Impact of Money Supply and Swiss Average Rate Overnight on the Stock Market in Switzerland

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List of Abbreviations

DCF	Discounted Cash Flow
VAR	Vector Autoregressive Model
SARON	Swiss Average Rate Overnight
SNB	Swiss National Bank
SMI	Swiss Market Index

1. Introduction and Motivation

This project was influenced by the idea and goal to analyze the Swiss monetary policy and its impact on the SMI. As the efficient market hypothesis states that a current price of assets incorporates all relevant information, it would be interesting to see how the SMI reacts to monetary policy decisions made by the SNB. Ioannidis & Kontonikas (2006) stated in their research, that identifying a link between financial prices and monetary policy is important, to better understand transmission mechanisms of monetary policy. Based on the aspect, that changes in asset prices play a key role in multiple channels, financial markets such as the stock, foreign exchange, mortgage, government, and corporate bond market are quick to incorporate new information available on the market.

Based on these ideas and descriptions, the following figure (1) already gives a first insight in how markets are impacted by monetary policy decisions:

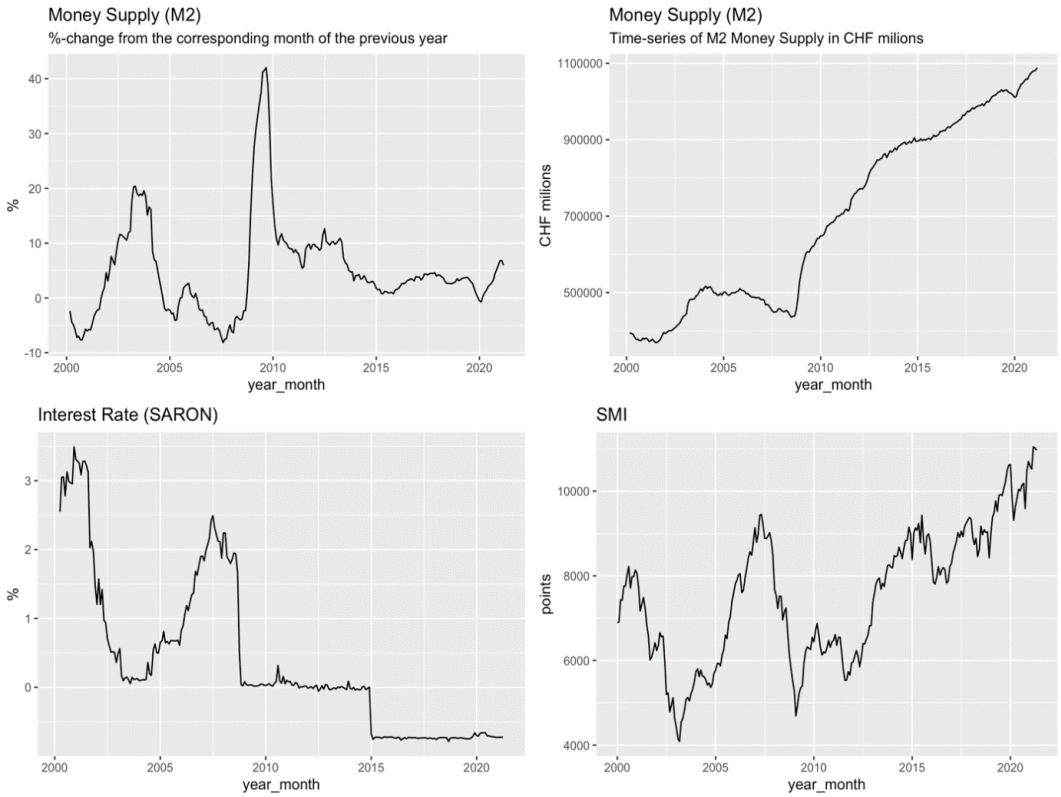


Figure 1: Overview of Monetary Supply, Interest Rate & SMI-Index

As shown in figure (1), the financial crisis around 2008 resulted in a large negative impact on international markets. The crisis was mainly, triggered by the inflated real estate market in the USA. Therefore, several central banks around the world hat to adjust their monetary policies. One of these changes can be seen during 2008, as the SNB increased the money supply available on the market. Combined with lowered interest rates, the financial markets then had the ability to recover.

