JÖNKÖPING UNIVERSITY
School of Education and Communication

Monetary Policy and Stock Market Valuation during the Covid-19 Pandemic.

Chosen Topic: Monetary policy and asset valuation

COURSE: *Advanced Topics in Finance, JATR29*

PROGRAMME: *International Financial Analysis*

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Abstract

This paper analyses the relationship between the federal funds rate, inflation, stock market returns and the composite leading indicator. With a focus on the impact a shock to the federal funds rate has on stock market returns. To evaluate this question a structural vector autoregression model is used. Monthly data is used, totalling in 34 observations. The results confirm a statistically relevant negative connection between shocks to the federal funds rate and inflation, stock market returns and the composite leading indicator. So that a decrease in the federal funds rate results in an increase in inflation, stock market returns and the composite leading indicator.

1. Introduction

Following the crash of 2007/2008 fiscal- but especially monetary policy has gained significance. This can be seen as a turning point at which central banks not only focus on price stability, but also selectively apply restrictive or expansionary monetary and fiscal policies to stabilise the economy. In March 2020 the US stock market crashed due to the COVID-19 pandemic, followed by the implementation of unprecedented fiscal and monetary policies. It was the goal of these policies to stabilize the economy. Since it is important to understand the influence monetary policy has on the economy and especially on the stock market, this paper tries to analyse these effects. A special focus is placed on the effect that a negative shock to the Federal Funds Rate (FFR) has on stock market valuation. However, other variables will also be considered, such as inflation and the composite leading indicator (CLI) are considered. The reciprocities between the variables are analysed using a structural VAR model. The sample period begins in January 2019 and ends in October 2021. Monthly data is considered, resulting in a total of 34 observations. Since the impact of monetary policy of the US as a response to the COVID-19 market crash is the focus, the paper could be considered an event study. This paper applies the SVAR model as it was brought forth by Kontonikasand and Zekaite (2018). The main variable considered is the FFR. Other variables considered are the change in the inflation rate, the log returns of the MSCI and the change in the composite leading indicator (CLI). The structure in the structural VAR model is assumed to be as follows. The FFR cannot be influence by any other variable. This is the case because it is the goal to identify the influence of shocks to the FFR to the other variables. Secondly, the change in the inflation rate can only be influence by the FFR, while it can cause changes in MSCI returns and the CLI. Thirdly, MSCI returns can only influence the CLI. Lastly, it is assumed that the CLI cannot influence any other variable. This paper finds a strong and statistically relevant connection between shocks to FFR and changes in inflation, changes in stock returns and the CLI. The results are consistent with the findings of Hayford and Malliaris (2003), in that changes shocks to the FFR influence stock market valuation.

The structure of the paper is as followed. Section 2 describes related literature, highlighting similarities and differences. Section 3 then gives a detailed overview of the data used for the framework in Section 4. Section 4 then describes the theoretical framework used to answer the question of this paper. Section 5 provides the results and their relevance. Section 6 provides avenues for future research as well as pointing out limitations of this paper.

2. Literature Review

A difference between this paper and classical papers with similar questions is the sample size. While most papers (Kontonikas and Zekaite 2008) (Hayford and Malliaris 2003) use sample periods over decades, this paper focuses on a period of 34 months. Another difference is the way the data is scaled. In contemporary literature mostly annual data is used (Hayford and Malliaris 2003), while here monthly changes in the variables are considered.

Further differences arise when the type of events that are studied are considered. While this paper focuses on the response of monetary policy to an exogenous shock, most papers focus on the impact of monetary policy on stock prices in the long run. For example, Kontonikas and Zekaite (2008) use a dummy variable when considering events during the terror attacks during September 2001. Other papers exclude periods of crisis completely (Hayford and Malliaris 2003). This is the case because it is the goal to study the long-term effects of monetary policy on stuck market valuation. This way claims about the long-term neutrality bias can be made. On the other hand, this paper is more concerned with the short-term impact of shocks to variables and less with their long-term implications. Further differences can be made out in the variables used as an input for the structural VAR model. Current papers studying the effects of the COVID-19 crash on the market use variables such as daily confirmed COVID-19 cases (Narayan, Purnaningrum and Khawari 2021), this paper focuses solely on the FFR, inflation, MSCI returns and the CLI. Moreover, some related literature introduces the beliefs of market participants. (Lettau, M., Ludvigsson, S. and Bianchi, F. 2018)

When considering the results similarities arise. This paper confirms the results found in contemporary literature (Kontonikas and Zekaite 2008), (Hayford and Malliaris 2003), (Narayan, Purnaningrum and Khawari 2021) that shocks to the FFR result in a change in stock market valuation and inflation.

