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A study of monetary policy and its' effect on commercial bank profitability

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ABSTRACT

This paper explores the role of the Swedish central bank in relation to the profitability of commercial banks. Utilizing local projection analysis, we examine the effect of policy rate and quantitative easing shocks from 2000 to 2023. Our study yields nuanced findings compared to the existing literature. In contrast to earlier studies, our findings indicate a negative effect of the policy rate on bank profitability, which we attribute to the potential economic downturn associated with an increased policy rate. Conversely, in line with other studies, we find that quantitative easing has a significant and positive effect on bank profitability. We argue that this effect is driven by the balance sheet adjustments generated by quantitative easing. By shedding light on these dynamics, our study contributes to a deeper understanding of the relationship between monetary policy and bank profitability.

Keywords: Bank profits, Commercial banks, Riksbank, Sweden, Monetary policy, Quantitative easing, policy rate, transmission mechanisms, SVAR, Local projections, Impulse response functions

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1. Introduction

In Sweden commercial banks have made unprecedented profits following the pandemic. The four biggest banks made 154 billion SEK in profits during 2023 (Dagens Nyheter, 2024), which is more than the Swedish military budget for the same year, something that has caused a public debate (see e.g. (Cervenka, 2023; Dagens Industri, 2023; Lindström & Goksör, 2024; SVT Nyheter, 2024). The debate began when the commercial banks published their quarterly reports in 2022, revealing enormous profits during a period of economic distress for the Swedish households, and is still ongoing. The Swedish Minister of Finance commented on the debate, saying that a large part of the profits amongst banks was due to the increase in policy rate widening the spread between interest rates on lending and interest rates on deposits (SVT Nyheter, 2024). As the Swedish banks reported higher profits than their European counterparts (Hansen et al., 2023), the discussion on whether these profits were in fact "too high" became more prominent. A point of contention in the debate has been that the rise of the policy rate by the Swedish Central Bank, the *Riksbank*, is responsible for the large profits (von Seth, 2023). In the recent period of financial difficulty, characterised by high inflation, the Riksbank increased the policy rate to combat inflation expectations. However, this in turn raised the commercial banks interest rates. The difference between the cost of borrowing and the profit of lending is defined as the *Net Interest Income* (Albertazzi & Gambacorta, 2009; Borio et al., 2017). It is the net interest income spread that has drastically increased for the Swedish banks in the recent years and has been the subject of an intense debate (Lucas & Lindberg, 2023). Some argue that the remarkably large profits from the net interest income should be viewed as "excess profits" and an indicator that there is something wrong within the Swedish financial system (Cervenka, 2023), while others argue that these profits are simply a reflection of the well-being of the Swedish banking sector. The executive boards of the largest banks referred to the profits as a natural component in a market with competition and a sign of a well-functioning and efficient banking sector, which is beneficial for the economy as a whole (Dahlberg, 2024; Hugert Lundberg, 2024). Although the answer to whether these profits are "too big" remains a political question and their origin is highly debated, the question of what role the Riksbank has played in the profits is highly relevant.

The Riksbank is one of the most influential parts of the financial system as its monetary policy actions transmit through the entire economy. Until recently, the Riksbank has been conducting expansive monetary policy and the effect of this on bank profitability in Sweden

has not yet been extensively researched. Are the large dividends of banks connected to the monetary policy actions of the Riksbank? If yes, then in what way? In this paper we will investigate the role of the Riksbank in regard to the recent surge in bank profits. We do this by estimating the effect of two different monetary policy tools, quantitative easing (QE) and the policy rate, on bank profits of the four largest commercial banks in Sweden. Previous studies on monetary policy have shown that both QE and the policy rate have ambiguous effects on the profits of commercial banks. The positive effect of the policy rate on bank profitability is mainly attributed to the fact that an increase in policy rate will drive up lending rates more than deposit rates. This effect widens the net interest income spread, which results in greater income for banks (Albertazzi & Gambacorta, 2009; Borio et al., 2017; Windsor et al., 2023). At the same time, a higher policy rate is expected to cool down the economy, which could have a negative effect on bank profits. Regarding quantitative easing, some studies show that QE stimulates the economy and strengthens the balance sheet of commercial banks, thus causing a positive correlation between bank profits and QE, while other papers argue that QE's effect on policy rate will decrease bank profits by decreasing the spread of banks net interest income. However, previous literature finds that the positive effects of QE and policy rate outweigh the negative ones (Acharya et al., 2019; Demertzis & Wolff, 2016; Karadi & Nakov, 2021; Krishnamurthy & Vissing-Jorgensen, 2011). The contribution of this thesis is to shed light on the relationship between monetary policy and bank profits in Sweden, which is an under-researched area and currently of high policy relevance due to the public debate surrounding the subject. The research question of the thesis is therefore: has monetary policy caused the increase of profits in commercial banks?

We answer this question by estimating *Impulse Response Functions* (IRFs) through Local Projections. The variables used in this report is based on quarterly data from 2000 to 2023 and consists of parameters for the Swedish and global economy. The method of Local Projections involves a two-stage estimation procedure following a Structural Vector Autoregression (SVAR) model and standard Least Square regression with fixed effects. The results will be presented as impulse response functions where we show that the policy rate will have a negative effect on bank profits and QE will have a positive effect.

The paper will be structured the following way: The analysis begins with an introduction, followed by section two which describes a historical background to monetary policy throughout the time frame to give context to the current situation. Section three sets up the

two hypotheses regarding the effect that monetary policy has on bank profitability and section four describes the econometric method and the data used. Thereafter, we present all results from the regression and IRFs in section five, concluded by a discussion in section six which analyses the results of monetary policy shocks.

2. Background

Monetary policy's impact on bank profitability is crucial for informed policymaking, as the Riksbank's decisions reverberate throughout the economy. To comprehend this impact on economic dynamics, historical context regarding Sweden's monetary policy implementation from the 1990s to present day is essential. Understanding Sweden's historical implementation of monetary policy will facilitate the interpretation of our results and is necessary before entering the debate regarding rising bank profitability and the Riksbank's role in relation to these profits.

2.1. Monetary policy: from conventional to unconventional inflation targeting in Sweden 1993-2023

Since 1993, the Swedish Riksbank has been an inflation-targeting institution with a goal of 2 percent (Riksbanken, 2023). To maintain this level of inflation, the Riksbank uses different monetary policy tools including policy rate, expectation setting and quantitative easing. However, since the 90's, the most common tool to mitigate fluctuations in the economy has been the policy rate, also known as *conventional monetary policy*. Prior to the financial crisis in 2008, the policy rate varied between 1.5 to 4.5 percent. During the global financial crisis this changed as the interest rate was decreased in order to mitigate the decline in demand that the crisis caused. In the years after the crisis, the Swedish economy fared quite well with increasing output and low unemployment rates. Inflation however, remained below target level, raising concern within the Riksbank (Andersson, 2024). As a preventive measure, the policy rate was decreased to negative levels in 2015, something that was regarded as unusual but introduced in several countries due to deflationary tendencies (Andersson et al., 2022). Although the policy rate was decreased to the negative levels the inflation stayed low, which was concerning for the Riksbank (Riksbanken, 2020). To prevent inflation from diminishing further, the Riksbank introduced quantitative easing (QE) as an *unconventional monetary policy* tool.

QE is implemented by a central bank through the purchasing of financial assets, such as government bonds, on the secondary market. The Swedish program for asset purchases started in 2012 with a very small amount to make sure that the infrastructure regarding QE would be in place (Riksbanken, 2024f).This option was then utilised in 2015 when the Riksbank followed the lead of the European Central Bank (ECB) and started a large-scale

asset purchasing program with the intentions of rising inflation levels in Sweden. The program was intended to last until 2017 and during this time the main assets purchased were nominal and real government bonds. The total purchases amounted to 290 billion SEK. The final result of the QE was an increased inflation which inched up towards the inflation target. However, the Riksbank decided to keep the holding of securities at a constant rate due to volatilities in the global markets. During the years of 2017 to 2020 the assets remained at the above-mentioned level, in combination with a negative interest rate (Anderson et al., 2022).

In 2020 the Riksbank decided to leave the negative policy rate and instead set it to zero. This was due to the fact that they considered the inflation to have recovered and negative policy rate as an expansionary measure to be redundant. When the effect of the pandemic entered the global markets in 2020, it caused widespread worry that a recession would follow in its wake (Andersson et al., 2022). Since the policy rate was zero, the Riksbank instead opted to use QE as a stimulating measure to increase liquidity in the financial sector and combat an economic downturn. The Riksbank's holding of assets peaked in December 2021 with more than 900 billion SEK, which amounts to 18 percent of the total GDP (see Figure 1).

The anticipated economic downturn, due to Covid-19, that prompted the second period of QE never materialised. Instead, the "perfect storm" that was the pandemic, the war in Ukraine, and the subsequent energy crisis, led to a negative supply shock and a surge in inflation in many parts of the world, particularly in Sweden (SCB, 2023). Compared to the previous decade, when inflation had been between zero and two percent, the increase at the beginning of 2022 was drastic. By the end of 2022, it reached its peak of 12.3 percent, which is 269 percent higher than the same period one year earlier (SCB, 2024a). As a result of this, alongside escalating inflation expectations, the Riksbank made eight increases of the policy rate during 2022 and 2023, eventually leading up to the 2023 level of four percent (Riksbanken, 2024b). These are the policy rate increases that have been prominent in the Swedish debate on bank profitability and their effect, as well as the effect of QE, on bank profits will be discussed further in Section 3. To visualise the recent surge in bank profits that initiated the debate, we add illustrations of the development of bank profits, the policy rate and quantitative easing from 2000 to 2023, (see Figure 1-3). In recent years we observe an upward trend in both profits, QE and policy rate, highlighting the importance of analysing the Riksbank's role in monetary policy.

