Impact of Inflation on Return and Pricing of Swedish Bank Stocks

A Fama-French Analysis on Monthly Stock Returns and Pricing of Handelsbanken, Swedbank, SEB and Nordea
Abstract
This study explores the influence of inflation on the monthly total stock returns and stock pricing of Swedish banks. The research question is systematically examined through a cross-sectional and time series analysis, utilizing Fama-French, Carhart, and Fama-Macbeth methodologies.

Contrary to the initial hypothesis, the outcomes from the Fama-French-Carhart regression, incorporating the inflation factor, reveal a consistently negative effect of inflation on stock returns across Swedish banks. This unexpected result challenges the anticipated relationship between inflation and stock returns. Furthermore, the assessment of risk premiums via the Fama-Macbeth regression does not identify a statistically significant risk premium for inflation exposure.

These findings contribute to understanding the dynamics between inflation and the financial performance of Swedish banks, prompting further inquiry into the factors influencing stock returns in the presence of inflationary pressures.

Keywords: Asset Pricing Theory, CAPM, Carhart, Fama-French, Fama-Macbeth, Inflation, NII, Risk Premium

Acknowledgments
We would like to express our gratitude to our supervisor, Fredrik Armerin, for his invaluable support throughout our thesis. Special thanks to Huseyin Aytug, Yao Fu, and Paolo Sodini, as well as the Swedish House of Finance, for compiling the Fama-French-Carhart Factor dataset for the Swedish Stock Exchange.
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1. Introduction

In this introduction, an overview of the subject will be presented to establish a foundational understanding for the analysis. Subsequently in the chapter, the study’s purpose is presented and the research questions are formulated.

During the first three quarters of 2023, the major banks in Sweden, Handelsbanken, Swedbank, SEB and Nordea’s aggregated profit for the year increased with 60.6% compared to the same period in 2022 (Institutions, 2023). According to the Swedish Financial Supervisory Authority’s second bank barometer report for 2023, the primary contributing factor to the increase in profits is the bank’s growth in the Net Interest Income (NII)\(^1\), whereas other revenue streams such as commission has remained relatively unchanged during the period (Finansinspektionen, 2023). During the same period, the policy rate in Sweden has experienced a significant increase, rising from 0% in the beginning of 2022, to 4.0% by the end of the third quarter 2023. (Riksbanken, 2023)

The main objective for a central bank is to maintain price stability (Munk, 2018). The Swedish monetary policy could be described as expansive during the recent decade, with the Swedish central bank, Riksbanken, keeping the policy rate at a negative level between the years 2015-2020 (Riksbanken, 2023). During the Covid-19 pandemic Riksbanken was stimulating the economy with an additional expansive monetary policy to keep the Swedish economy intact, keeping the policy rate low and increasing the money supply through Quantitative Easing (QE)\(^2\) (B. Andersson et al., 2022). This has had a positive impact on the market in the short run. Nevertheless, the effects of this showed years later with the inflation rate rising to a peak of 12.3% in December 2022 (SCB, 2023). This rapid escalation in inflation stands out compared to other nations, surpassing Riksbanken’s targeted inflation rate of 2%, and prompted Riksbanken to contemplate raising interest rates as a potential response, which they later did in May 2022 (Riksbanken, 2023).

In empirical analyses, both inflation and rising interest rates are associated with a negative impact on stock prices (Mishkin, 2012). This is primarily attributed to the

\(^1\) Net Interest Income will later be referred to as NII.

\(^2\) Quantitative Easing is a monetary policy in which a central bank increases the money supply by purchasing financial assets, typically government bonds, in order to lower interest rates and stimulate economic activity.
diminishing real value of money, resulting in reduced consumer purchasing power and diminished profitability for companies, consequently leading to a decline in stock prices (Fama and Schwert, 1977). Banks generate revenue by borrowing money at lower short-term rates and lending at higher long-term rates, positioning them as a potential safe investment for investors concerned about declining profits in the face of elevated interest levels (Mishkin, 2012). In the context of this thesis, our analysis aims to investigate whether inflation has a positively estimated effect on the returns of Swedish bank stocks.

The purpose of this study is to examine whether there is a significant positive relationship between the total return of Swedish bank stocks and rate of inflation. Furthermore, investigate how inflation affects the pricing of bank stocks. Thus, this study examines whether bank stocks could be regarded as viable investment in periods of rising inflation.

The research questions in this study are following:

RQ1: - Can inflation be an indicator for future excess return of Swedish bank stocks?

RQ2: - Is inflation a priced risk factor in the stock price of Swedish banks?

To address the research questions, we analyze the stock returns of prominent Swedish banks, Handelsbanken, Swedbank, SEB, and Nordea. This selection is motivated by these banks significant role as major contributors to lending in the Swedish housing market, constituting a substantial portion of the total mortgages (Finansinspektionen, 2023; Institutions, 2023). In fact, in the first three quarters of 2023, these four Swedish banks accounted for 57% of the total mortgages (Institutions, 2023).

We conduct a cross-sectional and time series regression methodology, drawing inspiration from the Fama-French framework rooted in the Capital Asset Pricing Model (CAPM)\(^3\) (Fama and Schwert, 1977; Fama and French, 2004). Additionally, we calculate the estimated risk premiums through the Fama-Macbeth two-step regression approach (Fama and MacBeth, 1973).

This study is limited to examining Sweden, and use bank stocks’ that are listed on the Large Cap of OMX Stockholm during the time period of 1996-2019.

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\(^3\)The Capital Asset Pricing Model will later be referred to as CAPM.
2. Theory and Previous Literature

In this section of the study we are going to outline banks operating model and theories applied, in order to analyze how banks generate profit. This will help us to conceptualize the banking system from a economical perspective, and provide a framework according to the purpose. Furthermore, this section will highlight a selection previous studies related to our topic.

2.1 Banks as Intermediaries

A bank is an institution whose primary purpose consists of granting and receiving loans from the public, and finance the majority of their lending through the public’s deposit accounts (Freixas and Rocher, 2008). Banks thereby play an important role in the economy considering how banks allocate capital through their functions which can be categorised in to four primary segments:

1. Provides payment service and liquidity
2. Transforming assets
3. Risk management
4. Monitoring borrowers and information processing

After the introduction of fiat money1 banks play two different roles in the management of money. Firstly, banks provide money exchange between different currencies issued by separate institutions. Secondly, banks provide payment services which cover the management of its clients accounts and payment settlement through money transfer (Ibid).

A generalised economic model that includes banks as intermediaries provides a framework for understanding the conditions under which markets can achieve a state of equilibrium, where supply equals demand for every commodity in every period. The model shown below is a simplification of this idea which could be applied when looking at the

---

1Fiat money is a type of currency that is declared by a government to be legal tender, despite the fact that it has no intrinsic value and is not backed by a physical commodity.
parties within financial markets as the model below shows:

Figure 2.1: Generalised economic model including banks
(Freixas and Rocher, 2008)

In the model, the consumer chooses consumption \((C_1, C_2)\), and savings is allocated between deposits \((D_h)\) and securities \((B_h)\) so that utility is maximised subject to the budget constraints.

\[
\begin{align*}
\max u(C_1, C_2) \\
C_1 + B_h + D_h &= \omega_1 \\
pC_2 &= \Pi_f + \Pi_b + (1 + r)B_h + (1 + r_d)D_h
\end{align*}
\]  

(2.1)