3. Data

To evaluate the impact of the monetary policy of the US in response to the market crash caused by the COVID-19 pandemic, four variables are considered. All variables are considered over a sample of 34 periods beginning 2019:1 and ending 2021:10.

The first variable considered is the monthly FFR (Federal Funds Rate). (FRED: FFR 2021) The data indicates a mean of 0.918% and a standard deviation of 101.46% over the sample. As seen in figure 1, the reason for the high variance is the drop-off of the RRF by 96.77% between January and March 2020. As the FFR influences the overnight interest rate on the interbank market for reserves, a sharp decrease could indicate measures to make investments more attractive.

The second variable considered is the change in then monthly inflation of the CPI (consumer price index) in the United States. (FRED: Inflation Rate 2021). The average inflation rate in the considered sample was 1.49% with a standard deviation of 9.34%. As seen in the graph in the top right corner of Figure 1, inflation sharply decreased in March 2020 by 38.93% followed by a sharp increase in April 2020 of 11.81%.

The third variable considered in the SVAR model is the MSCI index. (MSCI 2021) Monthly log returns are considered in this case. The average return over the 34-month sample period was 1.83%, with a standard deviation of 5.28%. As figure 1 shows the sharpest decrease in stock returns was in March 2020 of -14.27% followed by the sharpest increase in April 2020 of 12.2%.

The fourth variable considered in the SVAR is the change in the monthly CLI (Composite Leading Indicator) which gives information about the confidence of

business and consumer confidence in the market and therefore provides insight into market expectations. (OECD iLibrary 2021). For the purposes of this paper, changes in the monthly CLI are considered. Since the CLI lags be one month the data for the model will be adjusted, so that it starts in 2018:12 and ends in 2021:09. (Kontonikasand and Zekaite 2008) This is done to achieve a more accurate picture of the changes in the market outlook by its participants. Figure 1 shows that the sharpest decrease in the CLI was in April 2020 of -4.97%. Considering the lag of one month it also becomes apparent, that the market outlook had its low in March 2020. A further statistical evaluation of the variables used in this paper can be found in Table 1 in the appendix.

