Relationship Between Money Supply and Asset Prices in Developed Countries

Jonas Sørensen and Vegard Johansen

Abstract

We examine the relationship between money supply and asset prices. In particular, we examine the relationship between the money supply and the equity market in Japan, Switzerland, Singapore, Great Britain, and New Zealand. Since U.S. is the largest economy in the world, we also examine the relationship between U.S. money supply and other assets, namely gold, oil and three subsectors of the U.S. stock market (consumer staples, consumer discretionary and real estate). No long-run relationship is found when the Johansen test for cointegration is applied on the U.S. assets and money supply. Further, there is found no particular evidence that the latter variable is driving the price of these assets. Contrary, we find that the money supply and stock market of Japan, Switzerland, Great Britain and New Zealand are cointegrated during different time periods.

Keywords: Money supply; Asset prices; Cointegration; VEC models; VAR models

Universitetet
i Stavanger

UNIVERSITY OF STAVANGER BUSINESS SCHOOL

MASTER'S THESIS

STUDY PROGRAMME: Master in Business Administration	THIS THESIS HAS BEEN WRITTEN WITHIN THE FOLLOWING FIELD OF SPECIALISATION: Applied Finance IS THE THESIS CONFIDENTIAL? No **(NB!** Use the red form for confidential theses)

TITLE: Relationship Between Money Supply and Asset Prices in Developed Countries

ENGLISH TITLE: Relationship Between Money Supply and Asset Prices in Developed Countries

AUTHOR(S)		SUPERVISOR: Peter Molnar
Candidate number:	Name:	
2048 …………………	Jonas Sørensen ……………………………………	
2043 …………………	Vegard Johansen ……………………………………	

Acknowledgements

We would like to thank our supervisor, Peter Molnar, who has provided us with great assistance throughout the process of writing this Master Thesis. Also, we would like to thank Svein Olav Krakstad, who has been of great help when we have encountered statistical dilemmas.

1 Introduction

In 1971 President Nixon announced that the U.S. would drop the Gold Standard. Since then there has been a large increase in economic growth and money supply. Asset prices have risen substantially, and investments have made a large number of people rich. In the mid-1970s, the S&P 500 traded at a p/e ratio between 10-11(macrotrends, 2021). Today it is trading at a ratio around 38 (Wall Street Journal, 2021). When the announcement back in 1971 came, the broad definition of money, M2, equaled $ 683,7bn. In 1991, 20 years later, the amount had reached $ 3351,4bn. Hence, during the first 20 years after the Federal Reserve abandoned the Gold Standard, The U.S. experienced a five time increase in money supply. During the last 20 years, M2 increased by approximately 300% to a total amount of $ 19,979.4bn in March 2021. The money supply in the last year after the Covid-19 outbreak make up about 25% of the total increase in this period (The Federal Reserve, 2021).

In the recent decades central banks have applied unconventional monetary policies. Especially in times post financial crisis, more radical measures are implemented in an attempt to stimulate the economy. When central banks apply unconventional monetary policies, it is because the usual preferred actions do not achieve the market response one would normally expect. These policies can be seen in many forms. For instance, negative interest rates, suspension or changes to inflation targets and, credit- and quantitative easing (QE). The latter is the most high-profile form of unconventional monetary policy and was first applied in Japan in the 1990s (Joyce, Miles, Scott & Vayanos, 2012). When reacting to financial slump through the measure QE, the sought targets are for example to reduce long-term interest rates and raising the value of assets (Lima, Vasconcelos, Simão & de Mendonca, 2016).

More in general, variables such as employment, inflation and long-term interest rates are considered when deciding the long-run monetary policy in the U.S. (The Federal Reserve, 2020). These variables are regularly mentioned as determinants in countries' monetary policy. In the case of money supply, it is a longstanding debate whether it is exogenous or endogenous. Depending on the context it can both be determined exogenously by central bank, or endogenously by commercial banks and changes in economic activity (Sieron, 2019). It is argued that in the U.S., The Federal Reserve and their policy is the most important determinant of money supply. They set the reserve ratio for commercial banks. The required reserve ratio is determined by law. It is a ratio of cash to current and time deposits liabilities, and banks are required to hold a certain percentage of these in the central bank. If this ratio is high, banks will have less cash to lend out and money supply will go down (Schwartz, n.d.).

In the first 20 years after the U.S. dropped the Gold Standard in 1971, the inflation rate fluctuated between 4-10% with some exceptions. In the following 30 years (1990-2020), although we have seen large increases in asset prices and in money supply, the inflation rate has been stable at around 2% (World Bank, 2020). Congdon (2005) stated that too many, or most, considered the level of interest rates as the only determinant when explaining why inflation in prices occur. Some only recognize central banks' rediscount rate as the factotum of the economy. The way broad money supply fluctuates and effects asset prices in the economy, should be given more attention, and will remain important to our understanding of economies (Congdon, 2005). Regardless, there are numerous studies examining the effect money supply has on asset prices and vice versa. However, most of the literature on this topic use data prior to/the start of the 21st century (Wong, Khan & Du, 2006; Rahman & Mustafa, 2008; Gan, Lee, Yong & Zhang, 2006) or study the relationships between these variables in a time of crisis (Humpe & McMillan, 2020; Lima et al., 2016). Hence, there is a rather narrow selection of studies conducted including recent data in a long-run analysis.

In this paper we seek to determine whether there is a relationship between the money supply and asset prices. This paper adds to the existing literature on this topic by using data from the two previous decades. Thus, the impact of the Covid-19 pandemic is accounted for when studying the short -and long-run relationship between the two variables through using VAR and VEC models. The analysis is conducted for six different countries, namely the U.S., Great Britain, Japan, Singapore, Switzerland, and New Zealand. Asset prices are represented by the countries' main stock index. Additionally, for the U.S., five variables representing specific commodities and asset classes of the stock market are added. The time period of the applied data is mainly from 2001.05.31 – 2021.02.28, but there are two exceptions (Japan & New Zealand). The whole data sample is also divided into three sub-periods (2001.05.31-2007.12.31, 2008.01.31-2014.07.31 & 2014.08.31-2021.02.28), which is analyzed using the same methods.

We find no long-run relationship between the U.S. money supply (M2) and asset prices. Also, there is found no evidence of the former variable driving the latter in the short-run. But, the results of the second time period analysis, which includes the financial crisis, indicates that a positive change in M2 has a negative impact on most of the assets' price. Further, we find that there is a long-run relationship between the money supply and stock market of Japan, Switzerland, Great Britain and New Zealand during different time periods.

The rest of this paper is structured in the following order. Section 2 provides an overview of the monetary aggregates and their components. Further, there is a short introduction to the determinants of money supply, and an explanation of quantitative easing. Section 3 presents the existing literature on the topic. Section 4 describes the data, and the process of collecting and structuring it. Section 5 outline the statistical methods applied in the analysis of the data. Section 6 presents the results obtained, while Section 7 summarize and conclude.

2 Money Supply

Money supply is one of the most fundamental macroeconomic variables and is determined by the central bank. There are numerous of monetary measures. Therefore, Section 2.1 gives a brief introduction to the most common ones. Further, Section 2.2 elaborates on quantitative and credit easing. Additionally, examples of how different countries have implemented them is described.

2.1 Monetary Aggregates

The money supply or money stock represents the total amount of money in an economy at a given period of time. Money can function as a medium of exchange, a store of value, or a final settlement of debt. The different functions of money can be measured and identified with various measures of money supply. Choosing which money measure to analyze is dependent on what one wants to investigate. Usually, the different types of money are put into two main categories, namely Narrow and Broad Money. The former covers types of money that has high liquidity such as currency, and is usually defined as M1. While the latter is the sum of narrow money and the less liquid money categories, which among others includes saving deposits. Two additional monetary aggregates are MB (Monetary Base) and MZM (Money with Zero Maturity). The components of the different money supply definitions differ for each country. For a descriptive table of the narrow- and broad money-aggregates of the countries studied in this paper, see table A.2 in the appendix.

2.2 Quantitative- and credit-easing

QE refers to the act of injecting liquidity into an economy by central banks (Booth, 2020). The process starts with printing money. In fact, you can either print money or make it electronically. It is more convenient to do the latter and provide it to banks as balance sheet credits. The next step is distributing the money into the economy. There are several methods the central bank can apply, e.g. buying large amounts of assets or by lending to the banks directly. In both approaches, the amount of money into the broader economy will hopefully rise (Booth, 2020). Breedon, Chadha & Waters (2012) describe QE as a trade between the central bank and corporations, where central bank money is swapped with assets.

QE was first applied by the Bank of Japan (BOJ) when dealing with the burst of the real estate bubble and deflation of the economy in the 1990s. The interest rates in Japan were at the zero lower bound, and the central bank's goal was acquiring government securities from the banks. Hence, boosting the level of capital (reserves) in the financial sector. Their ambition was that if the reserves reached a large enough level, it would eventually raise commercial banks' willingness to lend to the broad economy. Thus, remove the deflationary pressure which further would lead to higher asset prices (Joyce et al., 2012).

During the financial crisis (2007-2009) the UK implemented QE to stimulate their economy. Unlike the BOJ, the Bank of England (BoE) focused on purchasing UK government bonds from outside the financial sector (Joyce et al., 2012). The objective of the QE was to improve the liquidity of the credit market through buying private-sector assets of high quality. Although in 2008, the Bank of England allowed some banks and building societies to swap their asset-backed securities for more liquid UK Treasury bills, their main target was the non-bank sector (Lyonnet & Werner, 2018). The QE-operation in the UK was not designed to fix liquidity-problems in the banks, but targeted various asset classes to raise the prices (Joyce et al., 2012). The European Central bank's (ECB) measures in the sovereign debt crisis in 2011 has been termed QE. Because of the complex composition of the financial system in the Eurozone, and ECB's objective regarding the measures, the QE is different from the other examples. Similar to the BOJ's actions, the ECB also targeted banks directly through lending against collateral. The main difference is that the ECB's aim was not to increase asset prices, but to achieve price stability (Cour-Thimann & Winkler, 2012).

A measure which is similar to the QE approach is called credit easing. They are similar in the form that they both focus on increasing the amount of money in the economy, and thus, expand the central bank's balance sheet. The key difference according to the chairman at the Federal Reserve, Bernanke (2009), is that QE focus on the quantity of bank reserves which is on the liability side of the central bank. Credit easing is a measure with more focus on the asset side of the central bank's balance sheet. By applying this measure, the end goal is to increase the total amount of money in the economy, but engineering where the money goes. The Federal Reserve accompanied by Bernanke, responded to the Great Recession by purchasing large amounts of treasuries and mortgage backed securities. This led to increased liquidity in the bank sector and interest rates fell. The Fed focused on the composition of the different assets (loans and securities), and how their position affects credit conditions for both private households and businesses (Bernanke, 2009). There was a great amount of effort deployed to stimulate the real estate market (Reisenbichler, 2019). The credit easing eventually helped to ease the financial crisis.

3 Literature review

There have been conducted a great number of studies on the relationship between different macroeconomic variables and asset classes. Many of them analyze which variables that can explain the stock market returns and their dynamic short- and long-run relationship.

Wong et al. (2006) conducted a study to examine the long-run relationships of the stock index in Singapore (STI) and in the U.S. (S&P 500), with the national interest rate and M1. Both testing the relationship for the whole data sample-period and for shorter subset periods. By applying cointegration tests and Granger causality tests on the full data-sample, it is suggested that Singapore`s stock prices display a long-run equilibrium relationship with interest rate and M1, but that is not the case for the U.S. Analysis of the sub-periods imply that the stock-market in Singapore move in tandem with interest rate and M1 prior to the Asian Crisis in 1997. In the U.S., the macroeconomic variables were strongly cointegrated with the stock market before the 1987 equity crisis, but this relationship gradually diminished and disappeared after the 1997 Asian crisis.

Jamaludin, Ismail & Manaf (2017) and Humpe & McMillan (2009) came to similar conclusions regarding the interconnection between money supply and stock prices. The former found that the money supply of Singapore, Malaysia and Indonesia was insignificant to the countries` stock market returns. The latter examined different macroeconomic variables and its influence on stock markets in the U.S. and Japan. The relationship between money supply and the stock prices in the U.S. was insignificant, while it had a negative and significant influence in Japan. Azad & Serletis (2020) studied monthly data between 1870-2020 for money supply and the stock market in the UK. Their analysis suggests that uncertainty about the money supply has a negative and significant effect on the stock market and that positive (negative) shocks to the money supply have positive (negative) effects on the share price. Gan et al. (2006) investigated the relationship between the stock index, money supply and six other macroeconomic variables in New Zealand. The Johansen Maximum Likelihood test affirm that there is a long-run relationship between the NZSE40 and the variables. The Granger causality tests reveal that the index is not the leading indicator for the variables tested. The FEVD test result indicates that the NZSE40 could be explained by the long- and short-term interest rate, M1 and GDP. Wasserfallen (1989) researched whether unexpected variations in macroeconomic variables have an effect on stock price indices in the UK and Switzerland. The results show that the effect is either not present, is very low, or are hidden by a low signal to noise ratio.

Rahman & Mustafa (2008) apply a vector error-correction model and studies the long-, and short-run dynamic effects between M2 and the oil price on the U.S. stock market. The study show that both M2 and the oil price have no long-run causal effect on the stock-market. The short-run dynamics on the other hand, show that these variables have Granger causal effect on the stock market. Others have found comparable results. E.g. Aziza (2010) who conducted a cross-country analysis and found that money and quasi-money growth have a long-run relationship with the stock-market. Azar (2014) finds that the growth rate in money supply has a negative delayed effect on U.S. stock returns. On the other hand, there are also studies that finds no impact at all. Chen, Wei, Huang & Elkassabgi (2020) investigated how macroeconomic variables influence the stock market in China. Through Granger causality tests, they found that money supply had no significant impact on the Chinese stock market and conclude that monetary policy does not affect stock returns.