\(\omega_1\) is the initial endowment of the consumption good whereas \(p\) is the price of consumption \(C_2\). \(\Pi_f\) and \(\Pi_b\) respectively are meant to reflect the profits of the firm and of the bank. \(r\) and \(r_d\) are the interest rates that are paid by bonds and deposits respectively. The model simplifies that there is a perfect substitution between bank deposits and bonds, which implies that the consumers program \((P_h)\) interior solution is found only when the interest rates are equal:

\[
r = r_d
\]  

(2.2)

The firm in the model optimises its level of investments \(I\) and its financing in order
order to maximise its profits. Financing can be conducted through banks loans $L_f$ and through the issuance of securities $B_f$.

$$
\begin{align*}
\max & \Pi_f \\
\Pi_f & = pf(I) - (1 + r)L_f - (1 + r_L)L_f \\
I & = B_f + L_f
\end{align*}
$$

(2.3)

$f$ is the representative firms production function. The interest rate for bank loans is denoted by $r_L$, and $r$ is the interest rate for securities (bonds). As with the case of the consumer, the interior solution can only be found when the interest rates are equal.

$$
r = r_L
$$

(2.4)

The banks optimal choice of loan supply $L_b$ is dependent on its demand for deposits $D_b$ and the banks issuance of bonds $B_b$ so that the bank maximises its profits.

$$
\begin{align*}
\max & \Pi_b \\
\Pi_b & = r_L L_b - r B_b - r_D D_b \\
L_b & = B_b + D_b
\end{align*}
$$

(2.5)

The equilibrium is determined by the interest rates $(r, r_L, r_D)$ and by the supply and demand levels. For the consumer this is determined by $(C_1, C_2, B_h, D_h)$, for the firm $(I, B_f, L_f)$, and for the banks $(L_b, B_b, D_b)$. The equilibrium is achieved such that each agent (consumer, banks, firm) optimises their utilities respectively and so that each market is cleared.

$$
\begin{align*}
I & = S \text{ (good market)} \\
D_b & = D_h \text{ (deposit market)} \\
L_f & = L_b \text{ (credit market)} \\
B_h & = B_f + B_b \text{ (bond market)}
\end{align*}
$$

(2.6)

From the notion that $r = r_D$ and $r = r_L$, the only possible equilibrium is where all the interest are equal such that:

$$
r = r_L = r_D
$$

(2.7)

Thus, in the only possible equilibrium solution, banks make zero profit. Subsequently, the banks decision should not affect other parties in the model since households are indifferent between deposits and securities, and firms are equally indifferent between
securities and bank credit. These results are only achievable when firms and households have unrestricted access to perfect financial markets (Freixas and Rocher, 2008)

Therefore, the model claims that banks are redundant institutions. However, it does not account for the fact that financial markets cannot be complete, and the industrial organisation banking approach where banks provide essential services to its counterparties.

Banks are primarily specialized in the simultaneous buying and selling of financial claims, similar to how traditional companies purchase and sell goods or services. Unlike traditional companies, banks deal in financial claims rather than physical goods or services. The existence of financial intermediaries like banks can be attributed to the presence of transaction frictions. Banks can be seen as intermediaries that purchase securities issued by borrowers and then sell those securities to lenders (Ibid).

However, the role of banks as financial intermediaries is more intricate due to two factors. First, banks often handle financial contracts that are not readily traded, making them difficult to sell. This is in contrast to financial securities, which are more easily marketable. As a result, banks are obliged to retain these assets on their balance sheets until the contract’s expiration. Second, the financial contracts held by banks differ from those demanded by investors. Therefore, banks play a role in transforming financial contracts and securities. Investors and borrowers can only achieve perfect diversification and risk sharing in the presence of complete markets (Ibid).

2.2 Banking Profitability

Unlike other companies, banks’ main sources of income is the NII, along with the non-interest income such as capital gains, fees and commissions. The NII is by far the largest contributor over time, and is strongly linked to the policy rate set by the central bank.

NII is the difference between the profits made from lending money to primarily mortgages and the cost of holding deposits from its costumers who demand interest for their money being held at bank accounts (Altavilla et al., 2018).

\[
\text{NII} = \text{Interest Income} - \text{Interest Expenses} \quad (2.8)
\]

One component which is essential for the banks profitability is the difference in maturity on assets and liabilities. We already know for a fact that the banks profits increase
when interest rates are higher, but the effect is relative to the balance sheet structure. One way to analyse the maturities of assets and liabilities of the banks is to determine the "maturity gap" of the bank. The maturity gap represents the difference in total market value of the interest rate sensitive assets and the interest rate sensitive liabilities. A positive maturity gap indicates that the bank has more assets maturing than liabilities in the same period, which means a interest change upward would increase profits for the bank (Investopedia, 2022).

\[
GAP_{i,j,t} = \sum_{j} \tau_{A,j} A_j - \sum_{j} \tau_{L,j} L_j
\]  

(2.9)

\(GAP_{i,j,t}\) is the maturity gap for entity \(i\), time bucket \(j\), and time period \(t\). \(\tau_{A,j}\) is the weight or proportion associated with repricing of interest-sensitive assets in time bucket \(j\). \(A_j\) is interest sensitive assets in time bucket \(j\), \(\tau_{L,j}\) is the weight or proportion associated with repricing \(^2\) of interest sensitive liabilities in time bucket \(j\), \(L_j\) is the interest sensitive liabilities in time bucket \(j\) (Ibid).

This model will help us interpret the relation between interest rate changes and changes in net interest income.

### 2.3 Random Walk

In 1953 the economist Maurice Kendall examined the proposition that stock prices reflect the expectations of a firm, and that recurring patterns of highs and lows in the economic performance is bound to be reflected in the securities prices. Kendall could not identify predictable patterns in the prices of stocks. The price development on a given day was seemingly random, and could go up just as well as down (Kendall and Hill, 1953).

Kendall was surprised of his findings that there is no pattern about the future performance of stock prices. However, if such a pattern would exist, investors would act on the future pattern immediately, which would eradicate the opportunity.

For example, if a stock today trades at $100 per share and the prevailing patterns predict that to stock will rise to $110 in three days, every investor with access to prediction would act on the situation which would cause the stock price to rise to $110. This leads to the conclusion that any information about the future performance of a stock,

\(^2\)Reprice means the opportunity to receive a new interest rate.
should already be reflected in the priced. Therefore, the prices of stocks can only move as a response to new, random information that has previously not been available to the market. Thus, the price reaction which follows as a response to the information is seemingly random. This conclusion is the quintessential foundation of the notion that changes in stock prices are random and unpredictable, the so called Random Walk (Bodie et al., 2021).

2.4 The Efficient Market Hypothesis

The Efficient Market Hypothesis (EMH)\(^3\) is a theory that builds the conclusion drawn in the Random Walk theory and claims that all known information about an asset or security is reflected in its price. This implies that it is not possible to achieve a higher yield on securities by exploiting public or private information, especially on a consistent basis. The theory was introduced by Eugene Fama who defined three different forms of efficient markets (Bodie et al., 2021).

Weak form market efficiency states that the price of a security represents all information that can be derived by studying the history of prices, trading volumes, short interest and other market trading data. Price history of securities such as stocks is essentially free and readily available to the public. In order for the theory to hold, if any data that would reliably indicate the future performance of a security can be identified, all investors would have already exploited the indication which will erode the future performance. As a result the weak-form of market efficiency claims that analyzing the trend of a security is needless since that should already be priced in (Ibid).

The second iteration of the efficient market hypothesis is semi-strong market efficiency. The semi-strong market efficiency asserts that all the publicly available information about a firm must already be showcased in the stock price. This included past trading history as per the weak-form of market efficiency, but also fundamental data on the company’s products, quality of management, structure of the balance sheet, and other fundamental metrics. If fundamental information is readily available to the public, it would be expected to be priced into the share (Ibid).