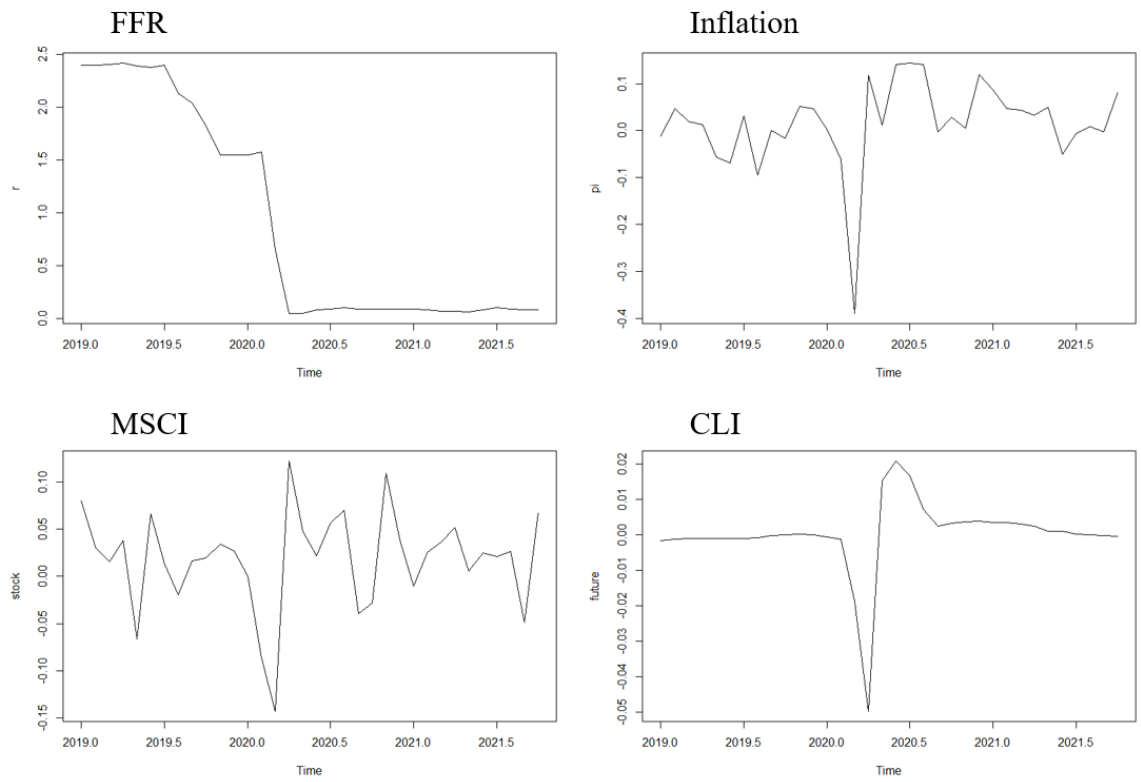

Figure 1 Development of the variables in the considered period

The data indicates that the market crash took place in March 2020. It can also be assumed, that the drop in the FFR was a response to the stock market crash. In this scenario the drop of the CLI in April 2020 (indicating the CLI for March 2020) can also be seen as caused by the stock market crash during the same time. Furthermore, the sharp decrease in inflation can indicate a sudden shock to the demand within the U.S economy, whereas the sharp increase in inflation could indicate multiple things. For one loosening in COVID-19 connected lockdown restrictions, but also a loosening of monetary policy by reducing the FFR. Weather these assumptions hold true, will be discussed in Section 5 where the results of the SVAR model are discussed.

4. Empirical Framework

The first variable in the framework is the FFR_t (Federal Funds Rate), which will serve as the main indicator for monetary policy. This is the case because the FED can influence the overnight interest rate on the interbank market by influencing the FFR, which in turn can create incentives to invest, but can also make investment less attractive. A closer description of this process can be found in the next section. The second variable introduced into the model is the monthly change in inflation indicated by $\Delta\pi$. The third variable introduced is the MSCI as a US-stock index, indicated by $\Delta MSCI_t$. Monthly log stock returns are considered in this case, to show the changes in stock prices. The fourth variable introduced into the model is the monthly CLI (composite leading indicator), indicated by ΔCLI_{t-1}, which "reflects business and consumer confidence […]" (OECD Library 2021) and therefore gives information about the expectations of market participants for the future. As Kontonikasand and Zekaite (2008) pointed out; the CLI lags by one month. Therefore, the time series for the CLI sample starts in $t-1$ (November 2019) and ends in $t-p-1$ (September 2019), totalling 34 observations. These variables result in the following (4x1) vector:

(1) $Z_t = [\, FFR_t, \Delta\pi,\ \Delta MSCI_t, \Delta CLI_{t-1}\,]$

The SVAR can be represented in the following form: (Kontonikasand and Zekaite 2018)

(2) $B_0 Z_t = B_1 Z_{t-1} + B_2 Z_{t-2} + \cdots + B_P Z_{t-P} + \varepsilon_t$

(3) $B(L) Z_t = \epsilon_t$

Where Z_t is the above mentioned (4x1) vector and $B_i\, for\, b\, \epsilon\, [1, 2, \ldots, p]$ is the (n x n) matrix indication the log coefficients. B_0 indicates the a (n x n) matrix of response coefficients. ε_t is a zero-mean error term. (Kontonikasand and Zekaite 2018) Therefore, if some relevant variables are left out of Z_t their effect will cumulate in ε_t.

By multiplying formula (3) on both sides with $B(L)^{-1}$ and B_0^{-1}, it follows: (Kontonikasand and Zekaite 2018)

(4) $A(L) Z_t = w_t$ for $A(L) = B_0^{-1} B(L)$ and $w_t = B_0^{-1} \varepsilon_t$

From solving formula (4) for Z_t follows: (Kontonikasand and Zekaite 2018)

(5) $Z_t = D(L) w_t$ for $D(L) = A(L)^{-1} w_t$

Since formula (4) defines $w_t = B_0^{-1} \varepsilon_t$ it follows: (Kontonikasand and Zekaite 2018)

(6) $Y_t = D(L) w_t = D(L) B_0^{-1} \epsilon_t$

Rewriting formula (6) into matrix form, results in the SVAR model used in this paper:

$$\begin{bmatrix} FFR_t \\ \Delta\pi_t \\ \Delta MSCI_t \\ \Delta CLI_t \end{bmatrix} = D(L) \begin{bmatrix} \beta_{11} & 0 & 0 & 0 \\ \beta_{21} & \beta_{22} & 0 & 0 \\ \beta_{31} & \beta_{32} & \beta_{33} & 0 \\ \beta_{41} & \beta_{42} & \beta_{43} & \beta_{44} \end{bmatrix} \begin{bmatrix} \varepsilon_t^{FFR} \\ \varepsilon_t^{\Delta\pi} \\ \varepsilon_t^{MSCI} \\ \varepsilon_t^{CLI} \end{bmatrix}$$

In this setup $D(L)$ represents the lag between the coefficients. (Kontonikasand and Zekaite 2018) This is the case because, shocks to variables do not immediately manifest themselves in a change in other variables, but only become relevant after some time. Therefore, an appropriate lag needs to be chosen. Furthermore, the amount by which a shock a variable changes another variable after a certain lag is given by the $\beta_{i,j}$ in the B_0^{-1} matrix.

