
MALMBERGS ELEKTRISKA B, (SE0000507659)	Industrial	SV. HANDELSBANKEN A, (SE0007100599)	Financials
PREVAS B, (SE0000356008)	Technology	JM, (SE0000806994)	Real Estate

SVEDBERGS B, (SE0000407991)	Industrial	CASTELLUM, (SE0000379190)	Real Estate
MICRO SYSTEMATION B, (SE0000526626)	Health Care	ASTRAZENECA, (GB0009895292)	Health Care
ORTIVUS B, (SE0000123085)	Health Care	GETINGE B, (SE0000202624)	Health Care
NGS GROUP, (SE0009947708)	Industrial	SWEDISH MATCH, (SE0015812219)	Consumer Staples
NTEK B, NOVOTEK B, (SE0000567752)	Technology	TELE2 B, (SE0005190238)	Telecommunications
SOF B, SOFTRONIC B, (SE0000323305)	Technology	LUNE, LUNDIN ENERGY, (SE0000825820)	Energy
HAV B, HAVSFRUN INVESTMENT B, (SE0000312043)	Financials	ELUX B, ELECTROLUX B, (SE0016589188)	Consumer Discretionary
SEMC, SEMCON, (SE0000379497)	Industrial	HEXA B, HEXAGON B, (SE0015961909)	Technology

Table B: Bounds test for cointegration, 2020-2022

Critical values	**10% I(1)**	**5% I(1)**	**1% I(1)**
High-risk F=17.190	4.616	5.172	5.378
Low-risk F=8.275	3.627	4.191	5.422

Table C: ADL error correction model, results for high-risk portfolio and low-risk portfolio, respectively. Pre-pandemic and pre-QE, 2007-2015.

Model	(1)	(2)
Portfolio	High-risk	Low-risk
ADJ		
Return *t-1*	-1.009731***	-1.299923***
	(0.0741022)	(0.1071848)
Long-run		
ΔlogBalanceSheet	-1.53386	-6.607816*
	(3.910465)	(3.639773)
ΔSEgvb10y	13.06906***	4.840311***
	(2.311095)	(1.061422)
IPI	0.0656495	0.0648156
	(0.0684375)	(0.0686502)
logTradevolume	-0.0892438	-0.2199533
	(0.2176598)	(0.3018101)
Short-run		
ΔReturn *t-1*	-0.0702584	0.2107027**
	(0.0498052)	(0.0909588)
ΔReturn *t-2*		0.2032305***
		(0.0726111)
ΔReturn *t-3*		0.1266385***
		(0.0487193)
ΔlogBalanceSheet	5.801291*	11.20025***
	(3.060179)	(3.738136)
ΔSEgvb10y	-7.762994***	
	(2.141438)	
ΔSEgvb10y *t-1*	-5.226049***	
	(1.691348)	
ΔSEgvb10y *t-2*	-3.454614***	
	(1.083228)	
ΔIPI		0.1686238
		(0.1162623)
ΔlogTradevolume		-1.065992*
		(0.5904418)
ΔlogTradevolume *t-1*		-1.161269**
		(0.5692358)
ΔlogTradevolume *t-2*		-1.118041**
		(0.5555191)
Intercept	1.647237	5.973255
	(3.414582))	(7.813208)
R-squared	0.5797	0.6045
Adjusted R-squared	0.5692	0.5916
Residual standard error	2.5407	3.0221
Observations	413	413

Standard errors are in paranthesis. *** p<0.01, ** p<0.05, * p<0.1

Table D: ADL error correction model, results for high-risk portfolio and low-risk portfolio, respectively. Pre-pandemic and with QE, 2015-2020.

Model Portfolio	(1) High-risk	(2) Low-risk
ADJ		
Return *t-1*	-0.9919119*** (0.0631142)	-1.066651*** (0.066651)
Long-run		
logBalanceSheet	-0.4327496 (0.7020695)	0.5663254 (0.7070288)
ΔSEgvb10y	1.192674 (2.175173)	2.351823 (1.665768)
IPI	0.0150472 (0.0807152)	0.0191864 (0.0811402)
logTradevolume	-0.2556576 (0.2129694)	-0.1190302 (0.4661526)
Short-run		
ΔSEgvb10y	2.42041 (1.660462)	
Intercept	2,037251 (10.49747)	-5.507864 (15.09952)
R-squared	0.5126	0.5395
Adjusted R-squared	0.5008	0.5303
Residual standard error	1.8642	2.0182
Observations	256	256

Standard errors are in paranthesis. *** p<0.01, ** p<0.05, * p<0.1

Table E: Augmented Dickey-Fuller test for unit root, 2007-2015

Pre-transformation			**Post-transformation**		
Variable	**P-value**	**Stationary I(0)**	**Variable**	**P-value**	**Stationary I(1)**
HRreturn	-21.131***	Yes	-	-	-
logBalancesheet	-1.505	No	ΔlogBalancesheet	-17.105***	Yes
logHRtradevolume	-9.223***	Yes	-	-	-
IPI	-8.548***	Yes	-	-	-
SEgvb10y	-0.699	No	ΔSEgbv10y	-23.252***	Yes
LRreturn	-22.193***	Yes	-	-	-
logLRtradevolume	-6.934***	Yes	-	-	-

*** p<0.01. ** p<0.05. * p<0.1

Table F: Augmented Dickey-Fuller test for unit root. 2015-2020

Pre-transformation			**Post-transformation**		
Variable	**P-value**	**Stationary I(0)**	**Variable**	**P-value**	**Stationary I(1)**
HRreturn	-15.599***	Yes	-	-	-
logBalancesheet	-3.207**	Yes	-	-	-
logHRtradevolume	-8.488***	Yes	-	-	-
IPI	-7.496***	Yes	-	-	-
SEgvb10y	-1.843	No	ΔSEgbv10y	-13.611***	Yes
LRreturn	-16.862***	Yes	-	-	-
logLRtradevolume	-10.636***	Yes	-	-	-

*** p<0.01, ** p<0.05, * p<0.1

Table G: Bounds test for cointegration. 2007-2015

Critical values	**10% I(1)**	**5% I(1)**	**1% I(1)**
High-risk F=37.917	3.527	4.027	5.078
Low-risk F=34.983	3.527	4.028	5.081

Table H: Bounds test for cointegration. 2015-2020

Critical values	**10% I(1)**	**5% I(1)**	**1% I(1)**
High-risk F=50.022	3.541	4.049	5.121
Low-risk F=58.576	3.541	4.048	5.119

Table I: Summary statistics. abnormal returns. 2007-2022

Variable	**Obs.**	**Mean**	**Std.Deviation**	**Min**	**Max**	**Median**	**Variance**	**Skewness**	**Kurstosis**
LRabnreturn	787	0.08	3.029	-15.13	19.717	0.21	9.175	0.214	7.602
LRabnreturn	787	0.086	3.247	-18.73	14.722	0.162	10.543	-0.064	7.222

NON-TECHNICAL SUMMARY

The Covid-19 pandemic caused countries around the world to take actions in order to slow down the negative effects that the pandemic had cause on economies. The Riksbank's attempt to mitigate the negative effects on the economy consisted of injecting more money into the economy. However. if the demand for such money does not exist, it will further cause consequences for the price of assets at the stock market. Results lead to the interpretation that because of the Riksbank's response to Covid-19, positive investment opportunities can be found at the Swedish stock market.