Strong market efficiency hypothesis is the third version of the efficient market hy-

\(^3\)The Efficient Market Hypothesis is later referred to as EMH.
hypothesis and states that all relevant information about a firm is reflected in the price of the security, including information that is only available to insiders of the company. This iteration is regarded as an extreme form of efficiency and few would argue that corporate officers have access to information that they would be able to profit from before the company would have to release the information to the public (Ibid).

Each iteration of the efficient market hypothesis implies that the price of a security is determined by the available information regarding the security. However, the theory does not claim that traders and investors are always correct or that the market price is correct. Market actors will always demand more information than what is available and it is possible that the market in hindsight has been completely wrong, valuating a security either to high or to low. The main takeaway from the EMH is that a given point of time, using information that is readily available, the market cannot determine whether the price is to high or to low. We can however expect the markets to be correct on average given that the market is rational (Ibid).

2.5 Inflation and Monetary Policy

Established in 1668, the Swedish Riksbank stands as the world’s oldest central bank, predating its counterparts by centuries. Initially, its primary objective was to extend loans to the Swedish government and facilitate international trade. It was not until centuries later that the American central bank the Federal Reserve, emerged. Over time, the Federal Reserve evolved into a dominant force, exerting considerable influence on the global economy (Bodie et al., 2021).

Riksbanken operates as an independent entity, detached from direct control by the Swedish government. The rationale behind central bank independence lies in mitigating potential political biases that elected parties might implement to in pursuit of short-term gains, such as manipulating monetary policy for electoral advantage. For instance, there’s a risk of implementing an expansionary monetary policy just before an election to artificially reduce unemployment, followed by a restrictive policy post-election to cool down an overheated economy (Mishkin, 2012).

Central banks worldwide, including the Riksbank, prioritize the maintenance of stability in price levels and the control of inflation. More precisely, their goal is to sustain
inflation close to a target level slightly above zero (Mishkin, 2012). Riksbanken, specifically, aims to keep inflation, adjusted for interest rate changes, at 2% annually. Central banks formulate and execute monetary policies to narrow the gap between observed inflation and the inflation target, a metric referred to as the inflation gap.

2.6 Capital Asset Pricing Model

Initially developed by Jack Treynor, William Sharpe, John Lintner, and Jan Mossin in the early 1960s, the Capital Asset Pricing Model establishes a linear relationship between the expected return of an asset and its systematic risk and is still used to a large extent today (Fama and French, 2004; Aytug et al., 2020; Markowitz, 1952). This model helps to explain the excess return of an asset, by calculated The CAPM model implies:

\[ R_{it} - R_{ft} = \alpha_i + \beta_i (R_{mt} - R_{ft}) + \epsilon_{it} \]  

Where the \( \beta_i \) of the stock is calculated through the covariance between the market return and the stock return:

\[ \beta_i = \frac{Cov(R_i - R_f, R_m - R_f)}{Var(R_m - R_f)} \]  

CAPM implies that the excess return of a stock is the return \( R_i \) minus the risk free rate \( R_f \), can be formulated through a function of the \( \beta \)'s effect on the market risk premium, \( R_m - R_f \), reflecting the extra return investors demand for bearing the risk of the overall market.

\( \alpha \) is the intercept in the regression model, which represents the unexplained variation in the model. This intercept is also referred to the "Jensen’s Alpha", and is a measure of the excess return of a stock (Fama and French, 2004). A positive \( \alpha \) indicates that the stock has outperformed the market, and vice versa. This term measures the unsystematic, or idiosyncratic risk.

\( \beta \) measures the sensitivity of an asset’s returns to changes in the market return. It represents the systematic or the undiversifiable risk of the asset, indicating how much the asset’s returns are expected to move in relation to the overall market return \( R_{mt} \) in time \( t \). \( \beta \) of 1 implies that the asset’s returns move in tandem with the market, while a beta
greater than 1 suggests higher volatility, and a beta less than 1 implies lower volatility compared to the market. $\beta_i$ is the covariance of the market risk premium and the excess return divided by the variance of the market risk premium. $\beta$ shows the sensitivity of a stock compared to the market portfolio $^4$ (Sharpe, 1964; Lintner, 1975).

Another way that CAPM could be formulated is by taking the expected value of the return instead of doing a regression model. This is the more traditional formulation of the Sharpe-Litner CAPM:

$$E(R_i) = R_f + \beta_i[E(R_m) - R_f]$$  \hspace{1cm} (2.12)

This version of the CAPM is used to formulate the expectation of future excess return instead of explaining previous returns.

2.7 Previous Studies

Kyriacos et al. published a study in 2006 where the primary purpose is to identify why the historic equity risk premium is bigger than what is considered to by reasonable by researchers. The paper measures the risk premiums in several countries over 132 years, and investigates the relationship between equity risk premiums and inflation by using a pooled cross-section and time series analysis. The study finds a significant positive relationship between inflation and the equity risk premium. The study claims that one explanation to this finding is the poor performance of bonds during periods of higher inflation which drives the equity risk premium. (Kyriacos et al., 2006).

A study by Ammer published in 1994 investigates the relationship between inflation and stock returns in ten industrialised countries. The study uses the Campbell and Schiller’s decomposition of stock returns which suggest that unexpected asset returns consists of two parts. Firstly, news about discount rate, and secondly, news about cash flows. Additionally, the study investigates the increased risk associated with a stock caused by increased inflation through investors increasing their required return on capital. The study finds that inflation has a negative effect on monthly stock returns for all countries except for The UK which exhibited a positive relationship (Ammer, 1994).

$^4$The market portfolio ($R_m$) represents a theoretical portfolio that includes all available assets, weighted by their market values.
A study by Eldomiaty et al. published in 2018 examines the effect of inflation rate and interest rates on the price of stocks. The authors examine the effect on non-financial firms listed on DJIA30 and NASDAQ100. The findings indicated a negative association between inflation rates and stock prices, suggesting that fluctuations in inflation rates may have a observable impact on stock prices. Conversely, a positive association was observed between real interest rates and stock prices, highlighting the influence of changes in real interest rates on stock market movements. Additionally, the study revealed that changes in real interest rates and inflation rates cause significant changes in stock prices, suggesting a directional relationship between these economic indicators and stock price movements (Eldomiaty et al., 2019).

Andersson and Uhrenholt published a study in 2005 where the purpose of was to examine the effect of a change in the policy rate on stock prices. The study examined the Swedish Riksbanken’s change in policy rates effect on 60 firms in several different sectors listed on Nasdaq Stockholm. The findings conclude that a raise of the policy rate leads to a negative abnormal return, and conversely that a decrease in the interest rate leads to a positive abnormal return. Additionally, the study found that stocks within the financial sector, IT, and industrials were the most sensitive towards changes in the interest rate (T. Andersson and Uhrenholt, 2005).

In conclusion, previous research have reached a consensus of a negative inflation of inflation on bank stocks. This study aims to fill the gap of examining the specific relationship between bank stock returns and inflation as a indicator for future interest rate changes. From what we have found there are no similar studies on specifically this subject.
3. Methodology

Initially, we perform a cross-section study to determine whether there are any significant effects of the Fama-French-Carhart risk factors on the return on bank stocks. By adjusting this regression to also control for inflation, we also estimate the effect of inflation on stock returns of Swedish banks.

Further on in the thesis we make a Fama-Macbeth estimation, by combining the cross-sectional dimension with the time series regression, to calculate the demanded risk premiums of investors for exposure to the risk factors.