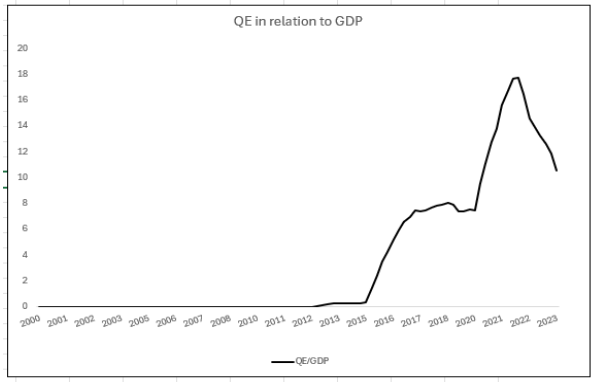

Figure 1. The Riksbank's holdings of in relation to GDP.

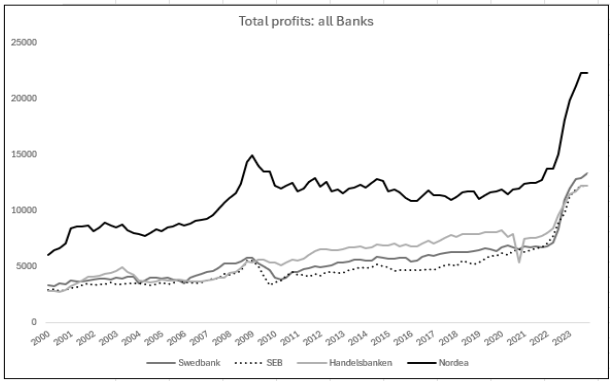

Figure 2. The development of profits from securities 2000 to 2023.

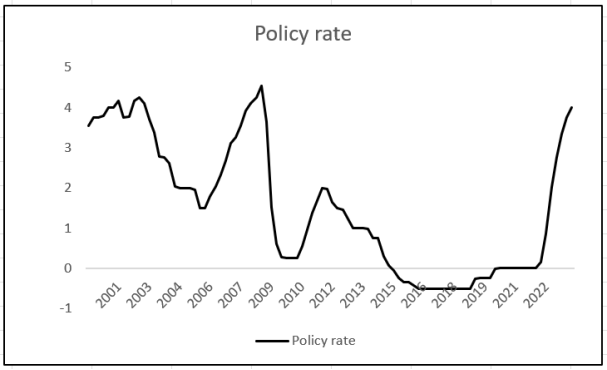

Figure 3. The development of the policy rate from 2000 to 2023.

The interplay between the increased policy rate and the large holdings of interest-bearing assets has proven to be expensive for the Riksbank. In 2023 the increased interest rates on the held assets generated losses of 59 billion SEK (Riksbanken, 2024c). Due to this deficit, the Riksbank proposed that the Swedish parliament should restore the equity with a capital injection of 43.7 billion SEK to cover the losses (Riksbanken, 2024d). The monetary policy of the Riksbank needs to be analysed further in order to determine if there is any merit to the claims that they are behind the surge in profits of commercial banks, if so, to what extent. This will be explored in the rest of the paper.

3. Monetary Policy and Commercial Bank Profits: 2 hypotheses

Given the historical background of monetary policy, the question of whether these policies have affected commercial bank profitability remains. The channels of monetary policy are the two presented above, policy rate and QE. Based on these, we present two hypotheses about their effect on bank profitability. The first hypothesis is that the policy rate will have a positive effect on commercial bank profitability (H1) and the second hypothesis is that QE will have a positive effect on bank profitability (H2). Below, we will present the theoretical framework for these hypotheses as well as research surrounding monetary policy and bank profitability.

3.1. The policy rate

The first channel through which monetary policy influences bank profitability is the policy rate, a conventional tool employed by the Riksbank to manage inflation expectations. As the policy rate determines the interest rates charged by commercial banks, it has a significant impact on the economy. Bank profitability is often estimated by the Net Interest Income, which is the difference between the cost of borrowing and the profit from lending (Albertazzi & Gambacorta, 2009; Borio et al., 2017). Due to the causal link between the policy rate and interest rates, the policy rate directly affects the net interest income spread of banks. A higher policy rate widens this spread, while a lower rate narrows it. This relationship has drawn criticism in the current debate, with many attributing the high bank profits to recent policy rate hikes by the Riksbank. This raises the critical question of how the policy rate has impacted bank profitability, leading us to formulate our first hypothesis

H1*: Commercial banks' profits increase as the policy rate increases.*

The link between policy rate and bank profitability was established several decades ago (Bernanke & Blinder, 1988; Hancock, 1985; Samuelson, 1945). Investigating the relationship between bank profits and monetary policy can be done in multiple ways. Measurements such as Return of Assets (ROA), Return of Equity (ROE) and the Net interest margin (NIM) are three common estimators and are all widely used in the literature regarding bank profits (Albertazzi & Gambacorta, 2009; Alessandri & Nelson, 2015; Borio et al., 2017; Joaqui-

Barandica et al., 2022; Kosmidou et al., 2005; Lang & Forletta, 2020). However, the recent debate surrounding bank profitability has been in regard to the net interest income and we will therefore use it as the profit measurement in this paper. The transmission mechanism from policy rate to the commercial banks are very direct, causing it to be such a conventional tool. If the policy rate goes up, commercial banks increase interest rates for Swedish households as well, consequently making borrowing more costly and saving more attractive. This procedure is meant to dampen economic activity and decrease consumption. Conversely, to stimulate the economy the Riksbank lowers the policy rate, making borrowing less expensive and investment more profitable as the interest rate among commercial banks decreases as well. As Freixas and Rochert (1997) summarise, due to the stickiness of deposit rates, there is an asymmetry in how banks interest rates are affected by increases in the policy rate. They argue that a raise in the policy rate will increase interest rates charged on loans more than interest offered on deposit. This asymmetry widens the net interest income spread among banks which transmits into profits for the banks (Driscoll & Judson, 2013).

Borio et al. (2017) highlights that the policy rate and its effect on bank profits have been neglected during the last 20 years. However, in recent years, there has been a newfound interest in the research area. The consensus is that an increased policy rate should have a general positive effect on bank profitability (Alessandri & Nelson, 2015; Demirgüç-Kunt & Huizinga, 1999; Windsor et al., 2023). Borio et al. (2017) showed that as the policy rate goes up, the net interest income spread increases and bank profits are affected positively. Simultaneously, there is a contrasting force due to the fact that higher interest rates increase the risk of defaults and thus an increase of loan loss provisions. Nevertheless, the positive effect of the increase of net interest income outweighs the negative effect and Borio et al. (2017) conclude that increases of the policy rate should have a positive effect on bank profitability.

Madaschi and Pablos Nuevo (2017) suggests that the Swedish commercial banks surging profitability is as a result of the increased policy rate, even though it has been negative during the researched period. This contradicts some previous literature who implies that the bank's profitability should decrease as the policy rate goes down. Madschi and Pablos Nuevo (2017) instead argue that this is evidence of the stability of the Swedish banking system.

The vast majority of research on the relationship between the policy rate and bank profits seems to favour a positive conclusion. However, Windsor et al. (2023) point out that the policy rate increases are used as a contracting measure for the economy. As the policy rate goes up, consumption and investment are expected to go down. This leads to lower issuance of loans which in turn will harm bank profitability and it might explain why Windsor et al. (2023) found a lower effect than Borio et al. (2017) of interest rates on bank profits. However, previous research on the subject seems to be inclined towards a net positive effect of an increase in policy rates on commercial bank profits.

3.2. Quantitative Easing

The second channel through which monetary policy influences bank profitability is through quantitative easing (QE). In contrast to the policy rate, QE is a relatively new monetary policy tool whose effects have not been as extensively studied or understood by researchers compared to conventional policy. In recent years, QE has played a significant role in the Riksbank's monetary policy actions and thus studying its effect on bank profitability is highly relevant. This brings us to the second hypothesis:

H2: ***Commercial banks' profit increases as quantitative easing increases.***

According to Krishnamurthy and Vissing-Jorgensen (2011), QE can affect the economy via several different channels of which three are significant for understanding the relationship between QE and bank profitability. The first channel concerns the banks' balance sheets, where the funds obtained by banks from selling their assets to the Riksbank are invested in riskier assets that yield higher revenue. This alone improves bank profits. Furthermore, the remaining government bonds that the Riksbank does not buy will appreciate in value, contributing to an overall strengthened balance sheet of the commercial banks. The assets that the Riksbank purchased during the pandemic had an average maturity of 5 years (Andersson et al., 2022), which means that the Riksbank continuously pays interest on the assets bought to the commercial banks. As the interest rates among commercial banks increase when the policy rate goes up, the Riksbank is "stuck" with costly government bonds for which it must pay large interest rates to the banks until they reach maturity. This is how the balance sheet channel can generate substantial profits for banks when QE is used by the Riksbank. The second channel concerns the effect on interest rates and lending. During QE, the banks'

liquidity increases, which makes them lower the interest rate. As a result of this, the issuance of loans goes up. However, as the interest rate decreases, the spread of the net interest income is also diminished, which has a negative impact on the profits of the banks. The third channel is through the likelihood of an economic boom following QE, stimulated by its positive impact on the bond market and subsequent reduction in interest rates. This will mitigate the negative effects of the second channel as banks are expected to issue more loans during a period of QE resulting in an increase of bank profitability in the long run. Another aspect of the third channel which contributes to the probability of an economic boom is the effect of QE announcement on expectations. When the Riksbank signals expansionary monetary policy at the same time as the policy rate is close to its lower bound, it can be interpreted as a commitment to keep the policy rate low for an extended period, as the Riksbank would face losses if the rate were increased significantly before the bonds matured.

