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The Impact of Macroeconomic Factors on the German Stock Market: Evidence for the Crisis, Pre- and Post-Crisis Periods

Kaan Celebi [1,2,*] and Michaela Hönig [1]

[1] Faculty of Business and Law, Frankfurt University of Applied Sciences, Nibelungenplatz 1, D-60318 Frankfurt am Main, Germany; hoenig@fb3.fra-uas.de
[2] Schumpeter School of Business and Economics, University of Wuppertal, Gaußstraße 20, D-42119 Wuppertal, Germany
* Correspondence: kcelebi@fb3.fra-uas.de; Tel.: +49-69-1533-2941

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Abstract: Today we live in a post-truth and highly digitalized era characterized by a flow of (mis-) information around the world. Identifying the impact of this information on stock markets and forecasting stock returns and volatilities has become a much more difficult task, perhaps almost impossible. This paper investigates the impact of macroeconomic factors, German government bond yields, sentiment and other leading indicators on the main German stock index, namely the DAX30, for the time period from 1991 to 2018. Using a dataset on 24 factors and over a timeframe of about 27 years, we found evidence that across most subsamples, the Composite Leading Indicator (OECD), the Institute for Economic Research (ifo) Export Expectations index, the ifo Export Climate index, exports, the Consumer Price Index CPI, as well as 3 y German government bonds yields show delayed impacts on stock returns. We further found that the delayed impact of the constituents of the monetary aggregate M2 on stock returns changed direction between the crisis and post-crisis periods. Overall, the results illustrate that in the crisis period a larger number of factors and economic indicators had significant impacts on the stock returns compared to the pre- and post-crisis periods. This implies that in the post-crisis period a macro-driven market prevails.

Keywords: financial markets & the macroeconomy; financial econometrics; monetary aggregates; information and market efficiency; financial crises

JEL Classification: C32; C58; E44; G01; G14

1. Introduction

For as long as stock markets have existed, traders have tried to investigate and forecast stock price and capital market developments. Familiar to traders and other interested parties is the finding that macroeconomic factors do indeed influence the stock price, as do corporate financial results, political situations and industry branch figures. Identifying the impact of this information on stock markets and, moreover, forecasting stock returns and volatilities play a crucial role in the economic sciences, especially regarding the discussion about the efficient market hypothesis. Since we now live in a post-truth and highly digitalized era where a lot of information flows around the world, it has become more difficult to estimate markets returns and risks considering the huge amount of information available and other possible factors. Macroeconomic factors, which are the focus of this analysis, represent (only) a fraction of the variables which have explanatory power vis-à-vis stock returns.

The inflationary era in the 1970s led researchers to investigate primarily the relationship between stocks and inflation especially for the stock market in the USA. Looking at the USA, Bodie (1976),

Fama and Schwert (1977), Fama (1981), Chen et al. (1986) and Pearce and Roley (1983, 1985) found a negative relationship between inflation and asset returns and also found that stocks act as a poor hedge against inflation. Fama (1981) explained the negative relationship with the "proxy effect hypothesis": the negative correlation between inflation and real activity and the positive correlation between real activity and stocks lead jointly to the negative relationship between inflation and stock returns. A further explanation for the negative relationship is given with the "inflation illusion hypothesis" by Modigliani and Cohn (1979): regarding the Fisher hypothesis, increasing inflation expectations lead to higher discounts of the future expected dividends meaning lower stock values.

Using the Arbitrage Pricing Theory, Chen et al. (1986) found that for the stock market in the USA, the term structure spread (difference between long- and short-term interest rates), expected and unexpected inflation, industry production and the spread between high and low level bonds are significant risk factors for the stock market. Ferson and Harvey (1991) showed similar findings to those of Chen et al. (1986). Hamilton and Susmel (1994) investigated not only the equity returns but also their volatilities by estimating Markov-switching GARCH models using monthly USA equity returns and found that the real economic conditions significantly explained the switching from low to high volatility regimes. The investigation shows an increasing incidence of months with high volatility in bust phases. Fama (1990) argued that if equity prices reflect expected future cash flows, equity price changes should predict future macro conditions. Using monthly, quarterly and annual USA stock returns, he found empirically, for the period of 1953–1987, a positive correlation between stock returns and industrial production growth.

