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The long-run relationship between inflation and real stock prices in the United Kingdom

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ABSTRACT

This study examines the long-run relationship between inflation and real stock prices in the United Kingdom. The analysis uses a Bivariate Vector Autoregression (VAR) model to investigate these variables' short-term and long-term dynamics. The findings reveal that, in the short term, real stock prices have a statistically significant positive impact on the inflation rate, while the effect of inflation on real stock prices is not statistically significant. An Impulse Response Function (IRF) analysis demonstrates that an inflation shock negatively affects real stock prices, but the reverse relationship is not observed. Additionally, the forecast error variance decomposition (FEVD) indicates that approximately 4.5% of the variations in real stock prices can be explained by changes in the inflation rate, while only 2.6% of the changes in the inflation rate can be explained by variations in real stock prices. The study identifies significant structural breaks during the 2008 financial crisis and the period surrounding Brexit. These events notably impact the relationship between inflation and real stock prices. From a long-term perspective, the VAR analysis suggests a stable and neutral relationship between these variables, as deviations from the mean relationship are temporary and tend to be corrected over time. This observation is in line with the classical macroeconomic theory proposed by Fisher (1930), that changes in the inflation rate should not affect the real value of equity investments.

Keywords: inflation, real stock prices, vector autoregressive model, structural breaks

JEL codes: G12, G14

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1 Introduction

In 2020 the United Kingdom left the European Union with the term now known as "Brexit". The British exit has made it more expensive for the United Kingdom to import goods and many companies left to move to the European Union. This combined with the high gas and energy prices has led to high inflation rates in the United Kingdom. In 2022 the inflation level has risen to the highest level in 41 years. The price level in England, Scotland, Wales, and Northern Ireland was 11.1 percent higher last October than the year before according to the British statistical bureau (ONS). Stock market prices represent the value of stocks traded on the stock market, which are influenced by a variety of economic factors, including inflation. The relationship between inflation and stock prices has been a topic of interest for economists and policymakers because it affects purchasing power, interest rates, investor expectations, and market sentiment. For these reasons, understanding this relationship is crucial to make informed economic and financial market decisions. Therefore, the research question of this study is: *What is the long-run relationship between inflation and real stock prices in the United Kingdom?*

Many studies have investigated the long-run relationship between the inflation rate and real stock prices. This thesis builds upon the paper of Arjoon et al. (2012), who found empirical evidence that, in the long run, real stock prices in South Africa are invariant to permanent changes in the inflation rate. In the long run, real stock prices have a positive response to a permanent inflation shock, suggesting that short-term price differences will be corrected in the long run. Therefore, the study concludes that inflation does not reduce the real value of stocks in South Africa in the long run. A similar study by Rapach (2002) measures the long-run response of real stock prices to persistent inflation for 16 industrialized countries. The estimated results provide sufficient evidence for the long-run neutrality relationship between inflation and real stock prices.

Nevertheless, different studies have a variety of theories and outcomes, which is why there is not a clear vision of the long-run relationship between inflation and stock prices. There are three possible relationships between the two variables. The first outcome is an inverse relationship between inflation and stock prices in the long run. Five different theories that confirm this negative effect are the inflation illusion hypothesis by Modigliani and Cohn (1979), the real after-tax hypothesis offered by Feldstein (1980), the proxy hypothesis by Fama (1981), the risk-premium hypothesis suggested by Devereux and Yet-man (2002) and Anari and Kolari (2010), and lastly, the time-varying risk-aversion hypothesis (Brandt, Wang 2003). The second outcome is a positive relationship between inflation and stock prices. Research by Alagidede and Panagiotidis (2010) shows that the response of stock prices to a shock in consumer prices reveals an initial negative response in Egypt and South Africa but turns positive in the long run. The third outcome is the classical macroeconomic theory of Fisher (1930), which suggests that the real value of equity investments should not be affected by changes in the inflation rate. This is

because nominal variables should not influence the long-run values of real variables. The return on assets should adjust to fully account for the inflation effect (Fisher 1930). It remains unclear which of these three effects describes the relationship correctly.

Much research has been conducted to investigate the relationship between inflation and stock prices in the long run in several countries. There has not been a study specifically researching the United Kingdom. The choice for this thesis to investigate the United Kingdom is because it has one of the biggest economies in the world and the inflation levels in recent years have been very high, partly due to the Brexit. The data used in this paper consists of quarterly observations of the nominal stock price index and consumer price index (CPI) for the United Kingdom. The data from Q1 2002 until Q4 2022 will be used. During this period, the Brexit occurred. When examining the data, a structural break may be evident as a result. Additionally, the pledging of stock prices in the years following the Brexit can be considered due to high inflation. Therefore, the model examines a structural break around Brexit.

The data concerning the CPI is taken from the Fred economic research database. The Stock market index data is contracted from the FTSE Russel database. The inflation rate series is computed by taking the first difference in the natural logarithm of the consumer price index. The real stock price series is calculated as the natural logarithm of the nominal share price index deflated by the CPI. I want to determine whether permanent changes in the rate of inflation have any effect on the real stock price. Therefore, it is required that both inflation and real stock prices be integrated of order one but not cointegrated. I begin by performing unit root tests for inflation rate and real stock price series and cointegration tests between the series. This will show if the data holds all the conditions necessary for meaningful examination of the long-run neutrality test. Next, a Vector Autoregression (VAR) model is used to analyze the dynamic relationship between inflation and real stock prices. The VAR model allows for the estimation of both the short-run and long-run effects of changes in one variable on the other while controlling for any other relevant factors.