The above shown SVAR model works on certain structural assumptions. Firstly, a shock to the FFR may affect inflation indicated by β_{21}, stock returns within the MSCI indicated by β_{31} and the market outlook in the CLI indicated by β_{41}. However, reciprocity is not assumed. This means that shocks to the inflation rate cannot affect the FFR, as well as shocks to the MSCI returns cannot affect inflation. Lastly shocks to the CLI cannot affect any of the other variables. This means that the CLI is considered a product of developments in all other variables, but itself has no effect on the others. Furthermore, it is assumed that inflation can affect stock returns as well as the CLI. Finally, stock returns only influence the CLI.

5. Results

To verify whether the data used is relevant a Granger Causality test has been conducted. The null hypothesis for FFR_t states: FFR_t does not Granger-cause $\Delta\pi_t$, $\Delta MSCI_t$, ΔCLI_t. Since the P-Value is sufficiently small (0.00008) the null hypothesis can be rejected, so that it can be concluded that FFR_t does Granger Cause changes in $\Delta\pi_t$, $\Delta MSCI_t$and ΔCLI_t. When considering $\Delta\pi_t$ the null hypothesis was: $\Delta\pi_t$ does not Granger-cause a change in FFR_t, $\Delta MSCI_t$, ΔCLI_t. Since the P-value is sufficiently small (0.000006) the null hypothesis can be rejected. The same could be concluded for the CLI with a sufficiently small P-value (0.001). However, when considering $\Delta MSCI_t$ the null hypothesis stands since the P-value is 0.108. The results concluded in this section still stand, since it is the primary concern of this paper to evaluate the effect a shock to the FFR has on stock market valuation and not the other way around.

The applied SVAR model in this paper uses two lags. This means that a change in one variable can take up to two months to fully manifest itself in a change in another variable. Since all data used in this paper is scaled into monthly data, the applied lags are two months. Meaning that the number of total observations is reduced to 32. The representation of the results is based on Kontonikasand and Zekaite (2008), where the

impulse response functions are given by the solid line while probability bands are given by dashed lines.

The first results considered are the impact of shocks to the FFR, to the other variables. The results indicate that a negative shock to the FFR causes an increase in inflation. The result is statistically relevant for one month after which it becomes statistically irrelevant. A negative shock of -1% to the FFR indicates an increase of +29.29% of the current inflationary level.[1] This result is consistent with the Keynesian macroeconomic view, that the money supply is a function of interest rates. (Keynes 2017: 146) This connection can be explained in the following way: A decrease in the FFR makes lowers the interest rate on the interbank market, since the deposit interest rate at the federal reserve is now lowered, which increases the supply of reserves to the interbank market. Since banks can get reserves cheaper, the interest rate for credit money is also lowered, which makes investments more attractive. This results in more investments. (Wray 2018:113) The Keynesian investment multiplier provides the connection between investment and demand and therefore also for the development of inflation. (Keynes 2017:107) A graphical representation of these concepts can be found in the appendix (Figure 5 and Figure 6). Furthermore, the results are also consistent with the long-run monetary neutrality assumption, since the results indicate that the change in inflation converges towards zero.

The affect a shock the FFR has on MSCI stock returns is like the response of the inflation rate. Specifically, the model suggests that a negative shock of -1% to the FFR cause an increase of +15,39% in stock returns. This effect can be explained by a similar methodology as when inflation changes were considered, since buying company shares can be seen as an investment. The results are statistically relevant for one month and become statistically insignificant after that. This is consistent with long-run monetary-neutrality assumption.