3.1 Fama-French 3 Factor Model

In 1993 Eugene Fama and Kenneth French revealed that market risk $\beta$ is not the only thing affecting expected return of an asset. They concluded that the size of the company in terms of market capitalization and also the valuation in terms of the book-to-market value are equally important factors to the stock return (Aytug et al., 2020). Together they introduced the Fama-French 3-factor model, which is built upon the CAPM model, but also takes two more explanatory factors into account, which are the market capitalization factor $SMB$ and the book to market factor $HML$.

$$R_{it} - R_{ft} = \alpha_i + \beta_i (R_{mt} - R_{ft}) + s_i SMB_t + h_i HML_t + \varepsilon_{it}$$

(3.1)

$R_{mt} - R_{ft}$ represents the same excess return metric of the market over the risk-free rate as in CAPM. This factor indicates how much return the market has made in comparison to the risk free rate, which typically is the return of a Treasury Bond or T-Bill.

$\alpha$ in this model is refereed to as the "three-factor alpha". This represents the intercept and has the same interpretation as the "Jensen’s alpha" in CAPM (Fama and French, 2004).

$SMB$ stands for “Small Minus Big”, which is a market capitalization size factor of a stock. It represents the return of a portfolio of small companies minus the return of a portfolio of big companies. The factor is calculated by combining the returns of
small-cap stocks and subtracting the returns of large-cap stocks, providing investors with insight into the performance difference between smaller and larger companies in the market.

HML stands for “High Minus Low”, which is a book-to-market value factor. It is calculated by taking the difference in the returns of high book-to-market (value) stocks and low book-to-market (growth) stocks. This factor is derived from sorting stocks based on their book-to-market ratios, where high values indicate a higher book value relative to market value, and low values suggest the opposite.

\( \beta_i, s_i, h_i \) are the covariance coefficients for each factor.

These factors represents the individual investors opportunity set in choosing stocks (Leite et al., 2020).

The factors are calculated from computing portfolios representing the different characteristics of the stocks.

The table below shows how the stocks are allocated into the different Fama-French portfolios by the book to market value as well as Market Capitalization.

<table>
<thead>
<tr>
<th>Book-to-Market ratio</th>
<th>Market Cap</th>
<th>Lower than 30th pct</th>
<th>Between 30th and 70th pct</th>
<th>Above 70th pct</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Below median</strong></td>
<td>SG (Small Growth)</td>
<td>SN (Small Neutral)</td>
<td>SV (Small Value)</td>
<td></td>
</tr>
<tr>
<td><strong>Above median</strong></td>
<td>BG (Big Growth)</td>
<td>BN (Big Neutral)</td>
<td>BV (Big Value)</td>
<td></td>
</tr>
</tbody>
</table>

As presented, the stocks are categorized into six portfolios being either ”Small” or ”Big” in terms of market capitalization and ”Growth”, ”Neutral” or ”Value” based on the book to market value (Munk, 2018). The data categorization from the Finbas dataset is described more in detail in the data chapter under section 4.2.
3.2 Fama-French-Carhart 4 Factor Model

In 1997, an extension of the Fama-French 3 Factor Model was introduced called the Carhart 4 Factor Model, which also includes a cross-sectional momentum factor on one-year last return, which drastically improved the explanatory power of the model further (Carhart, 1997).

\[ R_{it} - R_{ft} = \alpha_i + \beta_i(R_{mt} - R_{ft}) + s_iSMB_t + h_iHML_t + m_iMOM_t + \varepsilon_{it} \quad (3.2) \]

The Monthly Momentum Factor (MOM) is determined by taking the lagged one-month difference between the equal-weighted average returns of the highest-performing firms and the lowest-performing firms, as outlined by Carhart (1997).

In our study we also consider the effect of inflation on the return of bank stocks. Hence, we also include a fifth factor for the inflation in our model. This model is later used in order to examine the effect of the inflation on bank stock returns, and by controlling for the Fama-French and Carhart factors we will isolate the effect of inflation.

Our hypothesis is that bank stocks will have a positive beta value in this factor, and other stocks on the Stockholm Stock Exchange will have negative values.

\[ R_{it} - R_{ft} = \alpha_i + \beta_i(R_{mt} - R_{ft}) + s_iSMB_t + h_iHML_t + m_iMOM_t + i_i\pi_t + \varepsilon_{it} \quad (3.3) \]

Inflation (\(\pi\)) is measured in Sweden on a monthly basis. When we include this factor in our Fama-French-Carhart model we will also see the estimated effect of inflation on stock returns. This is especially interesting when looking at bank stocks as we expect a positive relationship between the inflation rate and the bank stock return.

The hypothesis in our study is that inflation will have a positive impact on bank stocks and thus formulated:

\[ \text{Hypothesis : Inflation has a positive impact on total bank return} \quad (3.4) \]
3.3 The Fama-Macbeth Approach

Further, our method include a Fama-Macbeth two-step regression to combine our cross-sectional and time series data. The Fama-Macbeth approach essentially enable us to perform a combination of time series and cross-sectional analysis to assess the relationship between inflation and stock returns over time.

The Fama-Macbeth two-step regression was introduced in 1973 by Eugene Fama and Robert Macbeth, and is now a widely used approach in empirical asset pricing theory. The motivation behind the Fama-Macbeth regression is to determine the risk premium of a particular risk factor (Fama and MacBeth, 1973). Initially the model only consisted of the conventional market risk factor as explanatory variable for stock return, such as in CAPM. The problem that Fama and Macbeth wanted to solve was the problem with time varying risk premiums. Instead of assuming a constant risk premium, the Fama-MacBeth approach estimates the risk premium for each time period, providing insights into the dynamics of risk-return relationships. The Fama-Macbeth approach also solves the problem with heteroscedasticity\(^1\). It allows for the estimation of risk premiums under conditions where the variability of asset returns may change across assets.

Equivalent to our Fama-French approach we use the monthly stock return including reinvested dividends of Swedbank, Handelsbanken, Nordea and SEB as well as other Large Cap stocks traded on the OMX Stockholm exchange as we analyse the risk premium of the whole market. Furthermore, we analyse the risk premium using the same control variables from the Fama-French approach, i.e market capitalization, book to market value, momentum and inflation.

The Fama-Macbeth method is a two-step approach: In the first step we do a time series regression for every \(t\) we have, meaning one separate regression for every year to estimate the coefficients (EViews, 2014).

\(^1\)Heteroscedasticity is the situation where the variance in the error term varies over time.
Step 1: Time-Series Regressions

The first step in the Fama-Macbeth approach is to estimate the coefficients for each risk factor for time period, in our case per month:

For each asset $1 - i$:

$$R_{i,t} - R_{f,t} = \alpha_i + \beta_i(R_{mt} - R_{ft}) + s_iSMB_t + h_iHML_t + m_iMOM_t + i_i\pi_t + \varepsilon_{i,t} \quad (3.5)$$

In the Fama-Macbeth approach we treat the estimated coefficients as the true coefficients, and then run the cross-sectional regressions for each time period:

Step 2: Calculate Risk Premium

To estimate the risk premium we run the regression for each time period and subsequently calculate the mean of the lambdas to get the risk premium for each risk factor.

$$R_{1,t} = \lambda_p + \lambda_{\beta\hat{\beta}} + \lambda_s\hat{s} + \lambda_h\hat{h} + \lambda_u\hat{u} + \lambda_i\hat{i} + u_i$$
$$R_{2,t} = \lambda_p + \lambda_{\beta\hat{\beta}} + \lambda_s\hat{s} + \lambda_h\hat{h} + \lambda_u\hat{u} + \lambda_i\hat{i} + u_i$$
$$\vdots$$
$$R_{i,t} = \lambda_p + \lambda_{\beta\hat{\beta}} + \lambda_s\hat{s} + \lambda_h\hat{h} + \lambda_u\hat{u} + \lambda_i\hat{i} + u_i \quad (3.6)$$

$\lambda$ represents the compensation for the exposure to each of the Fama-French risk factors at each time point, i.e the market risk premium. If we have an effect on the excess return of banking stocks we want the coefficient to not be equal to zero, $\lambda_i \neq 0$.