The papers written after the 1990s focused more on the announcement effect of macroeconomic factors on stock returns. McQueen and Roley (1993) argued that market participants' reactions to announcement surprises differ at different points of the business cycle in the USA. Thus, in boom phases, stock returns respond negatively to higher real activity. The authors explained this finding with the increase in discount rates being larger than the increase of expected cash flows, which leads to shrinking stock values in the boom phases. The time dependency of the impact of macro-announcements was also shown by Boyd et al. (2005). They found that announcements of higher unemployment have a positive effect on stocks during an economic expansion and have a negative effect during economic contractions. To explain this finding the authors regard higher unemployment as a predictor of lower interest rates and lower corporate profits. The relative strength of these two outcomes differs in boom and bust cycles, so that the sign of the unemployment announcement effect is business cycle dependent. Flannery and Protopapadakis (2002) showed that stock market returns are significantly correlated with inflation and money growth. They estimated a GARCH model of daily USA equity returns, where realized returns and their conditional volatility depend on 17 macro series announcements. They found six candidates for priced factors: three nominal (CPI, PPI, and a Monetary Aggregate) and three real (Balance of Trade, Employment Report, and Housing Starts). Errunza and Hogan (1998) investigated, via VAR-models markets for 1959–1993, whether macroeconomic factors explained time variation in seven European stock market volatilities. The authors showed that money supply volatility had a significant impact on stock volatility in Germany and France and that the volatility of industrial production had an effect on stock market volatility in Italy and the Netherlands. Cheung and Ng (1998) used Johanson's cointegration technique for Germany, Italy, the USA, Canada and Japan, and found long-term co-movements between the national stock market and macroeconomic factors including the real oil price, real consumption, real money supply and real GNP output. An international comparison was made in Rapach et al. (2005), where the predictive ability of nine macroeconomic factors was tested in 12 industrialized stock markets. Among the factor set, the interest rates were stated to be the most consistent and reliable predictors of stock returns across countries. Ratanapakorn and Sharma (2007) documented, using a vector error correction model and Johansen's cointegration technique, that between 1975 and 1999, USA stock prices relate negatively to the long-term interest rate. Their results showed that industrial production, money supply, inflation, exchange rate and the short-term interest rate have a positive relation to stock prices. Humpe and

Macmillan (2009) also used cointegration analysis for the USA and Japanese stock markets between 1965 and 2005 to examine the long-term relationship to macroeconomic factors, namely industrial production, consumer price index, money supply and the long-term interest rate. For the Japanese stock market, the authors detected a positive impact of industrial production and a negative impact of the money supply on stock prices. Furthermore, they showed that the consumer price index and the long-term interest rate have a negative effect on industrial production. For the USA stock market, they found a positive impact of industrial production and a negative impact of the consumer price index and the long-term interest rate on stock prices. Sir (2012) applied Johansen co-integration, an error correction model, variance decomposition and impulse response functions to investigate the long-run and the short-run dynamics between macroeconomic factors and stock returns in Germany and the United Kingdom for the period from 1999 to 2011. He found that the consumer price index, interest rates, exchange rates, money supply and industrial production lead to short-term adjustments and to long-term dynamic movements of stock prices.

The main motivation of this research was to detect the macroeconomic factors that do not have an immediate but a significant delayed impact on returns of the German stock market DAX30. In particular, we focused on macroeconomic impacts in the pre- and post-crisis periods and checked whether the market got more "macro-driven" during or after the financial crisis. Therefore, we applied ordinary least squares with Newey-West adjusted standard errors for 24 macroeconomic factors using quarterly data from 1991 to 2018 and investigated the presence of delayed and dynamic impacts of macroeconomic factors on stock market prices in Germany. Thus, since we used only lagged factors, our results could also provide some indications about the semi-strong market efficiency. To the best of our knowledge, comparable investigations for the DAX30, the time period in question and the econometrical model employed do not exist.

The remainder of the paper is organized as follows. Section 2 describes our data and the theoretical impact of macroeconomic factors on stock returns. In Sections 3 and 4 we present our econometric approach and discuss our empirical findings. Finally, Section 5 provides a conclusion.

2. Data

For our investigation, we worked with six different data sources: Deutsche Bundesbank, European Statistical Office (Eurostat), European Central Bank (ECB), Organisation for Economic Co-operation and Development (OECD), the Institute for Economic Research (ifo) and the Centre for European Economic Research (ZEW). The sample data set ranges from the first quarter of 1991, to the second quarter of 2018.[1] Table 1 gives an overview of the dataset and their sources. Monthly data were transformed to quarterly data using the end-of-quarter values. Additionally, the current account has been seasonally adjusted using the Census X-13 procedure. In order to get stationary series, we took the quarterly first difference of the current account, capital account, all time series of the ifo, the ZEW Indicator of Economic Sentiment and the German government bond yields (all maturities). For the remaining series, we used the quarterly first difference of the logarithm.

The dependent variable is the DAX performance index, which also takes dividends into account. Among classical macroeconomic variables like gross domestic product in real terms (GDP) or monetary aggregates, our dataset of independent variables contained German government bonds yields for the maturities of 1, 2, 3, 4, 5 years, as well as 3 to 5, 5 to 8 and 9 to 10 years and economic indicators. Since German government bonds yields are often used as a proxy for risk-free rates, which are crucial for discounted cash flow analysis, we wanted to detect the maturity with the largest explanatory power.