A positive, negative, or neutral effect can be observed between inflation and real stock prices in the long run. All three effects have been found in previous studies and without the analyses it is hard to state what the effect will be. However, this thesis builds upon the paper by Arjoon et al. (2012), therefore I assume that the largest effect will be the neutral effect. My hypothesis is that, in the long run, inflation is not expected to have an impact on stock prices. After the empirical tests, the effect inflation has on stock prices, in the long run, will become clear.

The empirical tests in this study show that the error terms tend to fluctuate around the same mean. This means that in the short-term different effects between inflation and real stock prices can be found. Nevertheless, these deviations from the mean are temporary and are corrected over time. From these

results it can be concluded that there is a stable and neutral long-term relationship between inflation and real stock prices.

The study is divided into several chapters, each contributing to a comprehensive understanding of the topic. It begins by establishing the theoretical framework, exploring the variables of real stock prices and inflation rates separately. It then delves into the existing literature to examine the relationship between these two variables. Subsequently, the study provides an overview of the data sources and their origins. The methodology for the empirical research is presented, outlining the specific tests and regressions to be conducted. The empirical results are then presented through tables and graphs, accompanied by explanatory notes. Lastly, the conclusion is drawn from the key findings from the results and provides recommendations for future research.

CHAPTER 2 Theoretical Framework

2.1 Stock Prices

Shares are traded on a stock exchange. Stock prices represent the current prices or market values of a share of a particular company (Saxo, 2023). Stock prices reflect the perceived value of a company. The value of a company depends on several factors, such as market conditions, financial performance, and prospects (Salaga et al., 2016). The nominal value of a stock refers to its price in current dollars, without considering inflation. By adjusting the nominal stock prices for inflation, the real stock prices are obtained (Rapach, 2002). When studying the long-run effect of inflation on stock prices it is important to use real stock prices, because inflation will consistently have a negative effect on nominal stock prices by deflating the value of the stock.

2.1.1 Efficient Market Hypothesis

The Efficient Market Hypothesis (EMH) states that a stock price reflects a company's true value at any given time. This suggests that stock prices quickly and accurately reflect all available information in the market (Malkiel, 1989). The stock price of a company fluctuates during a trading day due to factors that can influence investors' perception of a company's value. Stock prices rise when there is increased interest in buying a stock, leading to a rise in demand. According to the EMH, this can occur due to positive earnings, financial performance reports, news about a company, or optimistic investor sentiment about the market or a specific stock. Conversely, stock prices may decline when there is more selling pressure, increasing supply. Factors such as disappointing earnings, fear, uncertainty, or negative sentiment can lead to a decline in stock prices (Malkiel, 2005).

2.1.2 Macroeconomic Influence

There have been several studies conducted to determine the major influences on stock prices. According to the research by Cutler et al. (1988), political or global news has a relatively small market response. Stock price movements are primarily explained by news regarding future cash flows and discount rates. Additionally, it is concluded that approximately one-third of the return variance is attributed to macroeconomic news (Cutler et al., 1988). This implies that changes in macroeconomic variables, such as interest rates, inflation, GDP growth, and government policies, may impact company value and investor sentiment, subsequently affecting stock prices. This finding is particularly relevant for this paper as it aims to determine the effect of inflation on stock prices.

2.2 Inflation

Inflation measures how much more expensive a set of goods and services has become over a certain period, usually a year (International Monetary Fund, 2023). Many different theories on inflation are discussed in the economic literature. Inflation is usually classified into three types: demand-pull inflation, cost-push inflation, and built-in (structural) inflation (Dastgerdi, 2020). In this paper, I will

discuss the three different types of inflation and theories built within these types on the causes, or increase, of inflation.

2.2.1 Demand-pull Inflation

The first type of inflation I will discuss is demand-pull inflation, which originated with the Keynesian macroeconomic model. This theory approaches inflation from a macroeconomic context. According to this theory, a demand surplus is seen as the cause of inflation. When aggregate demand in an economy exceeds the available supply of goods and services, prices will rise (Auerbach, 1976). When there is high consumption or an increase in investments, the demand for goods and services increases, leading to a rise in prices. This often happens during periods of economic growth and can happen due to factors such as increased consumer spending, increased government spending, or expansionary monetary policy.

The demand-pull inflation is in line with the Keynesian view, which emphasizes the significant role of demand factors in causing inflation. Keynesian economists believe that government intervention, such as fiscal and monetary policies, can be used to manage aggregate demand. By managing aggregate demand, the government can control inflation and stabilize the economy (Che & Sákovics, 2008).

The original inflation theory is the quantity theory of money formulated by classical economists, which states that inflation is directly caused by an increase in the money supply within an economy. This theory aligns with the demand-pull inflation type as it explains inflation as a result of excess demand in the economy driven by changes in the money supply (Walker, 1895). The monetarist theory builds upon the quantity theory of money and emphasizes the role of the central bank in controlling the money supply and thereby playing an important role in managing inflation. However, in modern literature it is often argued that viewing the money supply as the sole cause of inflation is outdated (Howden, 2013).

2.2.2 Cost-push Inflation

The second type of inflation that will be discussed is cost-push inflation. This theory argues that inflation is caused by increases in production costs. Production costs increase when the price of wages, raw materials, or other production factors rises. If a company faces higher costs, they pass them on to consumers by raising the prices of their goods and services. This results in an overall increase in the price level in the economy, which, in turn, leads to inflation (Schwarzer, 2018). Due to the rigidity of wages or “sticky wages”, they are slow or difficult to increase, which means they do not quickly adjust to changing market conditions such as rising prices. As a result, prices rise while wages cannot increase at the same pace, leading to a decline in consumer purchasing power (Ascari & Merkl, 2009).