Other studies try to examine the effect money supply has on the price of commodities and consumer goods. A paper by Barnett, Bessler & Thompson (1983) was conducted using Granger causality test with monthly observations between 1970-1978 for M1, M2, reserve money and agricultural prices. The results imply that the increase in M2 money supply contributed to a rise in agricultural prices in the early 1970s. Browne & Cronin (2010) wrote an article which argues that it should exist a long-run and dynamic relationship between commodity prices, consumer prices and money supply. The use of Johansen's maximum likelihood procedure, a cointegrating VAR and U.S. data, provides evidence that display equilibrium relationships among the variables. Azar (2012) studies the long-run relationship between money supply, 48 different commodity prices and six commodity indices between. The study found supportive evidence of unit proportionality between the variables. Tromp (2014) examined the dynamics behind four agricultural food commodity prices, but unlike (Barnett et al., 1983), (Browne & Cronin, 2010) and (Azar, 2012) she finds that worldwide money supply has no significant effect on any of them.

Kasteler (2017) investigated the measure QE, and the overall impact it had on the price levels of oil, gold, and wheat. The data is analyzed by applying VAR- and VEC-models, and it is concluded that there is a long-term relationship equilibrium between the commodities and M2. Hingorani & No (n.d.) study the variables gold, money supply, equity market (S&P 500), inflation, and real interest rate in a multivariate model. The Johansen test indicates that all the variables are cointegrated with one cointegrating equation. Results from the Granger causality test state that CPI Granger causes M2 and real interest rate. The S&P 500 Granger causes real interest rate and CPI, but this is not the case the other way around. Real interest rate Granger causes M2. Gold prices on the other hand had no causal relationship with any of the variables except that the real interest rate Granger causes gold price.

We could only find a limited number of recent articles and studies about the effect of money supply on the real estate market. However, the ones we could find were primarily focused on the real estate market in China. Su, Wang, Tao and Chang (2019) explores the causality between housing prices and money supply. The use of Bootstrap full-sample causality test reported no causality between the variables. By analyzing the causality between them in sub-periods, it is found bidirectional causality. An increase in M2 has a positive impact on house prices, while crashing or soaring house prices affect the money supply. This provides proof that a stable supply of money can maintain a relatively stable price level in the real estate market. Zhang (2020) finds that there is a significant relationship between M2 and real estate prices in China. The result of the Granger causality test indicates that the money supply Granger causes the rise in house prices. Conversely, Chen, Wei & Huang (2019) finds no evidence of money supply impacting housing prices in China.

Goodhart & Hofmann (2008) study the links between money, credit, house prices, and economic activity in 17 different industrialized countries. The analysis is based on a fixed-effects panel vector autoregression. Furthermore, Granger causality tests are applied, which indicates that there is strong evidence of multidirectional causality between house prices, money, credit, GDP, CPI, and the interest rate. The monetary variables are found to have a significant effect on house prices, and house prices to have a significant effect on money and credit growth.

In periods of crisis there are several examples of central banks increasing the money supply in their countries through QE. A study by Humpe & McMillan (2020) investigate if the central bank's increase in money supply could explain the stock market resilience. A cointegration framework between different macroeconomic variables and the U.S. stock market shows that almost 50% of the recovery in the stock market is due to the rapid growth in money supply. Another example is presented by Lima et al. (2016). Their research paper investigates whether the QE conducted by the central bank of the U.S., the UK and Japan led to an increase in the stock markets in the period post the subprime crisis. The findings in the paper imply that the QE had a positive impact on the stock markets.

Based on the literature investigated it is clear that the research question whether money supply and asset prices have a significant relationship or not, is rather complex. The results deviate from country to country, and additionally, based on the variables and time period examined. Hence, there is no definite conclusion to this research topic.

4 Data

This section presents the data applied in the analysis. The objective of this paper is to determine whether there is a relationship between money supply and asset prices. To study the link between these variables, historical asset prices were downloaded from Reuters, except for NZX 50, where Investing.com was used to gather data. The money supply of six countries was collected from the central banks' webpages. Selected countries, their monetary aggregate and the stock indices are shown in Table 1. Although the abbreviations for the monetary aggregates are different, they have one common feature, which is that they are a measure of broad money (BM). The main stock indices of the chosen countries represent the development in asset prices. To maintain comparability, all of the indices are total return indices, i.e. the price development also accounts for dividends. Further, the stock indices are denoted using the following abbreviations: Swiss Market Index (SMI), Straits Times Index (STI), Financial Times Stock Exchange 100 Index (FTSE) and Nikkei 225 Index (N225). The two remaining indices are denoted as NZX 50 and S&P 500.

Table 1: Overview of the chosen countries & stock indices.

Country	Code	Monetary Aggregate	Stock Index (SI)	SI Ticker (Reuters)	Time Period
Switzerland	CHE	M2	Swiss Market Index	.SMIC	2001.05.31 – 2021.02.28
Singapore	SGP	M2	Straits Times Index	.TRISTI	2001.05.31 – 2021.02.28
Great Britain	GBR	M4	Financial Times Stock Exchange 100 Index	.TFTSE	2001.05.31 – 2021.02.28
Japan	JPN	M2	Nikkei 225 Index	.N225TR	2003.04.30 – 2021.02.28
New Zealand	NZL	Broad Money	NZX 50	.NZ50	2002.12.31 – 2021.02.28
United States	USA	M2	See Table 2 below		

Table 2: Overview of stock index, commodities & ETFs for the U.S.

Assets	Ticker	Time period
S&P 500	.SPXTR	2001.05.31 - 2021.02.28
Gold		2001.05.31 - 2021.02.28
West Texas Intermediate	WTI	2001.05.31 - 2021.02.28
Consumer Staples Select Sector SPDR Fund	XLP	2001.05.31 - 2021.02.28
iShares U.S. Real Estate ETF	IYR	2001.05.31 - 2021.02.28
Consumer Discretionary Select Sector SPDR Fund	XLY	2001.05.31 - 2021.02.28

Variables selected to represent the asset prices of the U.S. are not included in Table 1. The reason being is that the U.S. makes up a large proportion of the world's economy, and therefore, several assets are included in the analysis on top of S&P 500. These assets including the stock index are listed in Table 2. Yahoo Finance was used to retrieve the price development of XLP, XLY and IYR, whereas the spot price of gold and WTI was collected from Goldhub and U.S. Energy Information Administration. Note that the price of XLP, IYR and XLY are adjusted for dividends and stock splits. Further, plots of the money supply of the U.S. and Japan showed some seasonality. Therefore, seasonally adjusted data was chosen for these two countries. The frequency of the data is monthly, and the time period is from May 2001 to the end of February 2021. Notice that the time period is shorter for Japan and New Zealand. Data on the money supply of the former country was not available before April 2003. While the latter country renamed and changed the format of their stock index. This shift involved that the index went from not accounting for dividends to assuming that they were reinvested in the companies composing the index (Gaynor, n.d.). Launch date of the index was March 3, 2003. Thus, the three first months of data does not consist of actual performance, but how the index would have performed with the new methodology applied (S&P Dow Jones Indices, 2021-a).

Additionally, the data is divided into three sub-periods. The sub-periods are set by dividing the full sample time period by three. Hence, most of the variables are analyzed using the following sub-periods: (1) 05.31.2001 - 12.31.2007, (2) 01.31.2008 - 07.31.2014 and (3) 08.31.2014 - 02.28.2021.

4.1 Variable description

This section provides a short description of the assets studied in this paper. In general, the indices consist of a relatively large sample of publicly listed companies. Section 4.1.1 addresses the indices. Further, as the main focus of this paper lies on the relationship between the money supply of the U.S. and its assets, a more detailed description of the commodities, ETFs & index used to study this relationship is provided in section 4.1.2. For an overview of the components of the countries' monetary aggregates the reader is referred to Table A.2 in the appendix.

4.1.1 Stock Indices

The **Swiss Market Index** (SMI) consists of the 20 largest and most liquid companies in Switzerland, and includes large enterprises such as Swatch Group I and Nestle N. The composition of the stocks is weighted by their free-float market capitalization, and the maximum weighting is capped at 20% for each. The composition of stocks counts for about 80% of the total market capitalization of the Swiss equity market. Thus, makes it a good representation of the Swiss stock market (Six Group, 2021).

Straits Times Index (STI) is considered the benchmark index for Singapore. The top 30 stocks regarding size and liquidity are included. Like the SMI, STI also accounts for approximately 80% of the value, considering the respective equity market. Every quarter the comprised companies are reviewed, and companies are removed or added based on defined rules (Dayani, 2020).

Financial Times Stock Exchange 100 Index (FTSE) is part of a UK series where different indices measure the performance in different parts of the equity market, e.g. based on size, income, and industry. FTSE consist of the 100 largest blue-chip companies listed on the London Stock Exchange. This index is market-capitalization weighted consisting of companies like AstraZeneca, JD Sports Fashion and Burberry Group (FTSE Russell, 2021).

Nikkei 225 (N225) is perceived as the main index for Japanese stocks. It consists of domestic companies which are listed on the Tokyo Stock Exchange. The 225 companies composing the index are price weighted. About 48% of these are classified as technology companies. Once a year the companies and the sector weighting of the index is reviewed to maintain a proper representation of the Japanese stock market (Nikkei Indexes, 2021).

NZX 50 is the main stock market index of New Zealand. The 50 largest and qualified stocks on the New Zealand Stock Exchange are measured for their performance. The weights of the shares are decided by free-float adjusted market capitalization. The 50 shares cover roughly 90% of the market capitalization. Looking at the sector distribution, three sectors make up over 60% of the index. Namely health care (27,5%), utilities (19,4%) and industrials (16,7%) (S&P Dow Jones Indices, 2021-a).

4.1.2 Commodities, Index & ETFs

Gold does not have a definite spot price. Although, the LBMA (London Bullion Market Association), which is the gold price in London per troy ounce, is often used as a benchmark (Gold hub, 2021-a). Additionally, the total quantum of gold above ground is hard to obtain. Thus, the market capitalization is only roughly estimated. However, the World Gold Council estimates that there is approximately 197,000 metric tonnes of gold above ground (World Gold Council, 2019), thus, combined with a price (May 14th, 2021) of about $1,838 per troy ounce (Gold hub, 2021-a), the market capitalization is approximately $11.641 trillion. The price component of the market capitalization equation is driven mainly by economic expansion, market risk, opportunity cost and momentum. Furthermore, the two former factors are the key drivers of demand (Gold hub, 2021-b). Gold is known as a safe investment, and investors tend to increase their portfolio weight in gold to hedge against market uncertainties such as inflation and currency depreciation.

West Texas Intermediate (WTI) is crude oil extracted from U.S. soil and is produced in 32 states. Five of these deliver the majority of the total supply (71% in 2020), with Texas producing the most (43%). In 2018 the U.S. became the top producer in the world, and has since remained at the top, and produced 15% of total crude oil in 2020 (eia, 2021-a). WTI crude oil price, and other spot prices for oil, are volatile. In the recent decades there has been extreme changes in the prices over short periods of time. A lot of factors influence the oil prices, e.g. geopolitical and economic events such as wars and financial crisis, economic growth and changes in expectations of economic growth as well as changes in production (eia, 2021-b).

The **S&P 500 Index** is regarded as the best representation of the equity market in the U.S., and covers about 80% of the total market capitalization. The index’s inception year was 1957 and it includes approximately 500 leading companies in the U.S. Companies such as Apple

Inc., Alphabet Inc A, Tesla and JP Morgan Chase & Co are included. The weighting method applied is the free float-adjusted market cap. Information Technology is the largest sector, and compose about one fourth of the index (S&P Dow Jones Indices, 2021-b).

IYR is a real estate ETF composed of equities in the U.S. The fund has $4,896,190,640 in net assets and was launched in June 2000. It is exposed to U.S. real estate companies and real estate investment trusts (REITs). These companies invest directly in the real estate market. Hence, the ETF is exposed to a variety of sectors within the real estate market, e.g. Industrial-, Retail- and Mortgage-REIT's. American Tower REIT Corp and Prologis REIT Inc are currently the largest holdings of IYR (iShares, 2021).

XLY, was launched in 1998. It seeks to provide results that can represent how the consumer discretionary sector is performing. The ETF has a total of $19,322.55m in assets under management. The companies included are from sectors such as retail, automobile, luxury goods, hotels etc. As of May 2021, approximately 24% of XLY's holdings were invested in Amazon.com Inc. The second largest holding was Tesla Inc (12%) (State Street Global Advisor SPDR, 2021-a).

XLP is a fund that attempts to replicate the performance of the consumer staples companies included in the S&P 500. It is composed of companies within food and staples retailing, household products, food products, beverages, tobacco and personal products. As of May 13th, 2021, it consists of 32 companies and has a weighted average market capitalization of $171,348.23 m. In March 2021, 45% of the fund's holdings were invested in Procter & Gamble, Coca-Cola, PepsiCo Inc. and Walmart (State Street Global Advisor SPDR, 2021-b).

