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The High-Frequency Response of the Johannesburg Stock Exchange All Share Index to South African Trade Balance and Consumer Price Index Announcements: An Event Study Approach

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ABSTRACT

This study analyses the temporal effect of consumer inflation and trade balance surprises on both returns and returns volatility of the Financial Times Securities Exchange/Johannesburg Securities Exchange (FTSE/JSE) All Share Index (ALSI) using an event study approach and high-frequency intraday 1-minute quotes over the 2012–2021 period. Sub-samples are used to distinguish the effects of consumer inflation and trade balance shocks on stock returns and returns volatility during normal periods, crisis periods, economic expansions and economic recessions. A short 70-minute window period is used to isolate the effects of consumer inflation and trade balance shocks and limit data contamination, but also allow reasonable time for stock returns to fully digest the specific macroeconomic news. Consumer inflation and trade balance surprises are discovered to have statistically and economically significant effects on intraday high-frequency FTSE/JSE ALSI returns and returns volatility. And anticipated changes in consumer inflation and trade balances announcements are also found to have a bearing on stock returns and returns volatility (in most but not all instances) which suggests that the FTSE/JSE ALSI is to a large degree informationally inefficient with regards to consumer inflation and trade balance news. The empirical results indicate that stock returns do not always respond instantaneously to unexpected announcements especially in the case of consumer inflation, but the degree of mechanical efficiency is moderate to high (and not extremely high). Furthermore, the asymmetric GARCH results reveal that leverage effects are present - positive and negative consumer inflation and trade balance shocks have asymmetric effects on conditional variance.

I. INTRODUCTION

Given the multitude of diverse factors influencing stock prices, and the often-changing relationships between these variables, the prediction of stock returns and returns volatility can be a very challenging task. Factors such as the current and expected discount rate and growth rate of earnings,[1] and the perceived risk of a stock are some of the fundamental determinants of stock prices over long multi-year horizons. Over the short term, a wide set of technical factors (or firm external conditions) affect equity price movements, such as market performance, the returns of substitute financial assets, incidental transactions,[2] mergers and acquisitions, the demographics of the investors,[3] market sentiment, the stock's liquidity, technological innovations, inflation and other macroeconomic releases, and company news (Harper, 2021).

According to the semi-strong form of the efficient market hypothesis (EMH), all publicly available information is fully reflected in share prices and only new information that is unanticipated by market participants has an impact on stock prices. Macroeconomic data releases such as inflation, the current account balance and GDP surprises, amongst others, can alter the expectations of a stock's future dividends or the discount rate, and consequently the stock price (Frijns, Indriawan and Tourani-Rad, 2015). Companies are invariably concerned about the effect of macroeconomic surprises on share prices as the resulting changes in a firm's debt-equity ratio can influence its ability to raise additional capital. High-frequency traders are constantly paying attention to an array of news releases to profit from arbitrage opportunities in an inefficient stock market. Long-term investors on the other hand use economic news to guide their asset allocation and risk management strategies. And policymakers also keep a close eye on macroeconomic shocks and their influence on stock prices as equity market movements serve as an important leading indicator of economic growth and inflation (Forni, Hallin, Lippi, and Reichlin, 2003; Stock and Watson, 2003).

More frequent minor and major financial crises – country-specific, regional, and global financial market upheavals – over the past two decades or so have only complicated financial asset price predictability. The most notable global financial crises such as the emerging markets crisis in the late 1990s, the United States (U.S.) subprime mortgage crisis in 2007-8, the 2010-12 European debt crisis, and the more recent 2020 global financial crisis sparked by the Covid-19 pandemic that caused turmoil and elevated asset

[1] Company earnings may be measured by earnings per share and the price-earnings ratio.
[2] Incidental transactions are the demand for and supply of stocks that is caused by insider transactions and hedging strategies.
[3] High earning middle-aged investors tend to invest more in the stock market compared to older investors who are ready to sell assets to generate liquidity for retirement purposes.

price volatility in global markets. In response, central banks around the world have intervened, including monetary policy and macroprudential policy interventions, in an attempt to stabilise their countries' financial systems and curtail systematic risk. Given these recent developments in global financial markets, it is important to examine the magnitude and significance of economic shocks on stock market (and other financial markets) returns and returns volatility, and to appraise the validity and predictive power of primary asset pricing models. Understanding stock market dynamic responses to macroeconomic surprises is useful for at least three reasons. Macroeconomic surprises can induce speculative traders to exploit arbitrage opportunities and eliminate (or at least minimise) short-term mispricing in the equity market, but also prompt long-term investment inclined investors to resist short-termism and make well-informed investment decisions. And better estimates of conditional volatility will help market participants improve their asset pricing and risk management decisions. Furthermore, an understanding of how economic shocks impact the stock market aids policymakers in making appropriate policy decisions such as stabilising inflation and improving the trade balance of a country which would have positive effects on stock market activity (Majija, 2017).

The influence of trade balance news on equity prices quoted on the JSE is of much interest since international trade and trade imbalances have grown significantly over the years following the end of apartheid and South Africa's integration with the global economy, and South African monthly trade balances are notoriously volatile. And despite inflation subsiding to lower levels after South Africa's adoption of the inflation targeting framework in 2000, inflation shocks (together with changes in inflation expectations) are still a fundamental determinant of equity prices due to the likely South African monetary policy authority's response, guided by the inflation targeting framework. Furthermore, the JSE is the largest securities exchange in Africa, and the 17th largest in the world by market capitalisation, hence, this study may provide valuable insights for existing and prospective local and international investors on the South African stock market. The overarching objective of this paper is to estimate and analyse the statistical and economic significance of surprise South African trade balance and consumer price index (CPI) announcements effects on the returns and returns volatility of the FTSE/JSE ALSI during short windows around the times of these data releases. To this end, the event study approach is applied. One-minute stock returns are analysed in a 70-minute window period; that is, 10 minutes before the announcement and 60 minutes after the announcement.

Multiple studies, outlined in the literature review section of this paper, have found a link between macroeconomic announcements, and share price reactions when analysing the various global stock markets; mainly stock markets of developed economies. In South Africa, only a few studies have analysed the effect of consumer inflation and trade balance announcements on stock returns using lower

frequency data as opposed to the high-frequency data employed in this study. Moreover, researchers tend to focus on the dynamics of equity returns alone and this study will also examine the JSE returns volatility dynamics before and after a news announcement using both symmetric and asymmetric generalised autoregressive conditional heteroscedasticity (GARCH) models. Furthermore, the research paper will contribute to the existing literature by testing the degree of market efficiency in its mechanical sense,[4] but also its informational efficiency. This study covers the period January 2012 to December 2021, and the 1-minute data analysed here is dictated by data availability. Hence, the study may also provide valuable new insights on the behaviour of the South African stock market during crisis and heightened financial markets turmoil periods; the financial turmoil that gripped global markets in 2020, triggered by the Covid-19 pandemic, in particular.

The five key empirical questions that this study will address are: i) Do FTSE/JSE ALSI returns and returns volatility respond swiftly to South African (S.A.) consumer inflation and trade balance surprise pronouncements? ii) What is the extent (or magnitude) of these responses? iii) Are asymmetric reactions to 'good' and 'bad' news prevalent? iv) Does the state of the economy ('normal' times versus crisis periods and economic expansions versus economic recessions) have any bearing on the estimation results? v) Do returns and returns volatility dynamics change during financial crises periods compared with 'normal' times (or periods of relative calm)? and, vi) Do the empirical findings suggest 'informational efficiency' and a high level of 'mechanical efficiency?'[5]

The results of this study indicate that greater than expected CPI announcements have a significant positive effect on stock returns during normal periods and a generally significant negative effect on stock returns in the other three financial and economic environments (crises periods, economic expansions, and economic recessions) explored in this investigation. On the other hand, larger than expected trade balance announcements have a significant but weak effect on stock returns; that is, small positive effects during financial crises and economic recessions, and slight negative effects during normal periods and economic expansions. With regards to stock returns volatility, greater than expected CPI announcements have a weak but significant effect on stock returns volatility – negative, subdued effects during normal periods and economic recessions and small positive effects during economic expansions. However, positive CPI shocks have a large and significant positive effect on returns volatility before the

[4] According to May, Farrell and Rossouw (2018), "market efficiency in the mechanical sense (communications are speedy and asset prices adjust rapidly to new unanticipated announcements) and not 'efficient' market in the deeper economic-informational sense."

[5] According to the semi-strong form of the EMH, an 'informationally efficient market' is one in which all publically available and relevant information pertaining to a company's stock has been incorporated into its current price while 'mechanical efficiency' (already defined above) is an implication of the semi-strong form of the EMH.

announcement during crisis periods, and a sizeable and significant negative effect after the announcement. Positive trade balance shocks on the other hand have a small significant positive effect on returns volatility during financial crises and economic expansions and a small significant negative effect during relative tranquillity in financial markets and recessionary periods. Leverage effects are also discovered in the impact of both CPI and trade balance surprise announcements with 'bad news' generally having an unsurprisingly larger effect on stock returns than 'good news.'

The JSE benchmark stock market index returns is found to be informationally efficient to CPI announcements during normal periods. However, in the other three financial and economic environments, the South African stock market is not informationally efficient as expected changes in CPI are found to have a significant impact on stock returns and/or returns volatility in the early minutes after the announcement. Informational inefficiency of the South African stock market is also evident in trade balance anticipated changes in all economic environments where expected changes in trade balance announcements have a significant impact on stock returns in the early minutes after the announcement. The empirical results also indicate that stock returns do not always respond instantaneously to unexpected announcements, especially in the case of CPI shocks which also suggests a not too high degree of mechanical efficiency.

The remainder of this paper is structured as follows. Section 2 covers the relevant literature which includes the theoretical framework and empirical evidence on the effect of inflation and trade balance surprises on stock returns and returns volatility. Section 3 describes the methodology and econometric models used in this study. Data issues and preliminary data analysis results are reported in section 4. Section 5 presents and analyses the empirical findings, and section 6 concludes.

II. LITERATURE REVIEW

2.1 Modelling Stock Prices

The theoretical framework for the basic dividend discount model (DDM) and one of its more commonly used variants, the Gordon growth model (GGM), and extensions thereof, are presented here to hypothesise the relationship between consumer inflation and stock prices on the one hand, and the trade balance and stock prices on the other hand.

2.1.1 Multi-Period Dividend Discount Model (DDM)

According to the standard multi-period DDM, one of the oldest and most simple mathematical stock price evaluation methods in the field of Finance, the current fair value of a stock can be calculated by

summing all future expected cash flows of the security discounted to their present value with the cost of equity (Corporate Finance Institute, 2021). In this model, the current price of a stock, P_0, is depicted by the following mathematical formula:

$$P_0 = \frac{D_1}{(1+r)^1} + \frac{D_2}{(1+r)^2} + \cdots + \frac{D_n+P_n}{(1+r)^n}, \quad (1)$$

where D_1 and D_2 are the expected dividend payouts in periods 1 and 2 respectively, D_n and P_n are the stock's expected constant dividend and selling price at the terminal date (when the stock is disposed of) respectively, and r is the discount rate. Applying this model thus requires an investor to predict the stock's future dividends as well as the discount rate with a relatively high degree of accuracy which is a challenging task.

2.1.2 Gordon Growth Model (GGM)

The GGM, attributed to Gordon (1959), postulates that the expected dividends of a stock will grow for an infinite period of time at a constant growth rate, an improvement on the assumed constant stream of dividends (or zero dividend growth) in the basic DDM. Hence, the fair value of a stock may be calculated as follows:

$$P_0 = \frac{D_0(1+g)}{r-g}, \quad (2)$$

where P_0 is the stock price in the current period, D_0 is the dividend payment per share in the prevailing period, g is the nominal growth rate of the dividends, and r is the required nominal rate of return (often also referred to as the discount rate or cost of equity).[6]

In the Fisher (1930) hypothesis, the relationship between the nominal interest rate, the real interest rate and expected inflation is specified as:

$$(1+k) = (1+K)(1+\pi^e), \quad (3)$$

where k is the nominal interest rate, K is the real interest rate, and π^e is the expected inflation rate. Stocks are understood to be inflation neutral (or uninfluenced by inflation) if the following three conditions are satisfied: i) market participants anticipate inflation accurately; ii) nominal dividend growth and required nominal interest rates are affected by expected inflation in the same manner; and,

[6] And the GGM can be extended to account for varying dividend growth rates during the different phases (or stages) of the life of the firm.

iii) real dividend growth and required real interest rate are uninfluenced by changes in expected inflation. If any of these three assumptions are not satisfied, stocks will be an imperfect hedge against inflation. Furthermore, given these assumptions, equations (1) and (2) can be used to derive a stock valuation model where share prices are not affected by expected inflation (Wilcox, 2012):

$$P_0 = \frac{D_0(1+G)}{R-G}, \tag{4}$$

where *G* is the real growth rate of dividends, and *R* is the real required rate of return. Whether stock prices are inflation driven or inflation neutral is an empirical question.

Underlying the GGM (and the basic DDM and its other variants) is the efficient market hypothesis (EMH), attributed to Fama (1970). The semi-strong form of the EMH asserts that equity prices fully and fairly reflect all new publicly available information in addition to all past information. This hypothesis implies that the stock market only reacts to unanticipated, new and publicly available information, and the market responds instantaneously. Thus, market participants will not be able to generate abnormal returns by trading on this information. In addition, the hypothesis assumes that market participants formulate rational expectations; that is, they use all available, relevant information intelligently and adopt appropriate methods to formulate forecasts.

The behavioural finance hypothesis (BFH) claims that macroeconomic announcements are interpreted according to the context in which the news is received; that is, the current state of the economy, direction of the market influences, and how investors respond to the news. News that goes against the current direction of the market increases investor uncertainty about the future course of events. For instance, during an economic expansion, a rise in inflation is interpreted as "bad news" as it creates fears of an 'overheating' economy which may result in interest rate hikes and, hence, a decrease in stock returns. But during recessions, the same increase in inflation is perceived as 'good news' as market participants believe the economy is growing above expectations which results in an increase in stock returns (Veronesi, 1999).

From the DDM, its variants (including the GGM), the Fisher hypothesis, the EMH, and the BFH, one can hypothesise the relationship between consumer inflation and stock prices and the trade balance and stock prices. Starting with the consumer inflation–stock returns connection, an announcement of a consumer inflation rate that is higher-than-expected (more so if the actual inflation rate lies close to or surpasses the upper inflation rate target bound) will prompt market participants to expect a central bank monetary policy tightening, such as increasing the central bank rate with commercial banks following

suit by raising their prime lending rates. This will cause investors to forecast higher discount rates which will reduce the present value of the expected cash flows, causing stock prices to also fall.[7] In addition, positive inflation rate surprises indicate a decrease in the real returns on saving and investment, inflation–wage spiral and higher input costs, and increased costs of external financing (as investors will demand higher nominal returns on equity and charge higher lending rates to compensate for the higher-than-expected inflation rate). As a result, firms will be less profitable and expected dividends will decrease which will depress the valuation of a firm's stock (Majija, 2017; Lintner, 1975). The converse is true when a lower-than-expected inflation rate is announced. However, the effect of inflation surprises on the stock market also depends on the state of the economy. Market participants may interpret a positive inflation surprise as 'good news' if the economy is in a recession or emerging from one; reason being that this is indicative of an increase in consumer confidence and higher demand for goods and services. But in an expanding economy, positive inflation surprises may be perceived as 'bad news' as it causes investors to expect the central bank to conduct contractionary monetary policies (Boyd, Hu, and Jagannathan, 2005).

Turning to the trade account effects on the stock market, an announcement of a better-than-expected trade balance strengthens the domestic currency in the foreign exchange market, making imported goods and services cheaper but also reducing the domestic currency value of foreign currency denominated debt; at least temporarily.[8] As a result, the overall inflation rate may decrease (in line with lower imported inflation) which will increase equity prices. Additionally, an improvement in the trade balance indicates that domestic exporting firms are performing relatively well in the international markets, thus reinforcing the latter equity price rise which in turn attracts foreign portfolio inflows and possibly foreign direct investment. In contrast, a worse-than-expected trade balance announcement has the opposing effect on stock prices, but also dents investor confidence (Sadeghi,1992; Ajayi and Mougoue, 1996). It is also possible that these effects are dependent on the state of the economy – an unexpected improvement in the trade balance indicates higher demand for the domestic currency which will appreciate the home currency. However, a stronger currency will lead firms to being less competitive in the international markets due to an increase in the prices of their tradable goods. Thus, sales will decrease resulting in a decline in profits and dividends. This will cause investors to devalue the stock in the financial markets (Pettinger, 2021). Therefore, a negative relationship between trade balance

[7] If in addition to an increase in the short-term interest rates, the market expects the interest rate change to persist for a long period, a normal upward sloping yield curve instead of an inverted one, the impact on stock prices may be greater than a temporary or transitory interest rate change.

[8] If a worse than expected trade balance figure signals a downward revision of future trade balances, then like the inflation and interest rate effect noted above, the stock market effect is more likely to be larger than a once-off trade balance statistic.

improvements and stock prices is also possible but could also depend on the state of the economy. Also, during periods of high economic growth, an improvement in country's trade balance can further appreciate its currency which will negatively impact the competitiveness of its exports. As a result, the stock prices of export-orientated domestic firms may decrease. However, a country that is under economic recovery may realise that an improvement in the trade balance will also appreciate its currency, but this appreciation will make imported capital goods cheaper resulting in an increase in investment. Hence, stock prices will rise as the economy still has the capacity to grow. So, although the trade balance and stock prices are more likely to be positively related around the time of the trade statistic release, some counteracting effects may be present.

2.2 Stock Returns Volatility

Uncertainty and, hence, risk are important factors in financial asset pricing as almost all asset pricing theories link an asset's expected returns to its perceived risk. Thus, volatility measurement forms the basis of financial asset pricing models, market efficiency models, and investment and risk management strategies (Blasco, Corredor and Ferreruela, 2012). Volatility may be defined as a statistical measure of the dispersion (or second moments) of returns for a given security or market index. It creates uncertainty which affects the effective performance of the financial market, and the existence of volatility in the equity markets makes stock prices an inaccurate measure of the intrinsic value of a company. An unanticipated increase in current volatility causes investors to expect a rise in future volatility and risk premiums. As a result, expected future cash flows are discounted at a higher discount rate (incorporating the risk premium) which decreases current stock prices (Pindyek, 1984). Although asset price volatility is one of the most intricate and challenging areas in the fields of finance and financial economics, some advances have been made in developing historical and conditional volatility theoretical frameworks to gauge and forecast volatility. Some of the important theoretical foundations of asset price volatility relevant to this study are outlined here and several generalised autoregressive conditional heteroscedasticity (GARCH) models applied in this study are presented in the methodology section and estimated in the empirical analysis section.

2.2.1 Heterogeneous Information Shocks

Heterogeneous information shocks affect a stock's return process in discrete time. According to Maheu and McCurdy (2004), the innovations in the returns and returns volatility process are driven by a latent news process that has two different components, each characterised by their news impact: 'normal' news events are assumed to create smooth changes in the returns conditional variance overtime whilst news innovations such as surprise macroeconomic announcements in this study, where the announcement is

scheduled but the data release has an expected component and an unexpected (or surprise) component,[9] result in relatively infrequent and large changes (or jumps) in both returns and returns volatility. Maheu and McCurdy (2004) assert that "depending on the type and the importance of the information revealed by the news, the stochastic jump size may be negative, positive, big or small" and thus "the dynamics of volatility are affected by a time-varying rate of jump arrival, stochastic jump size, and volatility clustering."[10] Furthermore, depending on the type of information received by market participants, unexpected news releases can also have temporary or lasting effects on the volatility of equity returns. And once investors realise the returns innovations, they can trade strategically based on the dissemination of the news and liquidity trading, amongst other factors that are important sources of volatility clustering. Additionally, the quality and quantity of information relating to a stock's expected future cash flows determine its risk and price volatility. For instance, there can be large revisions in current prices when new information creates uncertainty about a company's prospects. Hence, the news arrival process has the most impact on price changes and returns volatility in the short run. Ross (1989) and Andersen (1996) also find that the volatility of stock prices is influenced by the rate of flow of information to the market.

2.2.2 Herding, Information Asymmetry and Contrarian Trading

In a perfectly efficient market, asset prices reflect all available and relevant information, and immediately respond to the arrival of new information. Hence, volatility arises due to asset prices continually adjusting to new information or changes in economic fundamentals. In general, irrational investors destabilise asset prices by buying stocks when prices rise and selling when prices decrease while rational investors on the other hand usually move asset prices toward their fair market value by purchasing stocks when prices are low and offloading shares when prices are high (Friedman, 1953).

Volatility is driven by uninformed herd (and liquidity) trading as the price changes caused by this form of trading tend to be reversed (Hellwig, 1980; Wang, 1993), concurred by Blasco, Corredor and Ferreruela (2012) who argue that an increase in herding intensity is found to cause greater volatility in financial markets. Furthermore, information asymmetry also has a bearing on volatility as uninformed

[9] Conditional variance is the dynamic evolution of the innovation variance, a concept expounded upon in the GARCH framework in the methodology section.

[10] Volatility clustering occurs when volatility changes over time and its degree shows a tendency to persist; that is, periods of low volatility and periods where volatility is high. This occurrence may be attributed to the persistent effect of macroeconomic variable shocks on financial asset prices and is most common in developing countries (Brooks, 2008). Demetrescu (2007) discovers that volatility clustering is a result of volatility forecasting activity investors use different models to analyse volatility and an increase in recently observed volatility leads to higher estimated volatility in the current period, leading to higher perceived risk and portfolio adjustments which further increases price volatility.

traders usually follow the market trend similar to herding behaviour. Although asymmetric information leads to uninformed trading, this behaviour may be rational if it occurs in the context of incomplete information (Wang, 1993). Avramov, Chordia and Goyal (2006) claim that both herding and contrarian traders (traders who go against the prevailing market sentiment based on technical analysis) also drive daily volatility.

2.2.3 Trading Volume

Another important determinant of volatility is trading volume. Copeland's (1976) model reflecting sequential arrival of information assumes that information only reaches one trader at a time, and each trader trades on this information before it reaches another trader.[11] Traders who perceive the information as negative are 'pessimists' and those who see it as positive are 'optimists.' After all the traders receive the information, the total trading volume depends on the sequence of 'optimists' and 'pessimists' through which final equilibrium is reached. Copeland (1976) finds a positive relationship between trading volume and asset returns volatility. Pronouncements of macroeconomic variables can influence trading volume and, hence, volatility, especially if market participants have a tendency of rebalancing their portfolios after the release of new information – there is likely to be increased trading activity and, therefore, heightened volatility in the stock market soon after the news release, especially if agents disagree about the effect of surprise announcements on stock returns. But if market participants share the same views about the effect of the new information release, trading activity will not be abnormal despite a change in stock returns.

In addition, since trading volume and the variance of price changes are positively related to the rate at which information arrives, they are also positively related to each other (Yadav, 1992). Epps and Epps (1976) discover that trading volume and asset price volatility are also correlated at the transaction level as the trading volume of a single transaction also determines the variance of the price change.

There are four types of traders in financial markets: i) informed investors who have private information and trade to maximise profits; ii) discretionary liquidity traders who do not have private information but have some discretion over the timing of their trades; iii) non-discretionary liquidity traders who make randomly buy and sell orders; and, iv) the specialist market makers who also do not have private information but learn continually from volume and price changes (Kyle, 1985; Admati and Pfleiderer, 1988). There are periods where there will be clustering in the trades of informed traders and discretionary liquidity traders which causes asset returns volatility to be the highest when trading is most active. So

[11] However, it is possible that this does not apply to newer trading systems (post-1990's) which are generally automated.

trading volume and (asset price or stock price) volatility are found to be positively related (Admati and Pfleiderer, 1988).

2.2.4 Risk

There are generally two types of risks, namely, endogenous risk and exogenous risk. Exogenous risk stems from external events associated with news releases, including macroeconomic shocks that have a bearing on financial markets. Macroeconomic data announcements enable investors to predict the future productivity of capital. For instance, when a government statistics agency announces information concerning the current inflation rate, it enables investors to forecast future inflation and monetary policy responses by the central bank which determines the profitability of a firm and returns to equity. The risk emanating from these announcements is the unexpected component of the data release and the announcement effects are well understood by market participants – adjusting expectations, in response to the shock, the reaction of market participants to these risks is well defined and rational because market participants' econometric models can predict the effect of the shock on the stock market (Rzepczynski, 2016). In the case of a dispersed information shock – one which is viewed by different agents as having different price implications – the process through which the dispersed information is impounded into prices as traders adjust their quotes causes asset price fluctuations. But this exogenous risk creates measurable or explained volatility in the financial markets.

On the other hand, endogenous risk is the risk generated and reinforced within financial markets by the interaction of market participants and is found to be the main cause of volatility dynamics in the market as it affects the precautionary motives of leveraged agents (Brunnermeier and Sannikov, 2014).[12] This type of risk occurs when asset prices adjust not because of changes in fundamental factors but due to trading in the markets or technical factors.[13] While exogenous risk can be easily detected as it is created by fundamental factors such as economic news or other external events, endogenous risk is created within the financial market by the interaction of market participants. Hence, endogenous risk creates unexplained volatility that is not related to specific factors and thus it is not easy to measure or explain (Rzepczynski, 2016). Portfolio adjustments caused by financial constraints or precautionary motives also create endogenous risk – when asset prices change because of constraints faced by market participants and not fundamental factors, there is an incentive to hold cash in order to purchase securities

[12] Precautionary motives are the buying or selling of assets to balance expected returns and risks of leverage.
[13] Some endogenous risk may also emanate from exogenous risk as market participants reacting to exogenous shocks such as news events can exacerbate the effect of those shocks by how they behave; for example, selling causes prices to fall, triggering further selling.

later at fire sale prices.[14] This precautionary motive results in a drop in asset prices in anticipation of a financial crisis and higher expected returns in periods of high endogenous risk.