2.2.3 Built-in Inflation

The third type of inflation that will be discussed is built-in inflation, also known as structural inflation or a wage-price spiral. This occurs when workers demand higher wages to keep up with rising living costs due to inflation. This subsequently causes firms to raise their prices to cover the wage costs increases. This leads to a self-reinforcing loop of wage and price increases. Therefore, you can argue that the inflation expectations theory is part of the built-in inflation theory. This theory demonstrates the significance of people's expectations regarding future inflation. When individuals anticipate price increases, i.e., a rise in inflation, they may adjust their behavior accordingly (Petropoulos Petalas et al., 2017). For instance, consumers or producers might rush to make purchases before prices go up, demand higher wages, or increase their prices. The same applies in the case of a decrease in inflation. These actions amplify the upward or downward movement of inflation. Inflation expectations are often seen as the main cause of inflation, since the economic system has evolved and people's income and wealth have grown (He & Liu, 2011). During the period surrounding Brexit in the United Kingdom, the British expected prices to increase, thereby reinforcing this process. This is also known as a self-fulfilling prophecy (Jussim, 1986).

In summary, the three types of inflation are demand-pull inflation, cost-push inflation, and built-in inflation. Within these types, the most prominent theories are the quantity theory of money, the monetarist theory, and the inflation expectations theory. All these theories are not necessarily mutually exclusive, and the actual cause of inflation can often be complex, resulting from multiple interactions between economic variables.

2.3 The long-run Relationship between Inflation and real stock prices

The analysis aims to examine the long-run relationship between real stock prices and the inflation rate. This comes with determining whether permanent changes in the rate of inflation have any effect on real stock prices. There are many theories on the topic of this long-run relationship. In this study, I will examine three different relationships: Inverse, positive, and neutral. Within these three types of relationships, different theories will be discussed.

2.3.1 Inverse Relationship

The first type of relationship I will discuss is an inverse relationship between inflation and real stock prices. An inverse relationship means that when one variable increases, the other variable decreases, and vice versa. For these variables, it suggests that as inflation rates rise, real stock prices tend to decline, and when inflation rates decrease, real stock prices tend to increase. This inverse relationship implies that there is a negative correlation between inflation and real stock prices (Mirmiran et al., 2005). This negative correlation is supported by five different theories.

The first theory is the inflation illusion hypothesis by Modigliani and Cohn (1979), which was developed to explain the depressed stock prices in the United States (US) market in the 1960s and 1970s. The theory suggests that high inflation leads to higher nominal interest rates. Due to these higher nominal interest rates, investors will use higher discount rates when estimating future returns. This can cause market participants to underestimate the long-term value of cash flows. As stock prices are discounted at these higher rates, the prices of shares will decrease.

The second theory that supports the negative correlation is the real after-tax hypothesis by Feldstein (1980). This theory suggests that during times of higher inflation, the government often implements a countercyclical policy by raising taxes. As a result, corporate profits decline when inflation rises, leading to lower stock prices. In other words, a negative relationship between inflation and stock prices emerges. Based on research by Zhang (2021), it is found that when a country's monetary authority implements a more countercyclical monetary policy, the relationship between stock returns and inflation becomes more negative. This aligns with the notion that higher taxes and interest rates can result in lower stock prices.

The third theory that also finds an inverse relationship between inflation and real stock prices is the proxy hypothesis by Fama (1981). They explain that an increase in inflation results in a change in expected economic growth. The theory suggests that investors perceive an increase in inflation as a sign of economic uncertainty, which leads to lower expectations for corporate profits and stock prices.

The fourth theory is the risk-premium hypothesis suggested by Devereux and Yet-man (2002) and Anari and Kolari (2010). This theory proposes that the nominal discount rate can have a negative effect on the value of stocks in the short term due to the inflation premium embedded in the discount rate.

The fifth theory, closely related to the risk-premium hypothesis, is the time-varying risk-aversion hypothesis (Brandt, Wang 2003). This theory argues that changes in inflation affect investors' risk aversion, causing an increase in the equity premium and, consequently, the real discount rate.

2.3.2 Positive Relationship

The second type of relationship possible is a positive relationship between inflation and real stock prices. A positive relationship means that when inflation rises, subsequently stock prices also rise. In a healthy economy with modest inflation, this often leads to higher stock prices. This positive correlation between stock prices and inflation is supported by historical data (Cadre, 2023). Research by Alagidede and Panagiotidis (2010) shows that the response of stock prices to a shock in consumer prices reveals an initial negative response in Egypt and South Africa but turns positive in the long run. In the short run,

individuals may seek to hedge against inflation by investing in stocks to secure the value of their money. As inflation decreases the value of money in savings accounts, stocks tend to appreciate (Bodie, 1976).

Stock prices can also positively influence the inflation rate through the wealth effect. When stock prices rise, individuals who own stocks experience increased wealth, leading to a greater sense of financial security and income. This can result in higher consumer spending, as individuals are more inclined to spend when the value of their assets, such as stocks, increases (Starr-McCluer, 2002). This increased consumer spending can contribute to an overall rise in the inflation rate.

However, it is important to note that the empirical evidence supporting the long-run positive relationship is not as strong as the evidence for the negative relationship. Additionally, the relationship between inflation and stock prices can be complex and influenced by various factors, which is why the relationship is still an ongoing debate.