4.2 Descriptive Statistics

The first difference of the logged price is commonly applied when studying the price development of stock indices (Lütkepohl & Xu, 2010). Hence, the data is log transformed. Further the first difference of the logged variables is calculated. Descriptive statistics of these transformed variables are shown for each variable in Table 3 and 4. The former consists of the U.S. data, while the latter illustrates the five other countries. For descriptive statistics of the variables during the sub-periods the reader is referred to the appendices (B.1 – B.6).

Table 3: Descriptive statistics for the U.S during the whole period.

	Observations	Min	Max	Median	Mean	SD	Skewness	Kurtosis
	Natural logarithm of the variables							
M2 U.S.	238	8.5434	9.8858	9.1021	9.1406	0.3510	0.1377	-1.0889
S&P 500	238	7.0588	8.9737	7.7267	7.8797	0.5033	0.4397	-1.0334
Gold	238	5.5831	7.5832	7.0721	6.7989	0.5729	-0.7198	-0.8571
WTI	238	2.8064	4.8969	4.0781	4.0485	0.4406	-0.4169	-0.5064
XLP	238	2.4677	4.1977	3.1236	3.2630	0.5190	0.2457	-1.4467
IYR	238	2.7579	4.5150	3.7835	3.7425	0.4817	-0.3587	-0.9304
XLY	238	2.6885	5.0861	3.5061	3.7437	0.6366	0.4447	-1.1528
	Δ of the natural logarithm of the variables							
	Observations	Min	Max	Median	Mean	SD	Skewness	Kurtosis
M2 U.S.	237	-0.0046	0.0623	0.0049	0.0057	0.0062	5.2811	39.4645
S&P 500	237	-0.1839	0.1206	0.0128	0.0063	0.0432	-0.7863	1.7607
Gold	237	-0.1910	0.1303	0.0097	0.0079	0.0491	-0.3460	0.9743
WTI	237	-0.5681	0.5456	0.0161	0.0031	0.1081	-0.9655	7.8474
XLP	237	-0.1280	0.0747	0.0082	0.0058	0.0337	-0.7662	1.3417
IYR	237	-0.3629	0.2817	0.0148	0.0069	0.0618	-1.3556	8.1059
XLY	237	-0.1905	0.1778	0.0109	0.0084	0.0527	-0.4331	1.5625

All variables in table 3 consist of 238 observations for the natural logarithm of the data in level format. WTI is the most volatile asset, with a standard deviation of approximately 10,8% for the first difference of the logged level. Accordingly, M2 has a standard deviation of 0,62% and is the variable with the least fluctuations. Further, M2 is the only variable that is positively skewed. The logged returns of M2, WTI and IYR are leptokurtic distributed, while the other four variables exhibit platykurtic distributions.

Table 4: Descriptive statistics for CHE, SGP, GBR, JPN & NZL during the whole period.

	Observations	Min	Max	Median	Mean	SD	Skewness	Kurtosis
Natural Logarithm of The Variables								
M2 CHE	238	12.8193	13.8956	13.4728	13.4256	0.3356	-0.1874	-1.5215
M2 SGP	238	12.0520	13.4814	12.9429	12.8174	0.4471	-0.3676	-1.2997
M4 GBR	238	13.7205	14.8608	14.5534	14.3937	0.3229	-0.7682	-0.7880
M2 JPN	215	15.7216	16.2589	15.9093	15.9329	0.1492	0.3634	-1.1004
BM NZL	219	11.4367	12.8098	12.1237	12.1389	0.3877	-0.0631	-1.1204
SMI	238	8.5866	10.0615	9.3202	9.3843	0.3639	0.0129	-1.0093
STI	238	6.9797	8.5366	8.1417	7.9771	0.4334	-0.7987	-0.6228
FTSE	238	7.4650	8.8509	8.2379	8.2516	0.3704	-0.1706	-1.0872
N225	215	9.1752	10.7767	9.9292	9.9133	0.4021	0.1607	-1.2424
NZX50	219	7.5395	9.4824	8.3096	8.4450	0.4927	0.4659	-0.8786
Δ of The Natural Logarithm of The Variables								
	Observations	Min	Max	Median	Mean	SD	Skewness	Kurtosis
M2 CHE	237	-0.0266	0.0795	0.0034	0.0044	0.0118	2.3822	11.8320
M2 SGP	237	-0.0209	0.0370	0.0047	0.0059	0.0090	0.6191	0.7963
M4 GBR	237	-0.0200	0.0788	0.0045	0.0048	0.0096	2.0079	13.9400
M2 JPN	214	-0.0022	0.0204	0.0025	0.0025	0.0021	3.2448	23.9133
BM NZL	218	-0.0181	0.0346	0.0066	0.0062	0.0088	-0.1202	0.0403
SMI	237	-0.1369	0.1180	0.0092	0.0037	0.0392	-0.6207	0.7788
STI	237	-0.2711	0.2003	0.0111	0.0052	0.0520	-0.9347	4.8789
FTSE	237	-0.1440	0.1195	0.0096	0.0035	0.0403	-0.7475	1.3479
N225	214	-0.2722	0.1402	0.0118	0.0075	0.0550	-0.8989	2.4692
NZX50	218	-0.1393	0.0837	0.0133	0.0085	0.0339	-1.1013	2.6945

M2 of Switzerland is the most volatile when compared to the money supply of the other countries. During the two recent decades, Japan has not increased their money supply as much as the other selected countries, and is the country with the lowest standard deviation (0,21%).

Comparing the standard deviation of the logged index returns, N225 (5,5%) and STI (5,2%) have the highest, while NZX50 has the lowest. The first difference of the logged money supply measures is leptokurtic for GBR, CHE and JPN, and platykurtic for the two remaining countries. All of the indices' logged returns are platykurtic apart from STI. Regarding skewness, NZL is the only country with negatively skewed money supply. All the indices' logged returns display negatively skewed distributions.

4.3 Correlations

The correlation between the money supplies and assets are shown in Table 5. During the whole period the only assets that are positively correlated with the U.S. money supply is Gold and XLY. The only asset that could be said to have some correlation with M2 of the U.S., when the entire data sample is studied, is WTI (-0.219). During the first and third time period, the selected assets and U.S. money supply have low to none correlation, except for WTI during the latter time period (-0.201). On the contrary, during the second time period all of the assets returns are to some degree correlated with changes in M2. Notice that all of them are negatively correlated, except for Gold, which is positively correlated with the U.S. money supply in all of the time periods utilized. This makes sense, since gold is viewed as a hedge against inflation, and one would expect that an increase in money supply should lead to higher inflation. The correlation between the stock market and money supplies in the five selected developed countries, is relatively low when the entire data sample is studied. Further, the correlations during the second time period are similar to the U.S. All of the stock indices' returns are negatively correlated with the broad money supply of their country of affiliation, except for NZX 50.

Table 5: Correlations between the first difference of the natural logarithm of the variables (MS = Money Supply).

			Whole Period			
	Gold	**S&P 500**	**XLP**	**XLY**	**IYR**	**WTI**
M2 U.S.	0.123	-0.008	-0.014	0.023	-0.063	-0.219
	FTSE	**STI**	**SMI**	**N225**	**NZX 50**	
MS	-0.119	0.065	-0.063	0.116	0.073	
			Time Period 1			
	Gold	**S&P 500**	**XLP**	**XLY**	**IYR**	**WTI**
M2 U.S.	0.119	-0.047	0.035	-0.049	0.052	-0.031
	FTSE	**STI**	**SMI**	**N225**	**NZX 50**	
MS	0.206	0.182	0.064	0.131	-0.048	
			Time Period 2			
	Gold	**S&P 500**	**XLP**	**XLY**	**IYR**	**WTI**
M2 U.S.	0.226	-0.259	-0.204	-0.237	-0.183	-0.375
	FTSE	**STI**	**SMI**	**N225**	**NZX 50**	
MS	-0.321	-0.042	-0.197	-0.03	0.117	
			Time Period 3			
	Gold	**S&P 500**	**XLP**	**XLY**	**IYR**	**WTI**
M2 U.S.	0.127	0.126	0.049	0.179	-0.027	-0.201
	FTSE	**STI**	**SMI**	**N225**	**NZX 50**	
MS	-0.069	0.041	0.045	0.177	0.208	

5 Methodology

This section presents the statistical methods applied to study the relationship between money supply and asset prices. Further, the assumptions and criteria utilized to define the statistical inputs into our model are specified. The number of variables and models is quite extensive. Hence, most of the assumptions and criteria are the same for each model. The readers that are interested to learn more about these methods are encouraged to read the references referred to in this section.

5.1 Stationarity test

To answer the research question, regression models are constructed. As time series plots (Appendix C.1-C.3) for most of the variables display an upward trending pattern, the Dickey-Fuller test developed by Dickey & Fuller (1979, 1981) is conducted to test whether the natural logarithm of the variables are stationary. Further, first differenced variables are tested. The number of lags are capped at 3.

(1) $\Delta y_t = \alpha + \beta_1 t + \beta_2 y_{t-1} + \varepsilon_t$

(2) $\Delta y_t = \alpha + \beta_1 t + \beta_2 y_{t-1} + \delta_1 \Delta y_{t-1} + \cdots + \delta_{p-1} \Delta y_{t-p+1} + \varepsilon_t$

To select the number of lags for each variable, the Augmented Dickey Fuller test is conducted with 3 lags and if the last lag is not significant the number of lags is reduced until the last lag is significant at a five percent level. Notice that often no lags are added to the regression model because none of them are significant. Hence, the test is a Dickey Fuller test (1) rather than an Augmented Dickey Fuller test (2). The variable y in both equations (1) and (2), is the time series in question. Thus, when testing if e.g. M2 U.S is stationary, the y represents the data of M2 in the U.S. Further, the ADF regression for the natural logarithm of the level variables is generally conducted with both an intercept and a time trend. While the stationarity test of the first differenced logged variables only includes an intercept. The results for both the logged and first differenced variables during the whole time period are shown in Table 6 and 7. Additionally, the stationarity tests on the variables for the three time periods are presented in Appendix D.

Table 6: ADF input and test results for the whole period (U.S.).

	Lags	Intercept	Time trend	Stationary
	Natural Logarithm of The Variables			
M2 USA	1	✓	✓	×
S&P 500	0	✓	✓	×
Gold	0	✓	✓	×
WTI	1	✓	×	✓
XLP	0	✓	✓	×
IYR	3	✓	✓	×
XLY	0	✓	✓	×
	Δ of The Natural Logarithm of The Variables			
	Lags	Intercept	Time trend	Stationary
M2 USA	0	✓	×	✓
S&P 500	0	✓	×	✓
Gold	0	✓	×	✓
WTI	1	✓	×	✓
XLP	0	✓	×	✓
IYR	3	✓	×	✓
XLY	0	✓	×	✓

According to the ADF-test, the only logged level variable that has a relatively constant mean and variance, is WTI. The test conducted on WTI is performed without a time trend, which is based on inspecting a time series plot, which showed no time trend. After calculating the first difference, all the variables are stationary. Consequently, all the variables excluding WTI, can be described as integrated of order 1, which is denoted I (1). WTI on the other hand is integrated of order 0, namely I (0), and is said to be stationary.

Table 7: ADF input and test results for the whole period (CHE, SGP, GBR, JPN & NZL).

	Lags	Intercept	Time trend	Stationary
	Natural Logarithm of The Variables			
M2 CHE	3	✓	✓	×
M2 SGP	3	✓	✓	×
M4 GBR	3	✓	✓	×
M2 JPN	1	✓	✓	×
BM NZL	0	✓	✓	×
SMI	1	✓	✓	×
STI	2	✓	✓	×
FTSE	0	✓	✓	×
N225	0	✓	✓	×
NZX50	0	✓	✓	×
	Δ of The Natural Logarithm of The Variables			
	Lags	Intercept	Time trend	Stationary
M2 CHE	3	✓	×	✓
M2 SGP	2	✓	×	✓
M4 GBR	2	✓	×	✓
M2 JPN	2	✓	×	✓
BM NZL	1	✓	×	✓
SMI	0	✓	×	✓
STI	1	✓	×	✓
FTSE	0	✓	×	✓
N225	1	✓	×	✓
NZX50	0	✓	×	✓

The Indices and Money supply of the five other countries exhibit an upward trending pattern at the log-level. Thus, the tests of the logged variables include both an intercept and a time trend to account for the stochastic trend in the variables. Whereas, on the first differenced variables only an intercept is applied. The former tests indicate that all the variables are non-stationary. While for the latter tests the null hypothesis is rejected. Hence, the stock indices and the money supply of these nations are I (1).

5.2 Applied Models

Because both the money supply and the assets show non-stationary behavior, a regression conducted on the levels of the variables could lead to models with a high R-squared value and statistically significant coefficients, even though there might be no relationship between the two variables. In statistical terms, a model indicating that there is a link between the dependent and independent variables when there is no connection, is known as a spurious regression model. Spurious regression models are described and discussed in a wide range of research papers and time series analysis textbooks (Granger & Newbold, 1974; Campbell & Perron, 1991; Phillips, 1986).

As running a regression with non-stationary variables might lead to a spurious relationship, the variables are first differenced to make them stationary. Thereafter, an autoregressive regression model could be applied to test the relationship between the variables. But, this would lead to missing out on testing for a long-term relationship. Hence, the Johansen test developed by Johansen (1988) is conducted to check whether the variables are cointegrated.