This visual example gives an idea on how financial markets are interacting with the money supply and the interest rate. This paper aims to investigate these relationships in the following chapters.

2. Literature Review

The discounted cashflow (DCF) model shows that there is a direct relationship between interest rates and stock prices. In the DCF Model the stock price (S_t) is the present value of expected future dividends (D_{t+j}). (Ioannidis & Kontonikas, 2006). We use the simplified DCF-model:

$$S_{t=}E_t\left[\sum_{j=1}^{k}\left(\frac{1}{1+R}\right)^{j} D_{t+j}\right]$$

Where (E_t) is conditional expectation at time *t, R* is the rate of return used to discount future cashflows and *K* is the time horizon. The formula implies a direct effect of changing interest rate on the stock price. If the interest rate is increasing, future cashflows are discounted with a higher rate and thus the present value of the stock price lower.

Accordingly, monetary policy is linked to stock prices by altering expected future cash flows. (Ioannidis & Kontonikas, 2006). Thorbecke (1997) found that expansionary monetary policy exerts a large significant positive effect on stock returns. He also provides support for the hypothesis that monetary policy, at least in the short run, has real and quantitatively important effects on the economy. This indicates and indirectly effects stock prices since an increase in economic output means higher profits and thus dividends of the individual firms.

Kohout (2010) found that in the long-term money supply is the most significant variable, out of all macroeconomic variables, in influencing the development of stock prices. This aligns with the previous statements concerning the interest rate, since a higher money supply lowers interest rate and vice versa. Additionally, money supply can also affect stock prices directly when the greater supply of money is allocated in stock market investments. (Sirucek, 2012).

3. Main Research Questions

The following research questions will be tried to answer.

1) Is there granger causality between the interest rate (SARON) and SMI?

Null hypothesis: The interest rate (SARON) does not Granger Cause SMI.

2) Is there granger causality between the money supply (M2) and SMI?

Null hypothesis: The money supply (M2) does not Granger Cause SMI.

4. Methodology

In a first step, the research tries to observe and understand decisions made by the SNB and their impact on different markets, such as the Money Supply (M2) and the SMI. This is done by using the decompose () function implemented in R, which decomposes time series in Trend, Seasonal and Random parts. For visual analysis, mainly the Random parts are then being analyzed and cross-referenced to the chronically ordered monetary events published on the SNB website.

To determine the relationship between SMI, M2 and SARON we use Vector Autoregressive (VAR) Models. VAR-Models were proposed by Sims (1980) to capture the dynamic structure of (economic) variables without making the exogeneity assumption, since VAR models typically treat all variables as endogenous.

VAR Models are traditionally designed for stationary variable without Trend. Dicky and Fuller (1979) suggested a test of the unit root. The null hypothesis in the test is that a root is present and thus the series nonstationary. The alternative hypothesis is that a series is stationary.

Granger causality testing is applied to answer the research questions. Granger (1969) writes:

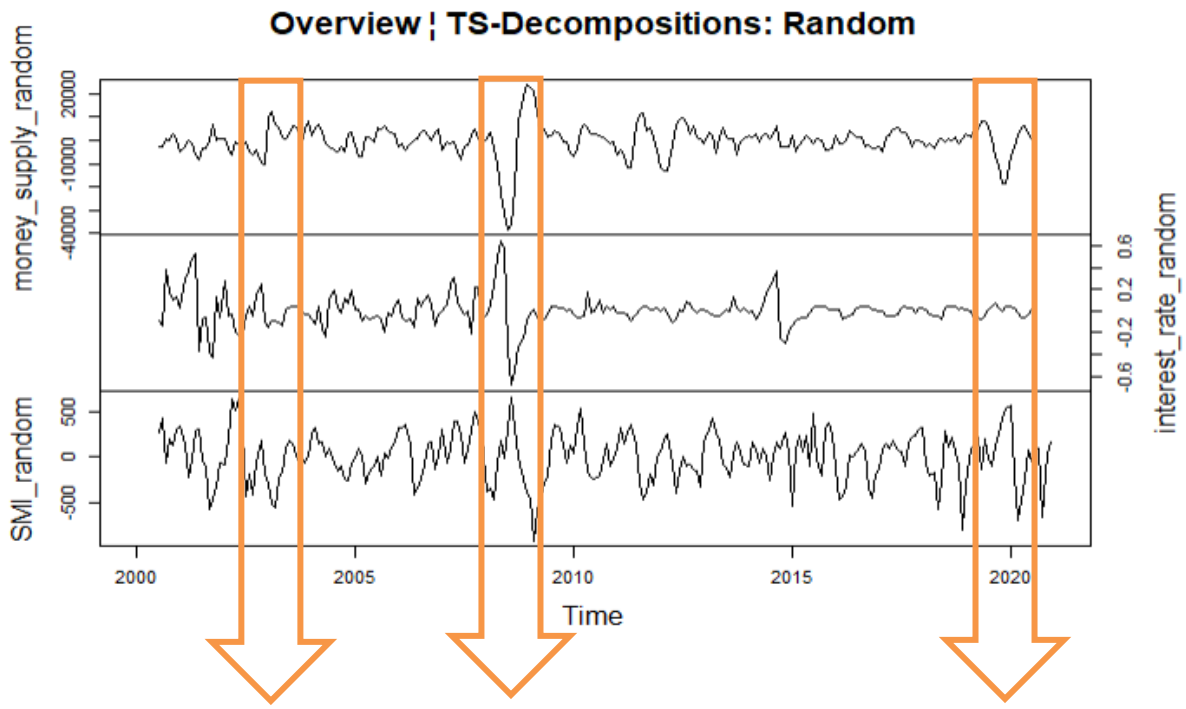
"The definition of causality used … is based entirely on the predictability of some series, say X(t),. If some other series Y(t), contains information in past terms that helps in the prediction of X(i) and if this information is contained in no other series used in the predictor, then Y(t):is said to cause X(t)." (p. 430)

Thus, by Granger causality we mean that past values of Y contain useful information on future values of X that is not contained in past and current X-values alone.

5. Visual Analysis

To better understand the impact of monetary decision made by the SNB, the research replicates a visual analysis by including the chronicle monetary events, provided on the website of the Swiss National Bank (2021). As to reduce the information load available, the project itself focusses on three impactful changes on the markets, depicted in figure (2):

Figure 2: Overview - Time Series Decompositions - Factor: Random



May 2002 => Feb. 2003	Feb. 2008 => Jan. 2009	June 2019 => May. 2020
On 2 May 2002, the SNB lowers the target range for the three-month Libor by half a percentage point to 0.75%–1.75%. **On 26 July 2002,** the SNB lowers the target range for the three-month Libor by half a percentage point to 0.25%–1.25%.	**On 11 March 2018**, the SNB announces that it will resume US dollar repo auctions as part of a coordinated move by several central banks to ease tensions in the money markets. **On 25 March, 18 April, 02 May, 26 Sept. - 2018**, the SNB offers banks US dollar liquidity amounting to a USD 6 - 12 billion through a repo auction.	**On 13 June 2019**, the SNB introduces the SNB policy rate and announces that it will use this rate in taking and communicating its monetary policy decisions going forward. The SNB policy rate replaces the target range for the three-month Libor. Interest on sight deposits held by banks at the SNB currently corresponds to the SNB policy rate and remains at –0.75%.