When considering the affect a shock to the FFR has on the CLI, compared to the other variables, it becomes apparent that the response of the CLI is lagged by one month. The results indicate that a negative shock of -1% to the FFR cause a change of +3.75% in the CLI. The lag of one month in this case is due to the structure that was assumed in the SVAR model. Since the CLI is assumed to be a result of the other variables changing, which all have lag, it can be concluded that effects on the CLI should be observable last. A negative shock to the FFR firstly changes the attractiveness of investments, which then increase consumption, which then inflates prices (stock prices specifically). Only after all these changes have taking place and market participants see an uptrend in the economy their market outlook changes resulting in the change in CLI. Combining this with the fact, that the data itself is lagged by one month that delayed reaction can explained. The results show after the delayed peak, the changes in the CLI converge towards zero. This can indicate that the euphoria caused by sudden spikes in stock prices disappears over time.

[1] So that price p would increase by the following amount in one month: $p^* = p * (1 + i * (1 + 0{,}2929))$

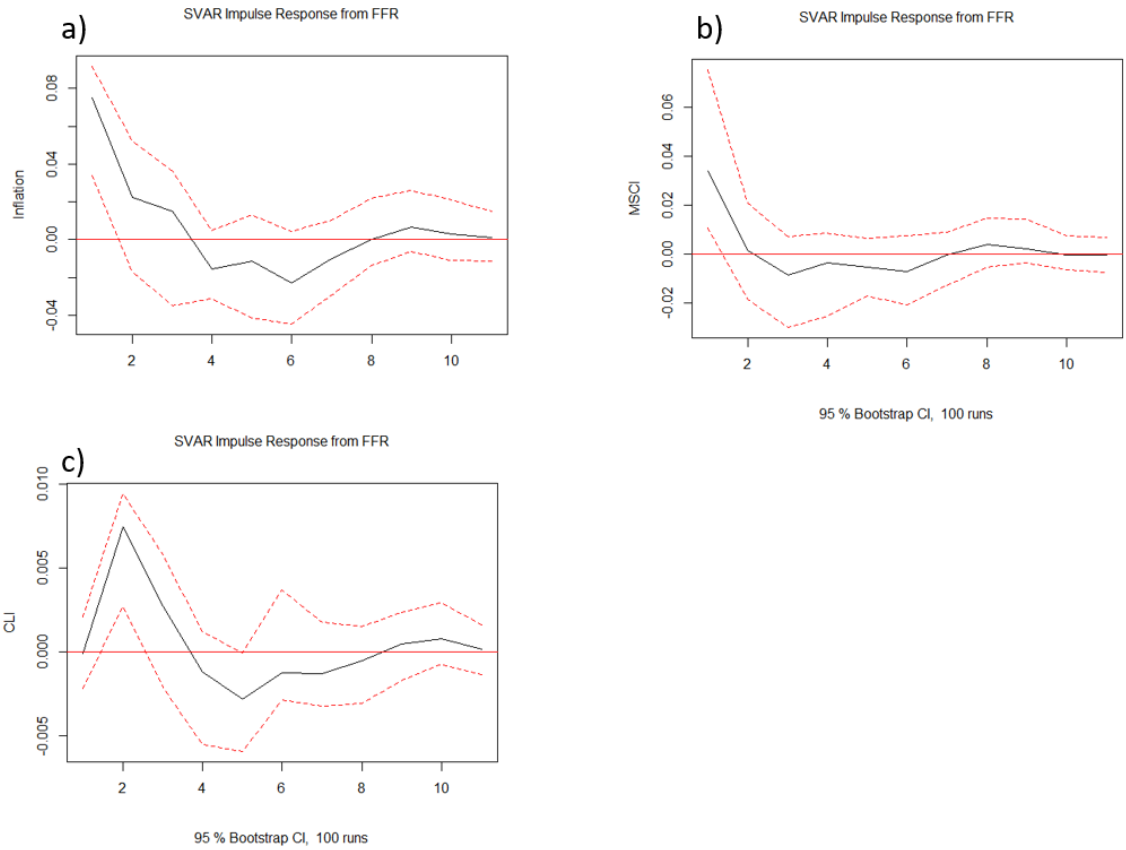

Figure 2 Responses to a Shock in FFR

Figure 2 shows the above-described findings. Where a) shows the response of inflation to a FFR shock; b) shows the response of MSCI to a FFR shock; c) shows the response the CLI to a FFR shock.

Now the effects of a shock to inflation will be considered. The results show that a positive shock to inflation results in a decrease in the MSCI index price. However, the results are inconclusive since they are not statistically relevant. Reasons for this will be discussed in section 6.