(3) $Y_t = \pi_1 Y_{t-1} + \cdots + \pi_p Y_{t-p} + \mu + \varepsilon_t$

(4) $\Delta Y_t = \Gamma_1 \Delta Y_{t-1} + \cdots + \Gamma_{p-1} \Delta Y_{t-p+1} + \pi Y_{t-p} + \mu + \varepsilon_t$

A criterion that has to be fulfilled for it to make sense to test for cointegration, is that the variables are integrated of the same order. If one of the log-level variables already has a constant mean and variance, it does not make sense to test for cointegration. Under such circumstances, an autoregressive model is applied, and the Johansen test is not performed. More specifically, a vector autoregressive (VAR) model (3) is developed. This is due to the fact that it is not clear which variable should be the endogenous one. The assets' price development could help explain some of the variance in the money supply, as market conditions have shown to have a large impact on central banks' monetary decisions (Castelnuovo & Nistico, 2010). Additionally, increased money supply could indeed be a driving factor in the price rally most of the assets have experienced during the two recent decades (Jamaludin et al., 2017; Su et al., 2019).

On the other hand, if the variables are integrated of the same order, the null hypothesis of no cointegration is rejected and we fail to reject the hypothesis that the variables are cointegrated, a vector error correction model (VECM) is utilized (4). If the test indicates that the variables do not have a common stochastic trend, a VAR model is applied (Juselius, 2006, p. 115). The trace and maximum-eigenvalue tests are both utilized to determine whether there is a long-term relationship between the I (1) variables. To reject the tests' null hypothesis, the critical values for the five percent significance level have to be smaller than the test statistics. Lütkepohl, Saikkonen & Trenkler (2001) conducted a local power comparison and found that there is not a major difference between the two tests. Although, they remark that based on the results of the simulations they prefer the trace test. Hence, if only one test is applied it is most commonly the trace, but in practice it is common to use both.

5.3 Model Input

In this subsection, literature regarding the input of VAR and VEC models is presented. Additionally, the criteria and reasoning behind the selected inputs of the applied time series regressions are elaborated on. Thus, section 5.3.1 addresses the lag selection criteria utilized, and the literature concerning it. Thereafter, section 5.3.2 is devoted to the inclusion/exclusion of an intercept and a time trend.

5.3.1 Lag selection

There is a wide range of lag selection criteria. Aikaike's information criterion (AIC) (Akaike, 1973), Schwarz information criterion (SIC) (Schwarz, 1978), Hannan-Quinn criterion (HQC) (Hannan and Quinn, 1979) and the final prediction error (FPE) criteria developed by Akaike (1969) are some of the most known. These are also the information criteria calculated by the VARselect function in the vars package in R developed by Pfaff & Stigler (2018), which is applied in this paper. Lütkepohl (2005, p. 151-157) and Liew (2004) compare them and run simulations to test which performs best under certain conditions. The latter research paper finds that the AIC and FPE should be used when the number of observations is less than 120. While utilizing HQC for samples larger than this will yield the most accurate number of lags. The former run simulations for 30 and 100 observations, and do not conclude on which is best to use in a small sample. Hence, HQC is used to determine the number of lags for the VAR and VEC models for the whole period, as all of the variables consist of more than 120 observations. On the contrary, the amount of data points in the three sub-periods is less than 120. Therefore, AIC is used to determine the number of lags for these models. The maximum number of lags is set to three and all the models contain at least one lag.

5.3.2 Intercept & Time Trend

Whether to include an intercept and time trend, and how to include them is a delicate issue that is widely discussed among statisticians and researchers. Franses (2001) provides guidance as to how these two variables should be added in the test for cointegration. Lütkepohl (2005) has devoted a subchapter (8.2) to different models incorporating the deterministic term, namely an intercept and a time trend. Juselius (2006, p. 99-100) presents a detailed description of five cases where different restrictions regarding the inclusion of the deterministic terms are implemented. In the first case neither an intercept or a time trend is added. The second case includes an intercept in the cointegrating relationship. In case three no restrictions are imposed on the intercept. The fourth case adds a time trend to the error correction term (ECT), while the intercept is unrestricted as in case three. The fifth and last case appoint no restrictions to the two deterministic terms. She denotes that when there are linear trends in the variables under study, the model that most likely should be used is the one presented in case four. Buteikis (n.d.) presents two models that fit trending data that is integrated of order one. Asset prices and macroeconomic variables most often exhibit such behavior, and that is the case for most of the variables studied in this paper. The first model, which he refers to as Case 3, includes an unrestricted constant. In the other model (Case 4), a trend term is added to the cointegrating relationship. When the variables are drifting it is recommended to test for both and utilize the results from the model with the smallest AIC. Since the variables under study are drifting, Buteikis' approach is applied. Hence, if the model with the lowest AIC indicates that there is a cointegrating relationship a VEC model is developed.

6 Results

In this section the results of the time series models are presented and discussed. Regression results from the three sub-periods is shown in appendix E. The first difference of the natural logarithm of the money supplies is denoted by m. Whereas, r stands for the first difference of the natural logarithm of the assets' price. The first subsection (6.1) contains the results of the time series models analyzing the relationship between the money supply in the U.S. and a relatively wide range of assets. The second subsection (6.2) presents the findings of the VAR models conducted with time series data from five other developed countries. Lastly, subsection (6.3) presents the results of the VEC models.

Diagnostic tests have been utilized to test the residuals of all the models for serial correlation and heteroskedasticity. The former is checked for by using the Breusch (1978) and Godfrey (1978) test for serially correlated error terms. While an ARCH-LM test (Engle, 1982) is applied to test whether the variance of the residuals is unequal during the time periods under study. Further, if the null hypothesis of at least one of the tests cannot be rejected, standard errors that are robust in the presence of serial correlation and heteroskedasticity are calculated for the VAR models. Thus, the dependent variables' standard error and significance level are not biased.

6.1 U.S. results

Table 8 display the results of the VAR models conducted by applying the full data sample for the money supply in the U.S., and the assets examined. The results of the time series models utilizing the data during the sub-periods are shown in the first six tables of appendix E.

6.1.1 Whole Period

The starting hypothesis of this paper was that the increase in money supply was one of the contributing factors to the growth in asset prices in recent time. This relationship should intuitively hold for Gold, which is viewed as a hedge against inflation. Although, inflation expectations are not purely driven by a change in the money supply, it is definitely a key element to it. Hence, when regressing lagged variables of the U.S. money supply on the price of gold, we would expect that the coefficients were positive. Based on the VAR (1) model, the lagged value of M2 is positive, but not statistically significant. Further, as one would expect, the change in the price of gold has no impact on the decisions made by the Federal Reserve regarding the money supply. For the S&P 500, it is not as clear as to how an increase in money supply would affect it. But, our starting hypothesis is rejected also in this case, as M2 does not have a statistically significant impact on the index. The lagged value of the S&P 500 is not able to explain some of the variance in M2. On the contrary, the VAR (1) model of WTI and M2 indicates that a change in the crude oil price has a positive and significant impact on the money supply.

Based on the models conducted on the ETFs, namely IYR, XLP and XLY, lagged changes in M2 cannot explain some of the variations in these assets' prices. The VAR (2) model applied with M2 as the endogenous variable, and the lagged values of IYR as explanatory variables, imply that the second lag of the real estate ETF has a negative and significant impact on the money supply.

Table 8: Regression results for the whole period (U.S.).

	Gold		S&P 500		IYR		XLP		XLY		WTI	
	m_t	r_t	m_t	r_t	m_t	r_t	m_t	r_t	m_t	r_t	m_t	r_t
Constant	0.002**	0.007 .	0.002**	0.004	0.003***	0.012*	0.002***	0.007*	0.002***	0.005	0.003***	-0.018*
	(0.001)	(0.004)	(0.001)	(0.004)	(0.001)	(0.006)	(0.001)	(0.003)	(0.001)	(0.005)	(0.000)	(0.013)
m_{t-1}	0.599***	0.350	0.592***	0.250	0.618**	-1.404	0.592***	-0.068	0.597***	0.445	0.520***	3.574 .
	(0.176)	(0.330)	(0.174)	(0.611)	(0.218)	(1.259)	(0.149)	(0.383)	(0.175)	(0.835)	(0.094)	(2.098)
m_{t-2}					-0.110	0.557						
					(0.132)	(1.000)						
r_{t-1}	-0.006	-0.123	-0.026 .	0.101	-0.018	0.060	-0.026	-0.022	-0.017	0.040	-0.018*	0.337**
	(0.007)	.	(0.155)	(0.086)	(0.011)	(0.107)	(0.018)	(0.065)	(0.013)	(0.076)	(0.007)	(0.108)
		(0.069)										
r_{t-2}					-0.013*	-						
					(0.006)	0.178*						
						(0.081)						
N	236	236	236	236	236	236	236	236	236	236	236	236
R^2	0.352	0.015	0.382	0.371	0.001	0.370	0.371	0.001	0.370	0.004	0.448	0.123

Significance level: '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1

Standard errors are in the parentheses

6.1.2 Time Period 1

The first time period captures both the 9/11 terrorist attack as well as the buildup and beginning of the financial crisis. The Johansen test results imply that there is no long-term relationship between the money supply of the U.S. and the commodities, ETFs and index studied. Thus, all variables are studied using a VAR model. contrary to the results during the whole period, lag one of gold has a negative and significant impact on M2. Conversely, there is found no relationship between the S&P 500 and the broad measure of U.S. money. According to the results of the VAR (1) model including WTI, M2 has a negative and significant impact on the West Texas Intermediate crude oil price. For the three remaining assets no link with M2 was found.

6.1.3 Time Period 2

For the second time period a VAR (2) model consisting of gold and M2, indicates that the latter variable has a significant impact on the former. But, the impact is negative which is the opposite of what one would assume. The same is the case for all of the other assets, excluding WTI where there is found no relationship. A possible explanation could be that the models captures the large price decreases these assets experienced during the financial crisis, while the Federal Reserve imposed quantitative easing to stimulate the economy. Hence, the model most likely interprets this money supply increase as an explanation to the assets' price decrease. Based on economic intuition, it is more accurate to describe the money supply increase as a result of the market crash during the financial crisis.

6.1.4 Time Period 3

The results of the last time period indicate that there is no relationship between the precious metal, namely gold, and the money supply. The same conclusion applies to the models containing the S&P 500 as dependent and independent variables. For WTI, the lagged value of the change in WTI has a negative and significant impact on M2. When WTI is set as the endogenous variable, M2 has a positive and significant impact on the crude oil spot price. The third lag of M2 is significant when regressed on the change in XLY. Whereas, no relationship is found for the two remaining ETFs.

6.2 VAR results for GBR, CHE, JPN, NZL & SGP

In Table 9 the results of the VAR model for GBR, SGP and NZL during the whole period is presented. Further, tables displaying the results for the countries during the different time periods can be viewed in Tables E.7-E.11 in the appendix. Contrary to the U.S. analysis, the Johansen test indicated that the money supply and stock index of some of these countries were cointegrated. Hence, some of the tables displaying the results is missing some regression models. These models are as mentioned previously presented in subsection 6.3.

6.2.1 Whole period

Based on the literature (Azad & Serletis, 2020; Gan et al., 2006; Wong et al, 2006), where results of significant influence from money supply on stock indices in the UK, NZL and SGP are presented, we would expect to obtain similar results in our analysis.

The VAR model indicates that M4 in GBR and the index FTSE have no significant relationship for the whole period. The same outcome is present regarding BM in New Zealand and the NZX 50. These results are contradictory to the literature. In the case of Singapore and STI on the other hand, one significant relationship occurs. The M2 has a positive and statistically significant impact on STI at a five percent level, which is in correspondence with the results found in the literature.

Table 9: Regression results for the whole period (GBR, SGP & NZL).

	FTSE		STI		NZX50	
	m_t	r_t	m_t	r_t	m_t	r_t
Constant	0.004***	0.004	0.005***	0.000	0.007***	0.009**
	(0.001)	(0.003)	(0.001)	(0.004)	(0.001)	(0.003)
m_{t-1}	0.110	-0.140	0.156*	0.759*	-0.108 .	-0.230
	(0.089)	(0.296)	(0.072)	(0.371)	(0.064)	(0.275)
r_{t-1}	-0.006	0.026	-0.015	0.118	-0.004	0.097
	(0.018)	(0.071)	(0.015)	(0.106)	(0.021)	(0.071)
N	236	236	236	236	217	217
R^2	0.014	0.002	0.03	0.033	0.012	0.012

Significance level: ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1

Standard errors are in the parentheses

6.2.2 Time period 1

There are VAR results for the countries NZL, JPN and SGP in time period 1. Neither broad money or the NZX 50 in NZL have a significant relationship on each other. In JPN the money supply does not have a significant effect on Nikkei, and vice versa. The money supply in Singapore has no significant influence on STI, but STI on the other hand, containing three lags, has a positive effect on the M2 in Singapore, but at a 10% level.

6.2.3 Time period 2

There are no statistically significant results in time period two considering GBR and SGP. In JPN, there is one statistically significant relationship at 1% level. Nikkei has a positive influence on the M2 in JPN. SMI on the other hand, both lags have a negative impact on the M2 of CHE.

6.2.4 Time period 3

In time period number three, at least one of the results in the countries GBR, SGP and CHE is statistically significant. A recurring result is that the influence of the stock index on the money supply, in the respective country, is negative. The second lag of FTSE and SMI are both accepted at a 1% significance level. In Singapore the relationship goes both ways. Lag two of STI has a negative impact on M2 SGP and is statistically significant at 10%. Further the first lag of M2 has a positive effect on STI, with a p-value accepted at a 5% level.