The ifo World Economic Survey series measures business cycle developments and other economic factors of more than 100 advanced, emerging or developing economies by interviewing more than 1000

[1] The data series for the unemployment rate and the real effective exchange rate start in Q1 1992 and Q1 1993, respectively. The data of the ZEW starts in Q4 1991.

economic experts (ifoWES 2017). The ifo Export Expectations and Export Climate series are measures of German export activities and are calculated by using company and consumer confidence indices and the price competitiveness of domestic companies against 37 trade partners (Elstner et al. 2013).

Table 1. Overview of the variables including data sources and the frequencies. ECB: European Central Bank; ifo: Institute for Economic Research; ZEW: Centre for European Economic Research; OECD: Composite Leading Indicator.

Variables	Source	Data Frequency
DAX performance index (dependent variable)	Bundesbank	Monthly
Classical macroeconomic variables		
Gross Domestic Product (real)	Bundesbank	Quarterly
Current account	Bundesbank	Quarterly
Capital account	Bundesbank	Quarterly
Unemployment rate	Bundesbank	Quarterly
Gross investments	Eurostat	Quarterly
Exports (nominal)	Eurostat	Quarterly
Savings rate	Bundesbank	Quarterly
Consumer price index	Bundesbank	Monthly
Real effective exchange rate	Bundesbank	Monthly
Output in the production sector	Bundesbank	Monthly
Labor productivity per hour worked	Bundesbank	Quarterly
Monetary aggregate M1	ECB	Monthly
Monetary aggregate M2	ECB	Monthly
Monetary aggregate M3	ECB	Monthly
German government bond yields		
1 year German government bonds yields	Bundesbank	Monthly
2 year German government bonds yields	Bundesbank	Monthly
3 year German government bonds yields	Bundesbank	Monthly
4 year German government bonds yields	Bundesbank	Monthly
5 year German government bonds yields	Bundesbank	Monthly
3–5 year German government bonds yields	Bundesbank	Monthly
5–8 year German government bonds yields	Bundesbank	Monthly
9–10 year German government bonds yields	Bundesbank	Monthly
Economic indicators		
ifo World Economic Survey: global economic current situation	ifo	Quarterly
ifo World Economic Survey: expectations for the next six months	ifo	Quarterly
ifo World Economic Survey: global economic climate	ifo	Quarterly
ifo Export Expectations (Germany)	ifo	Monthly
ifo Export Climate (Germany)	ifo	Monthly
ZEW Indicator of Economic Sentiment	ZEW	Monthly
Composite Leading Indicator	OECD	Monthly
Business Confidence Index	OECD	Monthly
Consumer Confidence Index	OECD	Monthly

The ZEW Indicator of Economic Sentiment is a leading indicator for the German economy, where about 350 financial analysts from banks, insurance companies and financial departments of selected large corporations are asked about the economic expectations for the medium-term (ZEW 2006). The Composite Leading Indicator (CLI) for Germany provided by the OECD is calculated using a wide range of short-term indicators and leading factors such as orders and inventory changes, financial market indicators, business confidence surveys and data on key sectors.[2] The Business Confidence Index (BCI) reflects developments in production, orders and stocks, whereas the Consumer Confidence Index (CCI) measures the consumption and savings behavior of households. Both indices are based on opinion surveys.

[2] A detailed description of the component selection is given by Guidetti and Gyomai (2012, p. 5).

The economic intuition in the case of economic indicators is straightforward. Since economic (leading) indicators reflect future economic development, lagged indicators should have some information about the present and future business success of publically-traded companies. Especially in a macro-driven market, leading indicators should have a positive and significant impact on stock returns. As mentioned above, the German government bonds yields reflect risk-free rates. We expect a negative impact of these yields on stock returns, since an increase of the risk-free rate increases the equity risk premium and thus the discount rate. Additionally, increasing yields could lead to a substitution effect among investors between stocks and interest-bearing assets like bonds. Regarding GDP, exports, the output in the production sector and the labor productivity, the economic intuition is again straightforward, since an increase of these variables leads to higher sales, and thus to higher cash flows. Regarding inflation, we expect a negative relation to stock returns. This is because higher inflation leads to an increasing risk-free rate, and thus to an increasing discount rate for stocks. Furthermore, increasing inflation could trigger economic tightening policies, which would put stocks under pressure. Because of the positive link between monetary aggregates and inflation, increasing monetary aggregates could lead to a slowdown of the stock market. However, increasing monetary aggregates also reflect monetary stimulus decisions of the ECB, which could increase cash flows, and thus stock returns.