2.3.2 Neutral Relationship

The third and final type of relationship outcome is the classical macroeconomic theory proposed by Fisher (1930), which suggests that changes in the inflation rate should not affect the real value of equity investments. According to this theory, nominal variables should have no long-run influence on real variables. The return on assets is expected to adjust fully to account for the inflation effect (Fisher, 1930). Another study that aligns with this theory is that of Rapach (2002), which measures the long-run response of real stock prices to a permanent inflation shock across 16 individual industrialized countries. Rapach's research results also show a neutral relationship in the long run between inflation and real stock prices.

This thesis builds upon the research conducted by Arjoon et al. (2012), who found empirical evidence that, long term, real stock prices in South Africa remain unaffected by permanent changes in the inflation rate. The study reveals a positive response in real stock prices to a permanent inflation shock in the long run, suggesting that deviations in short-run real stock prices will eventually correct toward their long-run value. Therefore, the study concludes that inflation does not lower the real value of stocks in South Africa in the long run. Hence, the hypothesis in this study is that the inflation rate has no effect on real stock prices in the long run, indicating a neutral relationship.

CHAPTER 3 Data

The data used in this paper consists of quarterly observations of the nominal stock price index and consumer price index (CPI) for the United Kingdom. The data covers the period from the first quarter of 2002 until the fourth quarter of 2022. Within this period recent data will be used and a twenty-year range will give a clear result of the long-term relationship between inflation and real stock prices.

The CPI measures the average changes in consumer prices and is a widely used measure of inflation. The CPI is calculated by assigning weights to different categories of goods and services based on their importance in the average consumer's expenses (Boskin et al., 1997). The CPI data for this study is obtained from the Federal Reserve Economic Database (FRED). The index is set to 100 in the first quarter of 2002, serving as the base against which subsequent values are compared.

Regarding the stock market variable, this paper uses the FTSE-All share index. The FTSE All-Share is made up of the FTSE 100, FTSE 250, and FTSE Small Cap. The FTSE All-Share index includes companies of varying sizes, ranging from large and medium-sized companies to smaller ones. The specific variable used in this paper is the Base Currency Price Index Value, which aligns with the research period of the CPI data. The stock market index data is sourced from the FTSE Russell database. FTSE Russell is a subsidiary of the London Stock Exchange Group, which also owns the London Stock Exchange and Refinitiv.

CHAPTER 4 Method

In this study, I aim to determine the long-term effect of the inflation rate on real stock prices. To calculate the inflation rate series, I first take the natural logarithm of the CPI. Then, I compute the first difference by subtracting the value at period t-1 from the value at period t. The real stock price series is calculated by taking the natural logarithm of the nominal share price index and subtracting the natural logarithm of the CPI.

The purpose of this research is to determine whether permanent changes in the rate of inflation have any effect on real stock prices. When analyzing the relationship between two variables, it is important that they have the same order of integration. For instance, if one variable is integrated of order one (I (1)), meaning it requires first differencing to achieve stationarity, while the other variable is integrated of order two (I (2)), requiring second differencing, interpreting their relationship becomes challenging. Therefore, both variables must be integrated to the same order; otherwise, the impact of inflation shocks on real stock prices cannot be properly observed.

To begin, I conducted unit root tests for the inflation rate and real stock price series. Four standard unit root tests are used: the augmented Dickey-Fuller (ADF; Dickey & Fuller, 1979), the Dickey-Fuller-GLS (Elliott et al., 1996), the NP (Ng & Perron, 2001), and the KPSS (Kwiatkowski et al., 1992) tests. The ADF, DF-GLS, and NP tests examine the null hypothesis of a unit root, while the KPSS test examines the null hypothesis of stationarity. These tests are performed on both the levels and first differences in inflation and real stock prices. By taking the first difference, I essentially examine the changes in the variables from one period to another, which can help identify patterns or relationships. The models include a constant and a linear trend.

Table 1 presents the results of these unit root tests. It appears that the null hypothesis of non-stationarity cannot be rejected by the ADF, GLS, and NP tests for both inflation and real stock prices at the levels. However, all three tests indicate stationarity when examining the first differences in both inflation and real stock prices. When a variable is non-stationary at the levels but stationary at the first differences, this is called first-order integration. According to the KPSS test results, inflation is non-stationary at both the levels and first differences, while real stock prices are stationary in both cases. This does not entirely align with the other three tests, but I assume that the outcomes of the three tests, and to some extent the KPSS test, are correct, and the remaining two results are incorrect. Consequently, there is enough evidence that both inflation and real stock prices are integrated of order one (I (1)). Table 2 shows the critical values for the tests in table 1 at 1%, 5%, and 10% levels of significance.

Table 1. Unit root test results

Test	Inflation		Real stock prices	
	Levels	First difference	Levels	First difference
ADF	0.720	-5.914***	-2.977	-9.088***
DF-GLS	-0.184	-5.628***	-2.781*	-7.239***
NP	-3.099	-61.018***	-20.903*	-80.930***
KPSS	0.196**	0.168**	0.088	0.040

Notes: ***, ** and * indicate the rejection of the null hypothesis of unit root at 1%, 5%, and 10% level of significance respectively, for the ADF, DF-GLS and NP tests. ***, **, and * indicate the rejection of the null hypothesis of stationarity at 1%, 5%, and 10% levels of significance respectively, for the KPSS test.

Table 2. Critical values

	Levels				First difference			
	1%	5%		10%		1%	5%		10%
ADF	-4.077;	-3.467	and	-3.160	ADF	-4.080;	-3.468	and	-3.161
DF-GLS	-3.641;	-3.065	and	-2.770	DF-GLS	-3.645;	-3.067	and	-2.773
NP	-26.822;	-20.394	and	-17.262	NP	-26.788;	-20.376	and	-17.248
KPSS	0.216;	0.146	and	0.119	KPSS	0.216;	0.146	and	0.119

Notes: This table shows the critical values for the Unit root tests. The left side shows the critical values for levels and the right side in the first difference.