2.2.5 Business Cycles, Financial Instability and Financial Crises

Since the sample period in this study covers the 2010-12 European debt crisis and the 2020 COVID-19 pandemic induced global financial market turmoil, a theoretical conception of volatility stemming from financial crises and turmoil in financial markets is also explored here. The European debt crisis occurred when multiple eurozone member countries failed to repay their government debt, leading to the failure of their financial institutions and a rise in government bond yields. As a result, global risk aversion rose and investors directed their capital into purchasing government bonds of the biggest and most financial robust countries such as the U.S., and there was a sell-off in equities around the world, especially in the financial sector as some financial institutions were exposed to European debt (Amadeo, 2022). On the other hand, the COVID-19 pandemic is a health crisis which had wide-ranging and a severe, though temporary, impact on financial markets and a far-reaching global economic slowdown. The pandemic was fully fledged in 2020 and it generated a slowdown in global economic activity because of a halt in production due to global lockdown restrictions. Government debt and unemployment also increased which reduced aggregated demand leading many companies to make losses or bankruptcy.

Asset price volatility and correlations tend to increase the more market participants become uncertain about asset fundamentals. During recessionary periods, investor uncertainty increases as market participants are unsure about future returns and when the economy will recover. But periods of high market volatility that are unrelated to economic downturns may also indicate rising investor uncertainty related to financial instability rather than to economic fundamentals. Financial system instability occurs when severe market disruptions associated with the insolvency of debtors and financial institutions reduces economic activity and hinders the financial system's ability to price and transfer risks and provide credit and liquidity. Hence, asset price volatility can increase even though the asset fundamentals are stable. Asset price volatility also occurs when investors become uncertain about long term economic and financial growth which causes them to attach greater significance to small pieces of news. Thus, the volatility of macroeconomic variables only explains a small percentage of asset price volatility (IMF, 2003). Furthermore, market volatility is typically low in the run-up to a financial crisis but increases drastically during and after the crisis. Higher asset price volatility is, therefore, unsurprising during crises as firms are uncertain about future investment payoffs and, hence, uncertain

[14] A fire sale refers to the selling of a security or other product at a price that is well below market value.

about the related macroeconomic fundamentals, such as investment and consumption, in line with conventional traditional finance postulations (Danielsson, Valenzuela, and Zer, 2016).

2.2.7 Amplification of Shocks

Brunnermeier and Sannikov (2014) discover that the financial system has asymmetric reactions to shocks; that is, positive shocks to the financial system are amplified by less than negative ones. They also uncover that the financial system has non-linear reactions to fundamental shocks – the amplification effect of large shocks on the financial system is greater than that of small shocks, and the former can lead to a financial crisis. However, during crisis periods, even small shocks are substantially amplified creating significant endogenous risk as there is uncertainty about whether the economy will recover or not.

The amplification of fundamental shocks is dependent on financial frictions,[15] the leverage positions of companies, banks or financial investors, and the reaction of asset prices to shocks which affect the net worth of leveraged agents and cause further adjustments in their portfolios. Leverage causes the financial system to be more sensitive to asset price declines and economic downturns (IMF, 2003). The amplification of shocks also depends on whether the financial system is in its steady state which is a balance point where agents reach their target leverage. At this point, the financial system returns to equilibrium after it experiences a small shock and leveraged agents can absorb negative shocks as they have sufficient time to rebuild net worth. Hence, near the steady state, equity prices are less responsive to shocks and amplification and endogenous risk is also lower. This creates nonlinearities where small shocks keep the financial system near the stable steady state, but large shocks throw the economy into unstable crisis regimes (Brunnermeier and Sannikov, 2014). Thus, during normal periods asset price volatility is low as financial markets generally experience small economic shocks which have slight amplification effects. Large shocks on the other hand are remarkably amplified, creating excess volatility in a financial market and can sometimes lead to a financial crisis.

During a financial crisis, investors and speculators are faced with margin calls and plunging values of their holdings. As a result, risky assets such as stocks are liquidated causing a severe decline in security prices. Funds are directed to less risky investments such as government bonds (as they are considered safe havens) which results in a rise in these asset prices. When institutions hedge idiosyncratic risks among one another, for example through mortgage-backed securities and credit default swaps, it increases leverage and makes the financial system less stable as there is extreme demand for securities

[15] Financial frictions are financial constraints that make it difficult for firms to fund investments from external resources (Rashid and Jabeen, 2018).

purchased through debt which can result in insolvency during economic recessions. This creates severe fluctuations in asset prices due to high trading volumes and changing demand.

2.3 Empirical Evidence

This subsection consists of two parts. First, the consumer inflation–nominal stock returns and returns volatility empirical findings are presented, followed by the trade balance–nominal stock returns and returns volatility discoveries. While rich empirical work can be undertaken for developed economies such as the G7, Australia and many other western European countries using granular data, this luxury does not exist for emerging market economies (EMEs) as high frequency intraday data for EMEs is not that extensive. The collection and thus availability of this data for some EMEs started only around 2005; for example, 2-minute quote data for the JSE, a highly developed stock market by international standards, goes back as recently as 2009 while 1-minute quotes were traced only as far back as 2012. EME event studies using high frequency intraday stock market data thus naturally lags those of developed economies. Based on the wide range of literature consulted, the scant empirical studies on EME macroeconomic surprises effects on EME stock prices applying intraday high frequency data appears to be limited to GDP and interest rate surprises, but also a very few investigations that assess the impact of US macroeconomic fundamentals on some EME financial asset prices. Unfortunately, not a single study on the impact of EME inflation and trade balances surprises on EME stock returns using intraday high frequency data could be located. So, this study presents a handful of EME inflation—stock returns empirical studies employing stock market lower frequency daily data with none traced for trade balance effects on the stock market using either intraday or daily data.

2.3.1 Consumer Inflation, Stock Returns and Returns Volatility

Grounded on the Fisher (1930) hypothesis (a relationship between both real and nominal interest rates and inflation), nominal stock returns are hypothesised to vary positively with the inflation rate as firms can pass on inflation to buyers through higher product prices. However, much of the classical studies using low frequency monthly data by Lintner (1975), Bodie (1976), Modigliani and Cohn (1979), Feldstein (1980), Fama (1981, Schwert (1981), Geske and Roll (1983), and Kaul (1987) find stock returns to be negatively related to inflation. According to Fama's (1981) proxy hypothesis, rising prices decrease profits in the short run as both sales and economic growth fall. Kaul (1987, 1990) uncovers that countercyclical monetary policies are to blame for the negative relationship between stock prices and inflation. Schwert (1981) states that unexpected inflation increases company revenues without an offsetting increase in inventory expenses and depreciation, resulting in an increase in real tax burdens

and, hence, a decrease in stock returns. Most of these studies were conducted in developed countries, mainly the U.S., during periods of stagflation.

Starting with developed economies studies, Jain (1988) uses regression analysis to study how hourly S&P 500 stock index returns and trading volume in the New York Stock Exchange (NYSE) respond to announcements of CPI over the period 1978 to 1984. CPI surprises are discovered to have a significant impact on stock returns. More specifically, a 1 percentage point surprise increase in CPI is found to cause a 0.55 percentage point decline in equity returns which is consistent with the findings of Schwert (1981). However, none of the economic variables considered have a significant impact on trading volume. With regards to the speed of adjustment, the NYSE is found to be mechanically efficient (to some extent) as the response of equity returns to surprise announcements occurs on average during the first hour.

Applying regression analysis, Adams, McQueen and Wood (2004) investigate the effect of unexpected inflation news on intraday NYSE stock returns – 1-minute, 5-minutes, 15-minutes and 1-hour horizons after the announcement – over the 1993-2000 period. They find that unexpected increases in CPI cause equity prices to fall; more specifically, a 1 percentage point surprise increase in CPI reduces the stock returns of large firms by 1.011 percentage points 60 minutes after the announcement and stock returns generally respond to inflation news in about 10 to 20 minutes post-inflation data release time. Furthermore, leverage effects are discovered and the relationship between stock returns and inflation is found to be dependent on the state of the economy – stock returns, particularly those of large firms, are found to be highly sensitive to unexpected increases in inflation when the economy is operating near the steady state.

Using an event study, Diaz and Jareño (2009) discover that positive inflation shocks have a statistically significant and positive effect on daily stock returns when the Spanish economy is in a recession as market participants believe this information signals the economy is growing above expectations, and that companies have a higher inflation absorption capability. And in non-recessionary periods, negative unexpected inflation shocks are found to increase equity returns as this is indicative of an economy that is not 'overheating'.

Turning to EME studies, Spyrou (2004) studies the relationship between equity returns and inflation using regression analysis on monthly data in ten emerging stock markets.[16] The relationship is found to be positive and statistically significant in Argentina, Malaysia, and the Philippines, and negative and

[16] Namely, Turkey, Philippines, Hong Kong, Malaysia, South Korea, Thailand, Argentina, Brazil, Mexico and Chile.

statistically significant in Thailand. Spyrou (2004) argues that inflation in emerging economies is mainly a result of money supply rather than output growth which explains why equity returns in emerging stock markets are generally positively related with inflation. Furthermore, in developed economies real activity is negatively related to consumer prices as explained by Fama's (1981) proxy hypothesis. But in emerging economies real activity is usually positively related to inflation as inferred by the Phillips curve. Hence, the positive relationship between inflation and stock returns in emerging stock markets and the negative one in developed markets. Plus, investors are familiar with high inflation in emerging economies causing them to not associate high prices with expectations of lower future economic growth. Other reasons as to why the stock return and inflation relationship differs between emerging stock markets and developed stock markets is that equity markets in developing countries are often characterised by lower liquidity, thin trading and less informed and rational market participants compared to developed markets.

In Nigeria, Omotor (2010) examines the effect of inflation and stock market returns by using regression analysis on monthly and quarterly data. The empirical relationship between inflation and equity returns is found to be positive and statistically significant. Similarly, the author states that this positive relationship between inflation and equity returns is witnessed in other emerging economies but not in Northern American economies where a negative stock return and inflation relationship is witnessed (Spyrou, 2004). This positive inflation-stock returns relationship is said to be a result of inflation being mainly caused by money supply rather than real economic activity and can be explained by Fisher's (1930) hypothesis.

A South African study by Gupta and Reid (2013) employs an event study and daily data to examine the response of industry-specific equity returns in South Africa to unanticipated macroeconomic news. CPI surprises are only found to have a significant negative effect in the gold mining index and an insignificant effect on the JSE ALSI. CPI effects on the gold mining index are found to be small in magnitude, and generally experienced in short horizons immediately after the news release. Majija (2017) extend the study performed by Gupta and Reid (*ibid*) and also find CPI coefficients that are statistically significant and are negative for most individual stocks considered. The negative inflation-stock return relationship can be attributed to the SARB's credible inflation targeting framework.

Pimentel and Choudhry (2014) study the relationship between inflation and equity returns in Brazil using monthly data and a vector autoregressive model in a period when the country experienced high inflation and monetary instability. Similar to Fisher's hypothesis, stock returns are found to provide a hedge against inflation but only in the long-run. During high inflation sub-periods, interest rate shocks

are discovered more relevant in explaining changes in stocks returns due to expected contractionary monetary policy and returns to equity are negatively related to inflation in the short-run. High inflation rates are believed to increase macroeconomic uncertainty as they lead to a reallocation of funds to unproductive activities which distorts economic efficiency and reduces economic growth. During sub-periods of low inflation, market participants are believed to be forward-looking (expecting low interest rates), more efficient in forecasting future changes in interest rates, and equity returns are mainly determined by their own lags.[17] Hence, in this sub-period, the stock-return and inflation relationship is found to be positive in the short-run.

Singh and Padmakumari (2020) use an event study on daily data to test for semi-strong efficiency in the Indian stock market. Abnormal returns in the equity market are uncovered owing to announcements of inflation. And returns to equity are discovered to be inversely related to inflation shocks as an increase in prices reduces aggregate demand in the short run. Using the standard GARCH model and an event window of three days, Andika, Fahmi and Andati (2019) observe that negative CPI surprises increase Indonesian stock market returns (LQ45 index). And the converse is true for positive CPI surprises as they lead to Bank Indonesia interest rate hikes.

The third group of studies are panel data (or multiple-country) investigations covering both developed and developing economies. Davis and Kutan (2003) apply the standard symmetric GARCH and asymmetric EGARCH models to estimate the predictive power of inflation on monthly stock returns and returns volatility in 13 countries which include developed and developing nations.[18] The impact of overall inflation (as opposed to only the unexpected component to be investigated in this study) on equity returns is significant for three countries over a 3-month horizon: increases in inflation lower stock returns in the Netherlands and the U.S., and increases returns in Israel. Over a 6-month horizon, a 1 percentage point increase in inflation decreases equity returns in Spain, the Netherlands, and the U.S., and increases equity returns in Israel. The negative effect of inflation in developed countries may be explained by tax effects; that is, higher expected future inflation leads to an increase in future tax liabilities which decreases future cash flows and results in a decline in equity returns today.

For countries with historically relatively high inflation such as Israel, equity returns are found to be positively correlated with inflation, whilst for low and moderate inflation countries such as the US a

[17] Forward-looking behaviour occurs when market participants base their investment decisions on expected future interest rates – when future interest rates are expected to decrease more equity investments are made resulting in positive returns.

[18] Thirteen countries: USA, UK, Spain, Netherland, Korea, Japan, Italy, Israel, Germany, Finland, Canada, Belgium and Austria.

negative relationship is uncovered between inflation and stock returns (Davis and Kutan, 2003). This is due to the different monetary policies implemented by developed and developing countries. Developed countries tend to have disciplined monetary policies and credible inflation targeting frameworks. Thus, during periods of economic expansions or high inflation, the central bank is more likely to hike interest rates which will decrease the demand for equities and increase the demand for fixed income instruments. But developing countries tend to have less disciplined monetary policies and less credible inflation targets as they usually conduct pro-cyclical or expansionary monetary policies for economic development which raises inflation whilst also increasing the demand for equity due to excess liquidity in the economy. The negative relation between stock returns and inflation can also be a result of central banks counter-cyclical monetary policies. Specifically, during recessionary periods, government deficits increase leading to an increase in money supply to the extent that public debt in monetised. This increases inflation and the risks of investing in government securities which increases sovereign bond yields as well other interest rates in the economy. As a result, stock returns decrease as they are discounted at higher interest rates (Geske and Roll, 1983). Kaul (1987) states that the relationship between equity returns and inflation can be positive, negative, or insignificant depending on the equilibrium dynamics in the monetary sector. If money demand is coupled with pro-cyclical monetary policies, the equity return-inflation relationship can be either positive or insignificant. Pro-cyclical monetary responses by the central bank during expansionary periods (with increasing inflation) create low interest rates and excess liquidity in the economy which is used to purchase securities resulting in higher asset prices.

Tong and Poon (2009) extend the research performed by Davis and Kutan (2003) by estimating the predictive power of inflation on monthly stock returns and returns volatility in four emerging markets that have experienced a financial crisis (Korea, India, Malaysia and the Philippines) and three mature markets (US, Singapore and Japan) using GARCH and EGARCH models. The impact of inflation on equity returns is only found to be significant in the U.S., Korea and the Philippines, where increases in inflation are discovered to reduce equity returns over a three-month horizon. The negative relationship is justified by the Pigou Effect: During periods of high inflation real wealth decreases which leads to a decrease in consumption and, hence, a decline in output, employment, and aggregate demand. As a result, stock returns also fall due to a drop in sales and firm profits. The negative stock return-inflation relationship is also said to be a result of tax effects.

Next, the empirical evidence literature review turns to asset price volatility. Edmonds and Kutan (2002) apply the standard GARCH model to daily data and find that actual positive CPI announcements had a weak but significant negative effect on stock returns volatility in Japan during the Asian financial crisis

as it was indicative of economic recovery through growing demand. Similarly, Davis and Kutan (2003) uncover that overall increases in inflation have a statistically significant negative effect on monthly stock returns volatility in Germany and Japan, employing GARCH and EGARCH models. Similarly

Kim, McKenzie and Faff (2004) apply ARCH and GARCH models to daily data and discover that higher-than-expected consumer inflation news increases stock market volatility in the US stock market (Dow Jones Index) because of expectations of a contractionary monetary policy from the U.S. Federal Reserve (Fed). And negative inflation shocks are discovered to create "a more stable trading environment" as they allayed fears of U.S. Fed. interest rate hikes. Kim et al. (2004) also find leverage effects in the stock returns response to CPI announcements using asymmetric GARCH models. Engle and Rangel (2005) also provide evidence that countries with high inflation rates, usually developing countries, tend to experience larger expected volatilities than those with low inflation rates (generally developed countries due to disciplined monetary policies) as investors constantly move funds to hedge against high inflation.

Aliyu (2009) applies the standard linear GARCH model and quadratic GARCH (QGARCH) model on monthly data to study the impact of inflation on stock returns volatility in Ghana and Nigeria. Nigerian Stock Exchange (NSE) returns are found to have higher volatility compared to Ghana as Nigeria has a more open economy – returns volatility in the NSE is found to be explosive but in the Ghana Stock Exchange (GSE) it is slowly mean reverting, and leverage effects are only discovered in the GSE. Overall, inflation is found to be one of the determinants of stock returns volatility in both the markets with a fall inflation in the previous month leading to increases in conditional volatility in the following month. Although Aliyu (2009) does not provide a reason for such behaviour, these outcomes may be attributed to the state of the economy – both countries were experiencing recessions during the sample period and so decreasing inflation signals a deteriorating economy through decreasing demand, leading to multiple portfolio adjustments by investors and, hence, increased volatility.

Tong and Poon (2009) discover that an increase in inflation raises stock return volatility in the US, Korea and India and reduces returns volatility in the Philippines over a three-month period. The authors state that countries with high inflation rates are more reactive to increases in inflation in terms of stock returns volatility.

In a local study by Chinzara (2011) using symmetric GARCH models on monthly data, inflation is discovered to create negative volatility 'spillovers' in the stock market; that is, an increase in overall inflation variability reduces stock market volatility. The negative relationship may be attributed to the introduction of the inflation targeting framework which disrupted the relationship between inflation

uncertainty and stock market volatility; if the inflation targeting framework is more transparent and monetary policy is credible, brief periods of inflation upticks (excluding crises periods) tend not to unnerve the stock market given the central bank's track record in stemming any undesirable inflation movements.

Likewise, Andika et al. (2019) find that positive CPI shocks reduce stock returns volatility in the Indonesian LQ45 index as it is suggestive of a growing economy through increasing aggregate demand and also because of Bank Indonesia's inflation targeting framework.

Based on the literature surveyed, the impact of increasing consumer inflation on returns volatility is generally negative for both developed and developing economies but also seems to be dependent on the source of inflation – increasing demand, supply side constraints or loose monetary policy, the economic environment as well as the macroeconomic regime.

2.3.2 Trade Balance, Stock Returns and Returns Volatility

Empirical studies that examine the effect of trade balance announcements on stock returns or volatility are scant as earlier papers have mainly focused on analysing the effect of inflation on equity returns according to Fisher's (1930) hypothesis. Given the dearth of investigations of trade balance–stock market interactions, current account balance and balance of payments studies, in addition to the scant trade balance studies, are also presented here.

In Australia, Sadeghi and Mussa (1992) observe that unexpected improvements of the trade balance lead to an increase in monthly equity prices. Sun and Tong (2000) study how the daily equity prices of U.S. and Japanese automobile corporations are affected by U.S. current account announcements. An unexpected deterioration in the U.S. trade balance is discovered to decrease prices of Japanese stocks but has no statistically significant effect on U.S. equity prices. The effect on Japanese shares is explained by the policy signalling hypothesis; that is, market participants would sell Japanese stocks as they expect the American government to impose import tariffs on Japanese exporting firms to favour U.S. businesses. But Edmonds and Kutan (2002) find that balance of payment announcements have a weak but significant negative impact on Japanese stock market returns (Nikkei 225 index) during the Asian financial crisis using a standard GARCH model. Furthermore, balance of payments announcements are found to have a weak but significant negative effect on volatility during this crisis period as it is indicative of economic recovery.

Using a standard GARCH model, Flannery and Protopapadakis (2002) discover that actual trade balance announcements have an insignificant effect on daily stock returns but a positive effect on trading volume

and the conditional volatility of daily stock returns of an American stock market index. This effect on returns volatility is found to be significant regardless of the sub-period or macroeconomic regime considered.

With regards to emerging market economies, there is limited literature that investigates the underlying relationship between the trade balance and equity returns, one of the motives for this study. Andika et al. (2019) observe that positive trade balance shocks increase returns in the Indonesian stock market (LQ45 index), and the converse is true for negative trade balance shocks. They also show that positive trade balance surprises reduce stock return volatility as it is indicative of a growing economy.

In the Indian stock market (Nifty 50), Reddy, Ingalhalli, and Sahay, H., (2019) use the EGARCH model and find that actual trade balance announcements increase daily stock return volatility. Trade balance news is also found to have asymmetric effects on conditional volatility.

In South Africa, Gupta and Reid (2013) uncover that current account surprises have an insignificant effect on all industry-specific stocks returns considered including the JSE ALSI returns. But Majija (2017) discovers that positive current account shocks have a significant positive effect on all individual JSE stock returns considered.

Overall, positive trade balance announcements are generally found to increase stock returns in both developed and developing economies, but this effect is also dependent on the economic environment and trade policy. However, there is no clear pattern with regards to the effect of trade balance announcements on returns volatility in developed and developing countries. These effects are also dependent on the state of the economy and what the announcement signals to investors at that particular time.

III. METHODOLOGY

3.1 Event Study Approach

As the name suggests, in an 'event study,' researchers assess the effect of an event – a news release – on financial asset prices shortly before and/or after the event. Cook and Hahn (1989) and Romer and Romer (1989) popularised this methodology, but it can be traced back to the early 1960s – Romer and Romer (1989) state that Friedman and Schwartz (1963) pioneered this technique. But Schwartz and Friedman (1989) contend that this approach was developed and first applied in Adam Smith's *'Wealth of Nations*' (1776).

In this study, the event study approach is employed to analyse stock returns and returns volatility temporal reactions to the arrival of scheduled CPI and trade balance announcements during short windows around the times of these announcements. This method also enables one to test an implication of the semi-strong form of the EMH; that is, whether the FTSE/JSE ALSI returns rapidly and fully adjust to publicly available new information in an unbiased manner so that arbitrageurs cannot profit from it (or such arbitrage opportunities are minimised and short-lived). Each macroeconomic news announcement has an expected component and an unexpected component (which indicates new and relevant information to the market). According to the EMH, only the unexpected or surprise component of the news announcement should have an effect on the market. Therefore, in an efficient stock market (in its mechanical sense rather than its deeper informational sense), CPI and trade balance surprise news will cause an immediate response in equity prices. However, if these exogenous shocks generate abnormal returns that persist for a long time after the event occurs, or the market responds before the announcement is made, this indicates that the market is inefficient (Torrecillas and Jareño, 2013).

With regards to the response speed, Pearce and Roley (1983, 1985) and Jain (1988) discover that equity prices respond fully to the news one hour after the announcement or within the trading day, which is consistent with mechanical efficiency, but Schwert (1981) finds stock prices still reacting in days following the news announcement. Wongswan (2009) states that announcement surprises cause large but temporary increases in volatility that last for 30 minutes after the announcement. The event study technique enables us to detect the relationship between news releases and the stock market as it makes it possible to analyse high-frequency data in short window periods. Another benefit of using this type of frequency data is that it minimises the problem of data contamination as stock prices respond to a wide variety of news during the course of any day. Also, the endogeneity problem is averted in this investigation as the trade balance and consumer inflation rates do not respond immediately following the changes in stock prices. In selecting the window period, one must find a balance between avoiding too short window periods as this may not allow the full impact of the news to be absorbed into stock prices whilst at the same time longer window periods could lead to data contamination. Here, one-minute stock returns are analysed in a 70-minute window period (10 minutes before the announcement and 60 minutes after the announcement).

Market participants formulate expectations about future macroeconomic announcements to an extent that they take positions based on these expectations. Thus, scheduled macroeconomic announcements are important in understanding stock market activity or trends prior to the actual announcement, and sometimes after the announcement in an inefficient stock market. Since traders may have different expectations and the existence of insider trading (based on news leakages) cannot be ruled out, some

arbitrageurs execute trades (buy or sell) shortly before the actual announcement in an attempt to generate profits. But this can result in losses and also increases returns volatility prior to the actual announcement. Once the announcement is made, traders will only react to the degree to which the actual announcement differs from their individual expectations in an efficient stock market as this indicates new information resulting in a change in stock returns and, hence, increased returns volatility (Kim, McKenzie, and Faff, 2004). In cases where market expectations coincide with the actual announcement, no new information is released and so the market will not respond (or minimal market reaction), consistent with the EMH.

3.2 Econometric Models

Particular stylised facts about financial market data are empirically observed. Firstly, the volatility of financial asset returns tends to vary overtime. Secondly, volatility clustering exists in asset returns; that is, there are periods where small changes in returns are further followed by small changes of either sign (market tranquillity), and other periods where large changes in returns are further followed by large changes (market turbulence). Thirdly, financial asset returns have leptokurtic unconditional distributions which indicates that large observation values occur more frequently. Fourthly, the leverage effect exists in asset returns where volatility tends to increase with bad news and decrease with good news (Black, 1976). Lastly, asset price volatilities of different asset classes tend to move together (Bachelier, 1900; Mandelbrot, 1963, 1967). And GARCH-type models have been developed (in part) to capture these features of financial time series data.