A higher exchange rate could lead to a decreasing demand for exports, so that sales decline, and thus, stocks decrease. On the other hand, higher exchange rates could lead to higher profit margins, since the cost of production decreases due to lower purchase prices from abroad. The current account sums up net exports, net income from abroad and net current transfers. Thus, an increasing current account surplus could increase stock returns due to higher income from abroad, which could increase the demand for stocks. On the other hand, the current account reflects the change in net foreign assets. Hence, in the case of an increase of the current account deficit, either other countries lend their savings to Germany or Germany liquidates its foreign assets. In either instance, the German economy would absorb capital, which could increase demand in the stock market. Similar to that, the capital account calculates transfers in assets and liabilities, and thus reflects inflows and outflows of money. Since a surplus of the capital account reflects an inflow of money, increasing capital account surpluses could increase stock returns. The unemployment rate contains information about corporate earnings and expected monetary and fiscal policy. On the one hand, increasing unemployment rates could be interpreted as a signal of lower future sales and earnings expectations of businesses, which would lead to lower stock returns. On the other hand, increasing unemployment rates could raise the expectation for expansionary monetary or fiscal policies, which would also have a stimulus effect on stocks. In particular, a shrinking interest rate would lead to higher stock valuations due to a lower discount rate. The savings rate reflects the share of the disposable income of a nation, which is not consumed, and thus could be used to acquire assets. Hence, higher savings rates could increase the demand for stocks and lead to higher stock returns. An increase in terms of gross investments could lead to both increasing and decreasing stock returns. Higher gross investments could be a signal for market participants that companies expect higher sales and earnings for the future. Nevertheless, market participants could expect lower dividend payouts due to higher expenditures for investments, which would lead to decreasing stock returns.

3. Model Specification

As is common in financial time series, the quarter-on-quarter change rate of the DAX performance index shows the presence of autocorrelation and heteroskedasticity.[3] Assuming homoskedasticity, the ordinary least squares OLS method aims to minimize the deviations between data points and a regression line to fit those points. With asset returns, volatility seems to vary during certain periods

[3] Therefore, we applied the Ljung-Box test for the returns and the squared returns.

of time and also depends on past variance. By applying an OLS to these heteroskedastic time series, periods with high volatility have a greater impact on the estimation of the coefficients, leading to inefficient coefficients and biased test statistics. To correct the biased test statistics, we perform OLS with Newey-West heteroskedasticity and autocorrelation consistent (HAC) standard errors.[4]

The macroeconomic factors are partly highly correlated. Therefore, a common OLS estimation, which includes all macroeconomic factors, leads to problems of multicollinearity. In this case, the test statistics are biased and it is impossible to obtain the isolated effect of an individual factor, which is the aim of this research. To determine the dynamic impact of a macroeconomic factor (MF) on stock returns (r) over several quarters, for each individual factor, we ran a separate OLS regression.[5] In this way, the estimated coefficients and the test statistics are free of the multicollinearity issue. In order to avoid endogeneity problems, we used only lagged variables, as follows:

$$r_t = \beta_0 + \beta_1 MF_{t-1} + \beta_2 MF_{t-2} + \cdots + \beta_k MF_{t-k} + \varepsilon_t. \quad (1)$$

This means that the stock returns were modeled by the last k periods of the macroeconomic factor. To determine the lag length k of each model, we used the Akaike information criterion.

To measure the joint impact of the lagged macroeconomic factor, we performed the Wald test with the following null hypothesis:

$$\beta_1 + \beta_2 + \cdots + \beta_k = 0. \quad (2)$$

The calculated test statistic, which follows a χ^2-distribution, reveals not only the significance of the sum of the lagged factor, but also the way in which the macroeconomic factor affects stock returns.

An additional test for joint significance is the likelihood-ratio test (lr-test). The test statistic, which also follows asymptotically a χ^2-distribution, is calculated by dividing the likelihood of the estimated model with the lagged factors by the likelihood of the model without including the lagged factors. A high resulting ratio is an indicator of a significant impact of the lagged factors on stock returns.

The Wald test does not take into account that lagged factors could have different directions of impact, since the sum of the coefficients is tested in this method. Thus, in the case of a model with two lagged factors, where the first lagged factor has a positive significant impact and the second lagged factor a negative significant impact, the Wald test could indicate that there is no overall significant impact on stock returns, as the sum of the individual significant impacts are neutralized. In contrast to that, the lr-test would indicate a significant joint impact, since it measures the increase of the goodness of fit of the model by adding the lagged factors. For this reason, we used the lr-test particularly to compare the explanatory power of the macroeconomic factors.

4. Discussion of the Results

4.1. Results for the Whole Time Period

First, we measured the lagged impact of macroeconomic factors on DAX returns with maximum of four lags (k) for the whole sample, the results of which are shown in Table 2. Both the Wald test and the lr-test showed strong evidence for a significant impact of lagged quarterly growth rates of the CLI on DAX stock returns. Particularly, the CLI seems to be the factor with the strongest impact regarding the lr-test and the adjusted R-squared. The number of lags included in the OLS specification is four and, according to the Wald test, the cumulative impact of these lags is positive. This means that

[4] We used Bartlett kernel weights with an automatic bandwidth selection procedure as described in Newey and West (1994).

[5] Additionally, we purposed to perform a Principal Component Analysis (PCA) to cluster the large dataset into a low dimensional set of components. By conducting an OLS regression in use of these components as explanatory variables, we would obtain a global model, in which the problem of multicollinearity would be countered. However, the use of the PCA shows us that the first two components explain only about 40% of the total variance and that 10 components are required to explain about 80% of the total variance. Because of the large amount of required components, we dropped the idea of using a PCA.

the past four quarters jointly had a positive effect on stock returns. From an economic point of view, the positive impact is very intuitive, since a positive economic outlook predicts higher earnings for enterprises for the next periods, which leads to increasing stock valuations.