The effect of QE on bank profits has not been as extensively researched as the effect of changes in the policy rate, mainly due to the fact that it is a relatively new monetary policy measure. Thus, there is not much on the subject within Sweden. Nevertheless, there have been some studies on the subject in an international context. Karadi and Nakov (2021) show that while QE might have a positive effect on bank profitability in the short run, it has a negative effect in the long. The long-run effect of QE is through low interest rates which diminishes the spread of the net interest income and thus, bank profits. Furthermore, in times of financial distress, they conclude that QE is an important monetary policy tool that has a positive effect on bank profits in the short run. Acharya et al. (2019) investigated the real effects of the ECB's QE on European banks after the global financial crisis. They concluded that central banks could recapitalise commercial banks through QE which will lead to large profit gains for the banks.

The duality of QE and its effect on bank profits is also studied by Demertzis and Wolff (2016) but from a broader perspective. The authors analyse the effect of QE made by the European Central Bank on European banks. Demertzis and Wolff (2016) recognize that the net interest rate should be reduced as quantitative easing pushes down interest rates and thereby decrease profits but that this negative effect will be counteracted by the fact that the balance sheet of banks improves. Even though there were concerns among European banks that their profits would be reduced because of the QE during the period of 2006-2015, Demettzis and Wolff can conclude that the profits have not been significantly affected. The

authors argue that this is most likely due to the positive effects of QE outweighing the negative ones. This line of reasoning is prominent in the research that has analysed the effect of quantitative easing on bank profitability. In conclusion, previous research concludes that similar to the policy rate, the net effect of QE is positive.

4. Methodology

4.1. Method

To test our two hypotheses, we rely on the two-step estimation technique developed by Jordá (2005) to study causal effects of monetary policy on bank profits over time. In the first step we estimate our two shock variables through a Structural Vector Autoregression model (SVAR). In the second step we implement these two exogenous shock variables in a standard Least Square regression (LS) to generate Impulse Response Functions (IRFs).

We want to examine how bank profitability among Swedish commercial banks respond to monetary policy over time. To visualise this effect, we create IRFs, which are common within the field of macroeconomics as they provide a dynamic understanding of how an economy responds to exogenous shocks or stimuli. The IRFs illustrates the effect of a shock of one variable on other variables over time by tracing its effect across different time periods. Step one in our approach for creating the IRFs is to first estimate the exogenous shock variables that represent policy rate and QE measures. This is done by constructing residuals via a SVAR, explained in section 4.3. Step 2 in our approach is to include the residuals, i.e shock variables, in a standard Least Squares model (LS) and regress it on the difference in profits over a period of two and a half years. What we are interested in is the coefficients for each shock variable as it is the estimated effect of QE and policy rate on bank profits. Lastly, we accumulate the coefficients of each regression over the entire horizon to create our impulse response functions which illustrate the total effect of monetary policy on commercial bank profitability over time. According to our hypotheses, we expect both policy rate and QE to have a positive effect on bank profitability.

This section consists of four parts. We begin by motivating the choice of method by introducing the two most commonly used econometric approaches for creating IRFs. We then proceed by introducing the Structural Vector Autoregression-method as the first step in generating Local Projections (4.2), followed by the second step of performing the Local Projections (4.3). The section is concluded with an explanation of the data (4.4).

The creation of impulse response functions can be done in several ways. The most established approach within macroeconomics is the Structural Vector Autoregression analysis

(SVAR). Recently however, more studies, led by Jordá (2005), have presented Local Projections as an alternative econometric approach for estimating the dynamic impact of structural macroeconomic shocks over time (Jordà, 2023). While the literature is scarce regarding which of the methods is preferred and although they are conceptually the same, they possess different strengths and weaknesses. While the SVAR-model is a very sophisticated method that extrapolates effects over longer time horizons, it is sensitive to misspecifications in the data generating process (DGP). The accuracy of the SVAR-model is completely dependent on complex assumptions of the underlying multivariate dynamic system, explained below in section 4.2. Although previous research shows that even misspecified SVAR-models still can generate feasible one-period forecasts, the issue of misspecification escalates when doing impulse response functions as the estimation errors compound (Jordà, 2005). In contrast to the SVAR-model, Local Projections do not require any specification or estimations of underlying complex multivariate dynamic systems. Instead, Local Projection can be estimated with standard Least Squares (LS) which makes it less sensitive and thereby more robust to misspecifications in the DGP.

Furthermore, as IRFs forecast over an increasing time horizon, compared to a one-period forecast, potential misspecifications will compound. The issue of compounded misspecification errors is circumvented as Local Projection creates a singular estimate of the shock for each time period in contrast to the SVAR-model that creates one equation for all time horizons. Furthermore, using Local Projections, we are able to simultaneously estimate the effect of a shock on multiple variables. While the flexibility of the Local Projection model aids in connecting the gap between macro- and microeconomics, which contributes to its employment, it can also be seen as a potential weakness (Jordà, 2023). Adding restrictions in the DGP increases the efficiency of the estimates and minimises the mean-square errors of the forecast. However, considering the objective of our paper, we pursue previous research by Jordá (2023), “The premium is on bias over efficiency” motivating that the Local Projection framework is more suitable for this analysis.

4.2. Step 1: SVAR-model

The purpose of the SVAR-model in this case is to estimate the residuals of the policy rate and QE, which can be interpreted as shocks to the economy that cannot be explained by the endogenous variables. However, since the shock terms also capture measurement errors,

policy mistakes and model misspecifications one should consider them with care. The SVAR-model's primary strength lies in its ability to shed light on the contemporaneous relationships frequently observed within economics. However, this relationship can be fickle and hard to distinguish with econometric methods, hence the frequent utilisation of the SVAR-model. A SVAR-model describes the dynamic relationships between stationary variables over time by studying the expected response of the variables to a given one-time structural shock (Kilian, 2013). The shock arises from factors that are not estimated within the model, allowing us to assess, for example, the effect of monetary policy on various variables. For a SVAR-model to be able to specify the causal effects of the variables on each other, a Cholesky decomposition is necessary. The technicalities of this decomposition will be presented further down, explaining the importance of the specific order in which the y-matrix is defined.

In our analysis, the y-matrix specifies the endogenous block which is composed of variables that are meant to model the Swedish economy. A broad range of variables have been taken into consideration for this analysis, with the intention of describing the Swedish economy without overparameterization of the SVAR-model. In line with Andersson (2023) the Swedish economy is determined by its GDP and will therefore be the first of the endogenous variables. The GDP is included as the GDP gap, which represents the state of the Swedish economy. The external balance is modelled by the exchange rate SEK/USD, the unemployment rate and the inflation level are included to capture the domestic economic situation. The variables that we will be estimating are QE and the policy rate. Since research shows that the policy rate does not have a contemporaneous effect on the other variables but rather a lagged effect of one to three years, it is placed last (ed. European Central Bank, 2001). The ordering of the variables is similar to the one of Andersson (2023).

The SVAR-model that is estimated is the following:

$$A_0 y_t = c + \sum_{i=1}^{I} A_i y_{t-i} + \sum_{j=0}^{J} D_j x_{t-j} + e_t \qquad (1)$$

Where

$$y_t = \begin{pmatrix} g\_s_t \\ e_t \\ unp_t \\ cpi\_s_t \\ qe_t \\ r_t \end{pmatrix} \quad (2)$$

is the vector containing the variables that represent the Swedish economy: *g_s* is the Swedish GDP gap, *e* is the exchange rate, *unp* is the level of unemployment, *cpi_s* is the Swedish inflation, *qe* is the quantitative easing and *r* is the policy rate issued by the Riksbank. The A_0 matrix captures the contemporaneous link between the variables in vector y_t, while A_i composes the parameters of the lagged effect.

The exogenous variables representing the global economy are represented in the x-matrix:

$$x_t = \begin{pmatrix} g\_us_t \\ cpi\_us_t \\ oil_t \end{pmatrix} \quad (3)$$

where *g_us* is the U.S GDP gap, *cpi_us* the U.S inflation and *oil* denotes the global crude oil price meant to capture the effect of energy prices on the Swedish economy. These are included since Sweden is a small, open economy which makes it sensitive to global economic fluctuations and are added in line with previous research (Andersson, 2023). As g_us, cpi_us and oil are added exogenously, they will affect the endogenous variables but not vice versa.

Due to the contemporaneous effects, the parameters in the matrix A_0 are unspecified. Hence, we cannot directly estimate equation 1. To circumvent this issue, we instead estimate the reduced form model. This is done by applying the Cholesky decomposition and impose a structure on A_0 of a lower triangular matrix (Lütkepohl, 2005). This creates the reduced form equation of the above SVAR where we assume the $A_0^{\square}$ matrix as a lower triangular matrix:

$$y_t = c + \sum_{i=1}^{I} B_i y_{t-i} + \sum_{j=0}^{J} S_j x_{t-j} + \epsilon_t \quad (4)$$

Where $B_i = A_0^{-1} A_i$ and $S_j = A_0^{-1} B_j$

The assumptions and ordering of this model determine the way the variables affect each other. By the ordering of y_t, we assume that QE and the variables above may have a contemporaneous effect on the policy rate, but the policy rate can only have a lagged effect

on QE. After estimating the reduced form SVAR we obtain the structural residuals which we save and use as the shock terms of and policy rate. Thus, obtaining the two exogenous variables representing monetary policy shocks. Due to the sensitivity of the SVAR-model, the number of lags is preferably kept as low as possible since a high lag order decreases the accuracy of the model (Lütkepohl, 2005). In our analysis, the lag length was set to two based on the Akaike Information Criterion (AIC), which is also in line with previous research stating that two is the most common lag length when dealing with quarterly data (Ivanov & Kilian, 2005).