Finally, the estimated risk premium for inflation is multiplied with each specific stocks inflation coefficient derived from the our 5 Factor Model. The product is the total pricing effect on expected return that the risk factor has on the specific stock. A positive product implies that higher inflation will demand a higher expected return, and the contrary if the multiplication product is negative.
3.3.1 Assumptions

When conducting the previously explained methods, we rely on several assumptions, listed below:

1. *Investors aim to maximize their economic utility.*
2. *Investors are rational and risk-averse.*

Regarding the CAPM model (and thereby also the Fama-French models), Sharpe and Lintner proposed two basic assumptions for Markowitz’s initial model (Sharpe, 1964; Lintner, 1975):

3. *Complete Agreement* – This assumption implies that investors agree that the distribution of asset returns is normal and the same for all assets.
4. *Borrowing and lending at a the same risk-free rate* – The second assumption is that investors can borrow and lend at the same risk-free rate $R_f$ (Fama and French, 2004). The risk-free rate uses Treasury Bills as a proxy. Although theoretically Treasury Bills could default, for the purpose of CAPM, we assume that this return can be considered as risk-free.
5. *No Endogeneity* – The independent variable (market return in the case of CAPM) is assumed to be exogenous, meaning it is not correlated with the error term. The error term $\epsilon$ is also considered to be IID.
6. *No Perfect Multicollinearity* – There is no perfect correlation between the risk factors.
4. Data

In this section we will describe the selection of the data use, and how the data set is structured. The factors are explained by presenting the calculation formulas and restrictions are analysed.

4.1 Selection of Data

The data we use is the total return for the banks in Sweden, Swedbank, Handelsbanken, Nordea and SEB as well as total return for 21 other Swedish stocks traded on the Large Cap list of OMX Stockholm exchange. The rationale behind including all 25 stocks instead of limiting the selection to only banks is to enhance the precision of calculating the Fama-Macbeth risk premium. This broader sample is chosen to capture a more comprehensive representation of market dynamics, aiming for a more accurate estimation of the market risk premium.

We are using the total return for all the stocks including reinvested dividend payouts, to account for return that is not attributable to share price development. The return data is gathered on a monthly basis. In order to calculate our Fama-French-Carhart factors we have gathered information from The Swedish House of Finance, who have compiled data over the Fama-French-Carhart 4 factors over the time period 1983-2019. One restriction here is that we only have this data up until 2020, meaning that we can not make any estimations using our regression models after this period.

By including the stock dividend payouts as a part of the total return measure of the stock, this will mean that our CAPM market factor will loose its explanatory power since dividend payout are not correlated with the market return. However, in the appendix we will do a robustness test by including a regression table for the stock return excluding dividends to see what the effect is compared to the effect on the total return including reinvested dividends.

The criteria for our selection of stocks is that they had to be listed since at least the first of January 1996, and be traded on OMX Stockholm Large Cap. Optimally, we would have used stocks that are included in the OMXS30 index, however since many
companies included in the index have been listed for a shorter period of time than our requirement, and that the company composition in the index have changed over time, we decided to construct our own portfolio of stocks instead. The total return data for the 25 stocks included in this thesis has been gathered from Thompson Reuters Eikon financial database (Thomson Reuters Eikon, 2023).

The stocks we selected apart from the banks is the following:

- **Industrials**: Atlas Copco A, SKF B, Sandvik, Volvo, Assa Abloy B, Trelleborg B
- **Retail/consumer goods**: Hennes & Mauritz B, Electrolux B
- **Raw materials**: Holmen, SSAB
- **Technology**: Ericsson B, Hexagon B
- **Construction**: JM, NCC B, Skanska B, Peab B
- **Real estate**: Hufvudstaden B, Fabege, Wallenstam B
- **Healthcare**: Getinge B, Elekta B

In our own model, we have also included a variable for inflation. The inflation data is collected from Statistics Sweden (SCB) and on a monthly basis in order to compute our own inflation factor. This variable shows the month over month rate of inflation in Sweden between 1996-2020. This factor will add to the ordinary Fama-French 5 factors and we will later calculate the risk premium for inflation through Fama-Macbeth regression approach.

4.2 The Fama-French-Carhart Factors

The Swedish House of Finance have constructed the Fama-French factors for the Swedish Stock Exchange between the years 1983-2020, using data from the Finbas dataset collected and distributed by the SHoF National Data Center Website (Aytug et al., 2020). The variables used to construct stock portfolios and risk factors are defined and explained in detail below. Since we are interested in the time period 1996-2020, this is the data we will be using from the data set.

The definitions of the variables are computed for each stock separately, except for the risk free rate and market return. Below are all the variables listed:

- **Total return** ($R_t$) - As mentioned previously, we use each stocks’ total return. Total return accounts for both the share price development, and the payouts of dividends for the specific stock, thus it provides a comprehensive view of the return
provided by owning the asset, and reinvesting cash flows received from the asset. The total return is calculated by subtracting the share price in period $t-1$ from the share price in $t$, and adding any dividends, and finally dividing by the share price $t-1$

$$R_{it} = \frac{\text{Price period } t - \text{Price period } t-1 + \text{Dividend received between } t-1 \text{ and } t}{\text{Price } t-1}$$

(4.1)

- **Risk free rate** ($R_{ft}$) - The risk free rate is regarded as the alternative to investing in the stock market, and represents the return of the one-month Swedish Treasury Bill as the proxy. The reason for this proxy is since the one-month Swedish Treasury bill is more liquid than the three-month. The calculation is made by dividing the risk free rate at a specific time by 360, and then multiplying the daily rate by the amount of days in a specific month.

$$R_{ft\text{daily}} = \frac{\text{Swedish Treasury bill rate}}{360}$$

$$R_{ft\text{monthly}} = R_{ft\text{daily}} \times \text{Number of days in a given month}$$

(4.2)

- **Market return** ($R_{mt}$) - We use the SIX Return Index to calculate the market return. This index, which includes all stocks listed on the Stockholm Stock Exchange and includes reinvested dividends, is a value-weighted index. The estimation of daily, weekly, and monthly market returns is governed by the following formula:

$$R_{mt} = \frac{\text{Index Current Period} - \text{Index Previous Period}}{\text{Index Previous Period}}$$

(4.3)

Regarding the factor data from Swedish House of Finance used in our regression models, the $SMB$, $HML$ and $MOM$ factors are constructed empirically by combining different portfolios which are including different characteristics. The portfolios are labeled as follows:

- **SG**: Small-Growth, **SN**: Small-Neutral, **SV**: Small-Value
- **BG**: Big-Growth, **BN**: Big-Neutral, **BV**: Big-Value
- **SW**: Small-Winners, **SL**: Small-Losers
• *BW*: Big-Winners, *BL*: Big-Losers

The factors are then constructed by summing the portfolios together and dividing as follows:

\[
SMB = \frac{SG + SN + SV}{3} - \frac{BG + BN + BV}{3}
\] (4.4)

\[
HML = \frac{SV + BV}{2} - \frac{SG + BG}{2}
\] (4.5)

\[
MOM = \frac{SW + BW}{2} - \frac{SL + BL}{2}
\] (4.6)

These portfolios each represent the characteristics of the Fama-French and Carhart factors, and from the calculation of the formulas we can see that the factors are equal weighted (Aytug et al., 2020).