The surprise component of the macroeconomic data (CPI and trade balance) announcement is calculated as follows:

$$S_{kt} = A_{kt} - F_{kt}, \tag{5}$$

where S_{kt} is the surprise announcement k at time t, A_{kt} is the actual announced value of the macroeconomic variable, and F_{kt} is the Bloomberg median forecast of the macroeconomic variable. Bloomberg forecasts are the best available consensus forecasts as these are based on the predictions of consumer inflation surveys of approximately 20 economists and trade balance surveys of some 8 economists. An advantage of using median forecasts is that the median is less affected by outliers, unlike the mean, thus the reliability of the estimation results is improved. And the use of median forecasts in this study, is consistent with much of the similar empirical research, thus making comparison of results easier.

An ARCH-type model is presented in the form of two equations: a mean equation and a conditional variance equation. The following mean equation specification applies to the ARCH-type models estimated in this study:

$$r_{k,t+k} = \theta_0 + \theta_1 S_t + \theta_2 D_i(t) + \varepsilon_{k,t}, \tag{6}$$

where $r_{k,t+k}$ is percentage change in the stock price between periods *k* and *t+k* (around the time of the event), θ_0 is the mean return, θ_1 is the sensitivity of equity returns to the surprise macroeconomic announcement, S_t, and ε_{kt} is the disturbance. $D_i(t)$ is a dummy variable capturing financial crisis and business cycle effects on the dependent variable: i) to distinguish between periods of market turbulence (high volatility) and relatively calm ('normal' periods) – *Di(t)* takes on a value 1 during the 2012 European debt crisis and the 2020 COVID-19 pandemic induced turmoil in financial markets and a value of 0 otherwise; ii) to differentiate between upward and downward phases of the business cycle, *Di(t)* takes on a value 1 during the expansionary phase and a value of 0 otherwise. And θ_2 is the dummy variable coefficient, a measure of the effect of that category relative to the omitted category. And a key assumption underlying z_t, the standardised residuals (or shocks) measured as $z_t = \varepsilon_t / h_t$, is serially uncorrelated with a mean equal to zero, $z_t \sim i.i.d\ [N(0,1)]$, but the conditional variance, h_t^2 (explained below), is time varying.

To estimate the impact of surprise CPI and trade balance announcements on stock returns volatility, both symmetric and asymmetric GARCH models are applied. The symmetric linear GARCH model conditional variance (or volatility) developed by Engle (1982) can capture volatility clustering and leptokurtic unconditional distributions in financial asset returns and is represented by the following equation:

$$h_t^2 = \omega + \sum_{i=1}^{p} \alpha_i \varepsilon_{t-i}^2 + \sum_{j=1}^{q} \beta_j h_{t-j}^2 + \delta_1 S_t + \delta_2 D_i(t), \tag{7}$$

where h_t^2 is the conditional variance (or volatility) of stock returns in period *t*, ω is the constant (or the variance that is not time varying), α_i is the responsiveness of the conditional variance to the mean equation lagged squared residuals (or shocks) in period *t-i*, ε_{t-i}^2, h_{t-j}^2 is the conditional variance in period *t-j*, β_j is the responsiveness of the conditional variance to the lagged conditional variance, h_{t-j}^2, S_t is the surprise announcement at time *t*, δ_1 captures the reaction of the stock return's conditional variance to the macroeconomic surprise announcement in period *t*, and δ_2 is dummy variable parameter (to establish whether on not the state of the economy (boom versus recession) and financial markets (financial market crisis or turmoil versus 'normal' times) also having a bearing on stock returns volatility.

However, the linear, symmetric GARCH model cannot capture leverage effects. Thus, to estimate possible asymmetric news effects, two non-linear GARCH models are also estimated here: the threshold ARCH (TARCH) model and the exponential GARCH (EGARCH) model. In the TARCH model, introduced by Zakoian (1994), the conditional variance equation is specified as follows:

$$h_t^2 = \omega + \sum_{i=1}^{p} \alpha_i \varepsilon_{t-i}^2 + \sum_{j=1}^{q} \beta_j h_{t-j}^2 + \sum_{k=1}^{r} \gamma_r \varepsilon_{t-k}^2 I_{t-k}^- + \delta_1 S_t + \delta_2 D_i(t), \quad (8)$$

where I_{t-i}^- is a dummy variable that takes the value 1 when $\varepsilon_{t-i} < 0$, otherwise it is 0, and all the other variables and parameters carry the same meaning as in the symmetric GARCH model above. In this model, α_1 is the conditional volatility impact of 'good news', $\varepsilon_{t-i} > 0$, and 'bad news', $\varepsilon_{t-i} < 0$, has an impact of $\alpha_i + \gamma_i$ on conditional volatility. Here bad news has a greater impact on volatility than good news which we term the 'leverage effect.'

The EGARCH variance model developed by Nelson (1991) has the following conditional variance equation:

$$ln(h_t^2) = \omega + \sum_{i=1}^{p} \alpha_i \left(|z_{t-i}| - E[|z_{t-i}|]\right) + \gamma_k \sum_{k=1}^{r} z_{t-1} + \sum_{j=1}^{p} \beta_j \, ln(h_{t-j}^2) + \delta_1 S_t + \delta_2 D_i(t), \quad (9)$$

where $ln(h_t^2)$ is the natural logarithm of the conditional variance (volatility) which makes the leverage effect exponential (rather than quadratic), ω is the variance equation constant term, and unlike the GARCH and TARCH models, the lagged shocks are specified as the standardised residuals, $z_{t-1} = \varepsilon_{t-1}/h_{t-1}$, α_i is the responsiveness of the natural logarithm of the conditional variance to the shocks in previous periods (z_{t-i}), and γ_k captures the presence of leverage effects. Provided $\gamma_i \neq 0$, positive and negative surprises will have asymmetric effects – if $\gamma_i < 0$, shocks that are regarded as 'bad news' leading to a fall in returns result in greater volatility than shocks 'considered as good news' of the same magnitude that increase returns (leverage effect). All the other variables and parameters carry the same meaning as in the symmetric GARCH model above.

For the purpose of this investigation, the above models are all one period lagged shocks and conditional volatility models ($p = q = r = 1$) which have been empirically proven to generally perform better than higher order ARCH-family models ($p, q, r > 1$).

IV. DATA

4.1 Data Issues

The sample period for this study which spans from January 2012 to December 2021 is dictated by the availability of high frequency minute-to-minute FTSE/JSE ALSI data. The consumer inflation surprise series in this study consists of 120 monthly observations while the trade balance surprise series comprises 117 monthly observations as Bloomberg does not provide any trade balance forecasts for 28 December 2017, 28 December 2018 and 28 December 2020. Over this sample period, the CPI data is always announced at 10h00 whilst trade balance data is consistently announced at 14h00 on the respective release dates. The CPI, trade balance and stock returns data were all sourced from Bloomberg.

Before running the regressions, secondary data is first generated. The FTSE/JSE ALSI mid-points are calculated as the average of 1-minute high and low index values. With regards to stock price data anomalies, significantly high JSE trading volumes occurring on 17 August 2021 due to corporate actions resulted in a record day of value traded in stocks and the JSE experiencing delays in processing these trades, but also a delayed equity market opening on 18 August 2021 (Fin24, 2021), the day of the CPI data release. But this will have an insignificant effect on the estimation results for the relatively sizeable sample size of 120 observations. As already mentioned earlier, the surprise components of the CPI and trade balance announcements are the differences between their actual values announced and their Bloomberg median forecasts – the market expectations for these variables are based on Bloomberg median predictions of approximately 20 economists for the CPI forecasts and 8 economists for trade balance forecasts.

Worth mentioning is that the JSE is a well-developed global exchange – currently ranked as the 17th largest securities exchange in the world by market capitalisation and is highly liquid with a relatively low market concentration by international standards. The FTSE/JSE ALSI is comprised of the largest 164 listed companies in South Africa, making up almost 100 percent of the market capitalisation. Advances in the development of the JSE together with S.A.'s adoption of an increasingly transparent and credible inflation targeting monetary policy framework in 2000 makes consumer inflation forecasting a less onerous task and this bodes well for both the 'informational' and 'mechanical' efficiency of S.A.'s stock market. However, S.A. monthly trade balance data is notoriously volatile.

As stated earlier, two dummy variable series are included as explanatory variables to capture possible financial market turmoil and business cycle phase effects. The business cycle dummy variable is based on Trading Economics' South Africa Leading Business Cycle Indicator month-on-month data. The latter

monthly data is chosen over the SARB quarterly business cycle series as this study employs monthly data.

4.2 CPI and Trade Balance Surprise Data: A Descriptive Analysis

In Table A1 in Appendix A, of the 120 CPI announcements considered in this study, 31 percent and 28 percent were in line with the market consensus median and mean forecasts, respectively. There are a few instances, 8 in total, where market participants expected a change in CPI in the opposite direction to the one actually announced. On 13 occasions, consumer inflation changed with no adjustment expected by the market. The actual inflation and the inflation mean and median surprises – both the magnitude and number of the median and mean market CPI forecasts deviations from the actual CPI announcement – have been on a downward trend during the sample period under investigation. However, this is not accompanied by a decline in CPI uncertainty amongst economists (measured as the difference between the highest and lowest CPI forecasts). But this non-scientific indication does not necessarily suggest that agents generally struggle to accurately predict actual inflation despite the SARB's adoption of an inflation targeting framework in 2000. Grimme, Henzel and Wieland (2012) argue that greater inflation forecast uncertainty "appears to be subject to systematic measurement error in more turbulent times such as economic downturns" which is the case for S.A. as GDP growth has been on a general downward trajectory for a sustained period of time, declining from 2.4% in 2012 to 6.4% in 2020.[19]

Turning to the trade data, Table A2 in Appendix A shows that only 2 of the 117 trade balance mean market forecasts were in line with the actual announcement, and no median market forecasts were equal to the actual announced trade balance value. There were 16 instances where market participants expected a change in the trade balance in the opposite direction to the actual announced trade balance value, and one instance where agents did not expect a change in the actual trade balance value when it actually changed. S.A.'s trade balance surprises – the magnitude of the median and mean market trade balance forecasts deviations from the actual trade balance announcement – have generally increased in tandem with the actual trade balance over the sample period. This is also accompanied by an increase in uncertainty amongst economists (the difference between the high and low trade balance forecasts) which is not surprising as S.A. monthly trade data has always been notoriously volatile (given the wide range of its constituent products and drivers, amongst other factors) and thus very difficult to predict.

[19] S.A. GDP growth data for the entire year 2021 was not available at the time of writing this thesis.

4.3 Preliminary Data Analysis

It is important to examine the statistical properties of all the variables prior to regression analysis to ensure the assumptions underlying the estimation techniques, ARCH-type modelling in this instance, are not violated. Tables A3 and A4 in Appendix A summarise the descriptive statistics for trade balance and CPI surprises and the stock returns around the time of the announcements. Similar to the approach adopted by Adams, McQueen and Wood (2004), 1-minute, 5-minute, 15-minute, 20-minute and 60-minute stock returns after the news announcement are analysed here.

In Tables A3 and A4 in Appendix A, non-normality, indicated by the JB-statistic, is evident in most of the data, except for the CPI surprise and corresponding 60-minute stock index returns series. From these statistics, one can infer that market participants can predict CPI announcements better than the trade balance announcements. And excess kurtosis and asymmetry – peaked distributions with fat or extreme tails – signals the presence of outliers. But GARCH-type models require that the mean equation standardised residuals (and not the raw residuals) be normally distributed. So, the standardised residuals will be tested for normality only after estimating the models and should non-normality be evident in standardised residuals, then this would justify fitting a Student's *t*-distribution or skewed Student's *t*-distribution to the ARCH-type model error terms.

Tables A3 and A4 in Appendix A also summarise the unit root test results. A battery of unit root tests are applied here as there is no single test that is uniformly most powerful. The Augmented Dickey Fuller (ADF) test improves the standard Dickey Fuller (DF) test by controlling for serial correlation in the error terms which is inherent in many financial time series. But the Phillips and Perron (PP) is often preferred over the ADF test as it deals with serial correlation more efficiently. However, the PP test suffers from serious size distortions and is highly sensitive to model specification. Hence, the Dickey-Fuller test with generalised least squares (DF-GLS) developed by Elliott, Rothenberg, and Stock (1996) which is a more powerful version of the DF test is also applied here; this test is best used in small sample sizes and in cases where there exists an unknown constant or linear trend in the series.

Some of these unit tests, such as the ADF and PP tests, usually fail to reject the null hypothesis of a unit root in many time series. Thus, to avoid committing a "Type II error", which is the probability of failing to reject a false null hypothesis, the KPSS test proposed by Kwiatkowski, Phillips, Schmidt, and Shin (KPSS) (1992) is also applied as it has the opposite null hypothesis of trend or level stationary. This test also complements the other unit root tests as it can accurately distinguish between series that seem to be stationary, non-stationary or not sufficiently informative. With regards to the number of lagged differences, the modified Akaike information criterion (MAIC) is used as it dominates other information

criteria; applying the MAIC leads to size improvements in all unit root tests whilst standard information criteria usually select lagged differences that are too small for the unit root test to have a good size. With regards to the results of the unit roots tests, the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests reject the null hypothesis of non-stationarity for all the series. The Elliot-Rothenberg-Stock Dickey-Fuller Generalised Least Squares (DF-GLS) test results also rejects the null hypothesis of a unit root, congruent with the ADF and PP unit root tests; in some instances, the DF-GLS test incorporating structural shift was employed. And finally, the KPSS test results also fail to reject the null hypothesis of stationarity.

V. EMPIRICAL ANALYSIS

In total, the results for 700 regressions are tabulated in Tables B1 to B10 in Appendix B, which are interpreted and discussed in the ensuing subsections below; and this excludes the multitude of initial set of exploratory regressions. First, the ARCH-type models estimation results for consumer inflation surprise effects on stock returns and returns volatility are presented and discussed followed by a comparable presentation and discussion of the trade balance surprise–stock market effects results. Here, two regression analysis approaches are pursued: i) dummy variable approach – to capture financial crises and financial market turmoil structural shifts and business cycle (expansion and recession) effects for the entire sample period under investigation (January 2012–December 2021); and, ii) subsample approach – splitting the entire sample into subsamples that separate crises and turmoil periods from 'normal' (relatively tranquil) times, and separate economic expansions from downward turns in the business cycle. The use of dummy variable regressions versus subsample regressions is a contentious issue in econometrics as both approaches have pros and cons. On the upside, dummy variable models are more robust if there is no multicollinearity between the multiple dummy variables – financial market upheavals and business cycle dummy variables in this study – as this approach allows for greater power of hypothesis tests for a given sample size. On the downside, models with dummy variables may produce regression models with many parameters which may become difficult or even impossible to estimate in some statistical packages. From this, one can obviously infer the advantages and disadvantages of the subsample approach. Also, the dummy variable coefficients are interpreted differently from the standard way of interpreting simple model coefficients since all dummy variables are measured relative to the default reference category.

5.1 Consumer Inflation Surprises–Stock Returns Estimation Results

5.1.1 Dummy Variable Model Results

Table B1 (in Appendix B) reports the financial market upheavals and business cycle dummy variables augmented symmetric GARCH model results – the estimates for mean and conditional variance equations 6 and 7, respectively, specified in the methodology section. The timing of the impact of CPI shocks on stocks is denoted by the value of *k* ranging from 10 minutes before CPI news announcement to 60 minutes after the scheduled announcement at 1-minute intervals. For each 1-minute interval, the corresponding estimation results for θ_1 (CPI surprise effect on returns) and δ_1 (CPI surprise effect on returns conditional variance or volatility) are recorded – the mean and variance equation surprise coefficients are the statistics not enclosed in parenthesis, the standard error statistic in round brackets and the *p*-value statistic in square parenthesis. In Table B1 (Appendix B), symmetric GARCH model statistically significant returns and returns conditional volatility responses to CPI surprises fluctuate between positive and negative returns and these are scattered over the 70-minute window period with no sustainable and clear patterns as the data set includes financial market upheaval periods and 'normal' times and economic expansions and downward turns in the business cycle. Also, the financial markets upheavals and business cycle phase mean and variance equation coefficients are mostly statistically insignificant at the 1% and 5% levels of significance.[20] Table B2 (Appendix B) tabulates the financial market upheavals and business cycle dummy variable augmented asymmetric TARCH model results from estimating equations 6 and 8 outlined in the methodology section, and problems similar to those for the symmetric GARCH model are encountered. Ren and Xiao (2012) draw attention to some of the pitfalls of multiple dummy variables in a regression: "the results suggest that testing and estimating interaction effects of dummy variables are not meaningful, and that dummy variable techniques should be handled carefully when introducing two or more dummies in a multiple regression model." These ambiguous and often meaningless results for multiple dummy variable models prompt a second different approach to estimating the impact of financial markets structural shift and business cycle effects on stock returns, a motivation for also employing the subsample approach – instead of employing financial market upheavals and business cycle dummy variables, the symmetric GARCH and/or asymmetric models are re-estimated for different subsamples to distinguish between financial market upheavals and normal times but also the different phases of the business cycle. Using separate regressions for different subsamples also enables the researcher to accurately determine the magnitude

[20] Due to table size constraints and the thesis length limit, the two dummy variable coefficients values, their standard errors and p-values are not reported in Table B1. These are, however, available from the author upon request. Also, statistically significant parameters are highlighted in grey background font in Tables B1 to B10 (Appendix B) for the convenience of the moderator and other readers.

and sign of CPI and trade balance surprise coefficients under different economic environments. In all instances, asymmetric effects are present, so the analysis proceeds by presenting and interpreting the TARCH and EGARCH model estimation results only.

5.1.2 Subsample Results

NORMAL TIMES: Consumer inflation surprise effects on stock returns and returns volatility results, based on the TARCH model (equation 6 and 8 in the methodology section) are presented in Table B3 (in Appendix B). The first set of simultaneously statistically significant mean equation consumer inflation surprise coefficient (θ_k) and variance equation consumer inflation surprise coefficient (δ_k) (at the 1% level) occur at k =11 (at 10h11 after the CPI data release at 10h00). Thereafter, 10 of θ_k and 18 of δ_k are statistically significant at 10% or lower levels. The significant mean equation surprise coefficients are more sporadic than persistent and are positively signed which means that positive CPI surprises lead to an increase in stock returns in normal periods. Stock returns responses to the CPI shock also peak early at 11 minutes post-CPI data release – a 1 percentage point increase in the CPI surprise leads to a 0.6 basis points increase in stock returns. Returns volatility is relatively subdued throughout most of the 70-minute window period, consistent with Engle and Rangel's (2005) findings that countries with low inflation rates (such as South Africa due to its credible inflation targeting framework) generally experience low stock return volatility than those with high inflation rates. Chinzara (2011) also discovers that increases in inflation can create negative volatility spillovers in the South African stock market because of the SARB's inflation targeting framework.

Similar to the 11-minute estimation results, in some respects, the 39-minute results are also meaningful since almost all the mean and variance equation coefficients are statistically significant at the 1% or 5% levels. Table 1 below summarises the mean and variance equation parameter values for these two stock returns: 11- and 39-minute returns. The impact of bad news (unexpected higher inflation) on stock returns ($\alpha_1 + \gamma_1 \approx 2.36$) is higher than the good news effect (unexpected lower inflation) $\alpha_1 \approx 1.49$ shortly after the CPI data release (at 10h11), indicating the presence of leverage effects, and dies out quite quickly 39 minutes post-announcement. Turning to the impact of consumer inflation surprises on conditional variance, volatility persistence is evident when there is bad news (higher-than-expected inflation) as $\alpha_1 + \beta_1 + \gamma_1 \approx 1$, in contrast to where the shock dies out in the case of good news (lower-than-expected inflation) since $\alpha_1 + \beta_1 \approx 0.12$. However, the 39-minute stock returns coefficient of determination (or adjusted r-squared equal to 14.25) indicates that consumer inflation shocks explain much more of stock returns movement only after the market has adequately digested the information.

And prior to the announcement time, none of θ_k are statistically significant which suggests that there is no leakage of CPI news or little speculative trading related to CPI data releases (Table B3 in Appendix).

Table 1: Impact of a 100-basis-point CPI surprise on returns and returns volatility – TARCH model estimates

NORMAL TIMES

Time interval	θ_1	δ_1	α_1	β_1	γ_1	$\bar{R}^2$
11m: 10h00-10h11 (*initial response*)	0.0060 (0.0005) [0.0000]	-0.0020 (0.0003) [0.0000]	1.4878 (0.1644) [0.0000]	-1.3687 (0.1230) [0.0000]	0.8734 (0.0459) [0.0000]	–
39m: 10h00-10h39 (*returns peak*)	0.0023 (0.0006) [0.0001]	0.0000 (0.0000) [0.0084]	0.0136 (0.0141 [0.3369]	0.9099 (0.0004) [0.0000]	-0.0405 (0.0185) [0.9287]	0.143

The first statistic is the estimated coefficient value.
The statistic in round parentheses is the standard error.
The probability statistic is inserted in square parentheses.

The positive effect of consumer inflation shocks on stock returns ($\boldsymbol{\theta_1}$) during normal times can be explained in part by the Fisher hypothesis which suggests that companies, especially large firms or monopolies, are able to transfer inflation shocks to consumers resulting in increased profits and stock returns. This may also be attributed to the SARB's credible, forward-looking inflation targeting framework as investors may believe that the central bank is unlikely to increase interest rates abruptly and sharply during normal periods in response to small to modest inflation shocks to ensure that the economy continues on its positive growth path which bodes well for stocks returns. And during normal periods, excess liquidity exists in the economy which creates inflation and is used to purchase all types of securities resulting in an increase stock returns.

While the asymmetric stock returns responses to consumer inflation surprises in this study are consistent with exchange rate returns reactions to consumer inflation surprises in Farrell, Hassan and Viegi (2012), in contrast, consumer inflation shocks explain more of the South African rand/U.S. dollar exchange rate movements than South African stock market movements around 5 minutes after the CPI release time; of course, cognisant that the Farrell et al. (*ibid*) exchange rate study is a somewhat older one. But this divergence is by no means a surprise since the foreign exchange market is much larger, more liquid and relatively more efficient than stock markets in general.

FINANCIAL MARKET UPHEAVAL PERIODS: The EGARCH model (mean and variance equations 6 and 9 in the methodology section) is estimated to capture financial asset price dynamics during periods of financial market turbulence (elevated uncertainty and market volatility) but also financial asset price asymmetric responses to surprise news or macroeconomic announcements. These results are presented

in Table B4 (Appendix B). Stock returns dynamics during periods of turmoil in financial markets are in many respects in stark contrast to their behaviour in periods of relative tranquillity (presented above). First, simultaneously statistically significant and positive θ_k and δ_k (at the 1% level) occur at k = -10 (ten minutes before the CPI data announcement) and persistent for some time until the consumer inflation data release. The early response of stock returns to CPI shocks prior to the announcement indicates that there is a lot of uncertainty and speculation during epochs of financial market upheavals. Thereafter, a relatively larger proportion of θ_k (consumer inflation shock effect on returns levels) and relatively smaller proportion of δ_k (consumer inflation shock effect on returns volatility), compared with normal times, are significant at 10% or lower levels.

The significant mean equation surprise coefficients are more persistent than sporadic and are spread out over much of the 70-minute window period. Not too long after the inflation numbers have been published, most θ_k are negatively signed which means that positive CPI shock have a negative effect on stock returns during financial crisis periods and periods of turmoil in financial markets while the opposite is true during normal times. The largest θ_k is observed 55 minutes after the event – 1 percentage point increase in CPI shock leads to a about a 1 basis point decrease in stock returns. During crisis periods, many companies become insolvent, and investors realise a decrease in the value of their financial asset holdings. This has a negative effect on production, investment and aggregate demand in the economy which creates stagflation. Increased upstream prices during crisis periods lead to increased business costs which ultimately results in decreased profits and stock returns. Furthermore, investors prefer to invest in assets regarded as safe havens during crisis periods (such as U.S. government bonds and gold) which provide a hedge against inflation. This results in a decrease in the demand for equities leading to a decrease in stock returns. Furthermore, in the midst of an economic or financial crisis, central banks tend to (but not always) conduct expansionary monetary policies and monetise the large government deficits. This increases inflation and the risk of investing in government securities (with the exception of safe haven government bonds). Consequently, stocks are discounted at higher discount rates which leads to a decrease in stock returns.

Returns variance surprise coefficients, δ_k, are statistically significant, positive, and persistent before the announcement and around the time of the announcement, thereafter all are significant δ_k but negative. The positivity and large magnitude of δ_k prior to the announcement and shortly after is caused by the great uncertainty that exists in the market with respect to future returns and economic recovery in crises periods which causes investors to attach greater significance to small pieces of news resulting in increased returns volatility. The increased volatility prior to the announcement may also be explained by investors with heterogeneous beliefs prepositioning. Furthermore, during periods of financial market

upheavals, returns volatility is high as the equity market generally experiences large CPI shocks which have high amplification effects, impacting investors' prepositioning. The large negative δ_k after the announcement could be a result of the beliefs investors have about the SARB's monetary policy stance to not increase interest rates abruptly and sharply as it might make the actual or likely economic crisis more severe. Edmonds and Kutan (2002) also find that CPI announcements had a weak but significant and negative effect on volatility in Japan during the 1997-8 Asian financial crisis.