Since a VAR model cannot be used if the variables are cointegrated (Fisher, Seater 1993), it is necessary to test for cointegration between inflation and real stock prices. Cointegration suggests that two or more non-stationary time series variables have a stable long-term relationship, even though they may have temporary deviations from this relationship in the short run. In other words, it means that time series move together over time. In this study, the augmented Engle-Granger (AEG; Engle & Granger, 1987) two-step procedure is conducted to test for cointegration. The null hypothesis in this test is non-cointegration.

In the first step of the procedure, a regression is run with inflation and real stock prices alternatively used as the dependent and independent variables. Then, the errors are predicted, summarized, and a Dickey-Fuller test with a constant term is performed on the errors. To verify the accuracy of these results, the AEG command in Stata is used. These tests will determine whether the data satisfies all the necessary conditions for a meaningful examination of the long-run neutrality test.

Table 3 presents the results of the AEG test and the Dickey-Fuller test on the errors, showing that both tests yield the same outcome of not rejecting the null hypothesis of non-cointegration.

Table 3. Cointegration test results

AEG statistic	
Dependent variable	
Inflation	Real stock prices
-0.808	-2.933

Notes: ***, ** and * indicate the rejection of the null hypothesis of non-cointegration at 1%, 5%, and 10% level of significance respectively, for the AEG test.

Next, a VAR model is used to analyze the dynamic relationship between inflation and real stock prices. The VAR model allows for the estimation of both the short-run and long-run effects of changes in one variable on the other and has proven especially useful for describing the dynamic behavior of economic and financial time series (Zivot & Wang, 2006). The number of lags is selected based on the Log likelihood ratio (LR; Anderson & Goodman, 1957), Final prediction error (FPE; Akaike, 1969), Akaike Information Criterion (AIC; Akaike, 1974), Hannan-Quinn Information Criterion (HQIC; Hannan & Quinn, 1979), and Schwarz Bayesian Information Criterion (SBIC; Schwarz, 1978). Table 4 shows the results of the lag-order selection. All the tests reveal that two lags is optimal for the model.

Table 4. Lag-order criteria

	Lag-order selection criteria					
Lag	LR	p	FPE	AIC	HQIC	SBIC
0			2.0e-07	-9.76175	-9.73802	-9.70262
1	13.407	0.009	1.8e-07	-9.8285	-9.75734	-9.65114
2	22.591*	0.000	1.5e-07*	-10.0086*	-9.89003*	-9.71303*

Notes: * indicates the optimal lag for the Lag-order selection criteria.

The VAR model is specified as followed using the optimal, two-lagged model:
Definitions:

$$S^{rsp} = real\ stock\ prices$$
$$I^{inf} = inflation\ rate$$

Formulas:

$$S_t^{rsp} = a_1 + \sum_{m=1}^{m=2} b_{11} S_{t-m}^{Rsp} + \sum_{p=1}^{p=2} b_{12} I_{t-p}^{inf} + u_t$$

$$I_t^{inf} = a_2 + \sum_{m=1}^{m=2} b_{21} S_{t-m}^{Rsp} + \sum_{p=1}^{p=2} b_{22} I_{t-p}^{inf} + v_t$$

Matrix:

$$\begin{bmatrix} S_t^{rsp} \\ I_t^{inf} \end{bmatrix} = \begin{bmatrix} a_1 \\ a_2 \end{bmatrix} + \begin{bmatrix} b_{11} & b_{12} \\ b_{21} & b_{22} \end{bmatrix} \begin{bmatrix} S_{t-1}^{rsp} \\ I_{t-1}^{inf} \end{bmatrix} + \begin{bmatrix} u_t \\ v_t \end{bmatrix}$$

To determine whether there is autocorrelation, a Lagrange-multiplier test is conducted. Positive autocorrelation means that high values tend to follow high values over time, and low values tend to follow low values over time. Negative autocorrelation indicates an inverse relationship between current and lagged values. Based on the results of the Lagrange-multiplier test presented in Table 5, there is enough evidence that there is no autocorrelation at the lag order used for the VAR, which is lag 2.

Table 5. Lagrange-multiplier test

Lag	chi2
1	6.1798
2	9.0441*

Notes: ***, ** and * indicate the rejection of the null hypothesis of no autocorrelation at the lag order at 1%, 5% and 10% level of significance respectively, for the Lagrange-multiplier test.

Once the Var model is estimated, I conduct an IRF. This analysis provides insights into the response of the variables to shocks from variables. This shows how changes in one variable affect the other over time. Then a FEVD is conducted, which helps to assess the relative importance of different factors explaining the forecast errors. By conducting these analyses, a comprehensive understanding of the relationship between inflation and real stock prices in the short and long term can be obtained. To examine the presence of potential structural breaks in the relationship between inflation and real stock prices, the Chow Break Test will be conducted. This test allows for the identification of significant breaks in the model that could indicate changes in the underlying dynamics. I am particularly interested in identifying a structural break during the period of Brexit, as it led to a significant rise in prices in Britain.

CHAPTER 5 Results & Discussion

Since both variables are integrated of order one, the first differences in real stock prices and inflation are used as the variables in the VAR. The short-run effects are observed through the lagged coefficients in the VAR model. Table 6 presents the results of the VAR with the first difference in the real stock price as the dependent variable. The analysis reveals that both the first lagged coefficient (-1.857) and the second lagged coefficient (-1.000) for the first difference in the inflation rate have a negative effect on the current first difference in the real stock price. This can be explained by rising interest rates, rising taxes, and market uncertainty Zhang (2021) & Fama (1981). However, these results are not statistically significant, indicating that the lagged differences in inflation do not have a statistically significant effect on the current first difference in real stock prices.