The shocks obtained from the reduced SVAR-model will now be used within the Local Projections framework.

4.3. Step 2: Local projections

We follow the method introduced by Jordá in 2005 to create impulse response functions without having to specify or estimate a complex underlying multivariate dynamic system. As it is done in other approaches like VAR and SVAR. By evaluating the effect of exogenous shocks on macroeconomic variables through Local Projection, we obtain an equation for each time horizon rather than one equation for the whole period as is the case in SVAR. After estimating the regressions, the estimated coefficients of the variables of interest from each time period are graphed across the entire time frame. This creates the IRFs, illustrating the plausible link between monetary policy shocks and bank profits, as outlined by Jordá (2005).

In our case, we add the residuals obtained from step 1 to our panel data and estimate their effect by using standard LS regressions with different time horizons in the dependent variable (Yaffee, 2003). To capture bank specific effects, we add two more control variables, total deposits and total assets. Since the data is not randomly selected, we account for potential biases arising from unobserved individual specific characteristics by applying fixed effects, in line with the logic behind the model and previous research on the subject (Alessandri & Nelson, 2015).

We begin by setting up the following least squares regression where we plot the time horizons (h) for the local projections from 1 to 10. This version of the least squares regression is what we will call the *baseline regression*:

$$profits_{t+h,i} - profits_{t,i} = \beta_1 shock_{QE,t} + \beta_2 shock_{r,t} + \theta X_t + \varphi T + \omega B_{i,t} + \alpha_i + e_t \quad (5)$$

h = 1, 2, 3, …., 10
i = Swedbank, SEB, Handelsbanken, Nordea.

Where $shock_{QE}$ stands for the QE shock term and $shock_r$ stands for the policy rate shock term, which both come from the SVAR-model. Vector X contains the control variables for the macroeconomy which are: GDP gap for Sweden, inflation for Sweden, exchange rate, unemployment, GDP gap for the U.S, inflation for the U.S and the crude oil price. Vector T includes two time-dummies to control for the global financial crisis and the covid-19 pandemic and the constant which represents the intercept of the regression. Vector B includes the bank specific control variables of total assets and total deposits. α_i accounts for the individual specific effect and $e_t$is the error term.

As the data is reported in quarterly intervals, the total time span on which our impulse response functions are computed over amounts to two and a half years. Regression 1 estimates the accumulated effect of QE and policy rate on bank profits without specifying potential differences in the effect amongst the banks. Since the response to monetary policy shocks might differ amongst the banks, the individual effects have also been tested. One bank is then used as the base scenario and the other banks as control variables with the shocks applied to the bank specific dummy variable. By this definition we are able to distinguish if they respond differently to the shocks. If the variables for one of the banks is significantly different from the base scenario, then they have a different way of reacting to changes in monetary policy. This is done though adding on the individual shocks of the banks to the baseline regression in the following way:

$$profits_{t+h,i} - profits_{t,i} = Baseline\ regression + BD_i \times shock_{QE,t} + BD_i \times shock_{r,t} \quad (6)$$

h = 1, 2, 3, …., 10
i = Swedbank, SEB, Handelsbanken, Nordea

Where vector BD includes the Bank Dummy variables for each bank, except the one that is tested against, e.g. as Swedbank is the base scenario in our first case, the QE shock will be multiplied with the dummy for SEB, Handelsbanken and Nordea. The same procedure is done with the policy rate.

By calculating estimates of the coefficients $\beta_{1,j}$ and $\beta_{2,j}$, where $j = 1,2,3,...,10$ for all time periods, we obtain the impact of each variable on bank profits respectively. Although we attain the impact of all variables, it is only the coefficients for our shock variables QE and policy rate ($\beta_{1,j}, \beta_{2,j}$) that are saved and plotted against the entire time span. The augmentation of these coefficients forms our Local Projections. Additionally, since the shocks are exogenous, we can include them simultaneously in each regression without the risk of endogeneity. As we are interested in a time span relevant to monetary policy effects, our time horizon is relatively short in terms of macroeconomic perspectives. Thus, the issue of cointegration between monetary policy and bank profits becomes irrelevant as it is largely related to the long-run equilibrium relationship between two variables (Watson, 2016).

4.4. Data

Our data sample includes the four main commercial banks in Sweden: Swedbank (Swed), Svenska Enskilda Banken (SEB), Handelsbanken (Handels) and Nordea. These banks have a dominating position and they represented 66 percent of the Swedish capital market in 2022 (Hansen et al., 2023). Apart from having the largest market shares, the first three banks are also labelled as the “large banks” by the Swedish Financial Supervisory Authority (Finansinspektionen, 2023). Nordea moved to Finland in 2018 but prior to this it was also labelled as a large bank by the Financial Supervisory Authority (Finansinspektionen, 2017). Due to this and the fact that it is still referred to as a “monetary policy counterpart” by the Riksbank Nordea is included as well (Riksbanken, 2024a)

The time period covers the first quarter of 2000 to the last quarter of 2023. This includes both periods of QE and largely encapsules the current monetary policy regime of inflation targeting. An important inclusion of data is the period between 2015 and 2023 since they include the most active periods of quantitative easing as well as the pandemic that ignited the debate around bank profitability and monetary policy. All variables are covered during this

period. Furthermore, the choice of quarterly data sorting was made because the dependent variable, bank profits, is quarterly reported. Additionally, the level of our exogenous shock variables, policy rate and QE, are normally announced by the Riksbank four times a year.

4.4.1. Descriptive Statistics

This section summarises all data used in the analysis. Firstly, the main variables of regression will be presented, secondly the control variables for the SVAR-model and thirdly the bank specific control variables for the local projections model. All variables have been transformed into growth rates to facilitate the inference of the results, with the exceptions of the policy rate, QE and GDP measurements. A Dickey Fuller test has been done for all variables (see Appendix 8.1) and a table for the sources of the data is included in Appendix 8.2. Further specification of the data is described below in this section.

In line with previous research, *bank profits* are defined as the Net Interest Income of each bank. Since the profit is measured as a growth rate, the original form of the data is highly volatile. This is due to the fact that profits vary during the quarterly cycle, where some quarters have high growth rates, and some quarters have low. To view the trend of the profits more clearly, the data was detrended before being applied in the panel data regression. The result of the detrending is illustrated in Figure 2. By doing this, the interpretability of the data is improved which allows for a better understanding of the underlying dynamics to bank profitability.

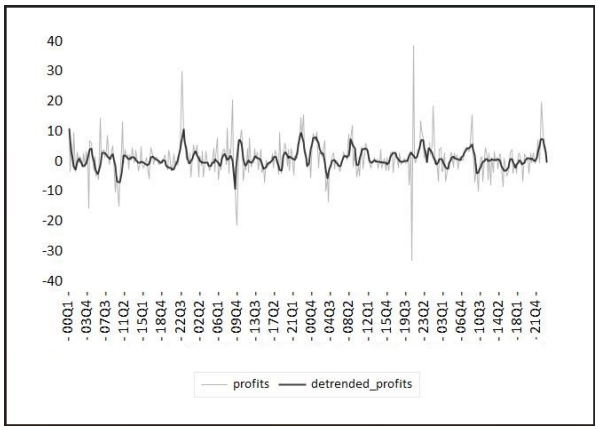

Figure 4. Growth rate of profits before and after detrending.

The first main variable of the SVAR-model is *Quantitative easing* which is based on the Riksbank's holdings of securities in SEK in nominal prices. The QE measurement in this report is calculated as the ratio of the Riksbank's holdings to the aggregated GDP over four

quarters. Resting QE on GDP levels serves both a pedagogical purpose and provides a percentual measure of the QE (Andersson et al., 2022). According to the Dickey-Fuller test (see appendix 8.1), QE is not stationary and is therefore taken in first differences. The second main variable, *policy rate,* is the quarterly percentage rate determined by the Riksbank. While the Dickey Fuller test indicates that the policy rate is a non-stationary variable, there is a substantial body of literature that employs the policy rate in levels rather than using its growth rate or taking it in first differences. This approach is supported by several influential studies see (Albertazzi & Gambacorta, 2009; Bernanke & Blinder, 1992; Bernanke & Gertler, 1995). Therefore, while the Dickey-Fuller test may suggest non-stationarity, there is a well-established precedent in the literature for incorporating the policy rate in levels when analysing its effects on macroeconomic variables. A visualisation of these three variables and their movements over time has been presented above in section 2.

The first control variable we include is the percentual difference between the cyclical GDP and the trend of GDP in the regression, called *GDP gap*. This estimate is highly stationary and illustrates the business cycles of an economy. When the GDP gap is positive, it is an indication of the economy experiencing a boom. Conversely, when the estimate is negative, it indicates a recession. The usage of the GDP gap instead of solely GDP was suggested by Chen and Gornicka (2020). The authors argue that the GDP gap removes the high fluctuation and non-stationarity of the standard GDP growth measure. The GDP gap is calculated by applying the Hodrick Prescott filter (with lambda=1600 as suggested by Hodrick and Prescott (1997)) on real GDP data, which is a common method for obtaining the GDP gap. Due to Sweden being a small but open economy, it is sensitive to movements on the international markets (Ekonomifakta, 2024). To control for this, we include the *SEK/USD exchange rate* in our analysis. Following previous research, (Miranda-Agrippino & Ricco, 2021; Romer & Romer, 2004) the *unemployment rate* and *inflation rate* were also included to control for the Swedish economy. Both inflation and unemployment rate are highly correlated with output and therefore important to take into account in our regression. Furthermore, as the Riksbank follows an inflation targeting regime, it plays a significant part in the financial system. To represent the global economy, the *U.S. GDP gap, inflation* and *crude oil price* have been included. Both U.S GDP gap and inflation have been transformed using the same method as the Swedish counterpart. Crude oil is also included as it is an important commodity that captures both the level of economic activity and energy prices. Both of which have an effect on the Swedish economy (Andersson, 2023; Antonio J. & Luis A., 2022). Lastly, the bank

specific control variables are *total assets* and *total deposits.* Total assets are a commonly used proxy for bank size (Kosmidou et al., 2005) and total deposits measure the amount of deposits held within the bank and represent their possibility of lending (Drechsler et al., 2017).