Table 2: Impact of a 100-basis-point CPI surprise on returns and returns volatility – EGARCH model estimates

FINANCIAL MARKET UPHEAVAL PERIODS						
Time interval	θ_1	δ_1	α_1	β_1	γ_1	$\bar{R}^2$
-10m: 9h50-10h00 (*initial response*)	0.0046 (0.0000) [0.0000]	19.6185 (4.4183) [0.0000]	-1.6890 (1.0919) [0.1219]	-0.0288 (0.0529) [0.5860]	2.0124 (1.1018) [0.0480]	–
4m: 10h00-10h04	-0.0020 (0.0003) [0.0000]	-1.9821 (6.8134) [0.7711]	0.1831 (0.0774) [0.0181]	-1.0904 (0.3179) [0.0006]	0.1831 (0.0774) [0.0181]	0.328
55m: 10h00-10h55 (*returns trough*)	-0.0101 (0.0000) [0.0000]	-4.7563 (3.5898) [0.1863]	-3.9750 (1.7715) [0.0248]	-0.0088 (0.2226) [0.9686]	2.6474 (0.7760) [0.0000]	–

The first statistic is the estimated coefficient value.
The statistic in round parentheses is the standard error.
The probability statistic is inserted in square parentheses.

Table 2 above tabulates the comprehensive comparative statistics for the response of returns before the announcement, returns reactions shortly after the data release and later on when returns peak. The table also summarises variance equation parameter values for three returns: -10-minutes (10 minutes before the data release), and 4-minutes and 55-minutes after the consumer inflation numbers have been publicised. As was the case during normal times (Table 1 above), a statistically significant γ_1 in Table 2 indicates the presence of leverage effects during crises periods where bad news (greater-than-expected inflation) generally causes larger returns reactions during financial market upheaval periods than in relatively tranquil periods. These asymmetric effects are present throughout the entire 70-minute window period. The consumer inflation surprise effect on volatility is only significant in a few minutes after the inflation announcement. Most of the statistically significant conditional variance coefficients are evident in the 4-minute returns but volatility persistence, $\alpha_1 + \beta_1$ and $\alpha_1 + \beta_1 + \gamma_1$, turns out to be negative instead of positive; since this subsample covers crises and financial market turmoil periods, one can expect some anomalies where volatility persistence can increase sharply and then fall abruptly (and vice versa) within minutes. The negligible or insignificant values for the -10-minute and 55-minute coefficient of determination (or adjusted r-squareds), denoted by a dash ('–') are perhaps not surprising

as these are the (near) boundaries of the 70-minute interval or window period and the news event explains more of the returns and returns volatility shortly after the inflation data release (at k=4) in a more or less efficient stock market such as the JSE (where efficiency here means efficiency in its mechanical sense rather than deeper information efficiency).

ECONOMIC EXPANSION: The results of the CPI subsample regressions during expansionary periods are presented in Table B5 (Appendix B). The first set of statistically significant θ_k and δ_k (at the 5% level) occur at k = -9. Thereafter, 17 θ_k and 13 δ_k are statistically significant at 10% (or lower) levels and all occur after the announcement. The significant θ_k are largely persistent in the first 20 minutes after the announcement and sporadic thereafter. Both positive and negative θ_k are significant which indicates heterogeneous beliefs, but the negative θ_k are greater in number and magnitude. The first significant θ_k 5-minutes post-data release shows the sharpest fall in returns – a 1 percentage point increase in the CPI shock leads to an approximately 381 basis points decline in stock returns. During expansions most investors expect the SARB to respond notably to positive inflation shocks by increasing the interest rate in an attempt to keep inflation within the 3%– 6% target range. As a result, the CPI shock will cause investors to discount dividends at a larger discount rate resulting in a sell-off of stocks and a decrease in stock returns. In non-recessionary periods in Spain, Diaz and Jareño (2009) find that negative inflation shocks have a positive effect on equity returns as it indicates that the economy is not 'overheating.' But during expansionary periods some investors believe that the inflation shock will have a positive effect on stocks as it stems from a growth in demand or the ability of companies to transfer inflation shocks to consumers. These contradicting beliefs results in volatility which is evident in the significant positive δ_k that occur through much of the 70-minute window period, concentrated in the first 33 minutes after the inflation announcement.

With regards to the significant variance equation surprise coefficients, most are positively signed but negligible in magnitude. Significant δ_k are persistent in certain minute returns but are generally sporadic throughout the entire window period. Negative δ_k indicates minutes when traders share homogenous beliefs with regards to the effect of the CPI shock on stock returns. For instance, the negative significant δ_k prior to the announcement indicates that most traders are speculating that a positive inflation shock is more likely to negatively affect stock returns as participants expect a SARB repo rate hike. Positive but negligible significant δ_k appearing 15 minutes after the consumer inflation data release indicate the time where traders have heterogeneous beliefs. Kim, McKenzie and Faff (2004) also discover that positive inflation shocks increase stock market volatility in the U.S. because of expectations of interest rate hikes from the Fed.

Table 3: Impact of a 100-basis-point CPI surprise on returns and returns volatility – TARCH model estimates						
ECONOMIC EXPANSION						
Time interval	$\boldsymbol{\theta_1}$	$\boldsymbol{\delta_1}$	$\boldsymbol{\alpha_1}$	$\boldsymbol{\beta_1}$	$\boldsymbol{\gamma_1}$	$\boldsymbol{\bar{R}^2}$
5m: 10h00-10h05 (*sharp response*)	-3.8088 (0.0057) [0.0000]	-0.0002 (0.1107) [0.9984]	0.4315 (0.0010) [0.0000]	0.2360 (0.0003) [0.0000]	9.7951 (0.0035) [0.0000]	–
6m: 10h00-10h06	-0.0031 (0.0014) [0.0261]	0.0000 (0.0000) [0.4865]	0.6012 (0.6414) [0.3485]	0.2025 (0.2905) [0.4857]	0.6704 (0.4907) [0.1719]	0.730
26m: 10h00-10h26	0.0030 (0.0027) [0.2686]	0.0001 (0.0000) [0.0683]	3.8400 (1.5999) [0.0164]	0.5340 (0.1682) [0.0015]	4.2377 (1.7195) [0.0137]	0.114
33m: 10h00-10h33 (*terminal responsive*)	0.0093 (0.0019) [0.0000]	0.0000 (0.0000) [0.0000]	0.1189 (0.0227) [0.0000]	0.5583 (0.0005) [[0.0000]	0.9685 (0.0556) [0.0000]	–
The first statistic is the estimated coefficient value. The statistic in round parentheses is the standard error. The probability statistic is inserted in square parentheses.						

In Table 3 above, while returns sensitivity to consumer inflation shocks, the absolute value of θ_1, fall sharply from 5 minutes to 33 minutes after the pronouncement, there is a moderate uptick in returns volatility responses over the same interval. Although leverage effects are present over the same interval, persistence of negative shocks (unexpected decline in consumer inflation) remains relatively subdued and stable at approximately $\alpha_1 + \beta_1 \approx 0.7$ in the first 5 minutes and 33-minute window period but positive shocks (unexpected higher consumer inflation which is considered bad news) persistence plunges but remaining explosive ($\alpha_1 + \beta_1 + \gamma_1 > 1$) over the comparative windows. During expansionary periods, market participants generally expect inflation to be higher than expected and when these expectations are met, increased return volatility occurs as agents reposition their portfolios in fear of interest rate hikes by the SARB. Adjusted r-squareds are low here as stock returns are also influenced by expected consumer inflation changes (as will be illustrated in subsection 5.3 below that presents and discusses the augmented TARCH and EGARCH models that capture both the unexpected and expected repo rate change effects on returns and returns conditional variance).

ECONOMIC RECESSION: The results of the CPI subsample regressions estimates for recessionary periods are presented in Table B6 (Appendix B). The first set of simultaneously statistically significant θ_k and δ_k (at the 1% level) occur at k = 2. Thereafter, 14 θ_k and 15 δ_k are statistically significant at 10% or lower levels. Prior to the announcement only the mean equation surprise coefficients are statistically significant at k = -10, -9 at the 10% level.

The significant θ_k are more sporadic than persistent throughout the 70-minute window period. The significant θ_k are positively signed prior to the announcement and both positive and negative significant θ_k are present post-data release time. Most of the significant θ_k after the announcement are positive but the negative ones are larger in magnitude. This is testament to the uncertainty that persists during recessionary periods with regards to future returns and economic recovery which is evident in the positive δ_k that is observed throughout the window period. Some investors believe the positive inflation shock stems from an economy starting to grow (showing positive signs of some increasing demand), but some investors believe the inflation stems from supply side constraints (stagflation). Other sources of inflation during recessionary times are the SARB and government's expansionary monetary and fiscal policies to stimulate consumer demand and investment. But this increased inflation signals to investors that equities will not provide a hedge against inflation causing them to invest in non-stock assets that will generate larger returns which results in a decline in stock returns. The positive θ_k in the 39th, 40th, 41st, 52nd and 53rd minutes could be the result of contrarian traders or rational investors as a large negative shock is experienced in the 33rd minute after the inflation announcement. And the positive θ_k prior to the announcement suggests portfolio rebalancing by stock traders or speculative trading as they are not persistent. Davis and Kutan (2003) find stock returns to be negatively impacted by increases in inflation in the U.S. and Netherlands during recessionary periods due to the central banks counter-cyclical monetary policies which increase inflation, public debt and the risks of investing in government securities. But Diaz and Jareño (2009) discover that inflation shocks have a positive effect on stock returns during recessionary periods in Spain as it signals a growing economy. Multiple classical studies by Feldstein (1980), Fama (1981), Schwert (1981), Geske and Roll (1983) and Kaul (1987) uncover a negative relationship between inflation and stock returns, most of which were undertaken during stagflationary periods in the U.S.

Only 16 δ_k are statistically significant and occur after the announcement. They are more sporadic than persistent and are almost all spread out across the 60 minutes post-announcement time. However, most δ_k are negligible in magnitude and negatively signed. The minutes where δ_k is negatively signed indicates homogenous beliefs and the minutes where δ_k is positively signed indicates heterogeneous beliefs which result in returns volatility. Furthermore, during recessionary periods investors generally expect the SARB to ease monetary policy, hence, the low volatility. Andika, Fahmi and Andati (2019) finds positive inflation shocks in Indonesia reduce stock returns volatility as they are indicative of a growing economy.

Table 4: Impact of a 100-basis-point CPI surprise on returns and returns volatility – TARCH model estimates						
ECONOMIC RECESSION						
Time interval	θ_1	δ_1	α_1	β_1	γ_1	$\bar{R}^2$
2m: 10h00-10h02 (*initial response*)	0.0033 (0.0001) [0.0000]	-0.0000 (0.0000) [0.0000]	0.5494 (0.0506) [0.0000]	-0.1198 (0.0002) [0.0000]	0.4720 (0.0015) [0.0000]	–
11m: 10h00-10h11	-0.0004 (0.0000) [0.0000]	0.0000 (0.0000) [0.0000]	-0.0528 (0.0000) [0.0000]	0.5617 (0.0018) [0.0000]	0.8735 (0.0002) [0.0000]	0.356
54m: 10h00-10h54 (*terminal response*)	0.0026 (0.0010) [0.0072]	0.0000 (0.0000) [0.0000]	0.1189 (0.0227) [0.0000]	0.5583 (0.0005) [[0.0000]	0.9685 (0.0556) [0.0000]	0.288
The first statistic is the estimated coefficient value. The statistic in round parentheses is the standard error. The probability statistic is inserted in square parentheses.						

Tables 3 and 4 above show a much quicker stock market responses to inflation shocks during recessions (2 minutes after event) than expansions (5 minutes after event). Like normal times in financial markets and economic expansions, returns volatility arising from the consumer inflation shock is also relatively subdued (in comparison to financial crises periods). Leverage effects present during recessions are lower compared with expansionary periods. And volatility persistence is evident when there is bad news (higher-than-expected inflation) in contrast to where the shock dies out in the case of good news.

The consumer inflation surprise effects on FTS/JSE ALSI returns and the presence of leverage effects suggests that the asymmetric ARCH-type models are a better fit for the data than the symmetric GARCH model. Furthermore, while the TARCH model is suitable for economic recessions and expansions and financial markets during relative tranquillity, heightened volatility during periods of financial market turmoil and crisis is unsurprisingly better modelled using the EGARCH model, an apt model for turbulent times in financial markets. It also should be noted that *r*-squareds for events studies are typically low and should not be a surprise in some cases as macroeconomic announcements are multidimensional and complex, and that measuring shocks in terms of survey expectations only provides a partial measure (Gurkaynak, Kisacikoglu and Wright, 2017). Hence, not all news is observable to the econometrician, and in a less efficient stock market, stock returns are also explained by expected announcements. Furthermore, the distribution of all the regressions standardised residuals (including the trade balance sample event studies below) are very close to a normal distribution, conforming with the TARCH and EGARCH model underlying assumption. Due to the thesis length constraint, the standardised residuals histogram and summary statistics are not presented here but may be requested from the author.

5.2 Trade Balance Surprises–Stock Returns Estimation Results

5.2.1 Dummy Variable Model Results

For economic state and financial markets conditions augmented ARCH-type model estimation results for the full sample, the problems are similar to those encountered for CPI surprise estimates (noted above); that is, trade balance surprise coefficients fluctuate between positive and negative signs, and these are scattered over the 70-minute window period with no sustainable and clear patterns. But a more serious problem for most of the window periods here is that the ARCH-type models optimization algorithm fails to reach convergence, and, hence, no estimation results are generated; one possibility is that outliers are the reason for non-convergence given that South African monthly trade balance data is known to be notoriously volatile. (These largely meaningless results are not reported here but are available upon request from the author). And for these reasons, the subsample asymmetric GARCH approach is also pursued here to capture trade balance surprise effects under different economic and financial market states; similar to the CPI surprises analysis in subsection 5.1 above, in order to obtain more meaningful results.

5.2.2 Subsample Results

Given the extremely volatile nature of South African monthly trade balance statistics which in turn generates stock market returns responses around the time of the trade balance data release, only the EGARCH model is applied here across the four different economic and financial market environments: normal times versus financial market turmoil and crises periods, and economic expansions versus economic recessions. And as already noted in subsection 5.1 above, the EGARCH model is more suitable for capturing the temporary explosive nature of some financial market returns, in addition to leverage effects.

NORMAL TIMES: Trade balance surprise effects on stock returns and returns volatility, based on the EGARCH model (equation 6 and 9 in the methodology section) are presented in table B7 (in Appendix B). The first set of simultaneously statistically significant θ_k and δ_k (at the 10% level) occur 3 minutes before the announcement (13h57). Thereafter, 15 of θ_k (trade balance shock effect on stock returns) and 26 of δ_k (trade balance shock effect on stock returns volatility) are statistically significant at 10% or lower levels. The statistically significant θ_k are only persistent for the first 10 minutes into the announcement and are sporadic thereafter. And the significant δ_k are generally sporadic throughout the entire window period. All significant θ_k are negative but negligible in magnitude. Hence, positive trade balance shocks have a negligible negative effect on stock returns during normal periods. Most significant θ_k are negative (although negligible in magnitude) possibly because a greater than expected trade

balance announcement signals, *ceteris paribus,* an appreciation of an already strong rand during normal periods which causes domestic exporting firms to be less competitive in international trade.

With regards to returns volatility, positive trade balance shocks have a negative effect on conditional volatility before and after the announcement, and a positive effect 2-, 10- and 38-minutes after the announcement. Most significant δ_k are negative perhaps due to positive trade balance shocks signalling a growing economy which reduces the uncertainty amongst investors. Furthermore, during normal periods, the stock market generally experiences small trade balance shocks which have low amplification effects that lead to moderate returns volatility. The significant positive δ_k after the announcement signal heterogeneous beliefs amongst traders as they attempt to digest the new information.

Table 5: Impact of 1 percent trade balance surprise on returns and returns volatility – EGARCH model estimates

NORMAL TIMES						
Time interval	$\boldsymbol{\theta_1}$	$\boldsymbol{\delta_1}$	$\boldsymbol{\alpha_1}$	$\boldsymbol{\beta_1}$	$\boldsymbol{\gamma_1}$	$\boldsymbol{\bar{R}^2}$
2m: 14h00-14h02	-0.0000 (0.0000) [0.0001]	0.0620 (0.0276) [0.0249]	0.0811 (0.3452) [0.8142]	0.2798 (0.2650) [0.2911]	0.5241 (0.2312) [0.0234]	0.068
4m: 14h00-14h04	-0.0000 (0.0000) [0.0007]	-0.0042 (0.0296) [0.8860]	-0.6441 (0.3368) [0.0558]	0.2501 (0.1885) [0.1846]	0.7961 (0.2452) [0.0012]	0.087
38m: 14h00-14h38 (*returns peak*)	-0.0000 (0.0000) [0.0000]	0.0940 (0.0227) [0.0000]	-3.2184 (2.2702) [0.1563]	-0.1269 (0.1408) [0.3676]	-1.4210 (1.1137) [0.2020]	–

The first statistic is the estimated coefficient value.
The statistic in round parentheses is the standard error.
The probability statistic is inserted in square parentheses.

Table 5 above presents a summary of θ_k and δ_k parameter values for the 2-, 4- and 38-minute window periods. Although asymmetric effects are present in the 2-minute and 4-minute returns, suggested by the statistically insignificant variance equation asymmetrical effects dummy variable coefficient, and GARCH effects and volatility persistence effects (measured by α_1 and β_1) are not statistically significant except for the 4-minute returns response to shocks in the previous period that is statistically significant but only at the 10% level ($\alpha_1 = 0.056$). The 2-, 4- and 38-minute returns are statistically significant but have low adjusted r-squareds. This is perhaps not surprising since the model captures only the direct trade balance effects on returns and not the indirect stock trade flows that ensue after the initial changes in stock prices which prompt new trading (buying and/or selling) that cause further stock price and returns adjustments. But modelling trade balance shocks and stock returns dynamics during tranquil

periods requires further exploration; for example, estimating the asymmetric power ARCH (APARCH) model, introduced by Ding, Granger, and Engle (1993), "that combines the flexibility of a varying exponent with the asymmetry coefficient to account for leverage effects" (May and Farrell, 2018).

FINANCIAL MARKET UPHEAVAL PERIODS: The EGARCH model is also employed to estimate the impact of trade balance shocks on stock returns and returns volatility during periods of financial market turbulence. These results are presented in Table B8 in Appendix B. The impact of trade balance shocks during periods of financial market upheavals is completely different to normal periods. The first simultaneously statistically significant θ_k and δ_k (at the 1% level) occur 6 minutes before the announcement. The early response of stock returns to shocks may be caused by the uncertainty and speculation that exists during these periods. After k = -6, 51, θ_k are statistically significant and are generally positive and persistent throughout the window period. And 30 δ_k are statistically significant, and also generally positive and persistent up to 37 minutes after the announcement. Hence, there is a larger proportion of significant θ_k and δ_k compared to normal periods.

Most significant θ_k (rounded off to four decimal places) are positive (but negligible in magnitude) because a greater than expected trade balance announcement signals a growth in domestic exporting companies' sales and, hence, economic recovery (which tends to be shaky rather than robust at least initially). Positive trade balance shocks also tend to cause an appreciation of a weak rand during periods of financial market upheavals which makes imports cheaper and reduces the value of foreign debt. This is in contrast to normal periods where most θ_k are negative. The largest significant θ_k is witnessed in the 26th minute and several minutes thereafter, where an unexpected 1 percent increase in the trade balance leads to a meagre 0.01 basis point increase in stock returns. However, looking at the broader international transactions between countries, Edmonds and Kutan (2002) discover balance of payment announcements to have a weak but significant, negative impact on stock returns in Japan during the Asian financial crisis.

Trade balance shocks generally have a small positive effect on stock return volatility before and after the announcement (unlike normal periods). Positive trade balance shocks during financial market upheavals may increase heterogeneous beliefs amongst investors and cause them to reposition their portfolios which creates volatility. Furthermore, during crisis periods, large trade balance shocks are exerted on the stock market which are greatly amplified causing increased returns volatility. Flannery and Protopapadakis (2002) find that trade balance announcements increase returns volatility in the U.S. regardless of the sub-period or macroeconomic regime. But Edmonds and Kutan (2002) observe that

positive balance of payments announcements in Japan hade a negative effect on returns volatility during the 1997-8 Asian financial (or emerging markets) crisis as they signal economic recovery.

Table 6 below provides a summary of θ_k and δ_k parameter values at k=1 and k=44. These minute returns provide meaningful results due to high statistical significance of the trade balance shock and leverage parameters. Trade balance shocks have a greater effect on returns volatility than on the returns levels ($\delta_1 > \theta_1$). And similar to consumer inflation shocks and stock returns dynamics, some EGARCH model results anomalies during financial market upheaval periods are also evident here – negatively signed α_1 in the 1-minute returns, asymmetric effects are present (γ_1 statistically significant at the 10% or lower levels), and volatility is not persistent in the last returns and returns volatility response (post-43 minutes after the trade balance data release).

Table 6: Impact of 1 percent trade balance surprise on returns and returns volatility – EGARCH model estimates

FINANCIAL MARKET UPHEAVAL TIMES						
Time interval	$\boldsymbol{\theta_1}$	$\boldsymbol{\delta_1}$	$\boldsymbol{\alpha_1}$	$\boldsymbol{\beta_1}$	$\boldsymbol{\gamma_1}$	$\boldsymbol{\bar{R}^2}$
1m: 14h00-14h01 (*initial response*)	0.0000 (0.0000) [0.0000]	0.2220 (0.0799) [0.0054]	-4.0369 (0.6327) [0.0000]	0.1441 (0.0375) [0.0001	1.3604 (0.7533) [0.0709]	0.011
44m: 14h00-14h44 (*last response*)	0.0000 (0.0000) [0.0029]	0.0689 (0.0339) [0.0424]	0.4681 (1.3215) [0.7232]	-0.1997 (0.7045) [0.7768]	3.1940 (1.2800) [0.0126]	0.113

The first statistic is the estimated coefficient value.
The statistic in round parentheses is the standard error.
The probability statistic is inserted in square parentheses.

ECONOMIC EXPANSION: The trade balance surprise subsample regressions results for the expansionary phase of the business cycle are presented in Table B9 in Appendix B. The first set of simultaneously statistically significant θ_k and δ_k (at the 5% level) occur 2 minutes before the announcement. Thereafter, 37 θ_k and 29 δ_k are statistically significant at 10% (or lower levels). The significant θ_k are persistent in the first 26 minutes after the announcement and patchy thereafter. And the significant δ_k are generally sporadic throughout the window period and are only persistent between the 19th and 31st minutes after the announcement. The very few significant θ_k and δ_k prior to the announcement are indicative of speculative trading (rather than data leakages).

Similar to normal sub-periods, most significant θ_k are negative (although negligible in magnitude) possibly because a larger than expected trade balance announcement signals an appreciation of an already strong rand during expansionary periods which results in a decrease in the competitiveness of

domestic exporting firms in the international markets. In addition, positive trade balance shocks during expansionary cycles could further increase inflation which negatively impacts stock returns because of the SARB's inflation targeting framework. But after 30 minutes, all significant θ_k are positive as a result of contrarian trading or heterogeneous beliefs amongst traders which is also reflected in the significant positive δ_k. Some investors believe the positive trade balance shock indicates an increase in sales and profits of domestic exporting firms.

Similar to financial market upheaval sub-periods, most significant δ_k are positive and small in magnitude because trade balance shocks tend to result in heightened heterogeneous beliefs amongst investors which creates volatility. Some investors believe the positive shock signals increased sales and, hence, profits for exporting firms, but most investors believe the shock will cause an appreciation of the rand which will make exporting firms less competitive or increase inflation which are likely to invite contractionary monetary policies from the SARB. But around the time of the announcement, trade balance shocks have a negative effect on returns volatility which is indicative of homogenous beliefs amongst investors.

Table 7: Impact of 1 percent trade balance surprise on returns and returns volatility – EGARCH model estimates

ECONOMIC EXPANSION

Time interval	$\boldsymbol{\theta_1}$	$\boldsymbol{\delta_1}$	$\boldsymbol{\alpha_1}$	$\boldsymbol{\beta_1}$	$\boldsymbol{\gamma_1}$	$\boldsymbol{\bar{R}^2}$
-2m: 13h58-14h00 (*initial response*)	-0.0000 (0.0000) [0.0037]	-0.0416 (0.0181) [0.0213]	-2.4671 (3.4767) [0.4779]	-0.7359 (0.1422) [0.0000]	0.6650 (1.2184) [0.5852]	0.122
12m: 14h00-14h12	-0.0000 (0.0000) [0.0000]	0.0435 (0.0003) [0.0000]	-2.9124 (0.0000) [0.6512]	0.0316 (0.0000) [0.0000]	1.1794 (0.0000) [0.0000]	0.027
44m: 14h00-14h44 (*returns peak*)	0.0000 (0.0000) [0.0000]	0.0335 (0.0159) [0.0355]	-1.7523 (0.5422) [0.4712]	-0.0038 (0.2842) [0.9894]	1.1927 (0.3923) [0.0024]	–

The first statistic is the estimated coefficient value.
The statistic in round parentheses is the standard error.
The probability statistic is inserted in square parentheses.

Table 7 above presents a summary of θ_k and δ_k parameter statistics of minute returns at k = -2, 12, 44. These window periods are chosen based on high statistical significance of most parameters. The impact of bad news (lower than expected trade balances) has a larger effect on returns volatility than good news during expansionary periods. In the 12-minute returns, the impact of 'bad news' on returns volatility, -$\alpha_1 + \gamma_1 \approx 4.09$, is greater than that of 'good news', $\alpha_1 + \gamma_1 \approx$ -1.73. These asymmetric effects are evident from 6 minutes before the announcement up until the 47th minute after the announcement.

Volatility persistence is also evident especially between the 19th and 31st minute returns. The coefficient of determination indicates that trade balance shocks explain much more of stock returns around the time of the announcement due to the uncertainty or speculation that exists in the market during expansionary periods.