6.3 VEC results

In Table 10 the results of the VEC models is exhibited. Through applying the Johansen Maximum Likelihood test procedure, these assets were found to have a long-term relationship with money supply. The models contain a time trend in the cointegrating relationship, because of the fact that this resulted in the lowest AIC-value for each model. For transparency, it is worth mentioning that the first four models have either heteroskedastic residuals, serially correlated residuals or both. Hence, the standard errors and p-values of the coefficients in these models are most likely biased. Regardless, the scale and sign of the coefficients are accurate. Also the coefficients that are highly significant is expected to be significant at least on a five percent level. But when the p-value indicates significance at the five percent level, it is likely that an unbiased value would have surpassed this significance level.

During the whole period, the test results imply that there is in fact a long-term relationship between the money supply of CHE and the SMI index. The error correction term (ECT) of the first model is negative and highly significant. Further, there is also short-run causality present, as both the lagged values of the SMI has a negative and significant impact on the money supply. Since the ECT of the second error correction model also is negative and statistically significant there is bidirectional causality. Thus, the variables drive each other towards the long-term equilibrium. The ECTs of the VEC model including M2 for japan and the Nikkei 225 index is both positive and have a relatively low p-value.

When testing for cointegration during time period 1, it was found that there is a long-term relationship between the money supply of GBR and the FTSE index. This is also the case for the money supply of CHE and the SMI index. The VEC model built for the two former variables indicates that there is unidirectional causality, as only the ECT of the error correction model where M4 is the endogenous variable, is significant. Consequently, the FTSE index drives the money supply towards its long-term equilibrium. The same results apply to the relationship between the money supply and stock index of CHE. Lastly, during time period 2 there is found a cointegrating relationship between the broad money supply of NZL and their main stock index. This is the only VEC model where there are no issues related to serially correlated or heteroskedastic residuals. Hence, both ECTs is statistically significant.

Table 10: Vector error correction model results.

	SMI		N225		TP1 FTSE		TP1 SMI		TP2 NZX50	
	m_t	r_t	m_t	r_t	m_t	r_t	m_t	r_t	m_t	r_t
Constant	0.263***	0.888**	-0.222***	-4.835**	1.760***	3.320 .	1.834***	-1.541	2.695***	-3.991 .
	(0.066)	(0.284)	(0.054)	(1.715)	(0.359)	(1.965)	(0.310)	(1.365)	(0.607)	(2.004)
ECT	-0.006***	-0.022**	0.015***	0.326**	-0.138***	-0.262 .	-0.107***	0.090	-0.245***	0.365*
	(0.002)	(0.007)	(0.004)	(0.115)	(0.028)	(0.155)	(0.018)	(0.080)	(0.055)	(0.183)
m_{t-1}	0.415***	-0.369	0.424***	-3.380 .	-0.225*	0.083	0.059	0.364	-0.044	-0.562
	(0.063)	(0.273)	(0.063)	(2.012)	(0.102)	(0.559)	(0.103)	(0.453)	(0.105)	(0.348)
m_{t-2}	-0.028	-0.259			-0.296**	0.528				
	(0.063)	(0.272)			(0.102)	(0.556)				
r_{t-1}	-0.030*	0.189**	0.005*	0.140*	-0.034	-0.020	0.063*	0.169	0.080*	0.198 .
	(0.015)	(0.065)	(0.002)	(0.068)	(0.023)	(0.124)	(0.030)	(0.133)	(0.035)	(0.114)
r_{t-2}	-0.067***	0.031			-0.048*	-0.067				
	(0.015)	(0.066)			(0.023)	(0.126)				

Significance level: ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1

Standard errors are in the parentheses

7 Conclusion

The relationship between the supply of money and asset prices is the topic of numerous research papers. By reading the literature it becomes obvious that the results are ambiguous, and that there is certainly not a universal answer as to how money supply and asset prices impact each other. Wong et al. (2006) found that the narrow monetary aggregate (M1) is cointegrated with the Singapore stock market, while they did arrive to the opposite conclusion regarding the U.S. M1 and stock market. Contrary, Jamaludin et al. (2017) found no relationship between the money supply and stock market development in Singapore. Humpe & McMillan (2009) came to the same conclusion as Wong et.al (2006) regarding the U.S. money supply and stock market. This relatively small amount of research papers is enough to illustrate the diversity of the conclusions related to the relationship between these economic variables. To arrive at a conclusion whether there is a relationship between the broad money supply of the U.S., GBR, CHE, SGP, NZL and JPN, and their main stock index during the two recent decades, VAR and VEC models have been applied. Additionally, for the U.S. five other assets is included in addition to the S&P 500. These assets include two commodities (WTI crude oil & Gold) and three ETFs representing the real estate market, consumer staples stocks and consumer discretionary stocks (IYR, XLP & XLY).

According to the analysis in this paper, there is no long-term relationship between M2 and the U.S. assets selected. Further, during the whole time period (2001.05.31-2021.02.28), time period 1 (2001.05.31-2007.12.31) and time period 3 (2014.08.31-2021.02.28) the only two models where the assets function as the dependent variable and the lag of M2 is significant, is during the first and last time period for WTI, and the last period for XLY. In the second time period (2008.01.31-2014.07.31), M2 has a negative and significant effect in all of the models except for the WTI-model. This might be explained by the fact that during this time period the financial crisis occurred. Hence, the asset prices decreased a lot while the Federal Reserve was printing a lot of money in an attempt to stimulate the economy. Consequently, the VAR models might interpret this as an increase in money supply causes declining asset prices, when the former could be said to be caused by the latter. Also, since it has been shown that the quantitative easing of the Fed helped stimulate the economy, one should expect that the M2 coefficients would be positive. But, the impact of quantitative easing is delayed

(Mamaysky, 2018). Thus, most likely the number of lags is not enough to capture this effect, as most of the models include only one lag of M2.

The Johansen test for cointegration indicated that there was a long-term relationship between the money supply and stock market in CHE and JPN during the whole period (2001.05.31-2021.02.28 & 2003.04.30-2021.02.28). In CHE, the two variables were also cointegrated during the first time period (2001.05.31-2007.12.31). But, only the ECT of the error correction model with M2 as the endogenous variable was statistically significant. Hence, SMI drives M2 towards the long-term equilibrium, which could indicate that monetary decisions in CHE is to some degree determined by the development in the domestic stock market. The same result applies to GBR during the same time period. Note that all these VEC models have biased standard errors and significance levels. Regardless, the coefficients are correct, and the coefficients with a relatively low p-value is most likely statistically significant at a five percent level. Lastly, there was found cointegration between the broad money supply of NZL and their main stock index known as NZX 50. The standard errors and p-values of this model are not biased, as there were no issues related to heteroskedasticity or serial correlation in the residuals.

References

Akaike, H. (1969). Fitting Autoregressive Models for Prediction. *Annals of the Institute of Statistical Mathematics*, 21, 243-247. https://www.scirp.org/(S(lz5mqp453edsnp55rrgjct55))/reference/References.

Akaike, H. (1973). Information Theory and an Extension of the Maximum Likelihood Principle. *International Symposium on Information Theory*, pp 267-281. https://www.scirp.org/(S(oyulxb452alnt1aej1nfow45))/reference/.

Azad, N.F. & Serletis, A. (2020). A century and a half of the monetary base-stock market relationship. *The Quarterly Review of Economics and Finance.* https://www.sciencedirect.com/science/article/pii/S1062976920301587

Azar, S. A. (2012). Commodity prices and the US money supply in the long run. *International Journal of Trade and Global Markets*, *5*(3-4). https://doi.org/10.1504/IJTGM.2012.049983

Azar, S. A. (2014). The Determinants of US Stock Market Returns. *Open Economics and Management Journal*, *1*, pp 1-13. https://benthamopen.com/contents/pdf/EMJ/EMJ-1-1.pdf

Aziza, F. O. F. (2010). The Effects of Monetary Policy on Stock Market Performance: A Cross-Country Analysis. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1743834

Bank of Japan. (2021). Retrieved from https://www.boj.or.jp/en/index.htm/

Barnett, R. C., Bessler, D. A. & Thompson R. L. (1983). The Money Supply and Nominal Agricultural Prices. *American Journal of Agricultural Economics*, *65*(2), pp 303-307. https://www.jstor.org/stable/1240878?seq=4#metadata_info_tab_contents

Bernanke, B. S. (2009, January 13th). The Crisis and the Policy Response. Retrieved from The Federal Reserve https://www.federalreserve.gov/default.htm

Booth, J. (2020). *The Price of Tomorrow: Why Deflation is the Key to an Abundant Future*.

Breedon, F., Chadha, J. S. & Waters, A. (2012). The financial market impact of UK quantitative easing. *Oxford Review of Economic Policy*, 28(4), pp 702-728.

Breusch, T.S. (1978). Testing for Autocorrelation in Dynamic Linear Models. *Australian Economic Papers*, 17(31), pp 334-355. https://onlinelibrary.wiley.com/doi/10.1111/j.1467

Browne, F. & Cronin, D. (2010). Commodity prices, money and inflation. *Journal of Economics and Business, 62*(4), pp 331-345. https://www.sciencedirect.com/science/article/pii/S0148619510000147

Brumm, H. J. (2005). Money Growth, Output Growth, and inflation: A Reexamination of the Modern Quantity Theory's Linchpin Prediction. *Southern Economic Journal*, 71(3), pp 661-667. https://www.jstor.org/stable/20062067?seq=1#metadata_info_tab_contents

Buteikis, A. (n.d.). 06 Multivariate models: Granger causality, VAR and VECM models. http://web.vu.lt/mif/a.buteikis/wp-content/

Campbell, J. Y. & Perron, P. (1991). Pitfalls and Opportunities: What Macroeconomists Should Know about Unit Roots. *NBER Macroeconomics Annual*, 6. https://www.journals.uchicago.edu/doi/abs/10.1086/654163

Castelnuovo, E. & Nistico, S. (2010). Stock market conditions and monetary policy in a DSGE model for the U.S. *Journal of Economic Dynamics and Control*, 34(9), pp 1700-1731. https://www.sciencedirect.com/science/article/pii/

Chen, S., Wei, W. & Huang, P. (2019). The Impact of Monetary Policy on Housing Prices in China. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3355856

Chen, S., Wei, W., Huang, P. & Elkassabgi, A. (2020). Influences of Macroeconomic Variables on Stock Market in China: An Empirical Analysis. https://poseidon01.ssrn.com/delivery.php

Congdon, T. (2005). Money and Asset Prices in Boom and Bust. *The Institute of Economic Affairs*. Pp 1-157.

Cour-Thimann, P. & Winkler, B. (2012). The ECB's non-standard monetary policy measures: the role of institutional factors and financial structure. *Oxford Review of Economic Policy*, 28(4), pp 765-803. https://watermark.silverchair.com/grs038.

Dayani, D. (2020, June 18th). Complete Guide to Investing in Straits Times Index (STI) ETFs In Singapore. Retrieved on May 14th 2021 from https://dollarsandsense.sg/complete-guide-investing-sti-etf/.

Dickey, D. A. & Fuller, W. A. (1979). Distribution of the Estimators for Autoregressive Time Series With a Unit Root. *Journal of the American Statistical Association*, 74(366), pp 427-431. https://www.jstor.org/stable/2286348?seq=4#metadata_info_tab_contents

Dickey D. A. & Fuller, W. A. (1981). Likelihood Ratio Statistics for Autoregressive Time Series with a Unit Root. *Econometrica*, 49(4), pp 1057-1072. https://www.jstor.org/stable/1912517?seq=1#metadata_info_tab_contents

eia. (2021). Petroleum & Other Liquids, Spot Prices. Retrieved on April 11th, 2021 from https://www.eia.gov/dnav/pet/pet_pri_spt_s1_d.htm?fbclid=IwAR0cnXbm5rOmaiHRhkw7AbqeYHCw_xoqK91gdXiABXexU84xKgE8OBJKH1o

eia. (April 8th, 2021-a). Oil and petroleum products explained, where our oil comes from. Retrieved on May 15th, 2021 from https://www.eia.gov/energyexplained/oil-and-petroleum-products/where-our-oil-comes-from.php.

eia. (April 6th, 2021-b). What drives crude oil prices? Retrieved on May 15th, 2021 from https://www.eia.gov/finance/markets/crudeoil/.

Engle, R.F. (1982). Autoregressive Conditional Heteroscedasticity with Estimates of the Variance of United Kingdom Inflation. *Econometrica*, 50(4), pp 987-1007. https://www.jstor.org/stable/1912773?seq=1#metadata_info_tab_contents

Fawley, B. W. & Neely, C. J. (2013). Four Stories of Quantitative Easing. *Federal Reserve Bank of St. Louis Review*, 95(1), pp 51-88.

Franses, P.H. (2001). How to deal with intercept and trend in practical cointegration analysis?, *Applied Economics*, 33(5), pp 577-579. https://www.tandfonline.com/doi/abs/10.1080/00036840121713?casa_token

FTSE Russell. (April 30th, 2021). *FTSE 100 Index* [Fact sheet]. Retrieved 14th May, 2021 from https://www.londonstockexchange.com/indices/ftse-100/news.

Gan, C., Lee, M., Yong, H.H. & Zhang, J. (2006). Macroeconomic Variables and Stock Market Interactions*: New Zealand Evidence. Investment Management and Financial Innovations*, *3*(4), pp 89-101. http://www.irbis-nbuv.gov.ua/cg

Gaynor, B. (n.d.). New turn on rollercoaster ride for NZX indices. Retrieved on May 14th, 2021 from https://milfordasset.com/insights/new-turn-on-rollercoaster-ride-for-nzx-indices.