Table 2. Results of ordinary least squares regressions for the whole sample. Only those factors which show a significant impact on stock returns are displayed, along with information about the lag structure, the Wald test with its *p*-value and measured direction of impact, the *p*-value of the likelihood ratio test and the adjusted R-squared. BCI: Business Confidence Index; GDP: Gross Domestic Product.

Factor	Number of Lags	Wald Test		lr-Test (*p*-Values)	Adjusted R-Squared
		p-Values	Direction of the Impact		
CLI	3	0.0272	positive	0.0004	0.1323
BCI	2	0.7237	positive	0.0175	0.0550
GDP	2	0.2444	negative	0.0289	0.0461
Gross investments	2	0.5052	negative	0.0639	0.0318
Unemployment rate	2	0.0205	positive	0.0844	0.0278
Exports	3	0.0801	negative	0.0948	0.0307
5 y German government bonds yield	4	0.0000	negative	0.0010	0.1271
3 y German government bonds yield	1	0.0184	negative	0.0055	0.0600
2 y German government bonds yield	1	0.0103	negative	0.0195	0.0403
1 y German government bonds yield	1	0.0033	negative	0.0478	0.0265
4 y German government bonds yield	1	0.0217	negative	0.0583	0.0235
3–5 y German government bonds yield	3	0.0090	negative	0.0909	0.0315

Although the Wald test shows insignificance, the lr-test indicates a significant impact of the BCI, GDP and the gross investments on stock returns. Using the three factors, the lowest Akaike value was achieved in the specification with two quarter lags. The measured insignificance using the Wald test is a result of opposite impacts in the two lagged quarters: By using the t-test, the BCI and GDP show in the first lagged quarter a positive and in the second lagged quarter a negative significant impact, whereby gross investments have a negative significant impact only in the second quarter.

For the unemployment rate, the Wald test indicates, with a *p*-value of 0.02, a significant and positive impact of the quarterly growth rates of the unemployment rate on stock returns. Nevertheless, the lr-test shows that the unemployment rate has a statistically significant impact only at the 10 percent level. The positive effect could be explained by an economic contraction, which leads to higher unemployment rates and lower interest rates and, as a result, to higher discounted cash flows. A similar explanation could also be appropriate for the finding that exports have a negative effect on stocks. However, the significance level in both tests is very low, while this effect is measured only by using three lagged quarters.

Regarding the lr-test and the adjusted R-squared, the second strongest impact is shown by the 5-year German government bonds yield. Since German government bonds are good proxies for risk-free rates. and thus for discount rates in discounted cash flow analysis, the negative significant impact due to the Wald test is not surprising for all significant maturities: rising yields shrink the valuation of stocks due to higher discount rates for future cash flows. Besides the 5-year maturity yield, the 3-year and 2-year government bonds yields also have statistically significant impacts at the 0.02 *p*-value level. Looking at the big picture, the medium-term maturity government bonds yield rates seem to have the highest impact on stocks regarding both lr-test and adjusted R-squared.

4.2. Results Before, during and after the Crisis

As a next step, we wanted to check whether the impact of the lagged macroeconomic factors on stock returns differ regarding crisis periods and non-crisis periods. For our research, the crisis period contains the financial crisis and the European sovereign debt crisis. The third quarter of 2007 is the first period of our crisis sample, since in August 2007 interest rates rose and transaction volumes declined sharply on the interbank lending market. The last period of our crisis sample is the third quarter of

2012, when the President of the ECB, Mr. Draghi, remarked at the Global Investment Conference in London:

> "Within our mandate, the ECB is ready to do whatever it takes to preserve the euro. And believe me, it will be enough."

After this speech, the ECB announced that they will buy government bonds of distressed Eurozone member countries, which is known as the Outright Monetary Transactions program. Although the ECB never used this program, the power of Draghi's speech and the promise of bond purchases lead to shrinking government bond yields of distressed membercountries (Wanke 2017).

Thus, we clustered the sample into a pre-crisis period (Q1 2001–Q2 2007, sample-size: 26), a crisis period (Q3 2007–2012 Q3, sample-size: 26) and a post-crisis period (Q4 2012–Q2 2018, sample-size: 26) and take the same Newey-West OLS approach, as in Section 4.1 with four lags at the maximum. Although Engle (1984) shows that both the Wald and lr-test are asymptotically equivalent, in the case of small sample sizes, the Wald test is less reliable than the lr-test (Agresti 2007, p. 13). Thus, for this section, since the three samples are small, the lr-test becomes more important for our analysis.