In order to account for the impact of both the financial crisis and covid-19 pandemic we include a dummy variable for each crisis. The time period the financial crisis dummy was 2007Q3 until 2010Q1. The time period for the covid-19 crisis was 2020Q1 until 2022Q2 (Riksbanken, 2022; The Public Health Agency of Sweden, 2023).

5. Results

In the following section, we will present the results of QE shocks and policy rate shocks on bank profits as impulse response functions. Additional regression results will be presented in table format to facilitate analysis and evaluate them against the previously stated hypothesis. The VAR-output that the impulse response functions is based on can be seen in appendix 8.3.

5.1. Impulse response functions

Figure 5 and 6 illustrates the IRFs for the estimated response in bank profit to policy rate and QE shock. Table 1 summarises the relevant statistics regarding the significance level of the results. Figure 5 indicates that policy rate has a negative effect on bank profits while Figure 6 illustrates the opposite reaction to QE. That is – during periods of high policy rate, bank profitability goes down, conversely, during periods of QE, bank profits are expected to increase. The negative effect of policy rate is statistically significant for the time horizons between 4 and 6, with the highest significance level during period 5 and 6. As one period to another signifies one quarter, the negative effect of a policy rate shock takes approximately one and a half years to transmit onto bank profitability. Table 1 illustrates that a 1 percent increase in the policy rate is expected to decrease bank profits between 0.4 to 0.5 percent, with a delayed effect of four to six quarters. The delayed effect of the policy rate is in line with previous research which shows that the ECB expects a lag of one to three years before the policy rate has an effect on the economy (ed. European Central Bank, 2001). Policy rates in the remaining periods are not statistically significant.

The level of significance is higher for a QE shock and remains for a longer period, as can be seen in Figure 6. The positive effect of QE on bank profits becomes statistically significant for horizons 4 to 8, implying that bank profitability is expected to increase during periods of QE and decrease during periods of quantitative tightening (QT), with a delayed effect of one year. Hence, an increase of 1 percent of QE will enhance bank profits by 0.6 to 0.9 percent with a lag of one to two years. These results are the general results of the shocks to the economy. Thereby we cannot distinguish if there have been differences in responses among the banks, this will instead be presented further down. However, what can conclude that the general response in banks profitability to monetary policy shocks is dual. An increase of the policy rate is expected to have a negative effect, while an increase in QE a positive one.

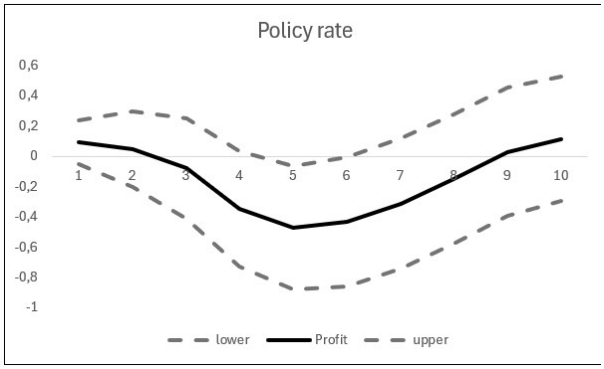

Figure 5. The effect of policy rate on bank profits, excluding individual bank responses. The values of the x-axis represent the value of h in the regression. Each increment along the x-axis corresponds to one quarter.

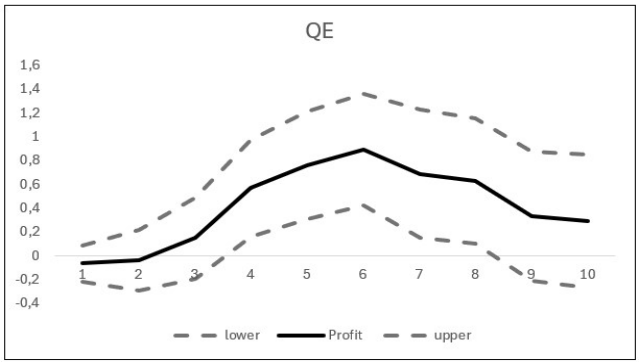

Figure 6. The effect of QE on bank profits, excluding individual bank responses. The values of the x-axis represent the value of h in the regression. Each increment along the x-axis corresponds to one quarter.

*Table 1. Results from panel data regression for horizon 1-10, excluding individual bank responses. The statistically significant results are highlighted with asterisks. * for 10%, ** for 5% and *** for 1%.*

Horizon	Policy shock coefficient	Std.error	p-value	QE shock coefficient	Std.error	p-value
1	0.0936	0.074293	0.2086	-0.0611	0.0773	0.4300
2	0.047748	0.127255	0.7077	-0.0347	0.1305	0.7904
3	-0.07818	0.168036	0.6421	0.1537	0.1747	0.3795
4	-0.34724	0.193002	0.0729*	0.5738	0.2082	0.0062***
5	-0.47135	0.205079	0.0222**	0.7613	0.2282	0.0009***
6	-0.43929	0.21612	0.0429**	0.9007	0.2372	0.0002***
7	-0.31855	0.217993	0.1449	0.6794	0.2701	0.0124**
8	-0.16587	0.21634	0.4438	0.6248	0.2662	0.0196**
9	0.010876	0.214057	0.9595	0.3016	0.2756	0.2747
10	0.09246	0.210187	0.6603	0.2917	0.2830	0.3035

5.2. Differences among Banks

As illustrated below, the IRFs for the individual banks follow the same general pattern as displayed in Figure 5 and 6. Implying that all banks are similar in the handling of monetary policy shocks. The differences between the banks are illustrated in Table 2, where Swedbank is the base that the other banks are compared against. The results indicate that there is no difference among the banks besides a slightly lower p-value for Handelsbanken in general, indicating that Handelsbanken might react differently to policy rate and QE shocks, as can be illustrated by Table 2. Since the results are not significant, there is no difference in how the banks react to changes in the QE or policy rate changes, which makes it possible to conclude that the banks react to changes of the policy rate in the same manner.

Below are illustrations of the differences in response to monetary policy shocks among banks (figure 7 to 10), along with a table of their average p-value (Table 2).