Godfrey, L.G. (1978). Testing Against General Autoregressive and Moving Average Error Models When the Regressors Include Lagged Dependent Variables. *Econometrica*, 46(6), pp 1293-1301. https://www.jstor.org/stable/1913829?seq=

Gold hub. (May 14th, 2021-a). Gold prices. Retrieved on May 14th, 2021 from https://www.gold.org/goldhub/data/gold-prices.

Gold hub. (April 30th, 2021-b). Long-term gold price drivers. Retrieved on May 15th, 2021 from https://www.gold.org/goldhub/data/long-term-gold-price-drivers.

Goodhart, C. & Hofmann, B. (2008). House prices, money, credit, and the macroeconomy. *Oxford Review of Economic Policy, 24*(1), pp 180-205. https://www.jstor.org/stable/23606731?seq=23#metadata_info_tab_contents

Granger, C.W.J. & Newbold, P. (1974). Spurious regressions in econometrics. *Journal of Econometrics*, 2(2), pp 111-120. https://www.sciencedirect.com/science/article/abs/pii/0304407674900347

Hannan, E.J. & Quinn, B.G. (1979). The Determination of the Order of an Autoregression. *Journal of the Royal Statistical Society*, 41(2), pp 190-195. https://www.jstor.org/stable/2985032?seq=1#metadata_info_tab_contents

Hingorani, V. L. & No, S. C. (n.d.). GRANGER CAUSALITY BETWEEN GOLD, MONEY SUPPLY, EQUITY MARKET, INFLATIONS, AND REAL INTEREST RATES IN A MULTIVARIATE MODEL. https://decisionsciences.org/wp-content/

Humpe, A. & Macmillan, P. (2009). Can Macroeconomic variables explain long-term stock market movements? A comparison of the US and Japan. *Applied Financial Economics*, *19*(2), pp 111-119. https://www.tandfonline.com/doi/full/

Humpe, A. & McMillan, D. (2020). The Covid-19 stock market puzzle and money supply in the US. *Economics Bulletin,* 40(4), pp 3104-3110. https://www.researchgate.net/profile/Andreas

Investing.com (2021). NZX50 (NZ50). Retrieved on May 10th, 2021 from https://www.investing.com/indices/nzx-50

iShares. (March 31st, 2021). *iShares U.S. Real Estate ETF* [Fact sheet]. Retrieved on May 15th, 2021 from https://www.ishares.com/us/products/239520/ishares-us-real-estate-etf.

Jamaludin, N., Ismail, S. & Manaf, S. (2017). Macroeconomic Variables and Stock Market Returns: Panel Analysis from Selected ASEAN Countries. *International Journal of Economics and Financial Issues, 7* (1), pp 37-45. https://www.researchgate.net/profile/Nurasyikin

Johansen, S. (1988). Statistical analysis of cointegration vectors. *Journal of Economic Dynamics and Control*, 12(3), pp 231-254. https://www.sciencedirect.com/science/article/abs/pii/0165188988900413

Joyce, M., Miles, D., Scott, A. & Vayanos, D. (2012). Quantitative easing and unconventional monetary policy- an introduction. *The Economic Journal*, *122*(564), pp 271-288. https://www.jstor.org/stable/23324224?seq=2#metadata_info_tab_contents

Juselius, K. (2006). *The Cointegrated VAR Model: Methodology and Applications*. OUP Oxford.

Kasteler, A. (2017). Quantitative Easing: Money Supply and the Commodity Prices of Oil, Gold, and Wheat (Master Thesis). Utah State University. https://digitalcommons.usu.edu/gradreports/1037/

Liew, V.K.S. (2004). Which Lag Length Selection Criteria Should We Employ? *Economics Bulletin*, 3(33), pp. 1−9. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=885505

Lima, L., Vasconcelos, C. F., Simão, J. & de Mendonca, H. F. (2016). The quantitative easing effect on the stock market of the USA, the UK and Japan: An ARDL approach for the crisis period. *Journal of Economic Studies*, 43(6), pp 1006-1021. https://www.emerald.com/insight/content/doi/10.1108/JES-05-2015

Lütkepohl, H. (2005). *New Introduction to Multiple Time Series Analysis.* SpringerLink.

Lütkepohl, H., Saikkonen, P. & Trenkler, C. (2002). Maximum eigenvalue versus trace tests for the cointegrating rank of a VAR process. *The Econometrics Journal*, 4(2), pp 287-310. https://onlinelibrary.wiley.com/doi/abs/10.1111/

Lütkepohl, H. & Xu, F. (2010). The role of the log transformation in forecasting economic variables. *Empirical Economics*, 42, pp 619-638. https://link.springer.com/article/10.1007/s00181-010-0440-1.

Lyonnet, V. & Werner, R. (2012). Lessons from the Bank of Englandd on "quantitative easing" and other "unconventional" monetary policies. *International Review of Financial Analysis*, 25, pp 94-105.

Macrotrends. (2021, May 8th). S&P 500 PE Ratio- 90 Year Historical Chart. Retrieved from https://www.macrotrends.net/2577/sp-500-pe-ratio-price-to-earnings-chart#google_vignette

Mamaysky, H. (2018). The time horizon of price responses to quantitative easing. *Journal of Banking & Finance*, 90, pp 32-49. https://www.sciencedirect.com/science/article/pii/S0378426618300475

Monetary Authority of Singapore. (2021). https://www.mas.gov.sg/

Nikkei Indexes. (April 30th, 2021) *Nikkei Stock Average Monthly Factsheet* [Fact sheet]. Retrieved on May 15th, 2021 from https://indexes.nikkei.co.jp/en/nkave/index/profile?idx=nk225.

Pfaff, B. & Stigler, M. (2018). Package 'vars'. Retrieved on May 26th from https://cran.r-project.org/web/packages/vars/vars.pdf

Philips, P.C.B. (1986). Understanding spurious regressions in econometrics. *Journal of Econometrics*, 33(3), pp 311-340. https://www.sciencedirect.com/science/article/abs/pii/0304407686900011

Rahman, M. & Mustafa, M. (2008) Influences of Money Supply and Oil Price on U.S. Stock Market. *North American Journal of Finance and Banking Research, 2 (2).* https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1536682

Reisenbichler, A. (2019). The politics of quantitative easing and housing stimulus by the Federal Reserve and European Central Bank 2008-2018. *West European Politics*, 43(2), pp 464-484. https://www.tandfonline.com/doi/full/10.1080/01402382.2019.1612160

Reserve Bank of New Zealand. (2021). Retrieved from https://www.rbnz.govt.nz/

Reuters. (2021). Retrieved on May 19th, 2021 from https://eikon.thomsonreuters.com/index.html?fbclid=IwAR32Gy4Jznk3z0DeQez43pY_imkFmd2yvlPTxXv4MC60Y06la-rP_beyHnM

S&P Dow Jones Indices. (April 30, 2021-a). *Equity S&P/NZX 50 Index* [Fact sheet]. Retrieved on March 27th, 2021 from https://www.spglobal.com/spdji/en/indices/equity/sp-nzx-50-index/#overview.

S&P Dow Jones Indices. (April 30, 2021-b). *Equity S&P 500* [Fact sheet]. Retrieved on May 15th, 2021 from https://www.spglobal.com/spdji/en/indices/equity/sp-500/#data.

Schwartz, A. J. (n.d.). Money Supply. Retrieved on May 10th, 2021 from https://www.econlib.org/library/Enc/MoneySupply.html

Schwarz, G. (1978). Estimating the Dimension of a Model. *Institute of Mathematical Statistics*. *https://projecteuclid.org/journals/annals-of-statistics/volume-6/issue-2/Estimating-the-Dimension-of-a-Model/10.1214/aos/1176344136.full*

Sieron, A. (2019). Endogenous versus exogenous money: Does the debate really matter? *Research in Economics*, 73(4), pp 329-338. https://www.sciencedirect.com/science/article/pii/S1090944319303606

Six Group. (February 1st, 2021). *Swiss Market Index SMI Total Return* [Fact sheet]. Retrieved on May 14th, 2021 from https://www.six-group.com/en/products-services/the-swiss-stock-exchange/market-data/indices/equity-indices/smi.html.

State Street Global Advisors SPDR. (March 31, 2021-a). *The Consumer Staples Select Sector SPDR Fund* [Fact sheet]. Retrieved on May 15th, 2021 from https://www.ssga.com/us/en/institutional/etfs/funds/the-consumer-staples-select-sector-spdr-fund-xlp.

State Street Global Advisors SPDR. (March 31, 2021-b). *The Consumer Discretionary Select Sector SPDR Fund* [Fact sheet]. Retrieved on May 15th, 2021 from https://www.ssga.com/us/en/institutional/etfs/funds/the-consumer-discretionary-select-sector-spdr-fund-xly.

Su, C., Wang, X., Tao, R. & Chang, H. (2019). Does money supply drive housing prices in China? *International Review of Economics & Finance*, *60*, pp 85-94. https://www.sciencedirect.com/science/article/pii/

Swiss National Bank. (2021). Retrieved from https://www.snb.ch/en/

The Bank of England. (2021). Retrieved from https://www.bankofengland.co.uk/

The Federal Reserve. (2020, August 27th). Review of Monetary Policy Strategy, Tools, and Communications. Retrieved May 12th 2021 from https://www.federalreserve.gov/

The Federal Reserve. (2021, May 8th). Money Stock Measures- H.6 Release. Retrieved from https://www.federalreserve.gov/

Tromp, L. (2014). Dynamics behind agricultural food commodity prices: a forecast (Master thesis). Erasmus School of Economics, Erasmus University Rotterdam. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.1001.6627&rep=rep1&type=pdf

Wall Street Journal. (2021, May 5th). P/E & Yields on Major Indexes. Retrieved from https://www.wsj.com/?mod=wsjheader_logo

Wasserfallen, W. (1989). Macroeconomics News and the Stock Market, Evidence from Europe. *Journal of Banking and Finance*, 13, pp 613-626. https://www.sciencedirect.com/science/article/pii/0378426689900332

Wong, W., Khan, H. & Du, J. (2006). Do Money and interest rates matter for stock prices. *Singapore Economic Review*, *51*(1), pp 31-51. https://repository.hkbu.edu.hk/cgi/viewcontent.cgi?referer=https://scholar.google.com/&httpsredir=1&article=1043&context=econ_ja

World bank, inflation, consumer prices for the United States (FPCPITOTLZGUSA). Retrieved on May 8th, 2021 from FRED, Federal Reserve Bank of St. Louis https://fred.stlouisfed.org/series/FPCPITOTLZGUSA

World Gold Council. (2019). How much gold has been mined?. Retrieved on May 15th, 2021 from https://www.gold.org/about-gold/gold-supply/gold-mining/how-much-gold.

Yahoo finance. (2021). Retrieved on April 11th, 2021 from https://finance.yahoo.com/

Zhang, S. (2020). Empirical Analysis on the Relationship between Monetary Policy and Real Estate Market Price in China. *Social Science, Education and Human Science.* *https://www.dpi-proceedings.com/index.php/dtssehs/article/view/34697*

A Appendix: Investigation of chosen countries' money supply

Table A.1: Central banks, and information regarding money supply.

Country	**Central Bank**	**Currency**	**Numbers denoted in**
The U.S.	The Federal Reserve	US dollars	Billions
GBR	The Bank of England	Pound sterling	Millions
Japan	The Bank of Japan	Yen	Billions
Singapore	Monetary Authority of Singapore	Singapore dollar	Millions
New Zealand	Reserve bank of New Zealand	NZD	Millions
Switzerland	Swiss national bank	Swiss franc	Millions

Table A.2: Monetary aggregates and their components.

U.S.	M1	Currency,	Demand deposits	Other liquid deposits
	M2	M1,	Saving deposits,	Small-denomination time deposits and Retail money market funds[1]
JPN	M1	Currency in circulation	demand deposits[2]	
	M2	Currency in circulation	Time deposits[3] etc.	
CHE	M1	Currency in circulation,	Sight deposits[2] of trade and industry,	Domestic sight deposits and Postal accounts[4]
	M2	M1	and Saving deposits	
NZL	M1	Currency held by public	and Transaction deposits	
	Broad Money	M1,	Saving deposits	Term deposits
GBR	M0	Currency in circulation	and banks' operational deposits[5] with Bank of England	
	M4	Currency not held by banks,	Deposits (including certificates of deposits)	Estimated holdings of currency
SGP	M1	Currency in circulation	Demand deposits	
	M2	M1	Short-term time deposits in banks	

1: **Retail Money Market Fund:** Money market refers to short-term debt investments. At retail level it refers to mutual funds bought by individual investors and money market accounts opened by bank customers.

2: **Demand/sight deposits**: deposited funds can be withdrawn at any time without given notice.

3: **Time deposits**: Interest-bearing bank account with pre-sate date of maturity (certificate of deposit for example).

4: **Postal accounts**: Account where you deposit or withdraw money by mail.

5: **Operational deposits**: Accounts where a significant withdrawal is unlikely within 30 days.

B Appendix: Descriptive statistics

Table B.1: Descriptive statistics for CHE, SGP, GBR, JPN & NZL during time period 1.