When adding the different explanatory variables to the model our \(R^2\) value is automatically going to increase, due to the fact that addition of the factor variables is picking up more of the total variation in the data. Therefore, we are calculating the adjusted \(R^2\) which penalizes the value for each new variable we add. This counteracts "overfitting", which is the problem of using too many explanatory variables in the training data. Overfitting occurs when then model starts to explain the random noise in the data, making the predictions of the model unreliable. In CAPM however, the primary focus is on the significance and interpretation of the \(\beta\) coefficient rather than explaining the total variation in the asset’s returns.

### 4.2.1 Restrictions

One of the restrictions for our study is that the Fama-French and Carhart factors data is only available until 2020, meaning that we will not be able to analyze the effect of the most recent period of rising inflation rate Sweden. However, our data set includes data on previous crises and inflationary chocks. This will facilitate for extrapolation of what could be seen as an explanation for the bank stock return.

Additionally, our data is collected on a monthly basis due to the frequency of inflation
data provided by Statistics Sweden, which is reported monthly (SCB, 2023). While using daily data could potentially offer more observations for a more detailed analysis of the relationship between inflation and the stock returns of Swedish banks. We contend that the availability of 286 monthly observations is sufficient. We assert that this sample size allows us to apply the Central Limit Theorem, enabling us to make reasonable assumptions about the normal distribution of the data.

The stock returns considered in this analysis are limited to those with available data spanning the period from 1996-2020. However, this data selection introduces the possibility of Survivorship Bias. Stocks absent from this time frame may exhibit different characteristics or experiences that could impact their returns. Survivorship Bias has been a subject of criticism in the Fama-French 3-factor model as well, where risk factors are estimated based on the data currently available, potentially overlooking the performance of non-surviving or excluded assets.

Moreover, we have identified missing data points for May 2019 in the Fama-French-Carhart dataset. Consequently, we opted to exclude this particular date when conducting the Fama-French-Carhart regression.
5. Results

In this chapter the results from our Fama-French and Fama-Macbeth regression will be presented objectively. All the tables for the Fama-French regression can be found at the end of the chapter for convenience reasons.

5.1 5 Factor Model Results

We have made regression tables for 25 stocks traded on OMX Stockholm Large Cap with the Fama-French factors including Carhart's momentum factor as well as inflation as explanatory variables. We then run a time series regression in order to estimate the effects of our Fama-French variables on stock return. The dependent variable is the monthly return for each of the stocks including reinvested dividend payouts. The coefficients are therefore the estimated total stock return per unit increase in the Fama-French factors. When using the inflation as a explanatory variable we can see that the estimates are either positive or negative depending on stock in question.

The outcomes of the Fama-French-Carhart regression including inflation are detailed in tables 5.1 and 5.2. In contrast to our initial hypothesis, the factor coefficients reveals a negative impact of inflation on the monthly reinvested returns of bank stocks. Specifically, a one percentage point increase in inflation corresponds to a decrease in the monthly total return for Swedbank, Handelsbanken, Nordea, and SEB by -1.774, -1.041, -1.312, and -1.398 percentage points respectively.

The magnitude to which inflation affects the returns of banks are rather uniform across the selection, which could suggest higher level of robustness attributable to the effect inflation has. Thus, our hypothesis of the positive effect of inflation on bank stock return is rejected since these coefficients are all significant on a 1% level.

Inspection of the other variables provides us with an understanding of the risk factors effect on stock returns. The CAPM $\beta$ is considerably low for all the stocks return. This is likely an effect of the reinvested dividend payouts included in the return metric, making the correlation between the market return and stock return lower. These coefficients are significant on varying levels.
SMB exhibits a positive coefficient for all the banks, with statistical significance observed at the 10% level for Nordea and SEB, suggesting that larger stocks tend to outperform smaller stocks.

HML is positive for all the banks; however, the coefficient for SEB is the only significant coefficient. All the coefficients are positive, indicating a consistent trend across the banks, but it's noteworthy that the positive impact is statistically significant only for SEB. This suggests that the book-to-market value factor has a potentially stronger and more meaningful influence on the returns of SEB compared to the other banks in the analysis.

This could indicate that the market is not efficient since a higher inflation rate will lead to higher interest rates, and subsequently increased earnings for banks. However, the results could indicate that investors are cautious in pricing bank stocks during periods of higher inflation. This could be attributable to two factors, firstly investors believing that the increased level of earnings are unsustainable, and therefore price the stocks accordingly. Secondly, a higher level of inflation is usually followed by an downturn in the overall economy. The absence of an increase in stock prices for banks could be a result of investors fearing that the economic downturn will subject banks to balance sheet related risks.

Another segment of significant results on stock returns is within the construction sector. Inflation has a significant effect on the monthly returns of JM, NCC, Skanska, and Peab at a magnitude of -1.512, -2.307, -1.806, -1.465, and -1.488 respectively. We find this rather unsurprising considering a higher inflation rate will lead to higher future interest rate and will limit the number of construction projects being initiated due to the higher costs associated with the project.

What we do find surprising is the overall lack of significant estimates for other sectors than banks and construction. Except Hexagon, H&M, Assa Abloy, Electrolux, and the bank and construction stocks, none of the estimates are significant at a five percent level. We expected that we would find a significant negative relationship between non-bank stocks and inflation partly due to the companies increased cost of capital, and investors reduced valuation as a result of increased discount rates.

In summary, the negative and statistically significant coefficients for inflation in the Fama-French-Carhart regression including inflation factor imply a noteworthy and consis-
tent negative effect of inflation on the monthly reinvested returns of the analyzed banks, contrary to the initially hypothesized positive relationship.

5.2 Fama-Macbeth Risk Premiums

Below we can see the estimated risk premiums which are presented for every Fama-French risk factor including the inflation factor. These risk premiums are estimated through the Fama-Macbeth two-step regression procedure. Below are the estimated risk premiums and the standard errors presented.

To interpret these estimated risk premiums, we will start with analysing the CAPM factor for market risk premium \((R_m - R_f)\). This risk premium is estimated to 0.008, which suggest that investors will demand an additional 0.8% premium in return for bearing the market risk.

The risk premium for the size factor (SMB) is estimated to -0.010. This indicates that investors are willing to accept a 1% lower return per increase in the size factor.

The risk premium for the value factor (HML) is estimated to -0.009, meaning that investors will on average demand 0.81% higher return for value stock.

The risk premium for the momentum factor (MOM) is estimated to 0.062%, indicating a demand a 6.2% excess return per unit increase in the momentum of the stock.

The estimated risk premium for our additional factor for inflation is 0.002. This means that investors may accept a 0.2% lower return per unit increase in inflation.