The results of the VAR with the first difference in the inflation rate as the dependent value are displayed in Table 7. This regression reveals that the coefficient for the first lagged difference (0.227) and the second lagged difference (0.508) of the real stock price has a statistically significant positive relationship with the current first difference in the inflation rate. This positive coefficient suggests that an increase in the second-lagged difference in real stock prices is associated with an increase in the current first differences in inflation. These results suggest a positive relationship between the first and second-lagged differences in the real stock price and the current first differences in inflation in the short run. This means that an increase in real stock prices in previous periods is associated with an increase in the inflation rate in the current period. This indicates that fluctuations in real stock prices, when analyzed over multiple periods, could potentially affect the behavior of the inflation rate in the short run. An explanation for this relationship could be that rising stock prices can positively impact consumer spending patterns (Poterba, 2000). This is in line with the behavioral economic theory called the wealth effect, which suggests that individuals tend to spend more when the value of their assets, such as stocks, increases (Starr-McCluer, 2002). When consumer spending rises, it can contribute to an increase in the overall rate of inflation.

The results in Table A1 show that the stability condition of the VAR model is satisfied as all the eigenvalues of the coefficient matrix lie inside the unit circle, lower than one. This implies that the system is stable and will not exhibit explosive or diverging behavior over time (Fox & Kapoor, 1968).

Table 6. VAR First difference real stock price

First difference real stock price	Coefficient
First difference real stock price	
Lag 1	-0.094
	(0.104)
Lag 2	0.129
	(0.101)
First difference inflation rate	
Lag 1	-1.857
	(1.476)
Lag 2	-1.000
	(1.520)
Constant	0.021
	(0.013)

Notes: Standard errors are shown in brackets. ***, ** and * indicate the p-values at 1%, 5% and 10% levels of significance, respectively.

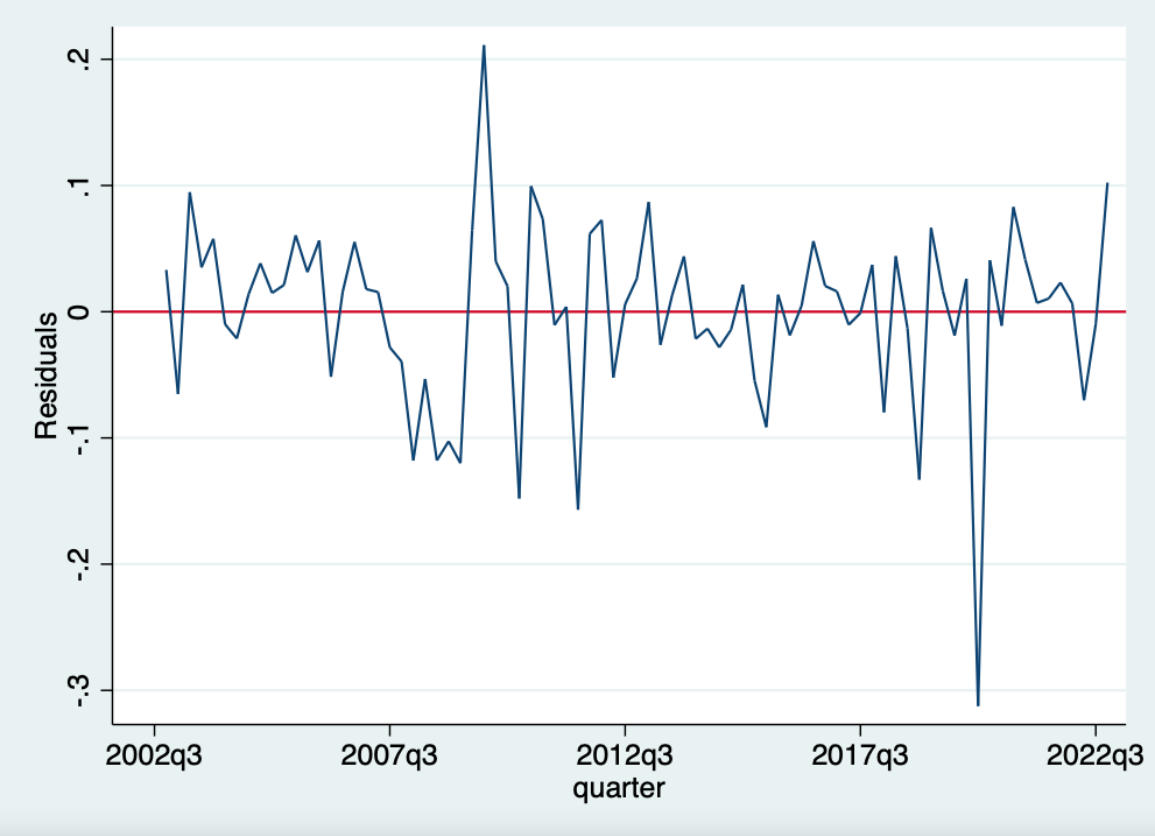
Table 7. VAR First difference inflation rate

First difference inflation rate	Coefficient
First difference inflation rate	
Lag 1	0.008
	(0.007)
Lag 2	0.004
	(0.007)
First difference real stock price	
Lag 1	0.227**
	(0.103)
Lag 2	0.508***
	(0.106)
Constant	0.002**
	(0.001)

Notes: Standard errors are shown in brackets. ***, ** and * indicate the p-values at 1%, 5% and 10% levels of significance, respectively.