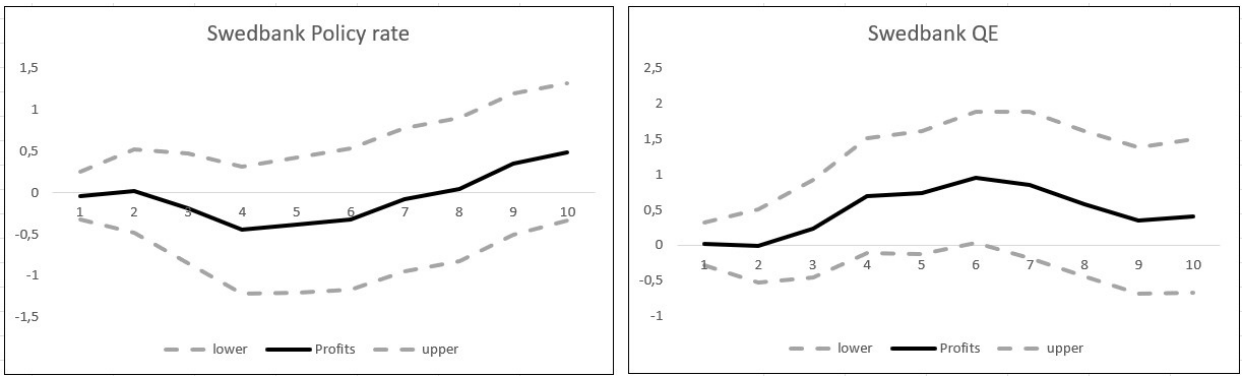

Figure 7. Swedbank - policy rate and QE shocks

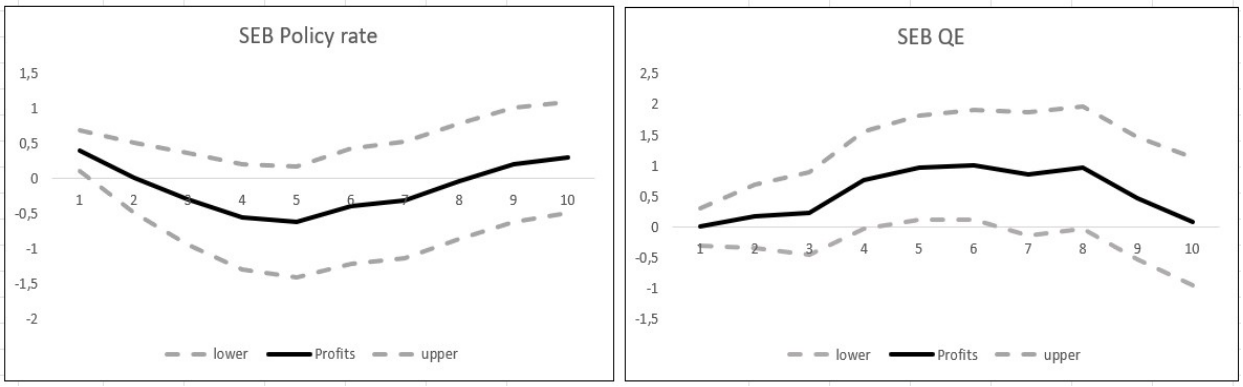

Figure 8. SEB -policy rate and QE shocks

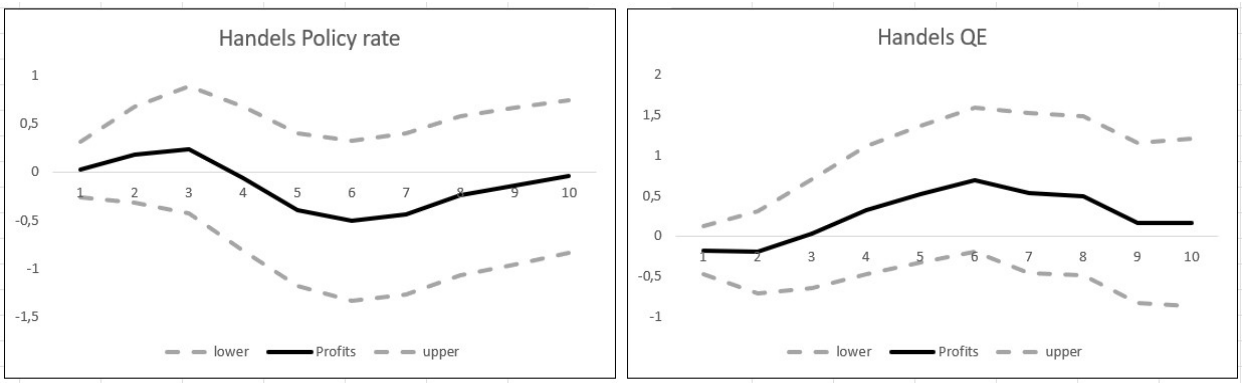

Figure 9. Handelsbanken - policy rate and QE shocks

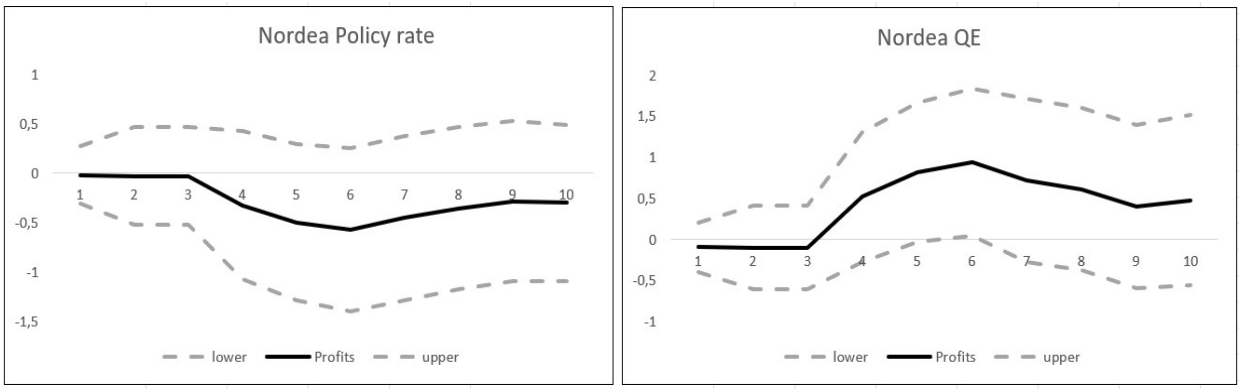

Figure 10. Nordea -policy rate and QE shocks

*Table 2. Average p-values of the individual bank-responses to monetary policy shocks. The statistically significant results are highlighted with asterisks. * for 10%, ** for 5% and *** for 1%.*

Shock	Average p-value
QE_swed	0.393524
i_swed	0.582473
QE_seb	0.827355
i_seb	0.760217
QE_handels	0.672304
i_handels	0.608211
QE_nordea	0.846538
i_nordea	0.658711

6. Discussion

The discussion will be divided into three parts. Firstly, there is a discussion around the results. Secondly, we discuss the robustness of the results and potential weakness of the model before finishing the section with a discussion of potential improvements of the method that could be included in further research.

6.1. Monetary policy affects bank profits

Our results both reinforce and challenge prevailing theories on monetary policy and its effect on bank profitability. Diverging from previous research (see Borio et al., 2017; Demirgüç-Kunt & Huizinga, 1999; Madaschi & Pablos Nuevo, 2017) our study uncovers an intriguing negative relationship between the Riksbank's policy rate and bank profitability in Sweden. Contrary to the widely held view that higher policy rates boost profits via wider net interest margins, our results suggest that a 1 percent increase in the policy rate decreases Swedish bank profits by 0.47 percent. This counterintuitive finding challenges the traditional notion that interest rate hikes inherently benefit banks through higher interest margins and makes us reject the first hypothesis. Windsor et al. (2023) discuss the potential negative effect of the policy rate through a general slow-down of the economy but conclude that the positive effect still surpasses the negative. In the Swedish context, the negative effect could be exacerbated by the high levels of household indebtedness and the prevalence of floating-rate mortgages in Sweden. As the policy rate rises the households find themselves in a tightened economic situation with less money to spend on investments and consumption. The ensuing reduction in economic activity and increased likelihood of defaults from an increased policy rate may offset any gains from wider interest margins, ultimately depressing overall bank profitability.

Regarding the effect of QE on bank profitability, we find that the positive effect is large and significant. Previous literature on QE's effect on bank profits have been ambiguous. According to Karadi and Nakov (2021), QE might have a negative effect on bank profitability if it is used too extensively and for a longer time period. On the other hand, Demertiz and Wolff (2016) show that the concern of QE eroding bank profitability is misplaced and that bank profitability has increased in times of QE. Our results show a positive relationship between QE and bank profitability in Sweden where a 1 percent increase in QE will cause a 0.9 percent increase in bank profits, with a lag of approximately 1.5 years.

Between the first and second quarter of 2020, QE was increased with 27.2 percent. This implies a 24.5 percent increase in bank profits solely due to the asset purchases of the Riksbank. Consequently, simply the increases of QE have led to a drastic surge in bank profitability. As described in the second hypothesis, there are several channels through which QE transmits to the commercial banks. Based on these results we can examine and discuss the likelihood of which of the channels that have been prominent in Sweden.

The first channel is the impact of QE on the economic situation in general. Conducting QE can increase expectations in the economy and cause higher levels of investments and thus increased inflow of lending rates for the banks. Nevertheless, during the last period of QE, the economic outlook was not improved but rather depressed as the inflation soared in the end of 2022 and the policy rate was increased in order to mitigate this. The effect of QE on bank profitability was therefore *not* likely due to an improved economic situation. The second channel through which QE affects the bank profitability is by lowering the interest rate. However, this should have a negative effect on bank profitability since it decreases the net interest margin. Thus, it is most likely *not* the reason as to why QE has had a positive effect on bank profits. The third channel is the balance sheet measures that QE yields. Due to the increased amount of assets held by the Riksbank, the commercial banks' income from interest bearing assets within the Riksbank bank grows. This is most likely the reason behind the positive effect of QE on the banking sector's profitability. Due to raised incomes for the banks, they can allocate more funds to riskier assets, which yield higher profits as well. Thus, the QE will cause both higher risk-taking by the banks, as well as higher profits in general. Although we do not have precise insight into how the Swedish commercial banks have managed the increase in money supply resulting from QE, it is evident from our results that the actions taken by the Riksbank have contributed to the recent upturn in bank profits.

As the policy rate has increased, the interest rates on the assets purchased by the Riksbank through QE have also risen. This suggests a potential link between the policy rate and the impact of QE, which could explain why we cannot directly observe the effect of the policy rate itself. Instead, its influence may be intertwined with the QE shock, as an increase in the policy rate translates into higher income for banks from the balance sheet measures associated with QE. A key consequence of QE has been the significant increase in interest-bearing deposits held by commercial banks at the Riksbank. As these deposits earn interest, banks effectively receive dividends tied to the prevailing policy rate. In 2022, the Riksbank

reported an unrealized loss of 59 billion SEK due to rising market interest rates reducing the value of its securities portfolio, primarily consisting of government and secured bonds acquired during the second round of QE. One could say that the funds distributed to banks through QE effectively become "free" revenue, as they now receive dividends on these deposits in the form of the policy rate. While the policy rate's direct effect appears negative, its indirect impact through QE-related balance sheet measures could be positive for bank profitability. Ultimately, our results indicate that the positive effect of QE overshadows the smaller negative effect of the policy rate. The net impact of the Riksbank's monetary policy stance has been a boost to commercial bank profitability in Sweden.

We can conclude from the results that there is no significant difference between the commercial banks in Sweden in how they react to shocks in monetary policy, as shown in Table 2. The banks have all been subject to the same levels of QE and the only bank that might react differently than the others are Handelsbanken, although there is no significance for this. One potential reason for handling the shocks differently could be due to internal structures within the bank. For example, different attitudes towards risk-taking in their portfolios. The individual responses to how Swedish banks are affected by monetary policy all follow the same general pattern but lack statistical significance. The lack of significance could also be explained by potential disturbances in the data due to the fact that it is divided into smaller samples when we examine the individual responses. Because of this, we cannot conclude anything about differences in how the banks react to QE, except that they individually seem to follow the same pattern. Similar result can be derived for the policy rate, which is reasonable since the policy rate affects all the banks the same way.