However, the standard errors is too big for us to make any significant conclusion from the risk premiums. We will therefore not calculate the company specific risk premium.
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Robust Standard Errors in parenthesis

p < 0.05, * p < 0.01, ** p < 0.001
Table 5.2: Dependent variable: Monthly stock returns including reinvested dividend payouts

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<td>smb_ew</td>
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<td>0.545**</td>
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<td>0.554***</td>
<td>0.750***</td>
<td>0.395***</td>
<td>0.493***</td>
<td>0.399***</td>
<td>0.616***</td>
<td>0.288**</td>
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<td>0.007</td>
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<td>(0.163)</td>
<td>(0.213)</td>
<td>(0.159)</td>
<td>(0.163)</td>
<td>(0.139)</td>
<td>(0.127)</td>
<td>(0.148)</td>
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<td>(0.127)</td>
<td>(0.129)</td>
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<td>0.255</td>
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<td>0.381***</td>
<td>0.313*</td>
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<td>0.241***</td>
<td>0.185**</td>
<td>0.150***</td>
<td>0.277***</td>
<td>0.137*</td>
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<td>0.024</td>
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<td>(0.117)</td>
<td>(0.088)</td>
<td>(0.090)</td>
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<td>(0.070)</td>
<td>(0.082)</td>
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<td>-2.307***</td>
<td>-1.806***</td>
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<td>(0.518)</td>
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<td>(0.404)</td>
<td>(0.470)</td>
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<td>(0.607)</td>
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<td>Constant</td>
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<td>0.038***</td>
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<td>0.023***</td>
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<td>0.011**</td>
<td>0.017**</td>
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<td>(0.007)</td>
<td>(0.007)</td>
<td>(0.007)</td>
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</table>

Observations: 286
R²: 0.066
Adjusted R²: 0.049
Residual Std. Error (df = 280): 0.049
F Statistic (df = 5; 280): 3.965***

Robust Standard Errors in parenthesis

p < 0.05, ** p < 0.01, *** p < 0.001
Table 5.3: Fama-Macbeth Risk Premiums

<table>
<thead>
<tr>
<th>Factor</th>
<th>Risk Premium</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Market Risk Factor ( (R_m - R_f) )</td>
<td>0.008</td>
<td>0.205</td>
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<tr>
<td>Size (SMB)</td>
<td>-0.010</td>
<td>0.150</td>
</tr>
<tr>
<td>Value (HML)</td>
<td>-0.009</td>
<td>0.190</td>
</tr>
<tr>
<td>Momentum (MOM)</td>
<td>0.062</td>
<td>0.522</td>
</tr>
<tr>
<td>Inflation (( \pi ))</td>
<td>-0.002</td>
<td>0.040</td>
</tr>
</tbody>
</table>
6. Analysis

In this section, an analysis and interpretation of the results is formed based on the thesis’s theoretical framework and hypothesis.

6.1 Analysis of Fama-French 5 Factor Results

The analysis firstly focus on determining the effects of inflation on stock return and later analyze the effect of the other factors.

Our hypothesis is argument that inflation should have a positive effect on return of bank stocks. The reasoning behind this argument is that inflation could be seen as an indicator of future interest raises. The banks profit originates from their NII, and thus when interest rate increases the margin spread between the interest rate on deposits and mortgage rate also increases. Theoretically, this would imply increased profits for the banks and later increase in stock price.

In contrast to the results in the regression table we can see that this is not the case. Rather, we have a negative coefficient on the inflation factor in our own Fama-French-Carhart 5 factor model. This means that when inflation increases, the stock return of all the banks decreases. This coefficient is also lower than -1 for all the four banks. The interpretation of this result is that the stock return decreases more than one unit per unit increase in inflation. The coefficient is significant on a 1% significance level, which means that we cannot accept accept our hypothesis for banks, concluding that inflation has a negative effect on bank stock return.

Additionally, we note that the negative effect of inflation is greater for bank stocks compared to other stocks. This is an interesting result since it is directly contrary to our hypothesis.

The additional negative effect specifically for bank stocks is not clear for us. One of possible feasible explanations for this is the increased uncertainty in the market and world economy of that increasing inflation has. From previous events such as the financial crisis in 2008, we have seen that the effect on banks has been disastrous. An example of this is the bankruptcy of one of Americas biggest banks Lehman Brothers and Bear Sterns.
The fear of this happening again is possibly one reason for the extended negative effect of inflation on bank stocks return.

6.2 Analysis of Fama-Macbeth Results

The Fama-Macbeth results in the previous section have provided valuable insights into pricing the Fama-French-Carhart factors. Here is a more detailed analysis of the findings:

- **Market Risk** \((R_m - R_f)\): The estimated Fama-Macbeth risk premium for market risk is 0.008. This positive risk premium suggests that investors are demanding compensation for bearing market risk. A higher market risk premium indicates a higher expected return for investments exposed to the overall market. This result indicates an overall systematic market risk in investing in stocks on the OMX Stockholm Stock Exchange.

- **Size** \((SMB)\): The estimated risk premium for size \((SMB)\) is -0.010. The negative sign implies that, according to the Fama-MacBeth analysis, smaller firms are expected to underperform larger ones, possibly due to additional risks associated with small-cap stocks.

- **Value** \((HML)\): The estimated risk premium for value \((HML)\) is -0.009. A negative value indicates that value stocks are expected to underperform growth stocks. This could be interpreted as investors requiring higher returns for holding value-oriented assets.

- **Momentum** \((MOM)\): The estimated risk premium for momentum is 0.062. This positive value suggests that investors are demanding a higher return for exposure to momentum stocks. Momentum strategies, involving buying past winners and selling past losers, seem associated with higher expected returns.

- **Inflation** \((\pi)\): The estimated risk premium for inflation is -0.002. This negative value suggests that, according to the Fama-MacBeth analysis, there’s a negative relationship between inflation and the future expected market return. This could be attributable to inflation eroding the real net present value of future cash flows, and a higher discount rate since higher inflation is usually followed by an increase in the policy rate.

While the estimates of inflation’s market risk premium are not statistically significant,
we cannot determine how inflation affects the market’s pricing of bank stocks through the operation of multiplying inflation’s market risk premium coefficient with each bank’s inflation coefficient derived in the time series analysis. If the inflation risk premium estimate had been significant, the results would imply that the market demands a higher expected return on bank stocks. However, the effect would largely result from the inflation coefficient, not an increased risk premium. These results are surprising as we expected the market to demand an increased expected return on bank stocks in periods of higher inflation to reflect the market’s anticipation of increased future earnings for the companies.

6.3 Future Research

Future research could employ the same empirical approach as this thesis but in a different country, exploring if the results are specific to Sweden or applicable globally. Targeted nations would share similarities in GDP per capita, income equality, financial markets, and key metrics. A multi-country study would mitigate country-specific factors that could distort estimates.

This thesis centers on inflation as a precursor to interest rate adjustments. Future research could exclusively focus on interest rate levels, distinguishing which macroeconomic variable influences the market more. The investigation could explore the impact of interest rates on monthly stock returns and risk premiums, comparing results with this thesis. Additional macroeconomic variables like GDP growth and employment levels may also be considered.

Examining the same thesis topic with an alternative empirical approach, such as an event study focusing on monthly stock returns, could offer insights. Designating the publication date of inflation data as the event window and analyzing market reactions in the subsequent trading days could illustrate how the market responds to inflation on those specific days.
7. Conclusion

In summary, our study has revealed surprising results which was contrary to our initial expectations. Instead of the expected positive correlation between inflation and stock returns for Swedish banks, we found a significant negative effect. Our hypothesis, predicting a positive relationship, was grounded in the belief that inflation would drive up interest rates, subsequently increasing bank profits, stock prices, and overall returns. However, our findings suggests a different picture, revealing a significant negative impact of inflation on bank stock returns. Given that rising profits from the NII will increase in the short run, the inflationary sentiment seems to create a fear from investors leading to decreasing stock prices. This result is not in accordance with previous studies, such as Eldomiaty et al. (2019).

This negative effect of inflation on stock returns on Swedish banks surpasses the observed impact on the other 21 stocks analyzed. A plausible explanation could be investor concerns, driven by fears that rising inflation might trigger a global economic downturn, such as in historical events like the financial crisis. These events have had a detrimental impact on banks, with credit defaults eventually leading to bankruptcy.

Concerning the second research question whether the risk premiums associated with inflation, our results indicate a negligible risk premium. This suggests that investors currently do not seek additional returns for exposure to inflation. The Fama-Macbeth risk premiums are not statistically significant estimates. Thus, we can not conclude whether inflation is a priced risk factor in the stock price of Swedish banks.