ECONOMIC RECESSION: The EGARCH model is also employed to estimate the impact of trade balance shocks on stock returns during recessionary periods. These results are presented in Table B10 in Appendix B. Analogous to the normal times and financial market upheaval periods disparities, in some respect, the impact of trade balance shocks in recessionary periods is totally different to that in expansionary periods. The first simultaneously statistically significant θ_k and δ_k (at the 5% level) occur in the 3rd minute after the announcement. Thereafter, 16 θ_k and 3 δ_k are statistically significant at 10% or lower levels and are both intermittent throughout the entire window period. Hence, a smaller proportion of θ_k and δ_k in recessionary periods is statistically significant compared to expansionary periods.

Furthermore, unlike expansionary periods, most significant θ_k are positive (but negligible in magnitude) as a larger than expected trade balance announcement signals export growth and economic recovery. Positive trade balance shocks also lead to an appreciation of the rand which increases investment and reduces the rand value of foreign currency denominated foreign debt. But negative significant θ_k are also observed, a result of heterogeneous beliefs amongst traders.

Also, in contrast to expansionary periods, most significant δ_k are negative because positive trade balance shocks during recessionary periods signal economic growth which reduces investor uncertainty. Investors also do not fear that the positive shock will increase inflation and lead to interest rate hikes by the South African central bank as the economy is in a recession, which also lowers return volatility. Andika, Fahmi and Andati (*ibid*) also observe that positive trade balance surprises reduce stock returns volatility in Indonesia as it is indicative of a growing economy. The significant positive δ_k right after the announcement is caused by increased trading as investors try to digest the new information.

The 18th and 24th minute returns provide meaningful results since all surprise coefficients are statistically significant (at the 10% level). Table 8 below provides a summary of θ_k and δ_k parameter values for these window periods. Similar to expansionary periods, the impact of 'bad news' (lower-than-expected trade balances) on conditional volatility ($-\alpha_1 + \gamma_1 \approx 1.81$) is larger than that of 'good news' ($\alpha_1 + \gamma_1 \approx -1.25$) in the 18th minute, but leverage effects are stronger in expansionary periods. Volatility persistence is also evident throughout the entire window period but tends to be sporadic and larger for negative shocks. The coefficients of determination indicate that trade balance shocks explain a small

percentage of stock returns, but this could be due to investors needing more time to analyse and digest the new information.

Table 8: Impact of 1 percent trade balance surprise on returns and returns volatility – EGARCH model estimates

ECONOMIC RECESSIONS						
Time interval	θ_1	δ_1	α_1	β_1	γ_1	$\bar{R}^2$
18m: 14h00-14h18 (*initial response*)	0.0000 (0.0000) [0.0000]	-0.0411 (0.0065) [0.0000]	-1.5325 (0.0466) [0.0000]	0.3616 (0.0010) [0.0000]	0.2766 (0.1292) [0.0323]	0.015
24m: 14h00-14h30 (*terminal returns*)	0.0000 (0.0000) [0.0573]	-0.0633 (0.0294) [0.0242]	-0.2086 (0.1194) [0.0806]	-0.5446 (0.0011) [0.0000]	0.9189 (0.0878) [0.0000]	0.044

The first statistic is the estimated coefficient value.
The statistic in round parentheses is the standard error.
The probability statistic is inserted in square parentheses.

5.3 Stock Market Informational Efficiency

A market is 'informationally efficient' if its asset prices always completely reflect all relevant, available information; all available public information in the case of the semi-strong form of the (EMH (Fama, 1970). Competition amongst the multiple 'intelligent' investors in an efficient market causes prices to always fully reflect information based on events that have already taken place and events that are expected to take place in the future. The EMH has two implications: i) high frequency traders only respond to new information such as unexpected news announcements; and, ii) profit-making through arbitrage is short-lived as traders respond imminently to this new information. In this section we test whether the market only reacts to consumer inflation and trade balance surprises or whether it also responds to anticipated consumer inflation and trade balance data releases. To achieve this, an additional independent variable is added to the relevant GARCH model (without dummy variables) mean and conditional variance equations: expected consumer inflation and trade balance changes are calculated as the market median forecast minus the previous period consumer inflation or trade balance value (or equivalently measured as the total actual change in the given macroeconomic variable in the current period relative to the previous period minus the unexpected change in that macroeconomic variable).

5.3.1 Expected Consumer Inflation Changes–Stock Returns Relationship

Table 9 below reports the consumer inflation surprise regressions results (θ_1 and δ_1 carry the same meaning as in subsection 5.1. above) together with the impact of expected consumer inflation changes announcements on stock returns and returns volatility indicated by θ_2 and δ_2, respectively. During normal periods anticipated changes in consumer inflation have no bearing on stock returns and returns

volatility suggesting that the JSE is informationally efficient with regards to reflecting the South African consumer inflation Bloomberg median forecast when expectations are formulated (or revised) and made public before the actual consumer inflation new data is released by Statistics South Africa (SSA) on prescheduled dates and times. However, during financial market upheavals and recessions, expected changes in consumer inflation have a significant impact on stock returns and volatility in the early minutes after the announcement. This could be the result of the great uncertainty and a widening in the high-low inflation forecast range of various economists that exists during these periods. Similarly, anticipated changes in consumer inflation have a bearing on stock returns but not stock returns volatility during economic expansions. Investors generally have strong beliefs of high inflation and some element of uncertainty during expansionary periods as they fear SARB interest rate hikes. The substantially amplified adjusted r-squareds when anticipated consumer inflation changes are accounted for in the various ARCH-type models indicates that expected announcements have a bearing on return levels and returns volatility in most instances (financial market upheaval periods and business cycle phases).

Table 9: Impact of 100 basis points consumer inflation surprise on returns and returns volatility

NORMAL TIMES (TARCH model estimates)					
Time interval	θ_1	θ_2	δ_1	δ_2	$\bar{R}^2$
8m: 10h00-10h08 (*initial response*)	0.0015 (0.0006) [0.0239]	0.0138 (0.0350) [0.6940]	0.0000 (0.0000) [0.0000]	0.0000 (0.0000) [0.2678]	0.109
FINANCIAL MARKET UPHEAVALS (EGARCH model estimates)					
Time interval	θ_1	θ_2	δ_1	δ_2	$\bar{R}^2$
6m: 10h00-10h06 (*initial response*)	-0.0014 (0.0000) [0.0000]	-0.1711 (0.0000) [0.0000]	-1.4148 (3.2939) [0.6675]	314.7156 (116.4065) [0.0069]	0.230
ECONOMIC EXPANSIONS (TARCH model estimates)					
Time interval	θ_1	θ_2	δ_1	δ_2	$\bar{R}^2$
7m: 10h00-10h07 (*initial response*)	0.0016 (0.0013) [0.2068]	-0.3195 (0.0712) [0.0000]	0.0000 (0.0000) [0.0022]	-0.0001 (0.0000) [0.1415]	0.220
ECONOMIC RECESSIONS (TARCH model estimates)					
Time interval	θ_1	θ_2	δ_1	δ_2	$\bar{R}^2$
11m: 10h00-10h08 (*initial response*)	-0.0005 (0.0000) [0.0000]	0.0378 (0.0093) [0.0000]	0.0000 (0.0000) [0.0000]	0.0000 (0.0000) [0.0000]	0.350

The first statistic is the estimated coefficient value.
The statistic in round parentheses is the standard error.
The probability statistic is inserted in square parentheses.

5.3.2 Expected Trade Balance Changes–Stock Returns Relationship

Table 10: Impact of 1 percent trade balance surprise on returns and returns volatility

NORMAL PERIODS (EGARCH model estimates)					
Time interval	$\boldsymbol{\theta_1}$	$\boldsymbol{\theta_2}$	$\boldsymbol{\delta_1}$	$\boldsymbol{\delta_2}$	$\boldsymbol{\bar{R}^2}$
2m: 14h00-14h02 (*initial response*)	-0.0000 (0.0000) [0.0095]	-0.0000 (0.0000) [0.0006]	0.0406 (0.0286) [0.1554]	0.0341 (0.0374) [0.3622]	0.031
FINANCIAL MARKET UPHEAVALS (EGARCH model estimates)					
Time interval	$\boldsymbol{\theta_1}$	$\boldsymbol{\theta_2}$	$\boldsymbol{\delta_1}$	$\boldsymbol{\delta_2}$	$\boldsymbol{\bar{R}^2}$
4m: 14h00-14h04 (*initial response*)	-0.0000 (0.0000) [0.0000]	-0.0000 (0.0000) [0.0000]	-0.0826 (0.0471) [0.0793]	0.0234 (0.0334) [0.4834]	0.064
ECONOMIC EXPANSIONS (EGARCH model estimates)					
Time interval	$\boldsymbol{\theta_1}$	$\boldsymbol{\theta_2}$	$\boldsymbol{\delta_1}$	$\boldsymbol{\delta_2}$	$\boldsymbol{\bar{R}^2}$
4m: 14h00-10h04 (*initial response*)	-0.0000 (0.0000) [0.0002]	-0.0000 (0.0000) [0.0395]	-0.0348 (0.0343) [0.3108]	-0.0093 (0.0378) [0.8060]	0.180
ECONOMIC RECESSIONS (EGARCH model estimates)					
Time interval	$\boldsymbol{\theta_1}$	$\boldsymbol{\theta_2}$	$\boldsymbol{\delta_1}$	$\boldsymbol{\delta_2}$	$\boldsymbol{\bar{R}^2}$
4m: 14h00-14h04 (*initial response*)	-0.0000 (0.0000) [0.0001]	0.0000 (0.0000) [0.0089]	-0.0272 (0.0367) [0.4582]	0.0275 (0.0480) [0.5665]	0.043

The first statistic is the estimated coefficient value.
The statistic in round parentheses is the standard error.
The probability statistic is inserted in square parentheses.

Table 10 above reports the trade balance surprise EGARCH regressions results with the impact of expected announcements on stock returns and returns volatility indicated by θ_2 and δ_2 respectively. Expected changes in trade balances have a significant effect on stock returns, though not stock returns volatility, in all economic and financial market environments which also confirms South African stock market informational inefficiency regarding the incorporation of expected trade balance changes into overall stock prices. Except for economic expansions, extending the EGARCH mean equation to include expected trade balance change effects on stock returns increases the coefficient of determination (adjusted r-squared) by less than the consumer inflation case as trade balance announcements are highly volatile and generally have a small effect on stock returns. This may cause some investors to initially pay less attention to trade balance information or take some time to unravel and digest this information when trading, and unanticipated trade balance announcements only explain a larger proportion of stock returns in later window periods once most traders have updated their information. However, some models may not be specified correctly, especially for the normal period sample as including the expected change in the trade balance results in the variance equation surprise coefficient being insignificant. This

is because unexpected and expected trade balance changes are highly correlated when trade balance changes are predicted accurately. Multicollinearity tests are required to confirm this which is beyond the scope of this study and conducting a coefficient diagnostics redundant variable test as recommended by May *et al*. (2018) is an area for future research.

VI. CONCLUSION

The purpose of this study was to enhance our understanding of the reaction of intraday FTSE/JSE ALSI returns and returns volatility to expected and unexpected CPI and trade balance announcements during normal periods, financial market upheavals, and the different phases of the business cycle (economic expansions and recessions). The results of this study indicate that both consumer inflation and trade balance announcements can have significant effects on stock returns and returns volatility, depending on the prevailing financial and economic environments. In particular, greater-than-expected CPI announcements are found to have a significant positive effect on stock returns during normal periods and a generally significant negative effect in all other economic environments. On the other hand, larger than expected trade balance announcements have a weak but significant effect on stock returns – a positive impact during financial market upheavals and economic recessions and a negative effect during normal periods and economic expansions. This weaker response of stock returns to trade balance announcements compared to CPI announcements may suggest that investors consider inflation news to be much more important.

With regards to stock returns volatility, greater than expected CPI announcements have a weak but significant effect on stock returns volatility; that is, a negative effect during normal periods and economic recessions and a positive impact during economic expansions. However, positive CPI shocks have a large and significant positive effect on returns volatility before the announcement during financial market upheaval periods but even a larger significant negative effect after the announcement. Positive trade balance shocks on the other hand have a small significant positive effect on returns volatility during financial market upheavals and economic expansions and a small significant negative effect during normal and recessionary periods. Leverage effects are discovered in the impact of both CPI and trade balance announcement with 'bad news' generally having a larger effect on stock returns than 'good news.'

In terms of mechanical efficiency, although the benchmark South African stock returns do not always respond instantaneously to unexpected consumer inflation and trade balance news, the intraday response times of stocks (not too long after these two news releases) shows moderate to somewhat speedy

responses. And the informational efficiency of the FTSE/JSE ALSI is financial markets and economic environment dependent. And so, market efficiency results are mixed.

Areas for future research include extending the sample size to include the 2008 global financial crisis or even earlier data as it will improve the statistical significance of the results and may lead to other important findings, but this is only feasible using lower frequency data as minute-by-minute South African stock market data is available only from 2012 onwards. Secondly, analysing how the different sub-indices or individual stocks traded on the JSE stock market react to expected and unexpected announcements would give us a better understanding of market behaviour at the disaggregated levels. Additionally, tests to uncover whether any periodicity exists in the high frequency data needs to be conducted to determine whether filtered and non-filtered data present significantly different results. And as already stated, multicollinearity tests and coefficient diagnostics redundant variable test are required to determine whether expected and unexpected changes in announcements are correlated when testing for informational efficiency. Finally, fitting other ARCH-type models (such as the APARCH model) to the data may also present some interesting and perhaps novel findings.

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APPENDIX A

Table A1: CPI surprise data

CPI data release year	CPI data release calendar month	CPI data release day of month	CPI Surprise (Actual- Mean)	CPI Surprise (Actual- Median)	Uncertainty (High-Low)
2012	1	18	-0.2	-0.2	0.3
	2	22	0.1	0.1	0.2
	3	22	-0.2	-0.3	0.3
	4	18	0	0	0.6
	5	23	-0.1	-0.1	0.3
	6	20	-0.2	-0.2	0.3
	7	18	0	-0.1	0.4
	8	22	-0.3	-0.3	0.3
	9	19	0	0	0.2
	10	24	0.3	0.3	0.3
	11	21	0.2	0.2	0.4
	12	12	0	0	0.5
2013	1	23	0	0	0.3
	2	20	-0.3	-0.3	0.5
	3	20	0.3	0.3	0.4
	4	17	-0.1	-0.1	0.7
	5	22	0.2	0.2	0.3
	6	19	-0.3	-0.2	0.5
	7	24	-0.3	-0.3	0.4
	8	21	0.2	0.1	1
	9	18	0	0	0.5
	10	23	0	0	0.6
	11	20	-0.2	-0.2	0.4
	12	11	-0.1	-0.1	0.5
2014	1	22	-0.1	-0.2	0.4
	2	19	0.1	0.1	0.3
	3	19	0	0	0.7
	4	23	0.1	0.1	0.4
	5	21	0	0.1	0.6
	6	18	0.1	0.1	0.5
	7	23	-0.1	-0.1	0.4
	8	20	-0.1	-0.1	0.4
	9	17	0.2	0.2	0.4
	10	22	-0.3	-0.2	0.6
	11	19	0	0	0.4
	12	10	0	0	0.3

CPI data release year	CPI data release calendar month	CPI data release day of month	CPI Surprise (Actual- Mean)	CPI Surprise (Actual- Median)	Uncertainty (High-Low)
2015	1	21	-0.1	-0.2	0.5
	2	18	-0.2	-0.1	0.7
	3	18	0.1	0.1	0.9
	4	22	-0.1	-0.1	0.8
	5	20	-0.1	-0.1	0.8
	6	17	0	0.1	0.3
	7	22	-0.2	-0.3	0.5
	8	19	0	0	0.6
	9	23	-0.2	-0.2	0.8
	10	21	-0.1	-0.1	0.3
	11	18	0	0	0.2
	12	9	-0.1	0	0.4
2016	1	20	0	0	0.4
	2	17	0.2	0.2	0.3
	3	23	0.3	0.2	0.9
	4	20	-0.2	-0.1	0.8
	5	18	0	0	0.8
	6	22	-0.3	-0.3	0.4
	7	20	0.1	0	0.5
	8	24	-0.1	-0.1	0.5
	9	21	-0.1	0	0.9
	10	19	-0.1	-0.1	0.5
	11	23	0.2	0.1	0.4
	12	14	0	0	0.6
2017	1	18	0.3	0.3	0.4
	2	15	-0.1	-0.1	0.6
	3	22	0	0	0.8
	4	19	-0.2	-0.2	0.4
	5	24	-0.3	-0.3	0.6
	6	21	0.1	0	0.8
	7	19	-0.1	-0.1	0.4
	8	23	-0.1	-0.1	0.7
	9	20	-0.1	-0.1	0.5
	10	18	0.1	0.1	0.3
	11	22	-0.1	0	0.6
	12	13	-0.1	-0.1	0.7
2018	1	24	0	0	0.5
	2	21	-0.1	0	0.4
	3	20	-0.1	-0.1	0.8
	4	18	-0.3	-0.3	0.7
	5	23	-0.1	-0.2	0.7

CPI data release year	CPI data release calendar month	CPI data release day of month	CPI Surprise (Actual- Mean)	CPI Surprise (Actual- Median)	Uncertainty (High-Low)
2018	6	20	-0.2	-0.2	0.4
	7	18	-0.2	-0.2	0.4
	8	22	0.1	0	0.6
	9	19	-0.3	-0.3	0.5
	10	24	0	0.1	0.7
	11	21	-0.1	-0.1	0.3
	12	12	0	0.1	0.5
2019	1	23	0	0	0.7
	2	20	-0.3	-0.3	0.6
	3	20	-0.1	0	0.8
	4	17	0	-0.1	0.6
	5	22	-0.1	-0.1	0.4
	6	19	0	0.1	0.6
	7	24	0.1	0.1	0.3
	8	21	-0.3	-0.3	0.4
	9	18	0.1	0.1	0.4
	10	23	-0.2	-0.2	0.6
	11	20	-0.3	-0.2	0.6
	12	11	0	0	0.3
2020	1	22	0	0	0.6
	2	19	0	-0.1	0.7
	3	18	0.2	0.1	0.7
	4	22	-0.1	-0.1	0.6
	5	22	-0.1	0	1
	6	15	-0.3	-0.1	1.3
	7	29	0	0	0.8
	8	26	0.3	0.2	1.1
	9	30	-0.1	-0.1	0.3
	10	28	0	0	0.3
	11	25	0.3	0.3	0.3
	12	9	-0.1	0	0.2
2021	1	20	0	0	0.3
	2	17	-0.1	-0.1	0.4
	3	24	-0.2	-0.2	0.6
	4	21	-0.1	-0.1	0.5
	5	19	0.1	0.1	1.7
	6	23	0.1	0	1.2
	7	21	0.1	0.1	0.6
	8	18	0	-0.1	1.2
	9	22	0.1	0	0.3
	10	20	0	0	0.4

CPI data release year	CPI data release calendar month	CPI data release day of month	CPI Surprise (Actual- Mean)	CPI Surprise (Actual- Median)	Uncertainty (High-Low)
2021	11	17	0	0	0.4
	12	15	0	0	0.7

Table A2: Trade balance surprise data

Trade data release year	Trade data release calendar month	Trade data release day of month	Trade balance surprise (Actual - Mean)	Trade balance surprise (Actual-Median)	Uncertainty (High - Low)
2012	1	31	5.5	6.3	11
	2	29	-9.8	-10.4	7.2
	3	30	-2.6	-2.5	10.4
	4	30	-1.5	-0.5	8.4
	5	31	-4.9	-4.9	6
	6	29	-2.1	-2.2	9
	7	31	-1.5	-0.7	8.8
	8	31	-1.2	-1.5	6.5
	9	28	-6	-5.3	5.5
	10	31	-6	-5.6	4
	11	30	-6.1	-5.7	9.5
	12	28	9	9.7	10.4
2013	1	31	-0.7	-0.3	10.7
	2	28	-13.9	-14.8	13.5
	3	28	3	3	5
	4	30	-0.3	0.7	11
	5	31	-5.3	-5.5	7.1
	6	28	0.8	1	7
	7	31	1.3	1.2	7
	8	30	-4.5	-5.2	5.4
	9	30	-4.8	-5.2	6.6
	10	31	-2.2	-2.5	12.2
	11	29	1	1.1	17
	12	30	10.2	10.2	10
2014	1	31	0.3	-0.2	16.1
	2	28	-5.3	-4.9	7.9
	3	31	6.4	5.2	13.3
	4	30	-9.8	-9.9	7.5
	5	30	-2.1	-1.7	10.6
	6	30	4.7	5.4	9.8
	7	31	5.6	6.1	5.6
	8	29	-3.2	-2.9	7.6
	9	30	-7.7	-7.6	10.1
	10	31	8.6	8.6	11.3
	11	28	-14.9	-15	13.1
	12	30	0	-0.5	6.8
2015	1	30	5.8	5	9.9
	2	27	-15.9	-16.4	27.5
	3	31	-2.6	-2.8	32.5

Trade data release year	Trade data release calendar month	Trade data release day of month	Trade balance surprise (Actual - Mean)	Trade balance surprise (Actual-Median)	Uncertainty (High - Low)
2015	4	30	7.6	7	8.5
	5	29	2.2	2.4	13.1
	6	30	7.6	8.1	7.2
	7	31	2.4	1.8	10
	8	31	-0.5	1.2	8.8
	9	30	-6.7	-6.5	12.8
	10	30	3.3	4	9.8
	11	30	-14.6	-13.6	13.2
	12	30	8.4	8.4	10.5
2016	1	29	3.4	3.3	11.4
	2	29	-6	-4.9	32.5
	3	31	4	4.1	6.5
	4	29	2.9	4.8	9.3
	5	31	0.7	1.3	15.9
	6	30	13.7	14.6	7.6
	7	29	4.5	3.7	13.8
	8	31	-2.8	-2.8	10.7
	9	30	-9.3	-10.2	10
	10	31	9	7.3	13.2
	11	30	1.5	2.3	23
	12	29	-0.3	-0.5	17.1
2017	1	31	4.8	5.7	16.4
	2	28	-7.9	-7.4	23.2
	3	31	3.4	3.6	16.9
	4	28	5.4	5.2	3.6
	5	31	-1.1	-2.3	5
	6	30	1.6	0.2	15.1
	7	31	0.9	1.3	8.1
	8	31	1.1	1.9	17.9
	9	29	3.9	3.8	15
	10	31	-6.9	-6	12.6
	11	30	8.3	10.1	14.9
	12	28	no data	no data	no data
2018	1	31	5	5.6	6.9
	2	28	-28.5	-26	17.5
	3	29	1.1	-0.6	10.2
	4	30	6.8	5.7	8.5
	5	31	-3.4	-3.6	2.5
	6	29	-1.9	-2.3	4.2
	7	31	6.1	7	3.8
	8	31	-10.4	-9.9	2.5

Trade data release year	Trade data release calendar month	Trade data release day of month	Trade balance surprise (Actual - Mean)	Trade balance surprise (Actual-Median)	Uncertainty (High - Low)
2018	9	28	10.2	10.6	18.3
	10	31	-8.3	-7.2	5.6
	11	30	-0.1	-0.5	16.6
	12	28	no data	no data	no data
2019	1	31	9.5	8.1	11.3
	2	28	0	1.4	25.3
	3	29	0.5	0.7	5.6
	4	30	-0.1	0.2	4
	5	31	-4	-4.7	5
	6	28	0.9	1	13
	7	31	-0.1	0.2	1.9
	8	30	-5.9	-5.8	3.5
	9	30	5.8	5.6	8.6
	10	31	3	3.2	4.5
	11	29	3.5	4.3	11.6
	12	27	-5.2	-6.1	11
2020	1	31	3.4	2.9	7
	2	28	11.5	11.8	11.3
	3	31	8.6	10.6	23.6
	4	30	14.9	14.7	22.5
	5	29	-48.4	-48	33.5
	6	30	25	25.7	37
	7	31	36.3	36.6	7.5
	8	31	23.6	24.9	21.2
	9	30	13.8	9.2	20.1
	10	30	4.1	3.5	16
	11	30	14.2	9.8	25
	12	28	no data	no data	no data
2021	1	29	2.1	2	22.4
	2	26	-8.8	-9.2	20.6
	3	31	9.2	6.9	25
	4	30	28	29.2	11
	5	31	13.3	13.7	21.2
	6	30	7.8	5	23.6
	7	30	7.6	3.7	18.6
	8	31	-11.3	-11.1	24.8
	9	30	5.8	7.4	21.7
	10	29	-12.9	-13	19.5
	11	30	-2.2	-3.2	13.5
	12	28	11.1	11	11.5

Table A3*:* Summary descriptive statistics – CPI surprises and stock returns (*for selected window periods*)

	Min	Max	Mean	Med	Std. Dev	Skew	Kurt	JB (prob)	ADF (prob)	PP (prob)	KPSS*	DF-GLS*
CPI surprises	-0.30	0.30	-0.04	0.00	0.14	0.12	2.82	0.47 0.79)	-6.00 (0.00)	11.83 (0.00)	0.10	-5.96
1-min returns	-0.001	0.002	0.000	0.000	0.000	0.5915	5.5625	39.82 (0.00)	-9.82 (0.00)	-9.81 (0.00)	0.04	-9.35
5-min returns	-0.002	0.004	0.000	0.000	0.001	0.80	5.36	4.60 (0.00)	-4.57 (0.00)	-10.01 (0.00)	0.08	-4.17
15-min returns	-0.006	0.005	-0.000	0.000	0.002	0.19	4.85	17.88 (0.00)	-6.93 (0.00)	-11.04 (0.00)	0.04	-3.80
20-min Returns	-0.008	0.006	0.000	0.000	0.002	-0.55	7.09	89.92 (0.00)	-4.11 (0.01)	-11.54	0.05	-10.96
60-min returns	-0.009	0.009	0.000	0.000	0.003	0.11	3.59	1.98 (0.37)	-6.53 (0.00)	-10.07	0.14	-6.52

* The 1%, 5% and 10% critical values for the Elliot-Rothenberg-Stock Dickey-Fuller DF-GLS test (based on the modified Akaike Information criterion with maximum lags of 13) are -3.56, -3.01 and -2.72 respectively. And the 1%, 5% and 10% critical values for the KPSS test are 0.73, 0.46 and 0.35 respectively.