	Observations	Min	Max	Median	Mean	SD	Skewness	Kurtosis
Natural Logarithm of The Variables								
M2 CHE	80	12.8193	13.1554	13.0918	13.0462	0.0996	-0.9628	-0.4614
M2 SGP	80	12.0520	12.6034	12.2270	12.2598	0.1664	0.7525	-0.6225
M4 GBR	80	13.7205	14.3307	13.9517	13.9831	0.1847	0.3454	-1.1979
M2 JPN	72	15.7216	15.8281	15.7717	15.7724	0.0283	0.0915	-0.9831
BM NZL	73	11.4367	11.9885	11.6863	11.6999	0.1661	0.1241	-1.2479
SMI	80	8.5866	9.5160	9.0103	9.0758	0.2513	0.1870	-1.0843
STI	80	6.9797	8.2286	7.4444	7.5042	0.3514	0.4168	-0.8826
FTSE	80	7.4650	8.2659	7.8349	7.8762	0.2183	0.1379	-1.0893
N225	72	9.1752	10.0571	9.6788	9.6894	0.2458	-0.2146	-1.1532
NZX50	73	7.5395	8.3669	8.0996	8.0446	0.2232	-0.4942	-0.7101
Δ of The Natural Logarithm of The Variables								
	Observations	Min	Max	Median	Mean	SD	Skewness	Kurtosis
M2 CHE	79	-0.0266	0.0560	0.0015	0.0024	0.0121	0.9510	3.3190
M2 SGP	79	-0.0209	0.0368	0.0051	0.0066	0.0108	0.4362	0.1778
M4 GBR	79	-0.0144	0.0242	0.0084	0.0077	0.0079	-0.3708	0.3037
M2 JPN	71	-0.0022	0.0041	0.0015	0.0015	0.0015	-0.4481	-0.3015
BM NZL	72	-0.0116	0.0251	0.0061	0.0075	0.0090	0.0636	-0.6842
SMI	79	-0.1369	0.1180	0.0104	0.0031	0.0420	-0.7938	1.2648
STI	79	-0.1797	0.1048	0.0210	0.0119	0.0473	-0.9767	2.2634
FTSE	79	-0.1254	0.0862	0.0099	0.0041	0.0369	-1.1303	2.0163
N225	71	-0.2722	0.1005	0.0040	0.0016	0.0601	-1.4861	4.5639
NZX50	72	-0.1261	0.0837	0.0130	0.0049	0.0393	-0.8723	1.0472

Table B.2: Descriptive statistics for CHE, SGP, GBR, JPN & NZL during time period 2.

	Observations	Min	Max	Median	Mean	SD	Skewness	Kurtosis
Natural Logarithm of The Variables								
M2 CHE	79	12.9842	13.7033	13.4778	13.4469	0.2178	-0.7968	-0.4069
M2 SGP	79	12.6105	13.1249	12.9540	12.9223	0.1571	-0.2913	-1.2395
M4 GBR	79	14.3351	14.6128	14.5546	14.5348	0.0686	-1.5056	1.4363
M2 JPN	72	15.8300	16.0105	15.9099	15.9144	0.0521	0.1766	-1.1868
BM NZL	73	11.9698	12.3483	12.1237	12.1326	0.1248	0.1942	-1.4107
SMI	79	8.8559	9.6506	9.2365	9.2779	0.1833	0.3446	-0.4260
STI	79	7.4164	8.3385	8.1177	8.0680	0.2131	-1.4935	1.8027
FTSE	79	7.7585	8.5324	8.2240	8.2184	0.1931	-0.3365	-0.4612
N225	72	9.3698	10.2560	9.5372	9.6715	0.2646	0.6845	-1.0644
NZX50	73	7.8329	8.6791	8.1572	8.2404	0.2206	0.3579	-1.1309
Δ of The Natural Logarithm of The Variables								
	Observations	Min	Max	Median	Mean	SD	Skewness	Kurtosis
M2 CHE	79	-0.0171	0.0795	0.0057	0.0084	0.0151	2.3625	7.8703
M2 SGP	79	-0.0122	0.0258	0.0060	0.0065	0.0085	0.1850	-0.5613
M4 GBR	79	-0.0200	0.0788	0.0012	0.0029	0.0123	2.9990	16.1345
M2 JPN	72	-0.0005	0.0053	0.0026	0.0025	0.0013	0.0959	-0.1595
BM NZL	73	-0.0181	0.0232	0.0048	0.0049	0.0087	-0.3678	-0.2706
SMI	79	-0.1110	0.0982	0.0067	0.0027	0.0407	-0.5438	0.2246
STI	79	-0.2711	0.2003	0.0113	0.0024	0.0629	-0.8843	4.5085
FTSE	79	-0.1377	0.0823	0.0072	0.0037	0.0462	-0.5616	0.1250
N225	72	-0.1239	0.1220	0.0132	0.0135	0.0535	-0.3128	-0.2057
NZX50	73	-0.0952	0.0758	0.0115	0.0103	0.0278	-0.8711	2.0692

Table B.3: Descriptive statistics for CHE, SGP, GBR, JPN & NZL during time period 3.

Natural Logarithm of The Variables

	Observations	Min	Max	Median	Mean	SD	Skewness	Kurtosis
M2 CHE	79	13.7007	13.8956	13.7960	13.7883	0.0584	0.0227	-1.2985
M2 SGP	79	13.1284	13.4814	13.2712	13.2772	0.1020	0.3919	-0.8195
M4 GBR	79	14.5488	14.8608	14.6734	14.6683	0.0900	0.5322	-0.5986
M2 JPN	71	16.0125	16.2589	16.1141	16.1144	0.0649	0.4334	-0.5592
BM NZL	73	12.3590	12.8098	12.5866	12.5842	0.1243	0.0477	-1.0230
SMI	79	9.5883	10.0615	9.7776	9.8031	0.1346	0.3312	-1.1343
STI	79	8.1395	8.5366	8.3774	8.3651	0.1000	-0.2936	-1.0963
FTSE	79	8.4587	8.8509	8.6922	8.6648	0.1125	-0.2088	-1.2989
N225	71	10.0675	10.7767	10.4122	10.3855	0.1551	0.0574	-0.2573
NZX50	73	8.6293	9.4824	9.0410	9.0499	0.2460	0.0231	-1.1748

Δ of The Natural Logarithm of The Variables

	Observations	Min	Max	Median	Mean	SD	Skewness	Kurtosis
M2 CHE	79	-0.0108	0.0136	0.0031	0.0025	0.0043	-0.4086	0.2460
M2 SGP	79	-0.0125	0.0370	0.0035	0.0045	0.0074	1.3350	3.5675
M4 GBR	79	-0.0110	0.0319	0.0038	0.0038	0.0070	0.8867	2.1510
M2 JPN	71	0.0003	0.0204	0.0029	0.0035	0.0028	3.5933	17.3836
BM NZL	73	-0.0175	0.0346	0.0081	0.0062	0.0087	-0.1120	0.7209
SMI	79	-0.0779	0.0899	0.0087	0.0054	0.0350	-0.3378	-0.0443
STI	79	-0.1900	0.1502	0.0049	0.0014	0.0439	-0.7186	4.4592
FTSE	79	-0.1440	0.1195	0.0112	0.0027	0.0377	-0.6529	2.4392
N225	71	-0.1085	0.1402	0.0151	0.0073	0.0512	-0.4961	0.0742
NZX50	73	-0.1393	0.0804	0.0149	0.0104	0.0339	-1.3105	4.2029

Table B.4: Descriptive statistics for the U.S. during time period 1.

	Observations	Min	Max	Median	Mean	SD	Skewness	Kurtosis
	<u>Natural Logarithm of The Variables</u>							
M2 U.S.	80	8.5434	8.9188	8.7526	8.7447	0.1032	-0.1336	-1.0248
S&P 500	80	7.0588	7.7930	7.4418	7.4516	0.1864	-0.0454	-0.7466
Gold	80	5.5831	6.7259	6.0306	6.0730	0.3145	0.2739	-1.0911
WTI	80	2.9648	4.5515	3.7846	3.7526	0.4242	-0.0483	-1.2773
XLP	80	2.4677	3.0096	2.7362	2.7295	0.1280	0.0788	-0.4430
IYR	80	2.7869	3.9518	3.3283	3.3289	0.3631	0.0754	-1.4563
XLY	80	2.8661	3.4891	3.2277	3.2062	0.1631	-0.3776	-0.6553
	<u>Δ of The Natural Logarithm of The Variables</u>							
	Observations	Min	Max	Median	Mean	SD	Skewness	Kurtosis
M2 U.S.	79	-0.0046	0.0210	0.0047	0.0048	0.0035	1.0441	4.6704
S&P 500	79	-0.1151	0.0844	0.0097	0.0034	0.0365	-0.6275	0.9469
Gold	79	-0.0867	0.1032	0.0152	0.0144	0.0413	0.0456	-0.4981
WTI	79	-0.1736	0.1688	0.0229	0.0147	0.0751	-0.4615	-0.3750
XLP	79	-0.1105	0.0554	0.0050	0.0030	0.0281	-1.1058	2.6036
IYR	79	-0.1491	0.1053	0.0170	0.0102	0.0474	-0.8027	0.6549
XLY	79	-0.1380	0.1250	0.0057	0.0026	0.0475	-0.3975	0.7801

Table B.5: Descriptive statistics for the U.S. during time period 2.

	Observations	Min	Max	Median	Mean	SD	Skewness	Kurtosis
				<u>Natural Logarithm of The Variables</u>				
M2 U.S.	79	8.9233	9.3446	9.1055	9.1339	0.1225	0.1261	-1.2745
S&P 500	79	7.0807	8.1753	7.6815	7.6901	0.2572	-0.0286	-0.5135
Gold	79	6.5941	7.5030	7.1638	7.1340	0.2390	-0.2748	-1.1191
WTI	79	3.6659	4.8969	4.5323	4.4639	0.2423	-1.3694	2.2148
XLP	79	2.6794	3.6201	3.1256	3.1637	0.2562	0.1900	-1.1365
IYR	79	2.7579	4.0337	3.7039	3.6378	0.3017	-1.0527	0.4801
XLY	79	2.6885	4.1068	3.5220	3.4950	0.3733	-0.0256	-0.8927
				<u>Δ of The Natural Logarithm of The Variables</u>				
	Observations	Min	Max	Median	Mean	SD	Skewness	Kurtosis
M2 U.S.	79	-0.0045	0.0217	0.0051	0.0054	0.0042	1.4303	3.7862
S&P 500	79	-0.1839	0.1037	0.0138	0.0053	0.0506	-0.9356	1.3826
Gold	79	-0.1910	0.1303	0.0146	0.0055	0.0631	-0.5169	0.3388
WTI	79	-0.3320	0.2041	0.0129	0.0015	0.0920	-1.2210	3.1620
XLP	79	-0.1280	0.0721	0.0122	0.0074	0.0366	-0.8731	1.2358
IYR	79	-0.3629	0.2817	0.0126	0.0049	0.0839	-1.1881	5.3651
XLY	79	-0.1905	0.1753	0.0160	0.0102	0.0599	-0.5791	1.1174

Table B.6: Descriptive statistics for the U.S. during time period 3.

	Observations	Min	Max	Median	Mean	SD	Skewness	Kurtosis
			Natural Logarithm of The Variables					
M2 U.S.	79	9.3472	9.8858	9.5329	9.5481	0.1402	0.8041	-0.0367
S&P 500	79	8.1804	8.9737	8.5176	8.5029	0.2247	0.2178	-1.1076
Gold	79	6.9660	7.5832	7.1564	7.1990	0.1537	1.0487	0.1622
WTI	79	2.8064	4.5700	3.9392	3.9327	0.2658	-0.8715	3.2230
XLP	79	3.6285	4.1977	3.8928	3.9025	0.1422	0.1967	-0.7631
IYR	79	3.9980	4.5150	4.2618	4.2661	0.1279	0.1015	-0.8901
XLY	79	4.1092	5.0861	4.5291	4.5368	0.2630	0.3141	-0.9604
			Δ of The Natural Logarithm of The Variables					
	Observations	Min	Max	Median	Mean	SD	Skewness	Kurtosis
M2 U.S.	79	0.0005	0.0623	0.0048	0.0069	0.0091	4.4325	21.2200
S&P 500	79	-0.1318	0.1206	0.0143	0.0103	0.0417	-0.5491	1.5290
Gold	79	-0.0767	0.1055	0.0004	0.0039	0.0392	0.2997	0.0582
WTI	79	-0.5681	0.5456	0.0161	-0.0071	0.1450	-0.6691	5.6600
XLP	79	-0.1025	0.0747	0.0086	0.0071	0.0361	-0.5404	0.4358
IYR	79	-0.2282	0.1145	0.0073	0.0055	0.0473	-1.3446	6.1393
XLY	79	-0.1663	0.1778	0.0131	0.0125	0.0498	-0.2579	2.2624

C Appendix: Plots of indices, commodities, ETFs and money supply.

Figure C.1: U.S. indexed price development for commodities, index and ETFs.

Figure C.2: Indexed development in money supplies.