In conclusion, our study challenges conventional expectations, highlighting an unexpected and significant negative relationship between inflation and stock returns for Swedish banks. This unforeseen trend underscores investor concerns about potential adverse effects on banks in rising inflation, deriving from historical economic downturns. Furthermore, the negligible risk premiums underscore the complex dynamics at play, emphasizing the intricate interplay between inflation and stock market outcomes.
References


Appendix

Table 7.1: Descriptive Statistics

<table>
<thead>
<tr>
<th>Company</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Median</th>
<th>25th %ile</th>
<th>75th %ile</th>
<th>Observations</th>
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<tbody>
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<td>SWED</td>
<td>0.009</td>
<td>0.091</td>
<td>0.012</td>
<td>−0.033</td>
<td>0.052</td>
<td>286</td>
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<td>0.081</td>
<td>0.011</td>
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<td>SEB</td>
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<td>0.016</td>
<td>−0.040</td>
<td>0.057</td>
<td>286</td>
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</table>

Fama-French-Carhart Factor Variables from Finbas database

rm: Market return (SIXRX index)
rf: Risk-free rate (1-month Swedish T-Bill)
rm_rf: Market return in excess of the risk-free rate
SMB$_{ew}$: Small minus Big (equally weighted)
HML$_{ew}$: High minus Low (equally weighted)
MOM$_{ew}$: Winners minus Losers (equally weighted)
infl: Inflation rate on a monthly basis
Figure 7.1: Graph of monthly inflation, and monthly return for the banks examined in this thesis.

Figure 7.2: Graph of monthly inflation, and monthly return for industrials examined in this thesis
Figure 7.3: Graph of monthly inflation, and monthly return for consumer stocks examined in this thesis

Figure 7.4: Graph of monthly inflation, and monthly return for raw material stocks examined in this thesis
Figure 7.5: Graph of monthly inflation, and monthly return for technology stocks examined in this thesis

Figure 7.6: Graph of monthly inflation, and monthly return for construction stocks examined in this thesis
Figure 7.7: Graph of monthly inflation, and monthly return for real estate stocks examined in this thesis

Figure 7.8: Graph of monthly inflation, and monthly return for healthcare stocks examined in this thesis
Table 7.2: Dependent variable: Stock returns excluding dividend payouts (Monthly)

<table>
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<tr>
<th></th>
<th>SWED</th>
<th>SHB</th>
<th>NRD</th>
<th>SEB</th>
<th>ATCO</th>
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<th>SAND</th>
<th>VOLV</th>
<th>ASSA</th>
<th>TRELLE</th>
<th>ELUX</th>
<th>HM</th>
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<td>0.997***</td>
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<td>(0.075)</td>
<td>(0.082)</td>
<td>(0.076)</td>
<td>(0.080)</td>
<td>(0.080)</td>
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<td>(0.094)</td>
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<tr>
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<td>-0.241**</td>
<td>-0.199*</td>
<td>-0.114</td>
<td>-0.273***</td>
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<tr>
<td><strong>hml_{ew}</strong></td>
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<td>0.372***</td>
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<td>0.373***</td>
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<td>40.482***</td>
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*Robust Standard Errors in parenthesis*

*p < 0.05, **p < 0.01, ***p < 0.001*
Table 7.3: Dependent variable: Stock returns excluding dividend payouts (Monthly)

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<td>-0.388***</td>
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<td>-0.110</td>
<td>0.102</td>
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<td></td>
<td>(0.140)</td>
<td>(0.155)</td>
<td>(0.130)</td>
<td>(0.147)</td>
<td>(0.131)</td>
<td>(0.104)</td>
<td>(0.132)</td>
<td>(0.089)</td>
<td>(0.118)</td>
<td>(0.113)</td>
<td>(0.120)</td>
<td>(0.182)</td>
</tr>
<tr>
<td>hml_ew</td>
<td>0.601***</td>
<td>-0.014</td>
<td>0.452***</td>
<td>0.674***</td>
<td>0.410***</td>
<td>0.334***</td>
<td>0.568***</td>
<td>0.201**</td>
<td>0.468***</td>
<td>0.525***</td>
<td>0.393***</td>
<td>0.451***</td>
</tr>
<tr>
<td></td>
<td>(0.155)</td>
<td>(0.172)</td>
<td>(0.144)</td>
<td>(0.163)</td>
<td>(0.145)</td>
<td>(0.115)</td>
<td>(0.146)</td>
<td>(0.099)</td>
<td>(0.131)</td>
<td>(0.125)</td>
<td>(0.133)</td>
<td>(0.201)</td>
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<tr>
<td>mom_ew</td>
<td>0.131*</td>
<td>-0.128</td>
<td>0.109</td>
<td>0.178**</td>
<td>0.046</td>
<td>-0.064</td>
<td>0.084</td>
<td>0.022</td>
<td>0.086</td>
<td>0.148**</td>
<td>0.046</td>
<td>0.173*</td>
</tr>
<tr>
<td></td>
<td>(0.077)</td>
<td>(0.085)</td>
<td>(0.071)</td>
<td>(0.081)</td>
<td>(0.072)</td>
<td>(0.057)</td>
<td>(0.072)</td>
<td>(0.049)</td>
<td>(0.065)</td>
<td>(0.062)</td>
<td>(0.066)</td>
<td>(0.100)</td>
</tr>
<tr>
<td>infl</td>
<td>-0.265</td>
<td>0.720</td>
<td>-0.575</td>
<td>-2.034***</td>
<td>-1.430***</td>
<td>-0.836***</td>
<td>-1.149***</td>
<td>-0.080</td>
<td>-0.740**</td>
<td>-0.580</td>
<td>0.356</td>
<td>0.995*</td>
</tr>
<tr>
<td></td>
<td>(0.444)</td>
<td>(0.492)</td>
<td>(0.413)</td>
<td>(0.469)</td>
<td>(0.416)</td>
<td>(0.330)</td>
<td>(0.419)</td>
<td>(0.283)</td>
<td>(0.375)</td>
<td>(0.359)</td>
<td>(0.383)</td>
<td>(0.577)</td>
</tr>
<tr>
<td>Constant</td>
<td>-0.003</td>
<td>-0.017**</td>
<td>0.013**</td>
<td>0.027***</td>
<td>0.014**</td>
<td>0.007</td>
<td>0.017**</td>
<td>0.002</td>
<td>0.010*</td>
<td>0.015**</td>
<td>-0.003</td>
<td>-0.008</td>
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<td></td>
<td>(0.007)</td>
<td>(0.008)</td>
<td>(0.007)</td>
<td>(0.008)</td>
<td>(0.007)</td>
<td>(0.005)</td>
<td>(0.005)</td>
<td>(0.005)</td>
<td>(0.006)</td>
<td>(0.006)</td>
<td>(0.006)</td>
<td>(0.010)</td>
</tr>
</tbody>
</table>

Observations 286 286 286 286 286 286 286 286 286 286 286 286
$R^2$ 0.308 0.522 0.361 0.275 0.243 0.392 0.262 0.204 0.227 0.259 0.199 0.105
Adjusted $R^2$ 0.295 0.513 0.349 0.262 0.229 0.382 0.249 0.190 0.214 0.246 0.185 0.089
Residual Std. Error (df = 281) 0.085 0.094 0.079 0.089 0.079 0.063 0.080 0.054 0.071 0.068 0.073 0.110

*Robust Standard Errors in parenthesis

$p < 0.05, \ast \ast p < 0.01, \ast \ast \ast p < 0.001$