What can be said about the debate in Sweden is that it might have had a skewed focus on the policy rate. Our results shed light on important questions regarding the Riksbank’s monetary policy and especially the effect of quantitative easing. The QE that the Riksbank conducted is a contributing factor to the large profits of commercial banks. As described in the background, the Riksbank is currently seeking refunding of 42.7 billion SEK due to the extensive QE. In case this is granted from the Swedish parliament, the financing will be taken from Swedish taxpayers. However, there is no way for the Swedish people to affect and hold the Riksbank accountable for its decisions regarding its monetary policy. Many consider it to be a positive thing since it, in general, leads to a more stable and well-functioning economy (see Andersson, 2024), but it also brings up questions regarding structural problems within

the Riksbank and its transmission channels. As displayed in this analysis, QE has caused immense profits for the banks, which will most likely be funded by tax revenue. Because of this, the effect of the Riksbank's *unconventional* monetary policy is what should be centred in the debate rather than the *conventional* one, as it is the leading factor contributing to the banks' increasing profits.

6.2. Robustness of the results

Besides the fact that the method of Local Projections increases the robustness of the regression compared to the SVAR-model, additional tests were conducted throughout the analysis. Unfortunately, because the time horizon in this analysis is too short, testing the robustness by dividing it into smaller sample periods becomes unproductive as it will fail to provide trustworthy estimates. Instead, two additional analyses were made to be compared to the finalised one where we excluded the dummy variables for the financial crisis and Covid-19, as well as one analysis for the sample period 2000-2019. The IRFs made for these can be found in Appendix 8.4 and 8.5. Although the significance level decreased, the results are in general the same. Indicating that the original application is robust. The regression was tested for heteroscedasticity using a Breusch-Pagan test, which failed to reject the null hypothesis of no heteroscedasticity (see Appendix 8.6). This does not entirely eliminate the risk of heteroscedasticity, but it strengthens the robustness of the results. A Wald's test was also conducted to ensure the results of the bank-specific shocks were not significant and could be rejected for all the variables (see appendix 8.7).

We also estimated the effect of GDP gap on bank profits as a robustness check to see if our results were in line with previous research (Albertazzi & Gambacorta, 2009; Klein & Weill, 2022). As illustrated in Figure 10, the GDP gap will have a positive effect on bank profitability. The effect of the GDP gap on bank profits becomes significant after approximately 7 horizons, up until 10 horizons (see appendix 8.8). This implies that as the GDP gap increases by 1 percent, bank profits are expected to rise by 4.2 percent as well, with a delayed effect of almost two years, reaching its peak at the 8^{th} horizon with a 5.8 percent increase. This result follows the previous literature on the relationship between GDP and bank profitability, which strengthens the validity of our results.

6.3. Future research

For future research, there are several measures that could be explored further to improve and deepen the analysis. One of the biggest takeaways for future research on the subject is to include other ways of measuring profit. As mentioned in the beginning there are several alternative measurements of profits, such as return on equity (ROE) and return on assets (ROA). These capture the movements in the financial markets better than the net interest income. This would promote other aspects of bank profitability which are out of reach for this analysis. Another aspect that could be expanded, is the cyclicality of bank profits. More extensive research on the subject could create a better understanding of commercial bank profitability. Especially how the Swedish economic cycle has affected the bank profits as Madaschi and Pablos Nuevo (2017) describes. Due to limited time, the dimensions of bank profitability have not been researched but would certainly provide interesting insight in further studies. The subject of active monetary policy and its effect on commercial bank profitability will most likely continue to be a relevant research area since it is crucial for informed decision making. As profits continue to rise and the debate in Sweden persists, there is a pressing need for policymakers to understand the effect of monetary policy on bank profitability. In conclusion, this paper aims to contribute to the research field by offering a comprehensive analysis of the dynamics between the Riksbank's monetary policy and the Swedish economy. By examining the effects of monetary policy shocks on commercial bank profitability, we hope that our study will provide insights to deepen the understanding of the relationship between the central bank’s actions and economic outcomes. These insights are meant to contribute to future discussions in regard to financial stability and growth in Sweden.

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8. Appendix

8.1. Dickey-Fuller test

Dickey- Fuller test results of the variables.

Variable	p-value	Test statistic
GDP gap Sweden	0.0016***	-3.970
Exchange rate	0.0000***	-8.716
Unemployment	0.0000***	-6.430
CPI Sweden	0.0013***	-4.149
QE	0.9694	0.151
First difference of QE	0.0000***	-7.696
Policy rate	0.4355	-1.685
GDP gap U.S.	0.0056***	-3.610
CPI U.S.	0.0236**	-3.194
Oil	0.0000***	-8.680
Profit_swed	0.0000***	-7.078
Profit_seb	0.0000***	-7.692
Profit_handels	0.0000***	-11.425
Profit_nordea	0.0000***	-7.026
TA[1]_swed	0.0000***	-11.882
TA_seb	0.0000***	-13.196
TA_handels	0.0000***	-11.461
TA_nordea	0.0000***	-9.843
TD[2]_swed	0.0000***	-10.797
TD_seb	0.0000***	-13.283
TD_handels	0.0000***	-12.454
TD_nordea	0.0000***	-10.391

8.2. Data sources

Variable	Source
Profits	(Refinitiv Eikon, 2024a)
QE	(Riksbanken, 2024e; SCB, 2024b)
Policy rate	(Riksbanken, 2024b)
GDP gap Sweden	(SCB, 2024c)
Exchange rate	(Riksbanken, 2024)
Unemployment rate	(SCB, 2024d)
CPI Sweden	(SCB, 2024a)
GDP gap U.S.	(Federal Reserve Bank of St. Louis, 2024a)
CPI U.S.	(OECD, 2024)
Oil	(Federal Reserve Bank of St. Louis, 2024b)
Total assets	(Refinitiv Eikon, 2024b)
Total deposits	(Refinitiv Eikon, 2024b)

[1] TA is an abbreviation of total assets
[2] TD is an abbreviation of total deposits

8.3. VAR-output

Below is the output from the VAR-regression that the Cholesky decomposition is then applied to in order to obtain the shocks to the policy rate and QE.

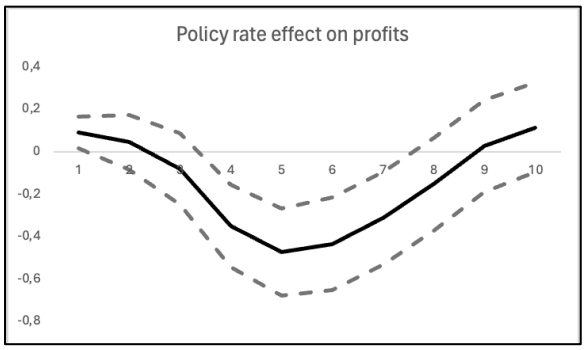
Vector Autoregression Estimates
Date: 05/12/24 Time: 16:51
Sample (adjusted): 2002Q2 2023Q4
Included observations: 348 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Variable	G_S	E	UNP	CPI_S	DIFF_QE	I
G_S(-1)	0.383715	2.988628	-2.489352	1.028226	-1.082515	-0.533124
	(0.05712)	(1.45762)	(2.80186)	(0.39883)	(0.24649)	(0.18116)
	[6.71760]	[2.05035]	[-0.88847]	[2.57811]	[-4.39168]	[-2.94283]
G_S(-2)	0.203557	-3.634732	-4.556959	-0.896271	0.786066	0.526572
	(0.04716)	(1.20331)	(2.31302)	(0.32925)	(0.20349)	(0.14955)
	[4.31675]	[-3.02061]	[-1.97013]	[-2.72220]	[3.86298]	[3.52096]
E(-1)	0.009603	-0.075149	-0.192879	-0.097029	0.044620	-0.058315
	(0.00241)	(0.06143)	(0.11807)	(0.01681)	(0.01039)	(0.00763)
	[3.98932]	[-1.22342]	[-1.63355]	[-5.77312]	[4.29558]	[-7.63859]
E(-2)	0.000833	-0.046838	-0.132322	-0.017475	0.020103	-0.037269
	(0.00264)	(0.06737)	(0.12950)	(0.01843)	(0.01139)	(0.00837)
	[0.31557]	[-0.69522]	[-1.02179]	[-0.94801]	[1.76457]	[-4.45104]
UNP(-1)	0.013610	0.043058	0.146341	0.003972	0.049274	-0.003313
	(0.00116)	(0.02957)	(0.05683)	(0.00809)	(0.00500)	(0.00367)
	[11.7465]	[1.45632]	[2.57496]	[0.49098]	[9.85529]	[-0.90151]
UNP(-2)	0.002902	-0.044175	0.295459	-0.019369	0.007098	-0.011525
	(0.00125)	(0.03198)	(0.06148)	(0.00875)	(0.00541)	(0.00397)
	[2.31512]	[-1.38124]	[4.80607]	[-2.21342]	[1.31244]	[-2.89935]
CPI_S(-1)	-0.009219	-0.295411	0.556177	1.064837	0.081890	0.072827
	(0.00726)	(0.18518)	(0.35595)	(0.05067)	(0.03131)	(0.02301)
	[-1.27037]	[-1.59531]	[1.56253]	[21.0164]	[2.61511]	[3.16440]
CPI_S(-2)	0.012920	0.181200	-0.029459	-0.266820	-0.124787	-0.046591
	(0.00656)	(0.16738)	(0.32175)	(0.04580)	(0.02831)	(0.02080)
	[1.96973]	[1.08255]	[-0.09156]	[-5.82594]	[-4.40861]	[-2.23961]
DIFF_QE(-1)	-0.057177	-0.126292	-1.757545	-0.258389	0.737543	-0.002999
	(0.01357)	(0.34629)	(0.66565)	(0.09475)	(0.05856)	(0.04304)
	[-4.21338]	[-0.36470]	[-2.64035]	[-2.72702]	[12.5946]	[-0.06967]
DIFF_QE(-2)	0.050417	0.515333	2.192422	0.111355	0.020198	-0.225719
	(0.01449)	(0.36971)	(0.71066)	(0.10116)	(0.06252)	(0.04595)
	[3.47993]	[1.39389]	[3.08505]	[1.10079]	[0.32306]	[-4.91234]
I(-1)	0.006152	-0.298842	-1.692873	-0.015832	0.378942	1.202339
	(0.01642)	(0.41906)	(0.80553)	(0.11466)	(0.07087)	(0.05208)
	[0.37459]	[-0.71312]	[-2.10157]	[-0.13808]	[5.34730]	[23.0849]
I(-2)	-0.008273	0.152423	2.126462	-0.115284	-0.396627	-0.292833
	(0.01569)	(0.40045)	(0.76974)	(0.10957)	(0.06772)	(0.04977)
	[-0.52719]	[0.38063]	[2.76256]	[-1.05216]	[-5.85706]	[-5.88376]
C	0.020049	-0.510930	0.233618	-0.184285	0.323586	0.016082
	(0.00866)	(0.22106)	(0.42493)	(0.06049)	(0.03738)	(0.02747)
	[2.31431]	[-2.31124]	[0.54978]	[-3.04671]	[8.65599]	[0.58534]
G_US	-0.250666	2.160271	-3.136674	2.329042	-0.870996	0.384466
	(0.07911)	(2.01887)	(3.88070)	(0.55240)	(0.34140)	(0.25092)
	[-3.16838]	[1.07004]	[-0.80828]	[4.21626]	[-2.55123]	[1.53225]