The effect of a positive shock to inflation indicates a positive response in the CLI. The results indicate that a shock of +1% to inflation causes a +4.8% change in the CLI. The results are statistically relevant for the first period and then become irrelevant. The reaction of the CLI, it is delayed by an additional month when compared to graph c) in Figure 2. This is due to the same mechanism as described above, just that now an additional factor needs to be added. Which is the belief of the participants whether the increase in inflation is a “desirable” economic development. For the most part inflation is perceived as negative by most market participants. Therefore, the initial reaction is negative and becomes positive in the following periods, as stock prices increase. The development also indicates that the shock is only temporary and converges towards zero in the long run.

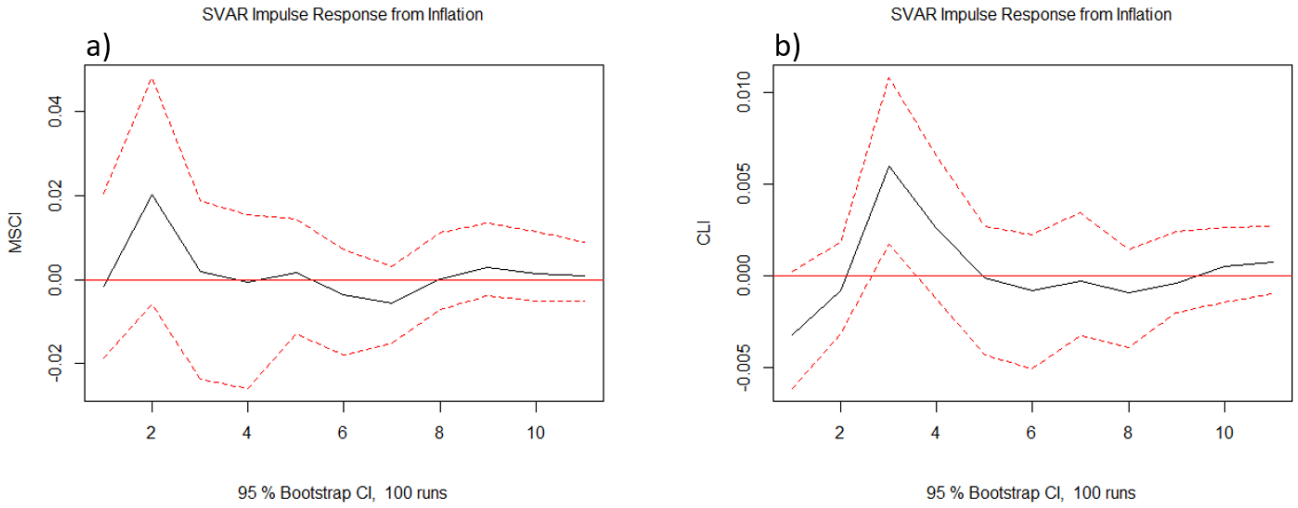

Figure 3 Responses to a Shock to Inflation

Figure 3 shows the above-described findings. Where a) shows the effect a shock to inflation has on stock prices and b) shows the effect on the CLI.

The last variable considered is the MSCI. The results show that a positive shock to the MSCI of +1% causes a +6.2% change in the CLI. Only the first period is statistically relevant, whereas the following periods are statistically insignificant. The positive connection between the MSCI and the CLI comes down to the beliefs of the market participants. Increasing stock returns after a market crash are generally seen as a market recovery. The results show that the effects of the shock disappear over time, making the series converge to zero. A graphical representation of this result can be seen in Figure 4 below.