The long-run relationship between inflation and real stock prices can be observed through the error correction term. Figure 1 illustrates the error terms of the VAR model plotted in a graph. The red line in the graph represents the average of these error terms. In the graph, the error terms fluctuate around the mean value, which suggests that any deviations from the equilibrium relationship are temporary and tend to be corrected over time. This indicates that there is a mechanism in place that brings inflation and real stock prices back to their stable long-run relationship. This is in line with the classical macroeconomic theory proposed by Fisher (1930), that changes in the inflation rate should not affect the real value of equity investments.

Figure 1. Residuals Error graph



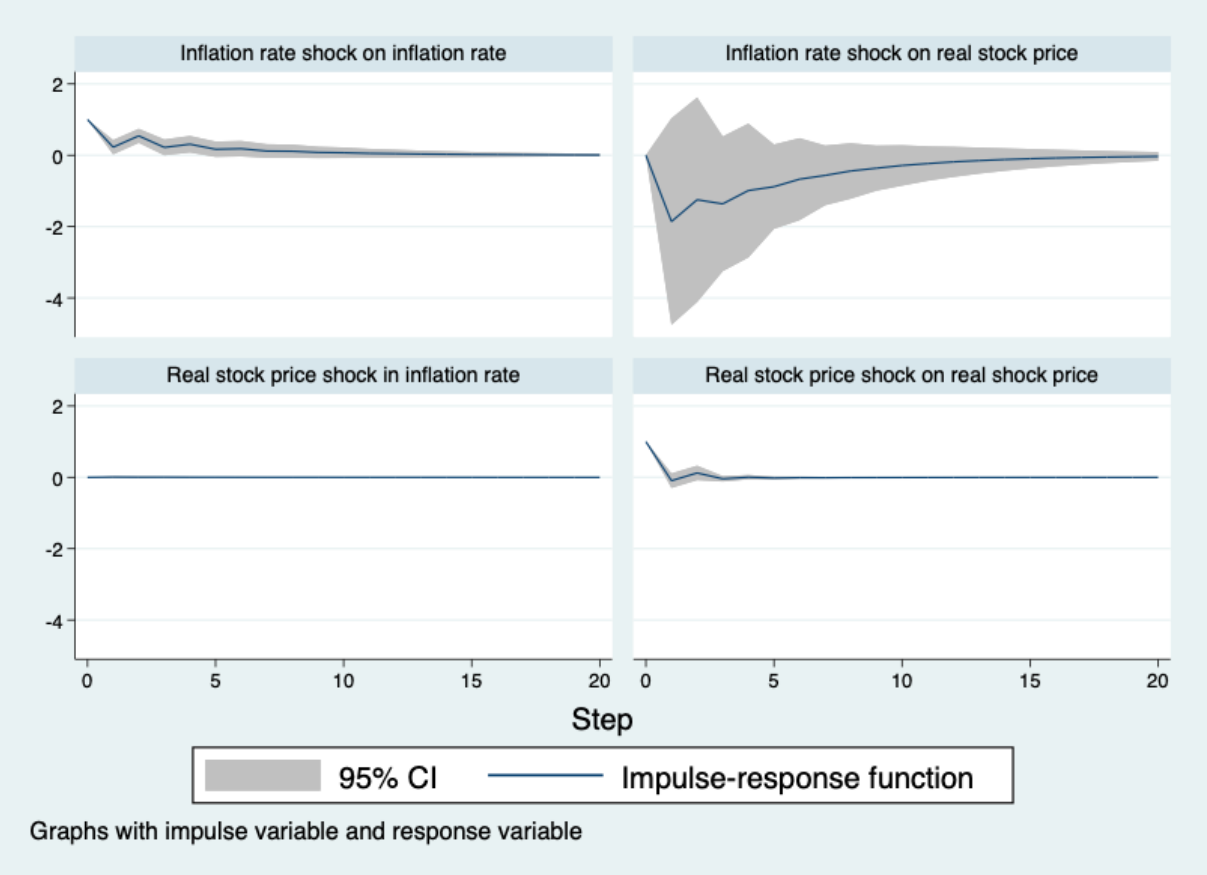
Notes: In this figure, the y-axis represents the residuals, and the x-axis represents the date. The red line shows the mean of the residuals.

In Table A2, the results of the Granger causality Wald tests are presented. These results indicate that there is no statistically significant relationship between the first difference in real stock prices and the first difference in the inflation rate.

Furthermore, different impulse response functions have been conducted. The results of these are shown in Figure 2. In the figure, the top-right panel indicates that a positive inflation shock has a negative effect on the real stock price. Which again can be explained by rising interest rates, rising taxes, and market

uncertainty Zhang (2021) & Fama (1981). Furthermore, the bottom-left panel reveals that a shock to the real stock price does not affect the inflation rate. This could indicate a more complex relationship or the influence of other factors such as indirect effects or limitations in the sample period or data.

Figure 2. Impulse Response Functions



Notes: This figure illustrates four different shocks and their corresponding responses between the variables Inflation rate and Real stock prices. The shaded grey area displays the 95% confidence interval, while the blue line represents the impulse response.

The Forecast Error Variance Decomposition shows the proportion of forecast error variance in each variable that can be attributed to its shocks versus the shocks from other variables in the model. The results of the variance decomposition for real stock prices and the inflation rate are displayed in Table 8. The second row displays the variance decomposition of real stock prices, explaining the changes in real stock prices through lagged values of changes. The third row shows the proportion in which changes in the inflation rate explain the real stock price. The highest value observed is 0.045, implying that approximately 4,5% of the changes in the real stock prices can be explained by the inflation rate.