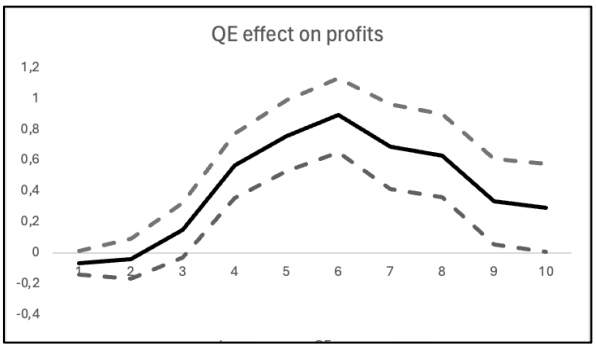
CPI_US	-0.010730	0.411283	-0.521971	0.307199	-0.097488	0.034316
	(0.00357)	(0.09113)	(0.17517)	(0.02493)	(0.01541)	(0.01133)
	[-3.00466]	[4.51326]	[-2.97985]	[12.3205]	[-6.32621]	[3.02993]
OIL	-0.001059	-0.043262	-0.099471	0.007545	0.003482	0.003278
	(0.00027)	(0.00684)	(0.01315)	(0.00187)	(0.00116)	(0.00085)
	[-3.94937]	[-6.32537]	[-7.56622]	[4.03186]	[3.01072]	[3.85631]
R-squared	0.777211	0.216207	0.429725	0.964797	0.769785	0.981624
Adj. R-squared	0.767145	0.180795	0.403959	0.963207	0.759383	0.980794
Sum sq. resids	1.489570	969.9771	3583.965	72.61816	27.73815	14.98301
S.E. equation	0.066983	1.709274	3.285586	0.467685	0.289048	0.212437
F-statistic	77.21324	6.105423	16.67833	606.6090	74.00848	1182.366
Log likelihood	455.1558	-672.1528	-899.5625	-221.1348	-53.67607	53.48902
Akaike AIC	-2.523884	3.954901	5.261854	1.362844	0.400437	-0.215454
Schwarz SC	-2.346771	4.132014	5.438966	1.539956	0.577550	-0.038341
Mean dependent	0.002629	0.041724	0.445632	1.962069	0.121002	1.289365
S.D. dependent	0.138809	1.888493	4.255738	2.438208	0.589260	1.532903

Determinant resid covariance (dof adj.)	7.35E-05
Determinant resid covariance	5.54E-05
Log likelihood	-1257.439
Akaike information criterion	7.778382
Schwarz criterion	8.841059
Number of coefficients	96

8.4. Monetary policy shocks on bank profits without dummies

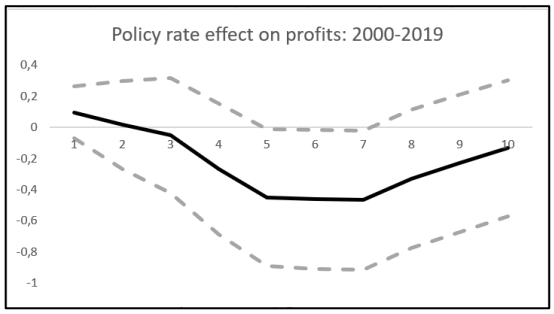


The effect of policy rate on bank profits, excluding individual bank responses and dummy variables for the financial crisis and pandemic. The values of the x-axis represent the value of h in the regression. Each increment along the x-axis corresponds to one quarter. The bold line illustrates profits and dotted lines a confidence interval of 5 %.

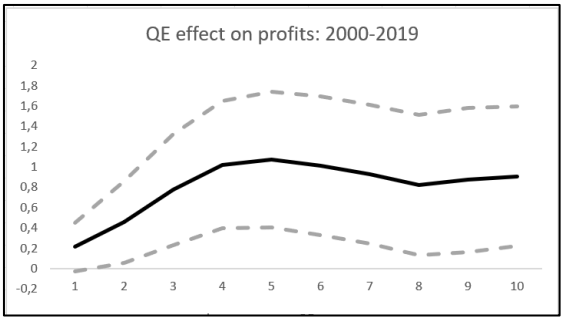


The effect of QE on bank profits, excluding individual bank responses and dummy variables for the financial crisis and pandemic. The values of the x-axis represent the value of h in the regression. Each increment along the x-axis corresponds to one quarter. The bold line illustrates profits and dotted lines a confidence interval of 5 %.

8.5. Monetary policy shocks when the covid-19 pandemic is excluded



The effect of policy rate on bank profits between 2000-2019, excluding individual bank responses and dummy variables for the financial crisis and pandemic. The values of the x-axis represent the value of h in the regression. Each increment along the x-axis corresponds to one quarter. The bold line illustrates profits and dotted lines a confidence interval of 5 %.



The effect of QE on bank profits between 2000-2019, excluding individual bank responses and dummy variables for the financial crisis and pandemic. The values of the x-axis represent the value of h in the regression. Each increment along the x-axis corresponds to one quarter. The bold line illustrates profits and dotted lines a confidence interval of 5 %.

8.6. Breusch Pagan heteroskedasticity test.

The test shows that we cannot reject the null hypothesis of constant variance and therefore we assume that we have homoskedasticity.

Breusch Pagan/Cook-Weisberg test for heteroskedasticity
Assumption: normal error terms
Variable: fitted values of p
H0: constant variance

chi2(1) = 1.91

Prob > chi2 = 0.1672

8.7. Wald Test

Where C(11) is $Shock_{QE}$ *dummy_seb, C(12) is $Shock_r$*dummy_seb, C(13) is $Shock_{QE}$*dummy_handels and so on for all the banks except Swedbank which is the base-line scenario. This result shows that there is no significant difference between the banks in how they react to monetary policy shocks.

Wald Test:
Equation: Untitled

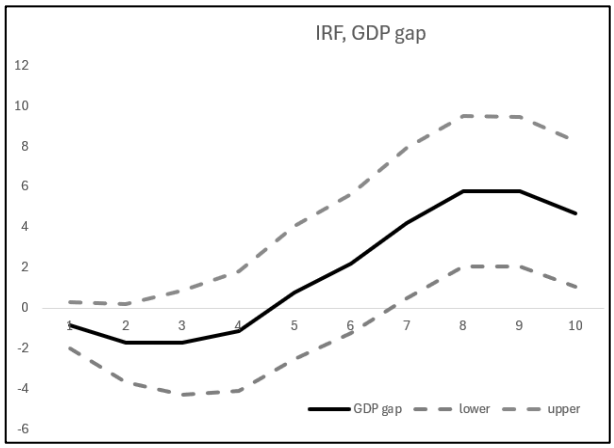
Test Statistic	Value	df	Probability
F-statistic	0.076966	(6, 318)	0.9982
Chi-square	0.461793	6	0.9983

Null Hypothesis: C(11)=0, C(12)=0, C(13)=0, C(14)=0, C(15)=0, C(16)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(11)	0.044637	0.665052
C(12)	-0.036992	0.616021
C(13)	-0.261755	0.660850
C(14)	-0.157645	0.611386
C(15)	-0.023897	0.660909
C(16)	-0.224452	0.611814

Restrictions are linear in coefficients.

8.8. GDP gap and its effect on bank profits



The effect of GDP on bank profits, excluding individual bank responses. The values of the x-axis represent the value of h in the regression. Each increment along the x-axis corresponds to one quarter.

*Table of the shock coefficients and their effect on bank profitability. The statistically significant results are highlighted with asterisks. * for 10%, ** for 5% and *** for 1%.*

Horizon	GDP gap shock coefficient	Std.error	p-value
1	-0.8676	0.585435	0.139264
2	-1.7270	0.992349	0.082716*
3	-1.7036	1.313893	0.195666
4	-1.1288	1.511043	0.455581
5	0.7751	1.678999	0.644643
6	2.2016	1.756681	0.211016
7	4.2000	1.898632	0.02767**
8	5.7997	1.900642	0.002472***
9	5.7653	1.888146	0.002459***
10	4.6635	1.844204	0.011952**