Table A4: Summary descriptive statistics – trade balance surprises and stock returns (*for selected window periods*)

	Min	Max	Mean	Med	Std. Dev	Skew	Kurt	JB (prob)	ADF (prob)	PP (prob)	KPSS*	DF-GLS*
Trad bal. surprises	-48.00	36.60	0.95	1.20	9.90	-0.49	8.93	176.26 (0.00)	-8.64 (0.00)	-10.72 (0.00)	0.10	-9.33
1-min returns	-0.002	0.003	0.000	0.000	0.000	1.38	21.99	179.4 (0.00)	-7.02 (0.00)	-7.06	0.05	-6.98
5-min returns	-0.005	0.003	0.000	0.000	0.001	-1.54	15.09	759.12 (0.00)	-8.73 (0.00)	-8.72 (0.00)	0.17	-8.77
15-min returns	-0.005	0.003	0.000	0.000	0.001	-0.40	6.00	47.11 (0.00)	-6.29 (0.00)	-10.7 (0.00)	0.20	-6.04
20-min returns	-0.005	0.004	0.000	0.000	0.001	-0.60	5.93	48.95 (0.00)	-10.5 (0.00)	-10.6 (0.00)	0.15	-10.6
60-min returns	-0.007	0.006	0.000	0.000	0.003	-0.32	3.91	6.00 (0.00)	-10.4 (0.00)	-10.5 (0.00)	0.12	-9.77

* The 1%, 5% and 10% critical values for the Elliot-Rothenberg-Stock Dickey-Fuller DF-GLS test (based on the modified Akaike Information criterion with maximum lags of 13) are -3.56, -3.01 and -2.72 respectively. And the 1%, 5% and 10% critical values for the KPSS test are 0.73, 0.46 and 0.35 respectively.

APPENDIX B

Table B1: Consumer inflation surprises–stock returns 'DUMMY VARIABLES' augmented symmetric GARCH model estimation results (70-minute window)

k	θ_1	δ_1	k	θ_1	δ_1	k	θ_1	δ_1	k	θ_1	δ_1	k	θ_1	δ_1
	-0.0004	0.0000		-0.0002	0.0000		-0.0016	0.0000		0.0025	-0.0002		-0.0679	-0.0029
-10	(0.0006)	(0.0000)	5	(0.0006)	(0.0000)	19	(0.4118)	(0.0000)	33	(0.0028)	(0.0037)	47	(0.1459)	(0.0308)
	[0.5259]	[0.1029]		[0.7953]	[0.7138]		[0.9969]	[0.9961]		[0.3735]	[0.9437]		[0.6419]	[0.9255]
	-0.0003	0.0000		-0.0004	0.0000		-0.0010	0.0000		-0.0146	-0.0001		0.0036	-0.0000
-9	(0.0006)	(0.000)	6	(0.0006)	(0.0000)	20	(0.0000)	(0.0000)	34	(0.0004)	(0.0016)	48	(0.0014)	(0.0000)
	[0.5871]	[0.2199]		[0.5469]	[0.1657]		[0.0000]	[0.9272]		[0.7957]	[0.9444]		[0.1505]	[0.0007]
	0.0000	0.9715		-0.0017	-0.0000		-0.0066	0.0000		0.0034	0.0000		0.0038	0.0000
-8	(0.0006)	(0.000)	7	(0.0011)	(0.0000)	21	(0.0079)	(0.000)	35	(0.0019)	(0.0000)	49	(0.0015)	(0.0000)
	[0.9096]	[0.9715]		[0.1504]	[0.0006]		[0.4061]	[0.5703]		[0.7689]	[0.3471]		[0.2194]	[0.4704]
	0.0011	-0.0006		0.0002	0.0000		0.0011	0.0000		0.0000	0.0000		-0.0005	0.0000
-7	(0.0034)	(0.0025)	8	(0.0009)	(0.0000)	22	(3.3157)	(0.0324)	36	(0.2502)	(0.0000)	50	(0.0000)	(0.0000)
	[0.7527]	[0.7969]		[0.8089]	[0.7697]		[0.9997]	[0.9999]		[0.3005]	[0.3736]		[0.0000]	[0.0000]
	0.0000	0.0000		-0.0014	-0.0000		-0.3011	-0.0000		0.0041	0.000		0.0074	-0.0000
-6	(0.0014)	(0.000)	9	(0.0014)	(0.000)	23	(0.0000)	(0.0000)	37	(0.0018)	(0.0000)	51	(0.0037)	(0.1516)
	[0.9476]	[0.5564]		[0.3088]	[0.0014]		[0.9553]	[0.9922]		[0.0215]	[0.2872]		[0.0438]	[0.0018]
	0.0004	0.0000		-0.0011	-0.0000		0.0013	0.0000		0.0038	0.0000		0.0010	0.2422
-5	(0.0005)	(0.0000)	10	(0.0011)	(0.000)	24	(0.0016)	(0.0000)	38	(0.0018)	(0.0000)	52	(0.0012)	(0.2900)
	[0.4916]	[1.0000]		[0.2683]	[0.0000]		[0.4629]	[0.3726]		[0.0397]	[0.2696]		[0.4036]	[0.4033]
	0.0007	0.0000		0.0012	-0.0000		0.0080	0.0000		0.0035	0.0000		0.0085	-0.0000
-4	(0.0004)	(0.0000)	11	(0.0009)	(0.0000)	25	(0.0085)	(0.0000)	39	(0.0018)	(0.0000)	53	(0.0035)	(0.0000)
	[0.0880]	[1.0000]		[0.1882]	[0.0054]		[0.3464]	[0.2866]		[0.0555]	[0.1615]		[0.0150]	[0.0095]
	0.0006	0.0000		-0.0014	-0.0000		0.0003	0.0000		0.0036	0.0000		0.0029	-0.0000
-3	(0.0004)	(0.0000)	12	(0.0010)	(0.0000)	26	(0.0008)	(0.0000)	40	(0.0018)	(0.0000)	54	(0.0016)	(0.000)
	[0.1041]	[1.0000]		[0.2064]	[0.1844]		[0.0000]	[0.3123]		[0.0483]	[0.2079]		[0.1329]	[0.0031]
	0.0001	0.0000		0.0014	-0.0000		-0.0019	0.0000		0.0071	0.0000		0.0031	-0.0000
-2	(0.0003)	(0.0000)	13	(0.0009)	(0.000)	27	(0.0640)	(0.0000)	41	(0.0111)	(0.0000)	55	(0.0016)	(0.0000)
	[0.7019]	[1.0000]		[0.1239]	[0.0129]		[0.9767]	[0.9221]		[0.5244]	[0.4055]		[0.1329]	[0.0026]
	0.0003	0.0000		0.0009	-0.0000		0.0003	-0.0000		0.0025	-0.0000		0.0033	-0.0000
-1	(0.0002)	(0.0000)	14	(0.0010)	(0.000)	28	(0.0000)	(0.0000)	42	(0.0012)	(0.0000)	56	(0.0017)	(0.0000)
	[0.1937]	[1.0000]		[0.3556]	[0.0673]		[0.9999]	[0.0000]		[0.7206]	[0.0661]		[0.1092]	[0.0049]
	0.0003	0.0000		0.0001	-0.0000		0.0004	-0.0000		0.0015	0.0000		0.0051	-0.0000
1	(0.0001)	(0.0000)	15	(0.0001)	(0.0000)	29	(0.0024)	(0.0000)	43	(0.0015)	(0.0000)	57	(0.0043)	(0.0000)
	[0.0449]	[1.0000]		[0.3261]	[0.0000]		[0.8604]	[0.8504]		[0.3023]	[0.0190]		[0.2354]	[0.1645]
	0.0002	0.0080		-0.0004	-0.0000		0.0011	0.0007		0.0026	-0.0000		0.0057	-0.0000
2	(0.0004)	(0.0004)	16	(0.0000)	(0.0000)	30	(0.0027)	(0.0026)	44	(0.0013)	(0.0000)	58	(0.0047)	(0.0000)
	[0.6650]	[1.0000]		[0.0000]	[0.0000]		[0.6620]	[0.7834]		[0.4057]	[0.5018]		[0.2256]	[0.1500]
	-0.0001	0.0000		-0.0005	-0.0000		-0.3543	-0.0000		0.0117	0.0000		0.0056	-0.0000
3	(0.0004)	(0.0000)	17	(0.3561)	(0.0003)	31	(0.0000)	(0.0000)	45	(0.0000)	(0.0000)	59	(0.0058)	(0.0000)
	[0.8492]	[1.0000]		[0.9988]	[0.9893]		[0.0000]	[0.0000]		[0.1573]	[0.5015]		[0.3293]	[0.3576]
	-0.0002	–0.0000		-0.0026	0.0000		-0.0000	-0.0000		-0.2630	-0.0000		0.0063	-0.0000
4	(0.0005)	(0.0000)	18	(0.0000)	(0.0000)	32	(0.0000)	(0.0000)	46	(0.0000)	(0.0000)	60	(0.0048)	(0.0000)
	[0.7387]	[0.7255]		[0.0000]	[0.5858]		[0.0000]	[0.0000]		[0.0000]	[0.0000]		[0.1872]	[0.1906]

The information in round parentheses is the standard errors and the probability statistics are inserted in square parentheses. The statistic not enclosed in brackets is the relevant CPI surprise coefficient. All values are rounded off to four decimal places.

Table B2: Consumer inflation surprises–stock returns 'DUMMY VARIABLES' augmented asymmetric TARCH model estimation results (70-minute window)

k	θ_1	δ_1	k	θ_1	δ_1	k	θ_1	δ_1	k	θ_1	δ_1	k	θ_1	δ_1
	0.0008	-0.0000		-0.0001	0.0000		-0.0025	-0.0000		-0.0015	-0.0000		-0.0679	-0.0029
-10	(0.0008)	(0.0000)	5	(0.0006)	(0.0000)	19	(0.0069)	(0.0000)	33	(0.0000)	(0.0000)	47	(0.1459)	(0.0308)
	[0.3026]	[0.3607]		[0.8637]	[0.1000]		[0.7191]	[0.9961]		[0.0000]	[0.0000]		[0.6419]	[0.9255]
	0.0001	0.0000		-0.0005	0.0000		-0.0020	0.0000		-0.3087	-0.0000		0.0039	0.0000
-9	(0.0004)	(0.000)	6	(0.0006)	(0.0000)	20	(0.0021)	(0.0053)	34	(0.1017)	(0.0035)	48	(0.0000)	(0.0000)
	[0.7427]	[0.0725]		[0.3460]	[1.0000]		[0.3311]	[0.3075]		[0.0024]	[0.9843]		[0.1719]	[0.0000]
	0.0000	-0.0000		0.0003	0.0000		-0.0034	0.0000		-0.1709	0.0000		0.0031	-0.0000
-8	(0.0006)	(0.000)	7	(0.0006)	(0.0000)	21	(0.0248)	(0.000)	35	(0.0001)	(0.0001)	49	(0.0022)	(0.0000)
	[0.8736]	[0.9551]		[0.6226]	[0.0283]		[0.8904]	[0.8515]		[0.0000]	[0.8399]		[0.1689]	[0.7332]
	-0.0001	-0.0000		-0.0003	0.0000		0.0011	0.0000		0.0060	0.0000		0.0031	-0.0000
-7	(0.0006)	(0.0000)	8	(0.0001)	(0.0000)	22	(0.7631)	(0.0009)	36	(0.0264)	(0.0000)	50	(0.0021)	(0.0000)
	[0.8611]	[0.7183]		[0.7008]	[0.0068]		[0.9989]	[0.9970]		[0.8195]	[0.8179]		[0.1532]	[0.0022]
	-0.0003	-0.0000		-0.0019	-0.0000		0.0024	0.0000		0.0045	0.000		0.0039	-0.0000
-6	(0.0005)	(0.000)	9	(0.0008)	(0.000)	23	(0.0000)	(0.0000)	37	(0.0018)	(0.0000)	51	(0.0017)	(0.00)
	[0.4773]	[0.6339]		[0.0148]	[0.0292]		[0.9712]	[0.9607]		[0.0117]	[0.3579]		[0.0198]	[0.0026]
	0.0006	0.0000		-0.0011	-0.0000		-0.0045	-0.0000		0.0044	0.0000		-0.0017	-0.0000
-5	(0.0013)	(0.0000)	10	(0.0008)	(0.000)	24	(0.0000)	(0.0000)	38	(0.0019)	(0.0000)	52	(0.0016)	(0.0000)
	[0.6290]	[1.0000]		[0.2106]	[0.8876]		[0.0000]	[0.0000]		[0.0195]	[0.2837]		[0.0000]	[0.0149]
	0.0005	0.0000		-0.0000	-0.0000		0.0081	0.0003		0.0035	0.0000		0.0036	-0.0000
-4	(0.0004)	(0.0000)	11	(0.0008)	(0.0000)	25	(0.0276)	(0.0009)	39	(0.0018)	(0.0000)	53	(0.0015)	(0.0000)
	[0.2323]	[1.0000]		[0.9663]	[0.0151]		[0.7690]	[0.7655]		[0.0555]	[0.1615]		[0.0159]	[0.0037]
	-.0001	0.0000		-0.0011	-0.0004		0.0037	0.0000		0.0044	0.0000		0.0031	-0.0000
-3	(0.0003)	(0.0000)	12	(0.0008)	(0.0002)	26	(0.0008)	(0.0000)	40	(0.0018)	(0.0000)	54	(0.0026)	(0.000)
	[0.6616]	[1.0000]		[0.2249]	[0.0771]		[0.6850]	[0.0000]		[0.2910]	[0.3183]		[0.2302]	[0.6662]
	-0.0007	0.0000		0.0010	-0.0000		0.0026	-0.0000		0.0035	-0.0000		0.0037	-0.0000
-2	(0.0003)	(0.0000)	13	(0.0011)	(0.0011)	27	(0.3322)	(0.0002)	41	(0.0019)	(0.0000)	55	(0.0016)	(0.0000)
	[0.0295]	[1.0000]		[0.3934]	[0.0024]		[0.9937]	[0.9843]		[0.8749]	[0.7742]		[0.0186]	[0.0017]
	0.0002	0.0000		0.0002	-0.0000		-0.0022	-0.0000		0.0031	-0.0000		0.0039	-0.0000
-1	(0.0002)	(0.0000)	14	(0.0021)	(0.000)	28	(0.1922)	(0.0341)	42	(0.0018)	(0.0000)	56	(0.0016)	(0.0000)
	[0.4819]	[1.0000]		[0.9194]	[0.7935]		[0.9908]	[0.9633]		[0.0093]	[0.5773]		[0.0170]	[0.0044]
	0.0003	0.0000		-0.0757	-0.0002		0.0009	-0.0000		0.0015	-0.0000		0.0051	-0.0000
1	(0.0002)	(0.0000)	15	(0.0000)	(0.0000)	29	(0.0011)	(0.0000)	43	(0.0015)	(0.0000)	57	(0.0045)	(0.0000)
	[0.1249]	[1.0000]		[0.0000]	[0.5636]		[0.4058]	[0.0265]		[0.3023]	[0.0190]		[0.2636]	[0.2222]
	0.0002	0.0000		0.0007	-0.0000		0.0012	-0.0000		0.0023	-0.0000		0.0053	-0.0000
2	(0.0004)	(0.0000)	16`	(0.0019)	(0.0000)	30	(0.0027)	(0.0000)	44	(0.0015)	(0.0000)	58	(0.0046)	(0.0000)
	[0.4996]	[1.0000]		[0.7294]	[0.9117]		[0.6645]	[0.8079]		[0.1199]	[0.0009]		[0.2434]	[0.2104]
	0.0001	0.0000		-0.0005	0.0000		0.0001	0.0000		0.0025	-0.0000		0.0041	-0.0000
3	(0.0006)	(0.0000)	17	(0.0011)	(0.0000)	31	(0.1221)	(0.0000)	45	(0.0015)	(0.0000)	59	(0.0056)	(0.0000)
	[0.8748]	(1.0000)		[0.6228]	[0.5446]		[0.9992]	[0.9942]		[0.0981]	[0.0004]		[0.4595]	[0.6407]
	-0.0003	0.0000		-0.0005	0.0000		-0.0002	0.0000		-0.0154	0.0000		0.0058	-0.0000
4	(0.0005)	(0.0000)	18	(0.0011)	(0.0000)	32	(0.0000)	(0.0000)	46	(0.0517)	(0.0000)	60	(0.0049)	(0.0000)
	[0.5286]	(1.0000)		[0.0000]	[0.5858]		[0.0000]	[0.0000]		[0.7661]	[0.5497]		[0.2395]	[0.2903]

The information in round parentheses is the standard errors and the probability statistics are inserted in square parentheses. The statistic not enclosed in brackets is the relevant CPI surprise coefficient. All values are rounded off to four decimal places.

Table B3: Consumer inflation surprises–stock returns 'NORMAL TIMES' TARCH model estimation results (70-minute window)

k	θ_1	δ_1	k	θ_1	δ_1	k	θ_1	δ_1	k	θ_1	δ_1	k	θ_1	δ_1
	0.0002	0.0000		0.0004	-0.0000		0.0008	0.0000		0.0008	-0.0000		0.0050	0.0032
-10	(0.0016)	(0.0008)	5	(0.0017)	(0.0000)	19	(0.0015)	(0.0000)	33	(0.0013)	(0.0000)	47	(0.0033)	(0.0000)
	[0.8965]	[1.0000]		[0.8538]	[1.0000]		[0.5861]	[0.0000]		[0.5239]	[0.3790]		[0.8784]	[0.5653]
	0.0000	0.0000		0.0001	0.0000		0.0017	-0.0000		0.0013	0.0000		-0.0002	0.0000
-9	(0.0022)	(0.0000)	6	(0.0024)	(0.0000)	20	(0.0008)	(0.0000)	34	(0.0016)	(0.0000)	48	(0.0052)	(0.0006)
	[0.9985]	[0.6693]		[0.9394]	[1.0000]		[0.0571]	[0.0439]		[0.3824]	[0.3650]		[0.9700]	[1.0000]
	0.0002	0.0000		0.0003	-0.0003		0.0024	-0.0000		0.0020	0.0000		0.0029	-0.0000
-8	(0.0017)	(0.0008)	7	(0.0010)	(0.0022)	21	(0.0009)	(0.0000)	35	(0.0013)	(0.0000)	49	(0.0022)	(0.0000)
	[0.9005]	[1.0000]		[0.7857]	[0.9015]		[0.0107]	[0.0477]		[0.1364]	[0.0310]		[0.1894]	[0.0758]
	-0.0004	0.0000		-0.0002	0.0008		0.0005	0.0000		0.0016	-0.0000		0.0038	-0.0000
-7	(0.0005)	(0.0000)	8	(0.0009)	(0.0021)	22	(0.0014)	(0.0009)	36	(0.0013)	(0.0000)	50	(0.0019)	(0.0000)
	[0.3712]	[0.0069]		[0.8041]	[0.7235]		[0.7244]	[0.6877]		[0.2274]	[0.9443]		[0.0460]	[0.0418]
	-0.0000	0.0000		-0.00044	0.0000		0.0008	0.0000		0.0004	0.0000		0.0038	-0.0000
-6	(0.0017)	(0.0000)	9	(0.0018)	(0.0000)	23	(0.0013)	(0.0000)	37	(0.0016)	(0.0000)	51	(0.0018)	(0.0000)
	[0.9840]	[1.0000]		[0.8155]	[0.8061]		[0.4920]	[0.4193]		[0.7991]	[0.3695]		[0.0385]	[0.0132]
	0.0008	0.0000		0.0009	-0.0000		-0.0009	0.0000		0.0012	0.0000		0.0033	-0.0000
-5	(0.0014)	(0.0011)	10	(0.0010)	(0.0000)	24	(0.0012)	(0.0000)	38	(0.0014)	(0.0000)	52	(0.0020)	(0.0000)
	[0.5371]	[1.0000]		[0.3346]	[0.2365]		[0.4913]	[0.0000]		[0.3924]	[0.8524]		[0.0951]	[0.1273]
	0.0007	0.0000		0.0060	-0.0020		0.0014	0.0000		0.0023	0.0000		0.0031	-0.0000
-4	(0.0015)	(0.0000)	11	(0.0005)	(0.0003)	25	(0.0014)	(0.0000)	39	(0.0006)	(0.0000)	53	(0.0022)	(0.0000)
	[0.6477]	[1.0000]		[0.0000]	[0.0000]		[0.3281]	[0.0000]		[0.0001]	[0.0084]		[0.1660]	[0.1044]
	0.0003	0.0000		-0.0005	-0.0005		0.0017	0.0000		0.0034	0.0000		0.0037	-0.0000
-3	(0.0015)	(0.0000)	12	(0.0089)	(0.0000)	26	(0.0017)	(0.0000)	40	(0.0016)	(0.0000)	54	(0.0020)	(0.0000)
	[0.8427]	[1.0000]		[0.9515]	[0.0000]		[0.3260]	[0.0690]		[0.0274]	[0.5849]		[0.0673]	[0.0176]
	0.0004	0.0000		-0.0008	-0.0000		0.0021	0.0000		0.0026	0.0000		0.0025	-0.0000
-2	(0.0014)	(0.0000)	13	(0.0046)	(0.0000)	27	(0.0016)	(0.0000)	41	(0.0017)	(0.0000)	55	(0.0025)	(0.0000)
	[0.7977]	[1.0000]		[0.8572]	[0.6307]		[0.1972]	[0.0183]		[0.1306]	[0.0018]		[0.3123]	[0.0810]
	0.0004	0.0000		0.0005	0.0000		-0.0003	0.0000		0.0035	0.0000		0.0039	-0.0000
-1	(0.0008)	(0.0006)	14	(0.0008)	(0.0000)	28	(0.0014)	(0.0000)	42	(0.0019)	(0.0000)	56	(0.0026)	(0.0000)
	[0.5870]	[1.0000]		[0.5202]	[0.0974]		[0.8529]	[0.2315]		[0.0633]	[0.6407]		[0.2628]	[0.0596]
	0.0003	0.0002		0.0013	0.0000		0.0008	0.0000		0.0043	0.0000		0.0030	-0.0000
1	(0.0008)	(0.0000)	15	(0.0013)	(0.0000)	29	(0.0013)	(0.0000)	43	(0.0019)	(0.0000)	57	(0.0022)	(0.0000)
	[0.6580]	[1.0000]		[0.3195]	[0.6049]		[0.5372]	[0.1739]		[0.0253]	[0.5142]		[0.1653]	[0.0298]
	0.0001	0.0000		0.0031	0.0000		0.0008	-0.0000		0.0038	0.0000		0.0026	-0.0000
2	(0.0014)	(0.0000)	16	(0.0031)	(0.0000)	30	(0.0013)	(0.0000)	44	(0.0019)	(0.0000)	58	(0.0022)	(0.0000)
	[0.9315]	[1.0000]		[0.1362]	[0.2454]		[0.5569]	[0.0292]		[0.0449]	[0.5536]		[0.2311]	[0.0029]
	0.0003	0.0000		0.0008	0.0000		0.0017	0.0000		0.0035	-0.0000		0.0021	-0.0000
3	(0.0017)	(0.0000)	17	(0.0016)	(0.0000)	31	(0.0014)	(0.0000)	45	(0.0016)	(0.0000)	59	(0.0022)	(0.0000)
	[0.8466]	[1.0000]		[0.5990]	[0.1335]		[0.2255]	[0.1407]		[0.0306]	[0.2507]		[0.3349]	[0.0009]
	-0.0005	0.0000		0.0002	0.0000		0.0004	-0.0000		0.0040	-0.0000		0.0004	-0.0000
4	(0.0011)	(0.0000)	18	(0.0014)	(0.0000)	32	(0.0012)	(0.0000)	46	(0.0014)	(0.0000)	60	(0.0022)	(0.0000)
	[0.9673]	[1.0000]		[0.8824]	[0.0291]		[0.7431]	[0.2069]		[0.0029]	[0.1767]		[0.8545]	[0.0387]

The information in round parentheses is the standard errors and the probability statistics are inserted in square parentheses. The statistic not enclosed in brackets is the relevant CPI surprise coefficient. All values are rounded off to four decimal places.