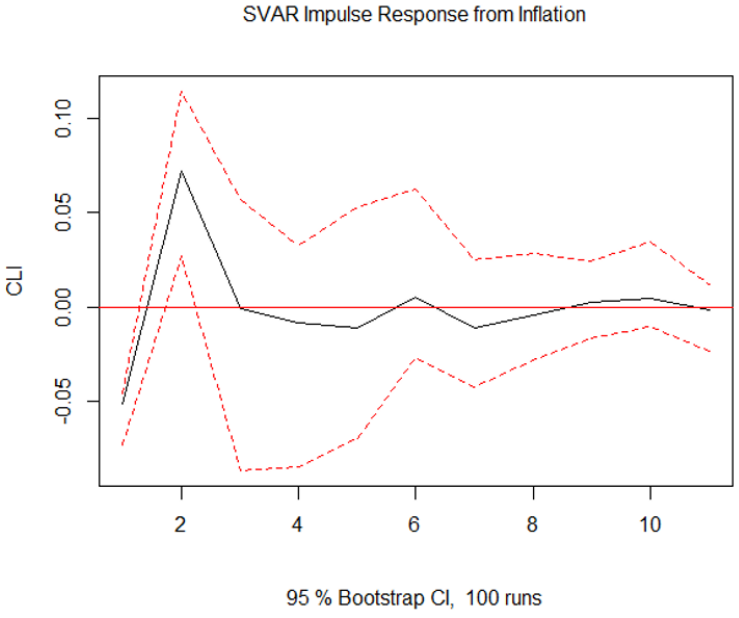

Figure 4 Impulse response of the CLI to a shock to the MSCI

6. Summary and Future Research

It was the goal of this paper to highlight the causality between the following variables: the federal funds rate, the change in inflation, log MSCI returns and the CLI. With a special focus on the impact a shock to the FFR has on the MSCI. For this purpose, a structural vector autoregression model (SVAR) has been used. The results showed that the FFR is negatively correlated with inflation and MSCI returns and the CLI. Meaning that a negative shock to the FFR causes a statistically significant increase in inflation, MSCI returns and the CLI. Since the variables are negatively correlated to the FFR it can be concluded that a positive should have a deflationary impact on the economy, since inflation and stock returns would decrease. Furthermore, the data suggest that this would have a delayed negative effect on the CLI. Furthermore, the data suggests, that the effect of an exogenous shock to a variable peaks immediately after the shock and then loses impact over time, where the effect then converges to zero. The conclusion found by Kontonikasand and Zekaite (2008), that exogenous shocks to the stock market effect the federal funds rate could not be confirmed in this case. This is due to the characteristics of the sample period considered. The period of one year before and one year after the stock market crash in March 2020 characterizes itself as a phase of special willingness to intervene on the part of the Fed, with the aim of creating stability in the financial markets.

The following limitations to this paper can be highlighted. For one, monthly data was gathered for a still ongoing event. Therefore, when considering the implemented lag of two, the total sample comes down to 32 observations per variable. Optimally, a lager sample period is preferred to gain more statistical preciseness. Long rung neutrality could only be implied but not confirmed, due to the results reaching statistical irrelevance after a few periods. Furthermore, the variables chosen only to serve as an overview of the mechanism at hand and not as a detailed description of economic modes of operation. Fiscal policy has not been considered as a variable. Therefore, the effects of Stimulus Packages (USA GOV 2021) on aggregate demand could not be considered. Further variables not considered in this model are monthly confirmed COVID-19 cases and restrictions connected to the spread of COVID-19. Using these variables could indicate how much COVID-19 measures have affected the stock market. From this follows another variable that could be considered, which is the unemployment rate, which could represent the situation on job markets. Furthermore, the output gap could be considered, to determine the extent to which a negative shock to the output gap affects fiscal policy and/or the stock market. The effect of these variables accumulates in the error term of the SVAR model. Additionally, a game theory approach could be taken to determine the impact of Bayesian beliefs about future developments in stock market valuations, but also about expectations about the actions that might be taken by the FED. Hayford and Malliarisaris (2003) approach could serve as a basis for future research. Finally, the effect of the above-mentioned variables could also be viewed from a micro perspective. Here single companies or market sectors could be taken as a reference group. Or the performance of portfolios based on firm size, growth, valuation, etc. could be used, where an approach like Kontonikasand and Zekaite (2008) could be adopted.

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8. Appendix

	FFR	Date	Inflation	Date	MSCI	Date	CLI	Date
Mean	0.92		1.49%		1.83%		0.01%	
Std. Dev.	101.46%		9.34%		5.28%		1.11%	
Min.	0.05	Apr 30, 2020	-38.93%	Mar 31, 2020	-14.27%	Mar 31, 2020	-5.10%	Apr 30, 2020
Max.	2.42	Apr 30, 2019	14.39%	Jul 31, 2020	12.20%	Apr 30, 2020	2.05%	Jun 30, 2020