On 18 December 2002, the Federal Council dissolves the Fund for needy victims of the Holocaust/Shoa.	**On 8 October 2018**, the SNB lowers the target range for the three-month Libor by 25 basis points to 2.0–3.0%. **On 06 Nov. 2018** again by 50 basis points to 1.5-2.5%. **On 20 Nov. 2018** again by 100 basis points to 0.5-1.5% **On 16 October 2018**, the SNB announces that it will finance the transfer of illiquid assets from UBS in the maximum amount of USD 60 billion.	**On 25 March 2020**, the SNB announces the introduction of the SNB COVID-19 refinancing facility. The facility allows banks to obtain liquidity from the SNB, which is secured by the federally guaranteed loans. The SNB thereby enables banks to expand their lending rapidly and on a large scale and, at the same time, to access the required liquidity.

6. Results

Figure (1) already indicates the presence of strong correlations between the variables. The left-hand side of Figure (3) confirms this notion. Both M2 and SARON are strongly correlated with the SMI. However, since strong deterministic trends are present, these correlations could be spurious.

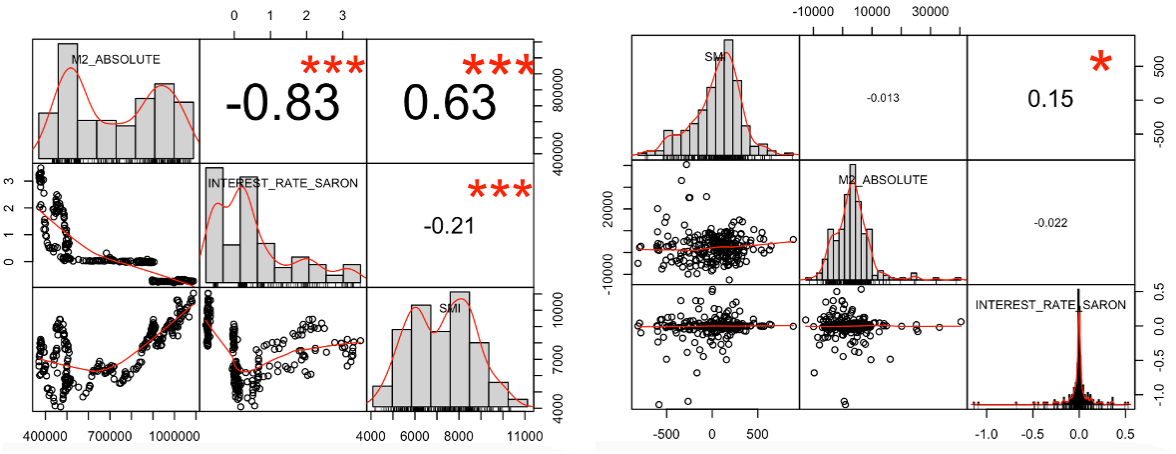


Figure 3 Correlations of SMI, M2 and Interest Rate.

Left: Original series / Right: First difference of the series (Returns)

To avoid wrong conclusions by statistically deviated results, we are testing for stationarity by applying the augmented Dickey-Fuller test. After taking the first difference of M2 and SARON, both tests yield p-values below 0.01, indicating stationarity for the two time-series.

The right-hand side of Figure (3) shows the correlation between the returns of the series. The approximatively, normally distributed returns indicate that a log transformation is not needed. The correlations of the returns are much weaker.

Testing for Granger causality between lagged SARON with lag 1 and SMI leads to a p-value of 0.00134 and thus strong evidence to reject the 0-hypothesis of no granger causality.

Applying the test with lagged M2 with lag 8 and SMI leads to a p-value of 0.00745 and thus to the same conclusion of rejecting the 0-hypothesis of no granger causality. Figure (4) shows the p-values for a range of lags for both M2 and SARON. The latter is the most significant at lag 1 with increasing p-values at higher lags. Contrary, Granger Test M2's p-values elbow (sharp decrease) at lag 4 and are lowest at lag 8.