Table B4: Consumer inflation surprises–stock returns 'FINANCIAL MARKET UPHEAVAL PERIODS' EGARCH model estimation results (70-minute window)

k	θ_1	δ_1	k	θ_1	δ_1	k	θ_1	δ_1	k	θ_1	δ_1	k	θ_1	δ_1
	0.0046	19.6185		-0.0007	2.2638		-0.0025	-5.5579		-0.0025	-9.4519		-0.0067	-8.7521
-10	(0.0000)	(4.1831)	5	(0.0031)	(3.9387)	19	(0.0003)	(8.6290)	33	(0.0000)	(9.1071)	47	(0.0000)	(8.2299)
	[0.0000]	[0.0000]		[0.8205]	[0.5655]		[0.0000]	[0.5195]		[0.0000]	[0.2993]		[0.0000]	[0.2876]
	0.0034	15.8808		-0.0012	0.6280		-0.0027	-3.4446		-0.0009	-12.3233		-0.0061	-14.7732
-9	(0.0000)	(6.8150)	6	(0.0000)	(4.5798)	20	(0.0000)	(3.6131)	34	(0.0011)	(11.7739)	48	(0.0000)	(0.5930)
	[0.0000]	[0.0198]		[0.0000]	[0.8909]		[0.0000]	[0.3404]		[0.4209]	[0.2953]		[0.0000]	[0.0127]
	0.0044	27.5673		-0.0048	6.1376		-0.0019	-4.9499		-0.0056	-10.4211		-0.0069	-10.3298
-8	(0.0000)	(6.6318)	7	(0.0019)	(11.5649)	21	(0.0000)	(3.9859)	35	(0.0017)	(5.0445)	49	(0.000)	(5.9243)
	[0.0000]	[0.0000]		[0.0114]	[0.5956]		[0.0000]	[0.2143]		[0.0007]	[0.0388]		[0.0000]	[0.0822]
	0.0024	24.2050		-0.0045	4.8211		-0.0027	-8.8370		-0.0061	-13.3135		-0.0054	-3.5192
-7	(0.0001)	(5.3463)	8	(0.0006)	(3.7328)	22	(0.0000)	(7.5141)	36	(0.0001)	(0.1353)	50	(0.0004)	(5.7650)
	[0.0000]	[0.0000]		[0.0000]	[0.1965]		[0.0000]	[0.2396]		[0.0000]	[0.0000]		[0.0000]	[0.5416]
	0.0029	12.5410		-0.0048	3.0262		-0.0017	-8.3460		-0.0040	-6.6147		-0.0078	-15.4795
-6	(0.0008)	(3.0615)	9	(0.0007)	(5.7706)	23	(0.0009)	(6.5593)	37	(0.0010)	(5.2278)	51	(0.0011)	(7.8883)
	[0.0002]	[0.0000]		[0.0000]	[0.6000]		[0.0476]	[0.2032]		[0.0001]	[0.2058]		[0.0000]	[0.0497]
	0.0007	-0.0135		-0.0031	-0.5876		-0.0009	-5.8212		-0.0016	-4.3782		-0.0056	-7.4955
-5	(0.0012)	(5.7742)	10	(0.0050)	(5.7089)	24	(0.0006)	(5.6129)	38	(0.0000)	(5.9478)	52	(0.0000)	(8.2530)
	[0.5651]	[0.9981]		[0.5380]	[0.9180]		[0.1712]	[0.2997]		[0.0000]	[0.4617]		[0.0000]	[0.3638]
	0.0014	17.3725		-0.0032	2.9311		-0.0005	-8.5675		-0.0044	-8.9309		-0.0072	-5.7213
-4	(0.0009)	(5.5995)	11	(0.0041)	(3.4213)	25	(0.0019)	(4.7721)	39	(0.0000)	(8.3376)	53	(0.0000)	(9.7637)
	[0.1162]	[0.0019]		[0.4347]	[0.3916]		[0.7946]	[0.0726]		[0.0000]	[0.2841]		[0.0000]	[0.5579]
	0.0020	17.1012		0.0028	-1.6754		0.0007	-5.8356		-0.0048	-6.8831		-0.0088	-6.9259
-3	(0.0000)	(3.9547)	12	(0.0000)	(3.7784)	26	(0.0012)	(4.9117)	40	(0.0000)	(6.9620)	54	(0.0000)	(9.7492)
	[0.0000]	[0.0000]		[0.0000]	[0.6575]		[0.5903]	[0.2348]		[0.0000]	[0.3228]		[0.0000]	[0.4774]
	0.0001	-0.3604		0.0006	1.0371		-0.0014	-5.9737		-0.0058	-6.8504		-0.0101	-4.7564
-2	(0.0002)	(3.6591)	13	(0.0013)	(3.0934)	27	(0.0000)	(6.0769)	41	(0.0000)	(4.2907)	55	(0.0000)	(3.5988)
	[0.6210]	[0.9215]]		[0.6302]	[0.7374]		[0.0000]	[0.3256]		[0.0000]	[0.1104]		[0.0000]	[0.1863]
	0.0019	6.1857		-0.0012	1.7580		0.0002	-5.9572		-0.0044	-7.2516		-0.0093	1.0035
-1	(0.0000)	(4.6742)	14	(0.0005)	(3.0974)	28	(0.0014)	(5.7601)	42	(0.0001)	(8.2026)	56	(0.0000)	(6.4101)
	[0.0000]	[0.1857]		[0.0114]	[0.5703]		[0.8642]	[0.3010]		[0.0000]	[0.3767]		[0.0000]	[0.8702]
	0.0006	-0.0331		-0.0006	-0.0142		-0.0002	-8.6282		-0.0037	-7.3265		-0.0075	-2.4018
1	(0.0000)	(2.1530)	15	(0.0011)	(3.1091)	29	(0.0029)	(7.3278)	43	(0.0002)	(6.7114)	57	(0.0000)	(4.2499)
	[0.0000]	0.9877]		[0.6507]	[0.9964]		[0.9444]	[0.2390]		[0.0000]	[0.2750]		[0.0000]	[0.5720]
	0.0021	3.8827		-0.0011	-0.0531		0.0000	-5.9862		-0.0054	-12.1874		-0.0075	-8.1772
2	(0.0000)	(0.9662)	16	(0.0000)	(3.5317)	30	(0.0000)	(9.5472)	44	(0.0000)	(11.5720)	58	(0.0000)	(6.1787)
	[0.0000]	[0.0001]		[0.0000]	[0.9880]		[0.0000]	[0.5307]		[0.0000]	[0.2923]		[0.0000]	[0.1857]
	-0.0028	-0.0198		0.0011	-0.7217		-0.0035	-12.1386		-0.0070	-9.1267		-0.0071	-9.3608
3	(0.0008)	(3.2370)	17	(0.0009)	(4.9207)	31	(0.0000)	(6.5030)	45	(0.0000)	(13.6756)	59	(0.0000)	(4.7079)
	[0.0002]	[0.9951]		[0.2022]	[0.8834]		[0.0000]	[0.0620]		[0.0000]	[0.5045]		[0.0000]	[0.0468]
	-0.0020	-1.9821		-0.0019	-0.9545		-0.0040	-8.2703		-0.0065	-12.0083		-0.0095	-10.1783
4	(0.0003)	(6.8134)	18	(0.0002)	(3.8537)	32	(0.0000)	(5.6007)	46	(0.0000)	(9.9978)	60	(0.0000)	(5.8591)
	[0.0000]	[0.7711]		[0.0000]	[0.8044]		[0.0000]	(0.1398)		[0.0000]	[0.2297]		[0.0000]	[0.0824]

The information in round parentheses is the standard errors and the probability statistics are inserted in square parentheses. The statistic not enclosed in brackets is the relevant CPI surprise coefficient. All values are rounded off to four decimal places.

Table B5: Consumer inflation surprises–stock returns 'ECONOMIC EXPANSION' TARCH model estimation results (70-minute window)

k	θ_1	δ_1	k	θ_1	δ_1	k	θ_1	δ_1	k	θ_1	δ_1	k	θ_1	δ_1
	0.0001	-0.0000		-3.8088	-0.0002		-0.0006	0.0000		0.0093	0.0000		-0.0021	0.0000
-10	(0.0011)	(0.0000)	5	(0.0057)	(0.1107)	19	(0.0000)	(0.0000)	33	(0.0019)	(0.0000)	47	(0.0026)	(0.0000)
	[0.9194]	[0.3792]		[0.0000]	[0.9984]		[0.0000]	[0.0000]		[0.0000]	[0.0000]		[0.4172]	[0.6975]
	-0.0042	-0.0000		-0.0031	-0.0000		0.0046	-0.0000		-0.0013	-0.0000		0.0001	0.0000
-9	(0.0020)	(0.0000)	6	(0.0014)	(0.0000)	20	(0.0086)	(0.0000)	34	(0.0027)	(0.0000)	48	(0.0024)	(0.0000)
	[0.0310]	[0.0007]		[0.0261]	[0.4865]		[0.6021]	[0.4178]		[0.6226]	[0.1380]		[0.9586]	[0.0000]
	0.0013	-0.0000		-0.0022	-0.0000		0.0019	0.0000		-0.0012	0.0000		0.0045	0.0000
-8	(0.0060)	(0.0000)	7	(0.0011)	(0.0000)	21	(0.0024)	(0.0001)	35	(0.0008)	(0.0000)	49	(0.0661)	(0.0002)
	[0.8347]	[0.8088]		[0.0413]	[0.1685]		[0.4311]	[0.5954]		[0.1227]	[0.5741]		[0.9452]	[0.7300]
	-0.0002	-0.0000		-0.0009	-0.0000		0.0012	0.0000		0.0001	-0.0000		0.0004	0.0000
-7	(0.0012)	(0.0000)	8	(0.0013)	(0.0000)	22	(0.0028)	(0.0000)	36	(0.0025)	(0.0000)	50	(8.1967)	(3.5638)
	[0.8378]	[0.5201]		[0.4815]	[0.9643]		[0.6526]	[0.5090]		[0.9617]	[0.2690]		[1.0000]	[1.0000]
	-0.0004	-0.0000		0.0034	-0.0000		-0.0021	-0.0000		0.0004	-0.0000		0.0036	0.0000
-6	(0.0010)	(0.0000)	9	(0.0015)	(0.0000)	23	(0.0020)	(0.0000)	37	(0.0027)	(0.0000)	51	(0.6944)	(0.0004)
	[0.7018]	[0.5697]		[0.0226]	[0.1243]		[0.2941]	[0.5749]		[0.8773]	[0.2740]		[0.9959]	[0.9934]
	-0.0003	0.0000		0.0038	-0.0000		-0.0021	-0.0000		-0.0015	-0.0000		0.0026	0.0000
-5	(0.0018)	(0.0000)	10	(0.0026)	(0.0000)	24	(0.0012)	(0.0000)	38	(0.0006)	(0.0000)	52	(0.0052)	(0.0000)
	[0.8678]	[1.0000]		[0.1473]	[0.1385]		[0.3174]	[0.6175]		[0.0172]	[0.8491]		[0.6163]	[0.8744]
	-0.0003	0.0000		0.0046	-0.0000		0.0014	0.0000		0.0006	-0.0000		-0.0032	-0.0000
-4	(0.0014)	(0.0000)	11	(0.0025)	(0.0000)	25	(0.0034)	(0.0000)	39	(0.0029)	(0.0000)	53	(0.0034)	(0.0000)
	[0.8527]	[1.0000]		[0.0674]	[0.4520]		[0.3023]	[0.2684]		[0.8372]	[0.4871]		[0.3398]	[0.2651]
	-0.0000	-0.0000		0.0044	-0.0000		0.0030	0.0001		-0.0003	-0.0000		-0.0015	-0.0000
-3	(0.0013)	(0.0000)	12	(0.0019)	(0.0000)	26	(0.0027)	(0.0000)	40	(0.0021)	(0.0000)	54	(0.0036)	(0.0000)
	[0.9737]	[1.0000]		[0.0241]	[0.4669]		[0.2686]	[0.0683]		[0.8760]	[0.2000]		[0.6698]	[0.8406]
	0.0000	0.0000		0.0140	-0.0000		0.0025	0.0000		0.0058	0.0000		-0.0021	0.0000
-2	(0.0018)	(0.0000)	13	(0.0079)	(0.0000)	27	(0.0028)	(0.0002)	41	(0.0069)	(0.0000)	55	(0.0031)	(0.0000)
	[0.9768]	[1.0000]		[0.0780]	[0.6596]		[0.3795]	[0.5555]		[0.4028]	[0.7883]		[0.4962]	[0.6957]
	0.0010	0.0000		0.0013	0.0000		-0.0002	0.0000		0.0051	0.0000		-0.0016	-0.0000
-1	(0.0011)	(0.0000)	14	(0.4898)	(0.0004)	28	(0.0052)	(0.0000)	42	(0.0047)	(0.0000)	56	(0.0037)	(0.000)
	[0.3722]	[1.0000]		[0.9978]	[0.9825]		[0.9691]	[0.0000]		[0.2811]	[0.8740]		[0.6701]	[0.7176]
	-0.0000	0.0000		-0.0007	0.0000		-0.0000	0.0000		0.0038	0.0000		-0.0027	0.0000
1	(0.0010)	(0.0000)	15	(0.2470)	(0.0000)	29	(0.0000)	(0.0000)	43	(0.0043)	(0.0000)	57	(0.0002)	(0.0000)
	[0.9358]	[1.0000]		[0.9978]	[0.9755]		[0.0000]	[0.0000]		[0.3755]	[0.8838]		[0.0000]	[0.0814]
	-0.0008	0.0000		0.0014	0.0000		0.0075	0.0006		-0.0008	0.0000		-0.0034	0.0000
2	(0.0015)	(0.0000)	16	(0.0000)	(0.0000)	30	(0.0394)	(0.0000)	44	(0.0000)	(0.0000)	58	(0.0209)	(0.0000)
	[0.6192]	[1.0000]		[0.0000]	[0.0643]		[0.8501]	[0.0000]		[0.0000]	[0.3375]		[0.8676]	[0.8261]
	-0.0008	0.0000		0.0000	0.0000		-0.0002	0.0000		0.0028	0.0000		-0.0020	-0.0000
3	(0.0023)	(0.0000)	17	(0.0000)	(0.0000)	31	(0.0000)	(0.0000)	45	(0.0036)	(0.0000)	59	(0.0027)	(0.0000)
	[0.7232]	[1.0000]		[0.0000]	[0.0000]		[0.0000]	[0.0000]		[0.4301]	[0.7994]		[0.4575]	[0.8511]
	-0.0017	0.0000		-0.0010	0.0000		0.0081	0.0000		-0.0005	0.0000		0.0014	0.0000
4	(0.0031)	(0.0000)	18	(0.0000)	(0.0000)	32	(0.0057)	(0.0000)	46	(0.0055)	(0.0000)	60	(0.0054)	(0.0000)
	[0.5894]	[1.0000]		[0.0000]	[0.0000]		[0.1561]	[0.7458]		[0.9233]	[0.9909]		[0.7931]	[0.4403]

The information in round parentheses is the standard errors and the probability statistics are inserted in square parentheses. The statistic not enclosed in brackets is the relevant CPI surprise coefficient. All values are rounded off to four decimal places.

Table B6: Consumer inflation surprises–stock returns 'ECONOMIC RECESSION' TARCH model estimation results (70-minute window)

k	θ_1	δ_1	k	θ_1	δ_1	k	θ_1	δ_1	k	θ_1	δ_1	k	θ_1	δ_1
	0.0015	0.0000		0.0010	0.0000		-0.0020	-0.0000		-0.3030	-0.0002		0.0033	-0.0000
-10	(0.0008)	(0.0000)	5	(0.0032)	(0.0000)	19	(0.1041)	(0.0000)	33	(0.0000)	(0.0004)	47	(0.0053)	(0.0000)
	[0.0767]	[0.3095]		[0.7574]	[1.0000]		[0.9843]	[0.9842]		[0.0000]	[0.6556]		[0.5319]	[0.6453]
	0.0017	-0.5791		0.0004	0.0000		0.0072	-0.0005		-0.0012	-0.0002		0.0041	-0.0000
-9	(0.0007)	(1.9598)	6	(0.0012)	(0.0000)	20	(0.0000)	(0.0000)	34	(0.0989)	(0.3127)	48	(0.0059)	(0.0000)
	[0.0170]	[0.7676]		[0.6989]	[0.1318]		[0.0000]	[0.0000]		[0.9900]	[0.9996]		[0.4971]	[0.6209]
	0.0011	-0.3809		-0.0004	0.0000		0.0040	-0.0002		-0.0046	0.0000		-0.0211	0.0000
-8	(0.0008)	(2.0231)	7	(0.0023)	(0.0000)	21	(0.0181)	(0.0000)	35	(0.0040)	(0.0004)	49	(0.0384)	(0.0000)
	[0.1566]	[0.8507]		[0.8539]	[0.2580]		[0.8240]	[0.0000]		[0.2477]	[0.8148]		[0.5822]	[0.5807]
	0.0009	-0.4159		0.0006	-0.0000		-0.0001	-0.0000		-0.0241	0.0000		-0.3252	0.0010
-7	(0.0003)	(1.5287)	8	(0.0007)	(0.0000)	22	(0.0054)	(0.0000)	36	(0.0426)	(0.0000)	50	(0.0009)	(0.0000)
	[0.0040]	[0.6357]		[0.3405]	[0.0021]		[0.9842]	[0.9811]		[0.5718]	[0.5958]		[0.0000]	[0.0000]
	0.0006	-0.0032		-0.0000	-0.0294		-0.0038	0.0000		-0.0045	0.0001		0.0018	0.0000
-6	(0.0007)	(0.0043)	9	(0.0017)	(0.2696)	23	(0.0031)	(0.0000)	37	(0.0043)	(0.0000)	51	(0.0011)	(0.0000)
	[0.3312]	[0.5796]		[0.9596]	[0.9131]		[0.2278]	[0.0244]		[0.2907]	[0.2627]		[0.1021]	[0.0083]
	0.0014	0.0000		0.0008	0.0000		-0.0036	0.0000		0.0070	0.0002		0.0046	0.0000
-5	(0.0036)	(0.0000)	10	(0.0011)	(0.0000)	24	(0.0032)	(0.0000)	38	(0.0046)	(0.0004)	52	(0.0023)	(0.0000)
	[0.6966]	[1.0000]		[0.4379]	[0.2428]		[0.2567]	[0.0663]		[0.1301]	[0.6468]		[0.0473]	[0.8356]
	0.0014	0.0000		-0.0004	0.0000		-0.0034	0.0000		0.0061	-0.0000		0.0004	0.0000
-4	(0.0034)	(0.0000)	11	(0.0000)	(0.0000)	25	(0.0045)	(0.0000)	39	(0.0022)	(0.0000)	53	(0.0012)	(0.0000)
	[0.6776]	[1.0000]		[0.0000]	[0.0000]		[0.4445]	[0.2437]		[0.0061]	[0.0256]		[0.7648]	[0.0479]
	0.0009	0.0000		0.0014	0.0000		-0.0013	0.0000		0.0079	-0.0000		0.0026	0.0000
-3	(0.0037)	(0.0000)	12	(0.0004)	(0.0000)	26	(0.0071)	(0.0000)	40	(0.0022)	(0.0000)	54	(0.0010)	(0.0000)
	[0.7994]	[1.0000]		[0.0007]	[0.0000]		[0.8488]	[0.8363]		[0.0004]	[0.0067]		[0.0072]	[0.0000]
	0.0002	-0.9336		0.0025	-0.0003		-0.0049	0.0000		0.0078	-0.0000		-0.0028	0.0000
-2	(0.0002)	(1.3532)	13	(0.0074)	(0.0003)	27	(0.0137)	(0.0000)	41	(0.0023)	(0.0000)	55	(0.0063)	(0.0000)
	[0.5746]	[0.4903]]		[0.7331]	[0.3368]		[0.7199]	[0.5830]		[0.0006]	[0.0069]		[0.6613]	[0.1012]
	0.0004	0.0000		0.0005	0.0000		0.0038	-0.0000		-0.0173	0.0000		0.0011	0.0000
-1	(0.0040)	(0.0000)	14	(0.0027)	(0.0000)	28	(0.3482)	(0.0002)	42	(0.0578)	(0.0000)	56	(0.0047)	(0.0000)
	[0.9088]	[1.0000]		[0.8506]	[1.0000]		[0.9912]	[0.9956]		[0.7642]	[0.7490]		[0.8178]	[0.9307]
	0.0006	0.0000		0.0075	0.0000		0.0064	-0.0000		0.0053	-0.0000		-0.0013	-0.0006
1	(0.0010)	(0.0000)	15	(0.0000)	(0.0000)	29	(0.0000)	(0.0000)	43	(0.0079)	(0.0000)	57	(0.0251)	(0.0000)
	[0.5244]	[1.0000]		[0.0000]	[0.0000]		[0.0000]	[0.0000]		[0.5012]	[0.6645]		[0.9591]	[0.0000]
	0.0032	-0.0000		0.0002	-0.0000		-0.0003	-0.0000		0.0051	-0.0000		-0.0032	0.0000
2	(0.0000)	(0.0000)	16	(0.0000)	(0.0000)	30	(0.0020)	(0.0000)	44	(0.0076)	(0.0000)	58	(0.0051)	(0.0000)
	[0.0000]	[0.0000]		[0.0000]	[0.0000]		[0.8961]	[0.2903]		[0.4988]	[0.6755]		[0.5371]	[0.0001]
	0.0006	0.0000		-0.0027	-0.0000		-0.0125	0.0000		0.0050	-0.0000		0.0004	0.0000
3	(0.0024)	(0.0000)	17	(0.0000)	(0.0000)	31	(0.0256)	(0.0000)	45	(0.0081)	(0.0000)	59	(0.0070)	(0.0000)
	[0.8201]	[1.0000]		[0.0000]	[0.0000]		[0.6264]	[0.6722]		[0.5418]	[0.6693]		[0.9498]	[1.0000]
	0.0005	0.0000		-0.0094	-0.0000		0.0054	-0.0000		0.0043	-0.0000		-0.3037	0.0004
4	(0.0027)	(0.0000)	18	(0.0747)	(0.0003)	32	(0.0028)	(0.0000)	46	(0.0070)	(0.0000)	60	(0.0000)	(0.0064)
	[0.8420]	[1.0000]		[0.8995]	[0.9408]		[0.0512]	[0.3753]		[0.5351]	[0.6583]		[0.0000]	[0.9558]

The information in round parentheses is the standard errors and the probability statistics are inserted in square parentheses. The statistic not enclosed in brackets is the relevant CPI surprise coefficient. All values are rounded off to four decimal places.

Table B7: Trade balance surprises–stock returns 'NORMAL TIMES' EGARCH model estimation results (70-minute window)

k	θ_1	δ_1	k	θ_1	δ_1	k	θ_1	δ_1	k	θ_1	δ_1	k	θ_1	δ_1
	-0.0000	-0.0531		-0.0000	-0.0147		-0.0000	-0.0614		0.0000	0.0020		0.0047	-0.0019
-10	(0.0000)	(0.0313)	5	(0.0000)	(0.0265)	19	(0.0000)	(0.0386)	33	(0.0000)	(0.0274)	47	(0.0000)	(0.0320)
	[0.4350]	[0.0900]		[0.0001]	[0.5807]		[0.8582]	[0.1114]		[0.6551]	[0.9422]		[0.9368]	[0.9535]
	-0.0000	-0.0264		-0.0000	-0.0023		-0.0000	-0.0866		-0.0003	-0.0186		-0.0000	0.0029
-9	(0.0000)	(0.0230)	6	(0.0000)	(0.0096)	20	(0.0000)	(0.0085)	34	(0.0009)	(0.0112)	48	(0.0003)	(0.0260)
	[0.1453]	[0.2508]		[0.0000]	[0.8137]		[0.8631]	[0.0000]		[0.7185]	[0.0969]		[0.9497]	[0.9112]
	-0.0000	-0.0313		-0.0000	-0.0251		0.0000	-0.0736		0.0002	-0.0595		0.0002	-0.0382
-8	(0.0000)	(0.0182)	7	(0.0000)	(0.0113)	21	(0.0000)	(0.0340)	35	(0.0011)	(0.0334)	49	(0.0006)	(0.0009)
	[0.2643]	[0.0856]		[0.0000]	[0.0260]		[0.8344]	[0.0301]		[0.8188]	[0.0749]		[0.7108]	[0.0000]
	-0.0000	-0.0439		-0.0000	-0.0060		-0.0000	-0.0621		0.0000	0.0004		-0.0000	-0.0373
-7	(0.0000)	(0.0276)	8	(0.0000)	(0.0288)	22	(0.0000)	(0.0392)	36	(0.0000)	(0.0300)	50	(0.0000)	(0.0082)
	[0.4466]	[0.1117]		[0.0000]	[0.8368]		[0.9759]	[0.1124]		[0.7900]	[0.9905]		[0.9820]	[0.0000]
	-0.0000	-0.0413		-0.0000	-0.0042		0.0000	-0.0205		-0.0000	-0.0690		-0.0003	-0.0289
-6	(0.0000)	(0.0261)	9	(0.0000)	(0.0302)	23	(0.0000)	(0.0322)	37	(0.0000)	(0.0094)	51	(0.0007)	(0.0120)
	[0.5145]	[0.1135]		[0.0840]	[0.8884]		[0.9183]	[0.5241]		[0.5319]	[0.0000]		[0.7236]	[0.0158]
	-0.0000	-0.0384		-0.0000	0.0398		0.0000	0.0000		-0.0000	0.0940		-0.0003	-0.0416
-5	(0.0000)	(0.0261)	10	(0.0000)	(0.0141)	24	(0.0000)	(0.0269)	38	(0.0000)	(0.0227)	52	(0.0011)	(0.0090)
	[0.5173]	[0.1409]		[0.0000]	[0.0047]		[0.9580]	[1.0000]		[0.0000]	[0.0000]		[0.8125]	[0.0000]
	-0.0000	0.0369		-0.0000	-0.0202		0.0000	-0.0039		0.0000	0.0309		-0.0000	-0.0698
-4	(0.0000)	(0.0291)	11	(0.0000)	(0.0288)	25	(0.0000)	(0.0306)	39	(0.0000)	(0.0280)	53	(0.0000)	(0.0351)
	[0.4004]	[0.2094]		[0.2106]	[0.4833]		[0.9958]	[0.8995]		[0.5485]	[0.2694]		[0.8109]	[0.0468]
	-0.0000	-0.0173		-0.0000	-0.0335		0.0000	-0.0003		0.0000	0.0261		-0.0000	-0.0215
-3	(0.0000)	(0.0091)	12	(0.0000)	(0.0247)	26	(0.0000)	(0.0302)	40	(0.0000)	(0.0279)	54	(0.0001)	(0.0397)
	[0.0522]	[0.0586]		[0.0487]	[0.1743]		[0.7072]	[0.9921]		[0.3971]	[0.3471]		[0.7134]	[0.5873]
	-0.0000	0.0084		-0.0000	0.0002		0.0000	0.0042		-0.0000	-0.0794		0.0000	-0.0087
-2	(0.0000)	(0.0157)	13	(0.0000)	(0.0073)	27	(0.0000)	(0.0330)	41	(0.0000)	(0.1347)	55	(0.0001)	(0.0208)
	[0.2338]	[0.5919]]		[0.0038]	[0.9833]		[0.7857]	[0.9000]		[0.0015]	[0.0000]		[0.6643]	[0.6766]
	-0.0000	0.0029		-0.0000	-0.0444		0.0000	0.0158		0.0000	-0.0247		-0.0000	-0.0061
-1	(0.0000)	(0.0177)	14	(0.0000)	(0.0302)	28	(0.0000)	(0.0316)	42	(0.0001)	(0.0091)	56	(0.0000)	(0.0396)
	[0.2511]	[0.8692]		[0.4954]	[0.1413]		[0.8488]	[0.6176]		[0.8580]	[0.0066]		[0.8424]	[0.8783]
	-0.0000	0.0112		-0.0000	-0.0300		0.0000	0.0293		-0.0000	-0.0330		0.0000	0.0080
1	(0.0000)	(0.0244)	15	(0.0000)	(0.0203)	29	(0.0000)	(0.0309)	43	(0.0000)	(0.0083)	57	(0.0001)	(0.0344)
	[0.0016]	[0.6468]		[0.2265]	[0.1450]		[0.7278]	[0.3418]		[0.3872]	[0.0001]		[0.9390]	[0.8169]
	-0.0000	0.0620		-0.0000	-0.0576		0.0000	0.0251		0.0013	0.0026		0.0000	0.0231
2	(0.0000)	(0.0276)	16	(0.0000)	(0.0118)	30	(0.0000)	(0.0314)	44	(0.0014)	(0.0339)	58	(0.0001)	(0.0349)
	[0.0001]	[0.0249]		[0.5384]	[0.0000]		[0.5946]	[0.4240]		[0.9264]	[0.9391]		[0.7430]	[0.5082]
	-0.0000	0.0267		0.0000	-0.0861		0.0000	0.0074		0.0000	-0.0581		-0.0000	0.0076
3	(0.0000)	(0.0290)	17	(0.0000)	(0.0075)	31	(0.0000)	(0.0314)	45	(0.0000)	(0.0252)	59	(0.0000)	(0.0154)
	[0.0000]	[0.3570]		[0.1186]	[0.0000]		[0.6064]	[0.8140]		[0.3256]	[0.0212]		[0.9289]	[0.6250]
	-0.0000	-0.0042		-0.0000	-0.0796		0.0000	0.0060		0.0000	-0.0533		0.0000	0.0071
4	(0.0000)	(0.0256)	18	(0.0000)	(0.0363)	32	(0.0000)	(0.0256)	46	(0.0000)	(0.0241)	60	(0.0000)	(0.0136)
	[0.0007]	[0.8860]		[0.7950]	[0.0283]		[0.7430]	[0.8142]		[0.3251]	[0.0270]		[0.8435]	[0.6016]

The information in round parentheses is the standard errors and the probability statistics are inserted in square parentheses. The statistic not enclosed in brackets is the relevant trade balance surprise coefficient. All values are rounded off to four decimal places.