Table 3 contains the results for the pre-crisis period, Table 4 shows the results for the crisis period and Table 5 sums up the results for the post-crisis period. At first glance, the results illustrate that using the lr-test, in the crisis period the amount of macroeconomic factors and government bond yields with significant impact on stock returns is higher than in both the pre- and post-crisis periods. The higher adjusted R-squared values in the crisis period in comparison to the values for the pre- and post-crisis periods validate the higher importance of macroeconomic factors in times of crisis. This implies that in the crisis period a macro-driven market prevailed.

Among the economic indicators, only the CLI and the ifo Export Climate index show significant impacts on stock returns in the pre-crisis period. Particularly, the CLI had the most explanatory power amongst all factors according to both the lr-test and adjusted R-squared. According to the Wald test, the CLI and the ifo Export Climate had a positive impact; however, only the CLI also has a statistically significant impact at the 10 percent significance level. Among the classical macroeconomic variables, the lr-test revealed that only the four quarter lagged exports had a significant impact on stock returns. According to the Wald test, the direction of the impact could not be determined with certainty.

In the pre-crisis period, the German government bonds yield with a maturity of 5 years showed a statistically significant impact at the five percent level in both tests. The 3 year government bonds yield had only a statistically significant impact at the 10 percent level using the lr-test. The sign of the impact of government bond yields are negative, which is in line with our expectations regarding the discounted cash flow valuation model.

Table 3. Results of OLS regressions for the pre-crisis period. Only those factors that show a significant impact on stock returns are displayed, along with information about the lag structure, the Wald test with its *p*-value and measured direction of impact, the *p*-value of the likelihood ratio test and the adjusted R-squared.

Pre-Crisis (2001q1–2007q2)					
Factor	**Number of Lags**	**Wald Test**		**lr-Test (*p*-Values)**	**Adjusted R-Squared**
		***p*-Values**	**Direction of the Impact**		
CLI	3	0.0673	positive	0.0278	0.1997
ifo Export Climate	3	0.7908	positive	0.0617	0.1432
Exports	4	0.9565	positive	0.0457	0.1804
5 y German government bonds yield	1	0.0459	negative	0.0286	0.1337
3 y German government bonds yield	1	0.1085	negative	0.0566	0.0942

Table 4. Results of OLS regressions for the crisis period. Only those factors that show significant impact on stock returns are displayed, along with information about the lag structure, the Wald test with its *p*-value and measured direction of impact, the *p*-value of the likelihood ratio test and the adjusted R-squared.

Crisis (2007q3–2012q3)					
Factor	**Number of Lags**	**Wald Test**		**lr-Test (*p*-Values)**	**Adjusted R-Squared**
		***p*-Values**	**Direction of the Impact**		
CLI	2	0.0000	positive	0.0042	0.3406
ifo Export Expectations	2	0.0021	positive	0.0067	0.3101
BCI	2	0.3477	positive	0.0118	0.2719
ifo Export Climate	1	0.0000	positive	0.0561	0.1152
ifo global expectation	1	0.0597	positive	0.0852	0.0859
ifo global current situation	4	0.8824	negative	0.0913	0.1463
M2	2	0.0123	negative	0.0126	0.2673
M3	1	0.0001	negative	0.0149	0.2061
Current account	3	0.7891	negative	0.0260	0.2431
CPI	3	0.0000	negative	0.0271	0.2397
M1	2	0.0006	positive	0.0422	0.1780
Unemployment rate	1	0.0001	positive	0.0627	0.1074
5 y German government bonds yield	4	0.4333	negative	0.0011	0.4754
3 y German government bonds yield	3	0.0538	negative	0.0014	0.4409
2 y German government bonds yield	1	0.0000	negative	0.0198	0.1870
3–5 y German government bonds yield	3	0.0046	negative	0.0199	0.2639
5–8 y German government bonds yield	3	0.0137	negative	0.0248	0.2468
9–10 y German government bonds yield	3	0.0210	negative	0.0360	0.2168
1 y German government bonds yield	1	0.0000	negative	0.0410	0.1372

Table 5. Results of OLS regressions for the post-crisis period. Only factors that show a significant impact on stock returns are displayed, containing information about the lag structure, the Wald test with its *p*-value and measured direction of impact, the *p*-value of the likelihood ratio test and the adjusted R-squared.

Post-Crisis (2012q4–2018q2)					
Factor	**Number of Lags**	**Wald test**		**lr-Test (*p*-Values)**	**Adjusted R-Squared**
		***p*-Values**	**Direction of the Impact**		
Exports	4	0.0000	negative	0.0062	0.3459
M1	4	0.3824	negative	0.0068	0.3399
Capital account	3	0.1925	positive	0.0222	0.2374
Gross investments	2	0.1130	negative	0.0349	0.1784
Real effective exchange rate	4	0.0716	positive	0.0511	0.1890
M3	2	0.4651	negative	0.0545	0.1459
CPI	4	0.3969	positive	0.0812	0.1480
3 y German government bonds yield	4	0.0080	negative	0.0230	0.2535

In the crisis period, the two quarter lagged CLI showed, according to both tests, the strongest impact. Besides the CLI, the ifo Export Expectations index, the ifo Export Climate index and the ifo Global Expectation index showed significant and positive impacts on stock returns with respect to both tests. According to the Wald test, the BCI and the ifo global current situation index had no impact on stock returns. Considering that these two indices were not forward-looking like the CLI and the ifo Export Expectations index, this result was not surprising. Following the lr-test, the BCI and the ifo global current situation index had a significant impact at the five and 10 percent levels, respectively.