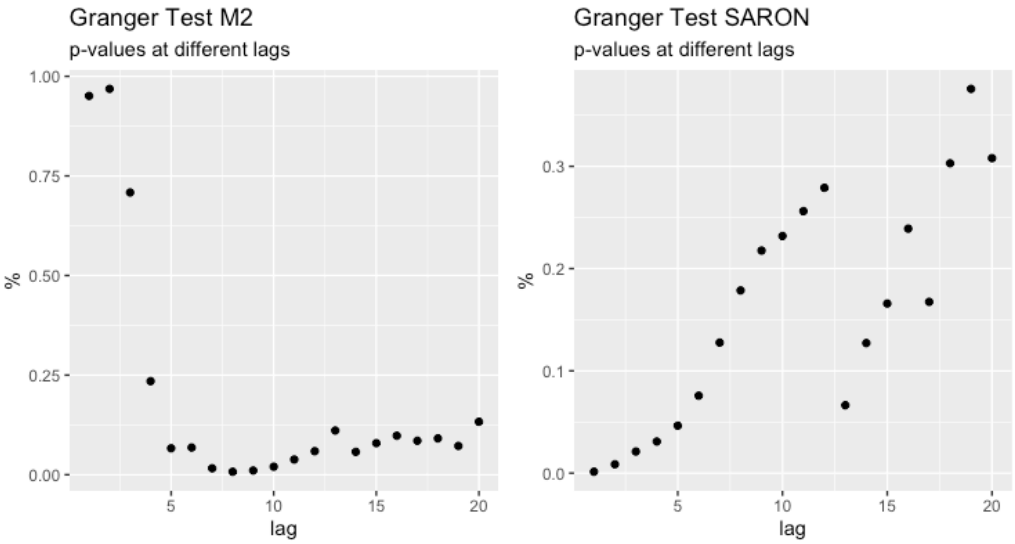


Figure 4 Granger Causality Tests with different lags

The results confirm the assumption suggested by the literature that the interest rate and money supply have predictable influence on stock prices. More precisely, the granger tests suggest that it is useful to include M2 and SARON for predicting SMI when the SMI's own history is already used for prediction.

We use the information from Figure (3) to estimate the final model, using a multivariate VAR-Model including SMI, M2 and SARON. According to the model output, previous values of the SMI add no additional information to predict future values of the SMI. This aligns with the efficient market hypothesis. The most suitable model consists of past values of SARON and M2 as well as an intercept. It is defined as followed:

$$\Delta SMI = 4.63 \ + 345 * \Delta SARON_{t-1} + 0.055 * \Delta M2_{t-4}$$

It is worth mentioning, that is not the intention to have a model with a high predictive power but to estimate the effect of M2 and SARON on the SMI. To increase predictive power, more variables would have to be considered. Furthermore, according to the VAR-model output, SMI, SARON and M2 seem to granger cause M2 and thus indicating more complex feedback effects, which can be further discussed but are out of the scope of this paper.

7. Conclusion

The reviewed literature suggests that stock-prices are depending on the interest rate and money supply. The DCF-Model includes a direct link between stock prices and the interest rate. Money supply seems to influence stock prices, firstly, by being correlated with the interest rate (and thus by the described link of the DCF-Model) and secondly, if an increase in money supply is allocated in the stock market.

Aligning with the literature, the paper shows that both variables granger cause SMI. However, there is a difference in response time. The tests indicate a quick response to changes in interest rate and a lagged response to changes in money supply. It would be interesting, to further analyze the role of money supply. To what extend does an increase in money supply flow into the stock market and to what extend does it flow into the economy? For example, a comparison with a baseline (which represents "normal" conditions) could indicate whether the Swiss stock markets are significantly driven by the allocation of excess money not used in the economy.

8. Structured List of Sources and Literature

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9. Appendix

9.1. Declaration of Originality

The undersigned hereby declares that he or she

- wrote the work in question independently and without the help of any third party,
- has provided all the sources and cited the literature used,
- will protect the confidentiality interests of the client and respect the copyright regulations of Lucerne University of Applied Sciences and Arts.

Date and signature

24.05.2021 Matthias Wenger

24.05.2021 Valentin Arbenz