Table B8: Trade balance surprises–stock returns 'FINANCIAL MARKET UPHEAVAL PERIODS' EGARCH model estimation results (70-minute window)

k	θ_1	δ_1	k	θ_1	δ_1	k	θ_1	δ_1	k	θ_1	δ_1	k	θ_1	δ_1
	0.0000	0.0761		0.0000	0.1468		0.0000	0.1083		0.0000	0.1173		0.0000	-0.0036
-10	(0.0000)	(0.0592)	5	(0.0000)	(0.0436)	19	(0.0000)	(0.0174)	33	(0.0000)	(0.0630)	47	(0.0000)	(0.0679)
	[0.4930]	[0.1985]		[0.0000]	[0.0007]		[0.0000]	[0.0000]		[0.0000]	[0.0627]		[0.0067]	[0.5915]
	0.0000	0.1988		0.0000	0.0778		0.0000	0.1149		0.0001	0.1206		0.0000	-0.0385
-9	(0.0000)	(0.0355)	6	(0.0000)	(0.0523)	20	(0.0000)	(0.0311)	34	(0.0000)	(0.0539)	48	(0.0000)	(0.0926)
	[0.2435]	[0.0000]		[0.4843]	[0.1362]		[0.0271]	[0.0002]		[0.0000]	[0.0252]		[0.0820]	[0.6776]
	-0.0000	0.1364		0.0000	0.1127		-0.0000	0.0000		0.0001	0.0482		0.0000	-0.0029
-8	(0.0000)	(0.4052)	7	(0.0000)	(0.0297)	21	(0.0000)	(0.0349)	35	(0.0000)	(0.0056)	49	(0.0000)	(0.0661)
	[0.6168]	[0.0008]		[0.0012]	[0.0001]		[0.9889]	[1.0000]		[0.0000]	[0.3927]		[0.0021]	[0.9648]
	0.0000	0.0096		-0.0000	0.2508		0.0000	0.0798		0.0001	0.0515		0.0000	0.0008
-7	(0.0000)	(0.0116)	8	(0.0000)	(0.0267)	22	(0.0000)	(0.0480)	36	(0.0000)	(0.0074)	50	(0.0000)	(0.0473)
	[0.0684]	[0.4061]		[0.0000]	[0.0000]		[0.0000]	[0.0968]		[0.0000]	[0.4862]		[0.0000]	[0.9860]
	0.0000	0.2316		0.0000	0.1680		-0.0000	0.1063		0.0001	0.1051		0.0001	0.0154
-6	(0.0000)	(0.0804)	9	(0.0000)	(0.0295)	23	(0.0000)	(0.0566)	37	(0.0000)	(0.0166)	51	(0.0000)	(0.0623)
	[0.0000]	[0.0040]		[0.0000]	[0.0000]		[0.0000]	[0.0603]		[0.0000]	[0.0000]		[0.0000]	[0.8050]
	0.0000	0.0293		-0.0000	0.1488		0.0000	0.1077		0.0000	-0.0228		0.0001	0.0403
-5	(0.0000)	(0.0211)	10	(0.0000)	(0.0331)	24	(0.0000)	(0.0256)	38	(0.0000)	(0.1230)	52	(0.0000)	(0.0500)
	[0.0000]	[0.1646]		[0.0000]	[0.0000]		[0.0000]	[0.0000]		[0.7633]	[0.8530]		[0.0000]	[0.4196]
	0.0000	0.0041		-0.0000	0.0729		0.0000	0.0829		0.0000	0.0147		0.0001	-0.0701
-4	(0.0000)	(0.0735)	11	(0.0000)	(0.0383)	25	(0.0000)	(0.0118)	39	(0.0000)	(0.1572)	53	(0.0000)	(0.0727)
	[0.0000]	[0.9557]		[0.0000]	[0.0574]		[0.0000]	[0.0000]		[0.4149]	[0.9255]		[0.0000]	[0.3345]
	-0.0000	-0.1099		0.0000	0.0570		0.0001	0.0753		0.0000	0.0181		0.0001	0.0616
-3	(0.0000)	(0.0595)	12	(0.0000)	(0.0527)	26	(0.0000)	(0.0345)	40	(0.0000)	(0.1344)	54	(0.0000)	(0.0547)
	[0.0000]	[0.0648]		[0.0000]	[0.2794]		[0.0000]	[0.0290]		[0.3300]	[0.8930]		[0.0000]	[0.2603]
	-0.0000	-0.0166		0.0000	0.1109		0.0000	0.0006		0.0000	-0.0216		0.0001	-0.0758
-2	(0.0000)	(0.0342)	13	(0.0000)	(0.0531)	27	(0.0000)	(0.0841)	41	(0.0000)	(0.1135)	55	(0.0000)	(0.1184)
	[0.8098]	[0.6269]]		[0.0185]	[0.0370]		[0.0000]	[0.9948]		[0.2002]	[0.8487]		[0.0000]	[0.5220]
	0.0000	-0.0234		0.0000	0.0026		0.0001	0.0707		0.0000	-0.0158		0.0001	-0.0091
-1	(0.0000)	(0.0292)	14	(0.0000)	(0.0546)	28	(0.0000)	(0.0365)	42	(0.0000)	(0.1011)	56	(0.0000)	(0.0535)
	[0.0000]	[0.4227]		[0.0850]	[0.9619]		[0.0000]	[0.0529]		[0.1409]	[0.8757]		[0.0000]	[0.9573]
	0.0000	0.2220		0.0000	0.0838		0.0001	0.0783		0.0000	0.0259		0.0001	0.0391
1	(0.0000)	(0.0799)	15	(0.0000)	(0.0521)	29	(0.0000)	(0.0193)	43	(0.0000)	(0.1168)	57	(0.0000)	(0.0491)
	[0.0000]	[0.0054]		[0.0000]	[0.1080]		[0.0000]	[0.0001]		[0.2264]	[0.8248]		[0.0000]	[0.4257]
	0.0000	0.2201		0.0000	0.1268		0.0001	0.0734		0.0001	0.0689		0.0001	-0.0662
2	(0.0000)	(0.0383)	16	(0.0000)	(0.0607)	30	(0.0000)	(0.0606)	44	(0.0000)	(0.0339)	58	(0.0000)	(0.1001)
	[0.0000]	[0.0000]		[0.0000]	[0.0367]		[0.0000]	[0.2263]		[0.0029]	[0.0424]		[0.0000]	[0.5084]
	0.0000	0.0553		0.0000	0.1299		0.0001	0.0730		0.0000	0.0238		0.0001	0.0021
3	(0.0000)	(0.0435)	17	(0.0000)	(0.0436)	31	(0.0000)	(0.0360)	45	(0.0000)	(0.1027)	59	(0.0000)	(0.1877)
	[0.4791]	[0.2036]		[0.0000]	[0.0029]		[0.0764]	[0.0426]		[0.3256]	[0.8166]		[0.0000]	[0.9910]
	-0.0000	0.1167		0.0000	0.0675		0.0001	0.0688		0.0000	0.0387		0.0001	0.0631
4	(0.0000)	(0.0526)	18	(0.0000)	(0.0566)	32	(0.0000)	(0.0356)	46	(0.0000)	(0.1035)	60	(0.0000)	(0.1356)
	[0.3925]	[0.0380]		[0.0344]	[0.2334]		[0.3118]	[0.0533]		[0.1081]	[0.7087]		[0.0000]	[0.6415]

The information in round parentheses is the standard errors and the probability statistics are inserted in square parentheses. The statistic not enclosed in brackets is the relevant trade balance surprise coefficient. All values are rounded off to four decimal places.

Table B9: Trade balance surprises–stock returns 'ECONOMIC EXPANSION' EGARCH model estimation results (70-minute window)

k	θ_1	δ_1	k	θ_1	δ_1	k	θ_1	δ_1	k	θ_1	δ_1	k	θ_1	δ_1
	-0.0000	0.0372		-0.0000	-0.0636		-0.0000	0.0429		0.0000	0.0415		0.0000	0.0234
-10	(0.0000)	(0.0351)	5	(0.0000)	(0.0336)	19	(0.0000)	(0.0218)	33	(0.0000)	(0.0289)	47	(0.0000)	(0.0232)
	[0.6402]	[0.2894]		[0.0000]	[0.0583]		[0.0002]	[0.0490]		[0.7319]	[0.1517]		[0.0006]	[0.3128]
	-0.0000	0.0550		-0.0000	0.0006		-0.0000	0.0170		0.0000	0.0362		0.0000	0.0229
-9	(0.0000)	(0.0307)	6	(0.0000)	(0.0326)	20	(0.0000)	(0.0021)	34	(0.0000)	(0.0252)	48	(0.0000)	(0.0293)
	[0.9487]	[0.0734]		[0.0000]	[0.9865]		[0.0000]	[0.0000]		[0.8371]	[0.1505]		[0.1232]	[0.4357]
	-0.0000	-0.0000		-0.0000	-0.0362		-0.0000	0.0284		0.0000	0.0327		0.0000	0.0184
-8	(0.0000)	(0.0254)	7	(0.0000)	(0.0309)	21	(0.0000)	(0.0068)	35	(0.0000)	(0.0184)	49	(0.0000)	(0.0277)
	[0.4159]	[0.4587]		[0.0003]	[0.2423]		[0.0000]	[0.0000]		[0.0178]	[0.0765]		[0.2636]	[0.5066]
	-0.0000	-0.0439		-0.0000	-0.0318		-0.0000	0.0415		0.0000	0.0156		0.0000	-0.010
-7	(0.0001)	(0.0289)	8	(0.0000)	(0.0253)	22	(0.0000)	(0.0064)	36	(0.0000)	(0.0279)	50	(0.0000)	(0.0257)
	[0.4024]	[0.4131]		[0.0000]	[0.2095]		[0.0000]	[0.0000]		[0.3703]	[0.5768]		[0.4289]	[0.7114]
	-0.0000	-0.0150		-0.0000	0.0717		-0.0000	0.0619		-0.0000	-0.0026		0.0000	0.0164
-6	(0.0000)	(0.0302)	9	(0.0000)	(0.0210)	23	(0.0000)	(0.0284)	37	(0.0004)	(0.0262)	51	(0.0000)	(0.0098)
	[0.0359]	[0.6194]		[0.0000]	[0.0006]		[0.0709]	[0.0295]		[0.9244]	[0.9201]		[0.0159]	[0.0939]
	-0.0000	-0.7273		-0.0000	0.0422		-0.0000	0.0740		-0.0000	0.0348		0.0000	0.0120
-5	(0.0000)	(0.0317)	10	(0.0000)	(0.0040)	24	(0.0000)	(0.0304)	38	(0.0002)	(0.0266)	52	(0.0000)	(0.0117)
	[0.7273]	[0.8716]		[0.0066]	[0.0000]		[0.0592]	[0.0150]		[0.8135]	[0.1909]		[0.1662]	[0.3068]
	0.0000	-0.0125		-0.0000	-0.0139		-0.0000	0.0634		0.0000	0.0155		0.0000	0.0188
-4	(0.0000)	(0.0176)	11	(0.0000)	(0.0302)	25	(0.0000)	(0.0098)	39	(0.0000)	(0.0222)	53	(0.0000)	(0.0250)
	[0.3115]	[0.4772]		[0.0072]	[0.6453]		[0.0266]	[0.0000]		[0.1014]	[0.4862]		[0.3376]	[0.4507]
	0.0000	-0.0438		-0.0000	0.0435		-0.0000	0.0696		0.0000	0.0188		0.0313	0.0000
-3	(0.0000)	(0.0317)	12	(0.0000)	(0.0003)	26	(0.0000)	(0.0061)	40	(0.0000)	(0.0210)	54	(0.0293)	(0.0000)
	[0.0082]	[0.1677]		[0.0000]	[0.0000]		[0.0000]	[0.0000]		[0.1547]	[0.3695]		[0.2847]	[0.5023]
	-0.0000	-0.0416		-0.0000	0.0441		0.0000	0.0647		0.0000	0.0357		0.0000	0.0366
-2	(0.0000)	(0.0181)	13	(0.0000)	(0.0162)	27	(0.0000)	(0.0050)	41	(0.0000)	(0.0194)	55	(0.0000)	(0.0178)
	[0.0037]	[0.0213]		[0.3620]	[0.0063]		[0.2237]	[0.0000]		[0.0691]	[0.0658]		[0.0833]	[0.0399]
	-0.0000	-0.0512		-0.0000	-0.0194		0.0000	0.0605		0.0000	0.0211		0.0000	-0.0260
-1	(0.0000)	(0.0223)	14	(0.0000)	(0.0140)	28	(0.0000)	(0.0303)	42	(0.0000)	(0.0209)	56	(0.0000)	(0.0268)
	[0.8317]	[0.0153]		[0.0000]	[0.1638]		[0.8346]	[0.0459]		[0.0383]	[0.3118]		[0.9939]	[0.3316]
	-0.0000	0.0168		-0.0000	0.0119		0.0000	0.0441		0.0000	0.0258		0.0000	0.0343
1	(0.0000)	(0.0112)	15	(0.0000)	(0.0222)	29	(0.0000)	(0.0083)	43	(0.0000)	(0.0120)	57	(0.0000)	(0.0248)
	[0.0000]	[0.1332]		[0.0165]	[0.5921]		[0.2713]	[0.0000]		[0.0228]	[0.1970]		[0.3383]	[0.1674]
	-0.0000	0.0102		-0.0000	0.0375		0.0000	0.0552		0.0000	0.0335		-0.0000	0.0290
2	(0.0000)	(0.0104)	16	(0.0000)	(0.0188)	30	(0.0000)	(0.0146)	44	(0.0000)	(0.0159)	58	(0.0000)	(0.0243)
	[0.0002]	[0.3284]		[0.0000]	[0.0465]		[0.0125]	[0.0002]		[0.0000]	[0.0355]		[0.3020]	[0.2335]
	-0.0000	-0.0283		-0.0000	0.0764		0.0000	0.0631		0.0000	0.0303		0.0000	0.0344
3	(0.0000)	(0.0018)	17	(0.0000)	(0.0285)	31	(0.0000)	(0.0109)	45	(0.0000)	(0.0225)	59	(0.0000)	(0.0112)
	[0.0000]	[0.0000]		[0.0000]	[0.0073]		[0.0000]	[0.0000]		[0.0001]	[0.1780]		[0.0080]	[0.0021]
	-0.0000	0.0081		-0.0000	0.0008		0.0000	0.0425		0.0000	0.0283		-0.0000	0.0369
4	(0.0000)	(0.0333)	18	(0.0000)	(0.0222)	32	(0.0000)	(0.0287)	46	(0.0000)	(0.0244)	60	(0.0000)	(0.0120)
	[0.0000]	[0.8081]		[0.0007]	[0.9729]		[0.7346]	[0.1383]		[0.0639]	[0.2464]		[0.8966]	[0.0609]

The information in round parentheses is the standard errors and the probability statistics are inserted in square parentheses. The statistic not enclosed in brackets is the relevant trade balance surprise coefficient. All values are rounded off to four decimal places.

Table B10: Trade balance surprises–stock returns 'ECONOMIC RECESSION' EGARCH model estimation results (70-minute window)

k	θ_1	δ_1	k	θ_1	δ_1	k	θ_1	δ_1	k	θ_1	δ_1	k	θ_1	δ_1
	-0.0000	-0.0193		-0.0000	-0.0265		-0.0000	0.0253		0.0000	-0.0266		0.0000	-0.0265
-10	(0.0000)	(0.0327)	5	(0.0000)	(0.0215)	19	(0.0000)	(0.0507)	33	(0.0000)	(0.0328)	47	(0.0000)	(0.0317)
	[0.8194]	[0.5537]		[0.5548]	[0.2187]		[0.5860]	[0.6178]		[0.3067]	[0.4168]		[0.6238]	[0.4021]
	-0.0000	-0.0224		-0.0000	0.0013		0.0000	-0.0231		-0.0000	-0.0234		0.0000	-0.0245
-9	(0.0000)	(0.0274)	6	(0.0000)	(0.0401)	20	(0.0000)	(0.0300)	34	(0.0000)	(0.0037)	48	(0.0000)	(0.0315)
	[0.7113]	[0.4129]		[0.0092]	[0.9741]		[0.2573]	[0.4416]		[0.4429	[0.0000]		[0.6303]	[0.4359]
	-0.0000	0.0000		-0.0000	-0.0345		-0.0000	0.0311		0.0000	-0.0366		0.0000	0.000
-8	(0.0000)	(0.0324)	7	(0.0000)	(0.0446)	21	(0.0000)	(0.0406)	35	(0.0000)	(0.0276)	49	(0.0000)	(0.0277)
	[0.1552]	[1.0000]		[0.0069]	[0.4389]		[0.4766]	[0.4440]		[0.6524	[0.1847]		[0.9597]	[0.3283]
	-0.0000	-0.0410		-0.0000	-0.0290		-0.0000	-0.0415		0.0000	-0.0377		0.0001	0.0342
-7	(0.0000)	(0.0301)	8	(0.0000)	(0.0441)	22	(0.0000)	(0.0417)	36	(0.0000)	(0.0364)	50	(0.0000)	(0.0319)
	[0.2563]	[0.1728]		[0.2193]	[0.5102]		[0.7978]	[0.3066]		[0.7728]	[0.3004]		[0.8831]	[0.2851]
	-0.0000	-0.0181		-0.0000	-0.0158		0.0000	-0.0562		-0.0000	-0.0214		0.0000	-0.0263
-6	(0.0000)	(0.0305)	9	(0.0000)	(0.0514)	23	(0.0000)	(0.0061)	37	(0.0000)	(0.0264)	51	(0.0000)	(0.0348)
	[0.4274]	[0.5540]		[0.7397]	[0.7584]		[0.0691]	[0.0000]		[0.9188]	[0.4179]		[0.6268]	[0.4488]
	-0.0000	-0.7273		-0.0000	-0.0357		0.0000	-0.0663		0.0000	0.0151		0.0000	-0.0240
-5	(0.0000)	(0.0317)	10	(0.0000)	(0.0387)	24	(0.0000)	(0.0294)	38	(0.0000)	(0.0161)	52	(0.0000)	(0.0355)
	[0.0000]	[0.8716]		[0.1012]	[0.3560]		[0.0573]	[0.0242]		[0.0487]	[0.3457]		[0.6268]	[0.4987]
	-0.0000	-0.0176		-0.0000	-0.0410		0.0000	-0.0180		0.0000	0.0222		-0.0000	-0.0055
-4	(0.0000)	(0.0132)	11	(0.0000)	(0.0367)	25	(0.0000)	(0.0273)	39	(0.0000)	(0.0166)	53	(0.0000)	(0.0122)
	[0.6802]	[0.1838]		[0.1911]	[0.2633]		[0.1262]	[0.5092]		[0.0000]	[0.1814]		[0.0726]	[0.6535]
	-0.0000	0.0291		-0.0000	-0.0342		0.0000	-0.0167		0.0000	0.0138		0.0000	-0.0275
-3	(0.0000)	(0.0207)	12	(0.0000)	(0.0422)	26	(0.0000)	(0.0227)	40	(0.0000)	(0.0154)	54	(0.0000)	(0.0343)
	[0.6857]	[0.1584]		[0.0447]	[0.4178]		[0.0010]	[0.4622]		[0.0322]	[0.3697]		[0.9015]	[0.4232]
	-0.0000	0.0052		-0.0000	-0.0502		0.0000	-0.0181		0.0000	-0.0164		-0.0000	-0.0085
-2	(0.0000)	(0.0222)	13	(0.0000)	(0.0431)	27	(0.0000)	(0.0268)	41	(0.0000)	(0.0272)	55	(0.0000)	(0.0154)
	[0.1268]	[0.8142]		[0.0771]	[0.2438]		[0.0145]	[0.4982]		[0.4066]	[0.5461]		[0.2496]	[0.5802]
	-0.0000	-0.0283		-0.0000	-0.0544		0.0000	-0.0169		0.0000	-0.0179		0.0000	-0.0219
-1	(0.0000)	(0.0317)	14	(0.0000)	(0.0464)	28	(0.0000)	(0.0341)	42	(0.0000)	(0.0305)	56	(0.0000)	(0.0331)
	[0.0000]	[0.3716]		[0.1355]	[0.2415]		[0.1695]	[0.6211]		[0.4109]	[0.5571]		[0.9468]	[0.5081]
	0.0000	0.0068		-0.0000	0.0400		0.0000	-0.0188		0.0000	0.0258		0.0000	-0.0201
1	(0.0000)	(0.0182)	15	(0.0000)	(0.0397)	29	(0.0000)	(0.0367)	43	(0.0000)	(0.0120)	57	(0.0000)	(0.0233)
	[0.7615]	[0.7116]		[0.4203]	[0.3176]		[0.0291]	[0.6079]		[0.6000]	[0.3728]		[0.0000]	[0.3887]
	0.0002	0.0612		-0.0000	-0.0498		0.0000	-0.0166		0.0000	-0.0293		0.0000	-0.0264
2	(0.0016)	(0.0372)	16	(0.0000)	(0.0377)	30	(0.0000)	(0.0318)	44	(0.0000)	(0.0339)	58	(0.0000)	(0.0276)
	[0.9051]	[0.0994]		[0.4849]	[0.1861]		[0.0176]	[0.6024]		[0.4815]	[0.3870		[0.8445]	[0.3388]
	-0.0000	-0.1183		-0.0000	0.0483		0.0000	-0.0159		0.0001	-0.0298		0.0000	0.0228
3	(0.0000)	(0.0576)	17	(0.0000)	(0.0425)	31	(0.0000)	(0.0302)	45	(0.0000)	(0.0364)	59	(0.0000)	(0.0232)
	[0.0000]	[0.0399]		[0.8552]	[0.2553]		[0.1675]	[0.5981]		[0.5675]	[0.4135]		[0.6523]	[0.3260]
	-0.0000	-0.0159		0.0000	-0.0411		0.0000	-0.0160		0.0000	0.0283		0.0000	0.0000
4	(0.0000)	(0.0420)	18	(0.0000)	(0.0065)	32	(0.0000)	(0.0265)	46	(0.0000)	(0.0244)	60	(0.0000)	(0.0000)
	[0.1032]	[0.7048]		[0.0000]	[0.0000]		[0.2003]	[0.5462]		[0.4445]	[0.4359]		[0.7313]	[0.6328]

The information in round parentheses is the standard errors and the probability statistics are inserted in square parentheses. The statistic not enclosed in brackets is the relevant trade balance surprise coefficient. All values are rounded off to four decimal places.