Table 1 Table 1 Statistical overview of the used variables

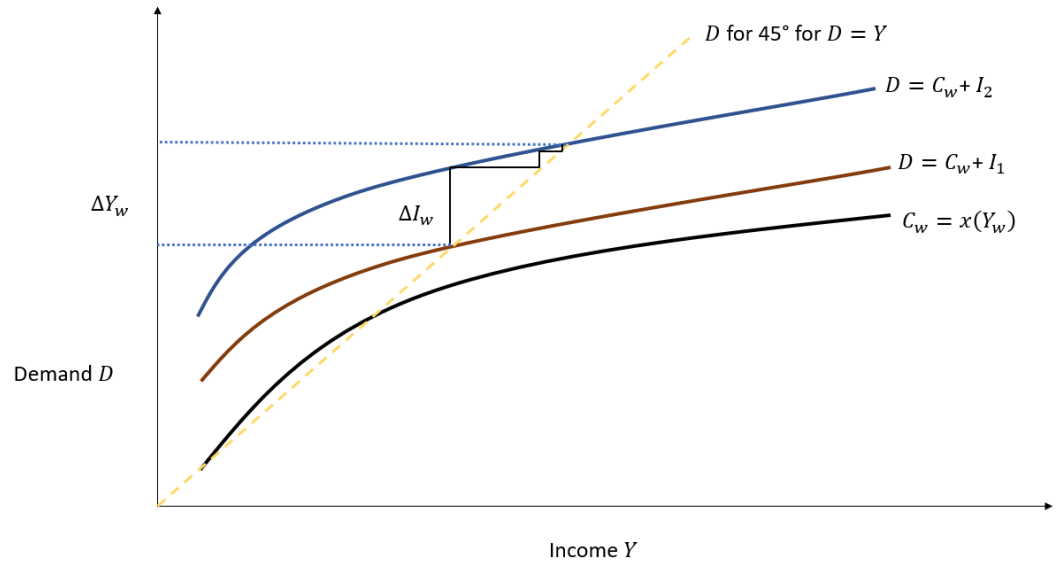

Figure 5 Keynesian Investment multiplier (own representation based on Rojas 2021)[2]

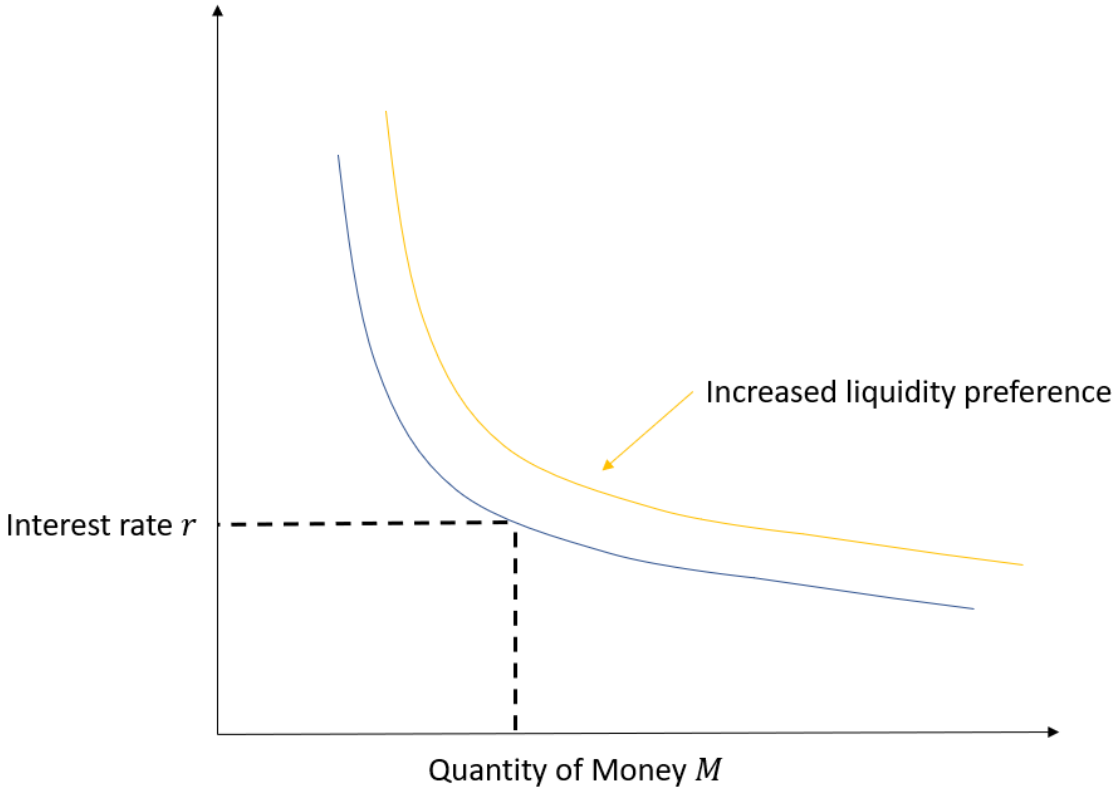

Figure 6 Keynesian relation between money supply and interest rates (own representation based on Rojas 2021)

[2] Where D represents demand, Y income and C consumption