Regarding the lr-test, the number of German government bonds yields with significant impacts on stock returns jumped from two to seven, where the level of statistical significance is at a minimum of five percent. These are the 5 y, 3 y, 2 y, 3–5 y 5–8 y 9–10 y and 1 y German government bonds yields. With the exception of the 5 y government bonds yield, the direction of the impacts of these yields was

negative. As previously discussed, in the pre-crisis period, the 5 y and the 3 y German government bonds yields have the strongest impact on stock returns among government bonds regarding both the lr-test and the adjusted R-squared. The number of lags of the 5 y and 3 y yields increased from one quarter to four and three quarters, respectively.

Regarding the lr-test, the three quarter lagged current account has a significant impact on stock returns at the five percent level. However, the direction of this impact cannot be measured using the Wald test. According to the lr-test, the one quarter lagged unemployment rate shows a significant impact on stock returns at the 10 percent significance level. The Wald test confirms this finding and reveals that the direction of the impact is positive. As indicated in Section 2, the positive impact could be a result of market participants' expectation of expansionary fiscal and monetary policies in response to growing unemployment, which would also have a positive effect on stock prices. Furthermore, Wald test shows that the three quarters lagged CPI has a significant impact on stock returns at the one percent significance level. As expected, the direction of the impact is negative, which could be explained by increasing discount rates for stocks due to higher inflation. The lr-test confirms the significance of the impact at the five percent level. Both tests show that the impacts of all three monetary aggregates are significant at a minimum of the five percent level. While in the pre-crisis period, none of the three money supply variables show any impact on stock returns, in the crisis period all of these factors have a significant effect on stock returns. The Wald test reveals that the two quarters lagged M1 has a positive impact on stock returns, while M2 and M3 show negative impacts. An explanation for the positive impact of M1 could be the excess liquidity caused by expansionary monetary policy especially during the crisis period, which led to increasing bond prices and decreasing interest rates. Considering that stock prices are reflecting the value of discounted future cash flows, lower interest rates lead to higher stock valuations. Additionally, the excess liquidity could increase the demand for stocks, so that stock prices rise. Furthermore, companies could benefit from a lower cost of capital and increase their investments, which would have a positive effect on future cash flows, and thus on stock returns. The negative impacts of M2 and M3 are quite interesting, since M1, which has a positive impact, is part of both M2 and M3. Considering that both broader monetary aggregates M2 and M3 include, in addition to M1, longer-term deposits and less liquid assets, the negative effect can only be explained by them. In the course of this section we will examine the impacts of the monetary aggregates in more detail.

In the post-crisis period, the number of indicators with a significant impact on stock returns sinks to zero. Among the government bonds yields, only the four quarters lagged 3 y yields showed a significant impact at the five percent level according to the lr-test. The Wald test confirmed the significant impact and shows that the variable exhibits a negative impact.

Among the classical macroeconomic variables, we have a surprising result regarding the exports. The lr-test shows that the four quarters lagged exports had a significant impact on stock returns at the one percent level. Nevertheless, the Wald test indicates that the direction of the impact was negative, which is against our expectations and intuition. A possible explanation for this result will be provided. Among the monetary aggregate variables, the four quarter lagged M1 and the two quarter lagged M3 have significant impacts at the one percent and 10 percent level, respectively, regarding to the lr-test. However, the Wald test did not confirm these findings, and thus could not provide the directions of the impact. An explanation as to why the increase of M1 did not impact positively on stock returns, as it does in the crisis period, could be that the money supplied or the excess liquidity was no longer used to purchase bonds and stocks. Instead, financial institutions could loan this liquidity to the real economy following the crisis period. Additionally, taking into consideration the loose monetary policy of the ECB, the negative impacts of exports could be caused by financial sector behavior: banks directed their liquidity or funds from stocks and (government) bonds towards the real economy, which could increase exports and decrease stock prices due to lower demand and higher discount rates.

Both, the two quarter lagged gross investments and the three quarter lagged capital account showed an impact on stock returns at the five percent significance level regarding the lr-test. However, the Wald test could not provide any evidence for a significant impact for both variables. Regarding the

lr-test, both the four quarters lagged CPI and real effective exchange rate have significant impacts on stocks at the 10 percent levels. However, the Wald test could only show that the real effective exchange rate has a significant impact at the 10 percent level with a positive impact on stock returns. Thus, an appreciation of the euro lead to higher future stock returns. This impact could be explained by the foreign demand for the euro: increasing demand leads to higher exchange rates and a positive impact on stocks due to higher demand for European and German assets.