Moving on, the fourth row illustrates how changes in real stock prices explain the inflation rate. The maximum value at which changes in the inflation rate are accounted for by changes in real stock prices

is 0.026 or 2.6%, which is a lower value than the percentage of changes in real stock prices explained by the inflation rate. Lastly, the fifth row showcases how changes in the inflation rate explain the inflation rate itself.

Table 8. Variance Decomposition

Lags	Real stock price		Inflation rate	
	Real stock price	Inflation rate	Real stock price	Inflation rate
1	1	0	0.000	0.100
2	0.984	0.016	0.013	0.987
3	0.977	0.023	0.016	0.984
4	0.969	0.031	0.020	0.980
5	0.964	0. 036	0.022	0.978
6	0.961	0.039	0.023	0.977
7	0.959	0.041	0.024	0.976
8	0.958	0.042	0.025	0.975
9	0.957	0.043	0.025	0.975
10	0.956	0.044	0.025	0.975
…	…	…	…	…
30	0.955	0.045	0.026	0.974

Notes: This table shows the proportion of forecast error variance in each variable that can be attributed to its own shocks versus the shocks from other variables in the model.

To examine the structural breaks in the relationship between inflation and real stock prices, the Chow break test has been conducted. The results from the Chow test are displayed in Table 9. The analysis uncovered several significant findings. Firstly, a strong structural break was observed in the first quarter of the year 2008 during the economic crisis. This break served as a crucial point in our analysis, highlighting the impact of the crisis on the relationship between inflation and real stock prices. Furthermore, I investigated the influence of Brexit on this relationship by conducting the Chow test for two key periods: the first quarter of 2016 when Brexit was voted on by the British government, and the first quarter of 2020 when Brexit occurred. Intriguingly, both events resulted in a significant structural break in the model. These findings suggest that the occurrence of Brexit had a notable effect on the dynamics of the relationship between inflation and real stock prices. These structural breaks highlight the significance of external events such as the 2008 economic crisis and Brexit.

Table 9. The Chow test

Breakpoint	Chi2(2)
2008q1	48.314***
2016q1	7.906**
2020q1	9.7224***

Notes: ***, **, and * indicate the rejection of the null hypothesis of no structural break at 1%, 5%, and 10% levels of significance respectively, for the Chow test.

CHAPTER 6 Conclusion

In this study, the main objective is to examine the short-term and long-term relationship between the inflation rate and real stock prices. The analysis of the Bivariate Vector Autoregression model reveals significant findings. In the short term, it is observed that real stock prices have a statistically significant positive impact on the inflation rate. This means that an increase in real stock prices can lead to an increase in the general price level. On the other hand, although inflation appears to have a negative effect on real stock prices, this effect is not statistically significant. To confirm these findings, an Impulse Response Function is employed, which demonstrated that an inflation shock negatively affects real stock prices. However, contrary to the VAR results, the IRF shows that a shock to real stock prices does not impact inflation. Furthermore, the forecast error variance decomposition suggests that approximately 4.5% of the variations in real stock prices can be explained by changes in the inflation rate. Only 2.6% of the changes in the inflation rate can be explained by variations in real stock prices.

Moreover, the study identifies a significant structural break at the onset of the 2008 financial crisis. This highlights the impact of the crisis on the relationship between inflation and real stock prices. Additionally, there is evidence of a structural break during the period surrounding Brexit, encompassing both the decision-making phase and the actual occurrence. Therefore, both the financial crisis and Brexit have a significant impact on the relationship between inflation and real stock prices.

Examining the long-term perspective, the VAR analysis shows that the error terms tend to fluctuate around the same mean. This implies that deviations from the mean relationship are temporary and are corrected over time. Consequently, these findings support the presence of a stable and neutral long-term relationship between inflation and real stock prices. These conclusions are supported by the outcomes of the Granger causality Wald test.

In summary, this study reveals varying results in the short term regarding the association between inflation and real stock prices, suggesting the presence of a relationship. The proportion of changes in the real stock price explained by the inflation rate is approximately 4.5%, provide further insights into this dynamic. Conversely, changes in the inflation rate account for 2.6% of the variations observed in the real stock price. Furthermore, a positive and neutral effect of real stock prices on the inflation rate and a negative effect of the inflation rate on real stock prices is found. However, a neutral relationship consists between these two variables in the long term.

These findings highlight the complexity of the relationship between inflation and real stock prices and emphasize the need for further research to investigate the underlying mechanisms and factors driving the observed short-term fluctuations. Exploring additional variables, such as other macroeconomic

indicators or monetary policy, could provide a more comprehensive understanding of the dynamic between inflation and real stock prices. Additionally, conducting cross-country studies or analyzing different sectors within the stock market could offer insights into potential variations in the relationship. By expanding the knowledge in this area, the ability to predict and manage the impacts of inflation on stock prices can be optimized, which will add to more informed decision-making in the economy and financial markets.

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APPENDIX A Causality Tests and Stability Analysis

Table A 1. Eigenvalue stability condition

Eigenvalue	Modulus
0.8033693	0.803369
-0.6080577	0.608058
-0.4108014	0.410801
0.3485282	0.348528

Notes: The table shows if the eigenvalues of the coefficient matrix lie inside the unit circle, this is the case if the values are lower than one.

Table A 2. Granger causality Wald tests

Equation	Excluded	Chi2
First difference real stock price	First difference inflation rate	2.8193
First difference real stock price	ALL	2.8193
First difference inflation rate	First difference real stock price	1.6091
First difference inflation rate	ALL	1.6091

Notes: ***, ** and * indicate the p-values at 1%, 5% and 10% levels of significance, respectively.