Table 6 displays the results of our Newey-West OLS model using lagged quarterly growth rates of the differences between M2 and M1 and between M3 and M2. In the pre-crisis period, neither of the differences had a significant impact regarding both tests. In the crisis period, where the financial crisis and the European debt crisis caused turmoil in the capital markets, the one quarter lagged difference between M2 and M1 showed a significant and negative impact on stock returns at the one percent significance level according to both tests. Since the difference of M2 and M1 reflects "near money" deposits, such as deposits with an agreed maturity of up to two years and deposits redeemable at notice of up to three months, a possible explanation for this finding could be that market participants undertake a portfolio reallocation due to higher risk aversions.[6] Thus, in times of insecurity and crisis, investors prefer safer and liquid assets, so that the demand for non-monetary assets, such as stocks, shrinks and the demand for liquid and low-risk monetary assets—such as those in M2—rises. This explanation is also valid for the negative impact of the one quarter lagged difference between M3 and M2, which includes money market instruments or marketable instruments issued by monetary financial institutions. The adjusted R-squared figures and the lr-test indicate that the growth rate of M2 minus M1 has more effect on stocks than the growth rate of M3 minus M2. This picture is not very surprising for a crisis period, since M2 has more liquid and low-risk deposits than M3. However, according to the Wald test, the impact direction of the three quarters lagged growth rate of M2 minus M1 turns to positive in the post-crisis period. This result reflects that an increase of liquidity, which could be driven, for instance, by loose monetary policy in the post-crisis period, increases after several quarters both the monetary assets of M2 and, due to lower risk aversions, non-monetary assets like stock returns. Referring to the lr-test, the impact of the two quarters lagged M3 minus M2 is significant at the 10 percent level. However, the impact direction cannot be measured by the Wald test.

Table 6. Results of OLS regressions using quarterly growth rates of the differences between M2 and M1 and between M3 and M2 for the pre-crisis, crisis and post-crisis periods.

Factor	Sample	Number of Lags	Wald Test		lr-Test (p-Values)	Adjusted R-Squared
			p-Values	Direction of the Impact		
M2 minus M1	Pre-crisis	1	0.5873	positive	0.6183	−0.0318
M3 minus M2	Pre-crisis	1	0.3166	positive	0.4376	−0.0178
M2 minus M1	Crisis	1	0.0000	negative	0.0059	0.2669
M3 minus M2	Crisis	1	0.0823	negative	0.1361	0.0530
M2 minus M1	Post-crisis	3	0.0090	positive	0.0820	0.1349
M3 minus M2	Post-crisis	2	0.9967	negative	0.0798	0.1171

5. Conclusions

On the whole, the results illustrate that for all sample variations, several macroeconomic factors showed a delayed impact on German stock returns. Across most subsamples, the CLI, the ifo Export Expectation index, the ifo Export Climate index, exports, the CPI, and 3 y German government bonds yields show a lagged impact on stock returns. For the savings rate, the output in production, labor

[6] For the methodology of monetary aggregates we refer to ECB (2012, pp. 110–11).

productivity, the ifo Global Economic Climate index, the ZEW Indicator of Economic Sentiment and the Consumer Confidence Index, we cannot provide any evidence indicative of delayed impacts. We demonstrated that in cases of significance, lagged German government yields have a negative impact on stock returns. The results show that in the pre-crisis and crisis periods, the lagged CLI had a positive impact on stock returns. Lagged exports had a negative impact on stocks in the post-crisis period. This result, which could at first sight appear to be economically counterintuitive, can be explained by the changing behavior of financial institutions after the crisis period. In the crisis period, lagged monetary aggregates M2 and M3 had a negative impact on stocks, whereas lagged M1 showed a positive impact. Even though M1 has a significant impact also in the post-crisis period, the direction of the impact was not observable. Furthermore, we found that the impact direction of the lagged difference between M2 and M1 changed: in the crisis period, the impact on stock returns was negative, whereas the impact turned to positive in the post-crisis period.

The results for the subsamples also illustrate that in the crisis period, more macroeconomic factors, in particular leading indicators, had a significant impact on the German stock market compared with the pre- and post-crisis periods. This implies that in the crisis period, a macro-driven market was prevailing. Thus, the bottom line of our research is that in crisis periods asset managers and other investors should pay greater attention to trends in classical macroeconomic variables, government bonds yields and especially leading economic indicators than in non-crisis periods.

Apart from including additional macroeconomic variables, further research could be applied on the impact of these factors on sectoral stock market indices, which could provide a basis for tactical asset allocation decisions. Since the information regarding changes in these factors is publicly available, the semi-strong market efficiency hypothesis could be tested in future research by evaluating a trading rule in use of the measured delayed impacts. It would be also interesting to apply this approach to other stock market indices of industrial and emerging economies and make comparisons between them, which could also reveal useful information for investors.

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