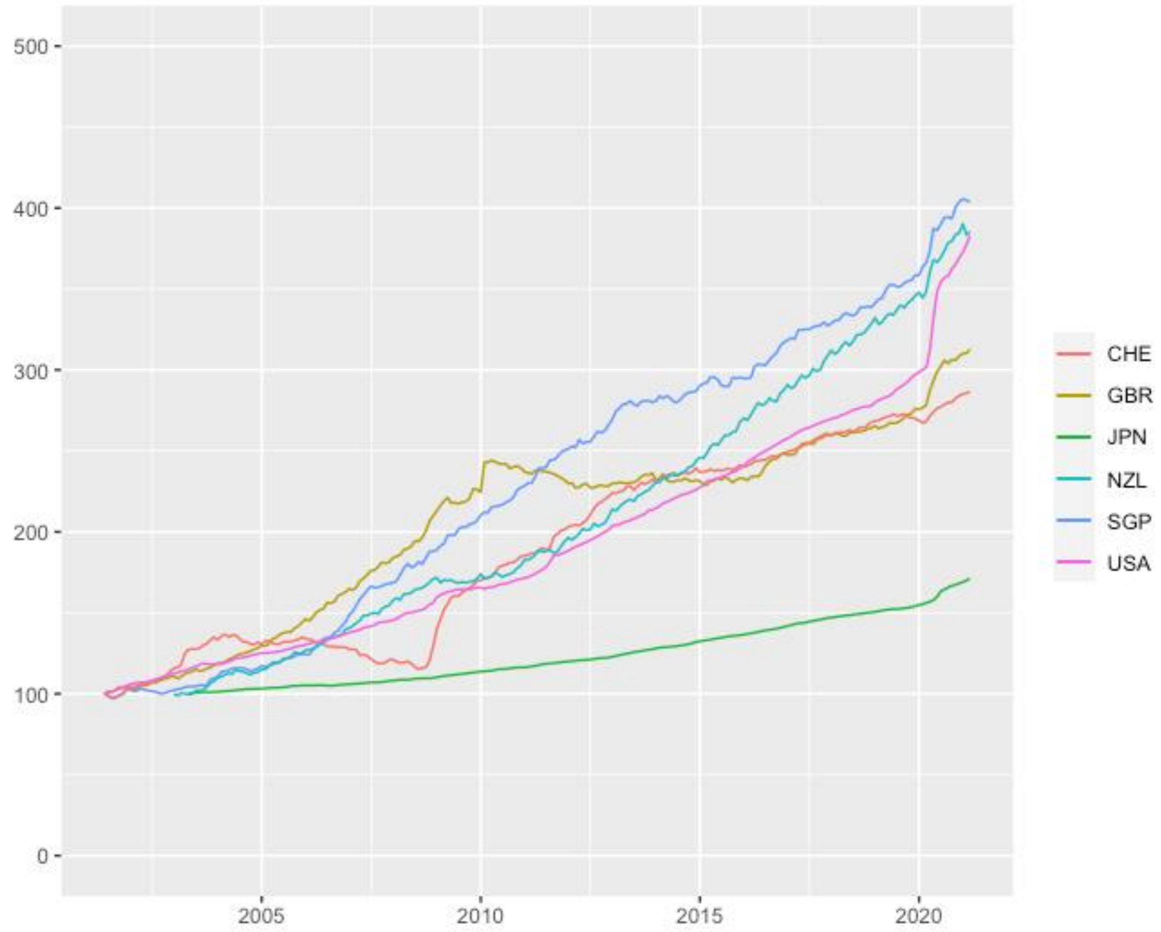


Figure C.3: Indexed development in stock indices of JPN, NZL, CHE, GBR & SGP.

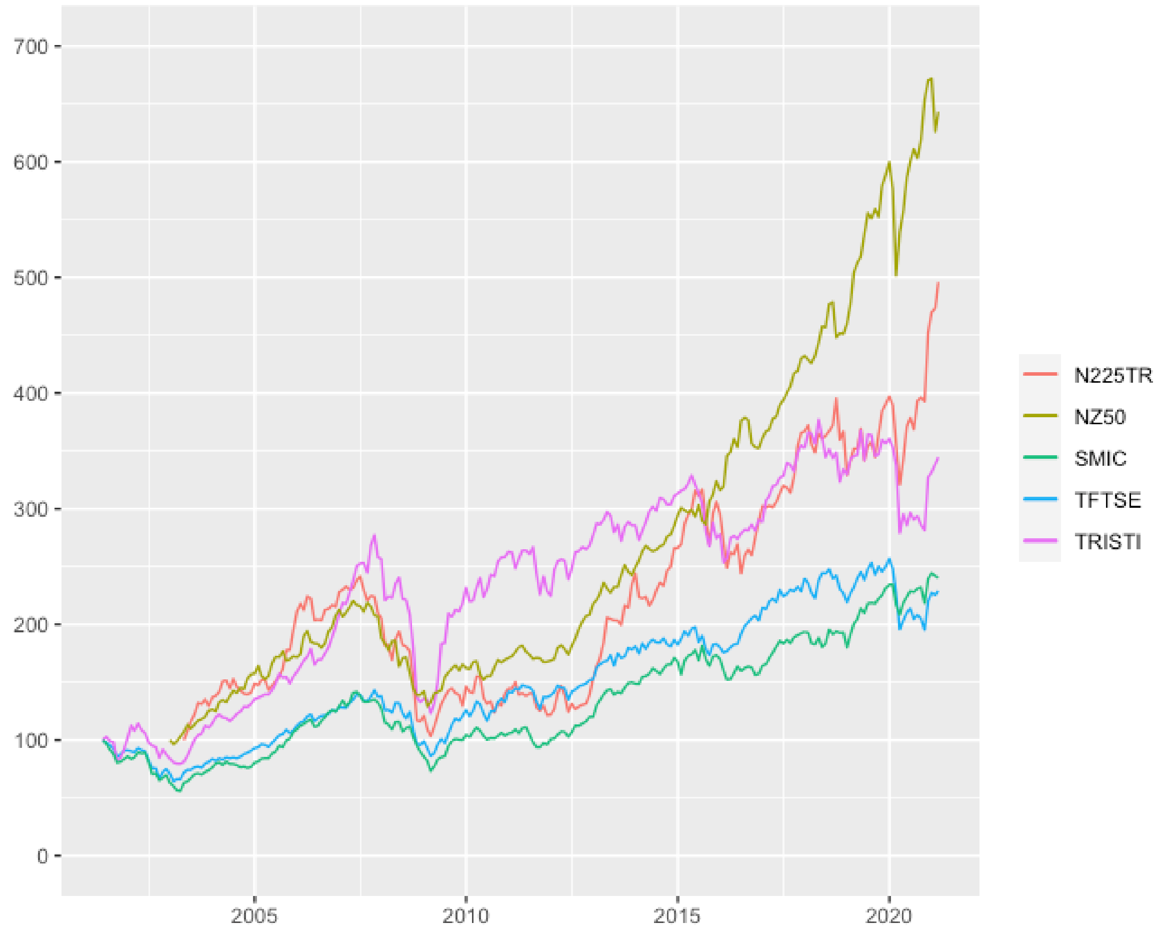


Figure C.4: First difference of logged U.S. assets.

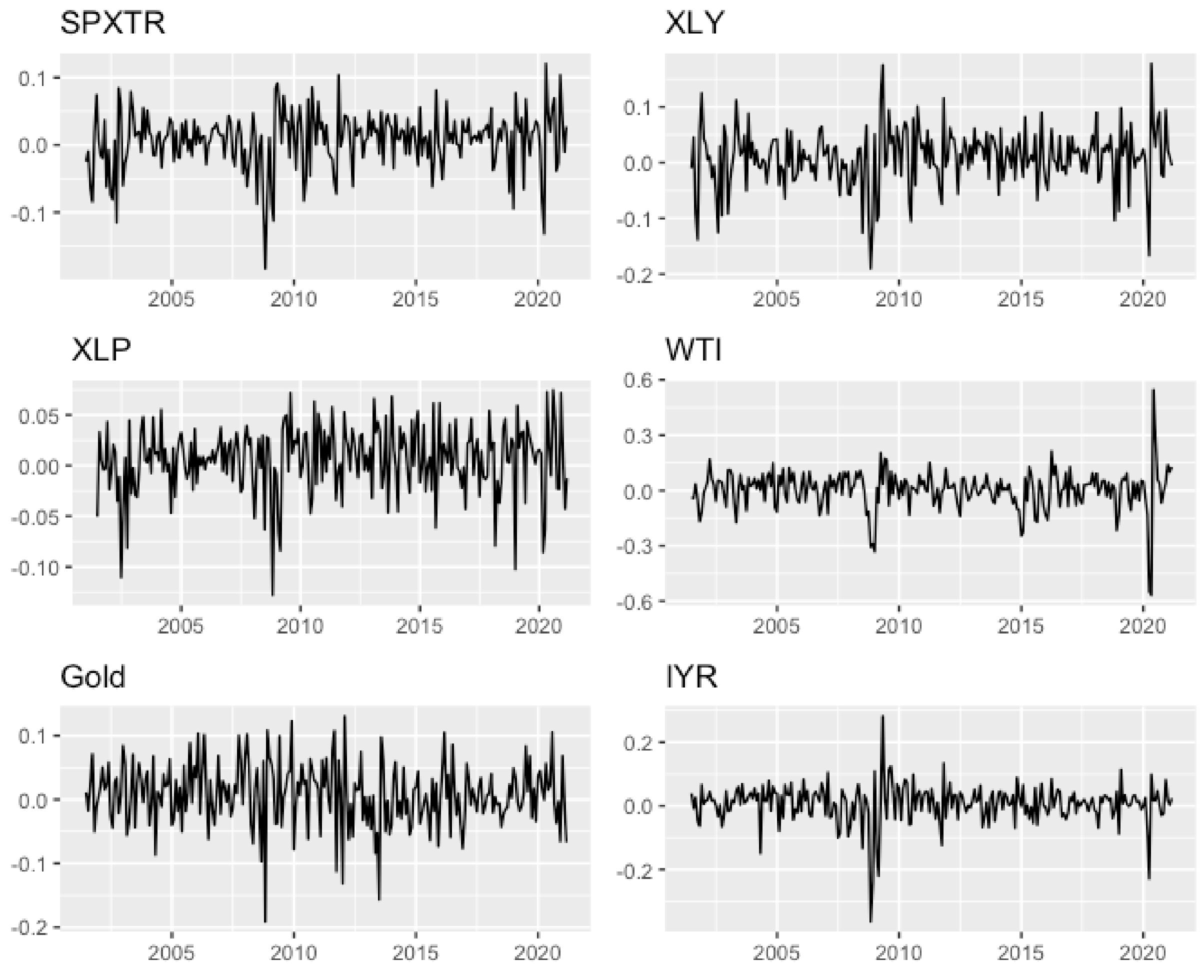


Figure C.5: First difference of logged money supplies.

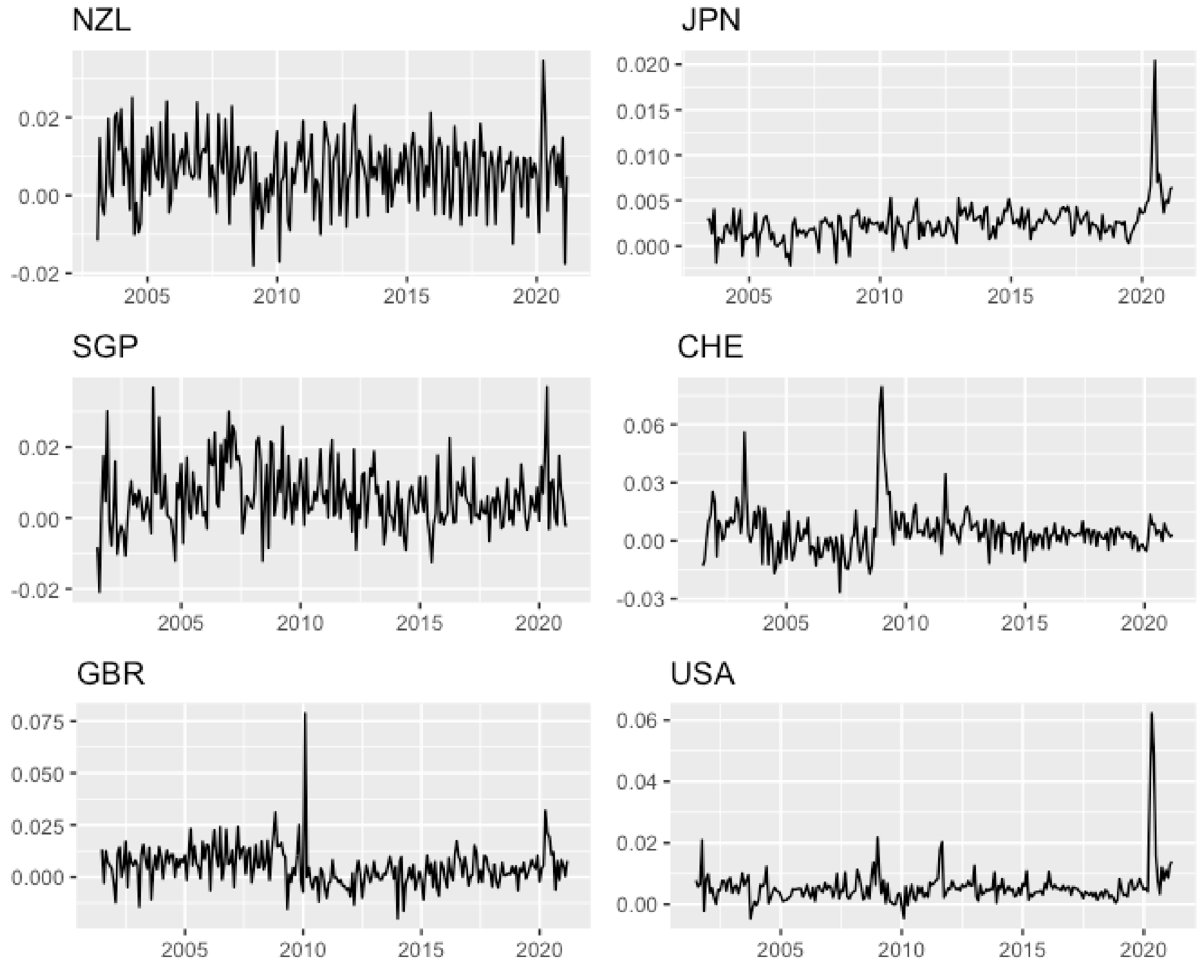
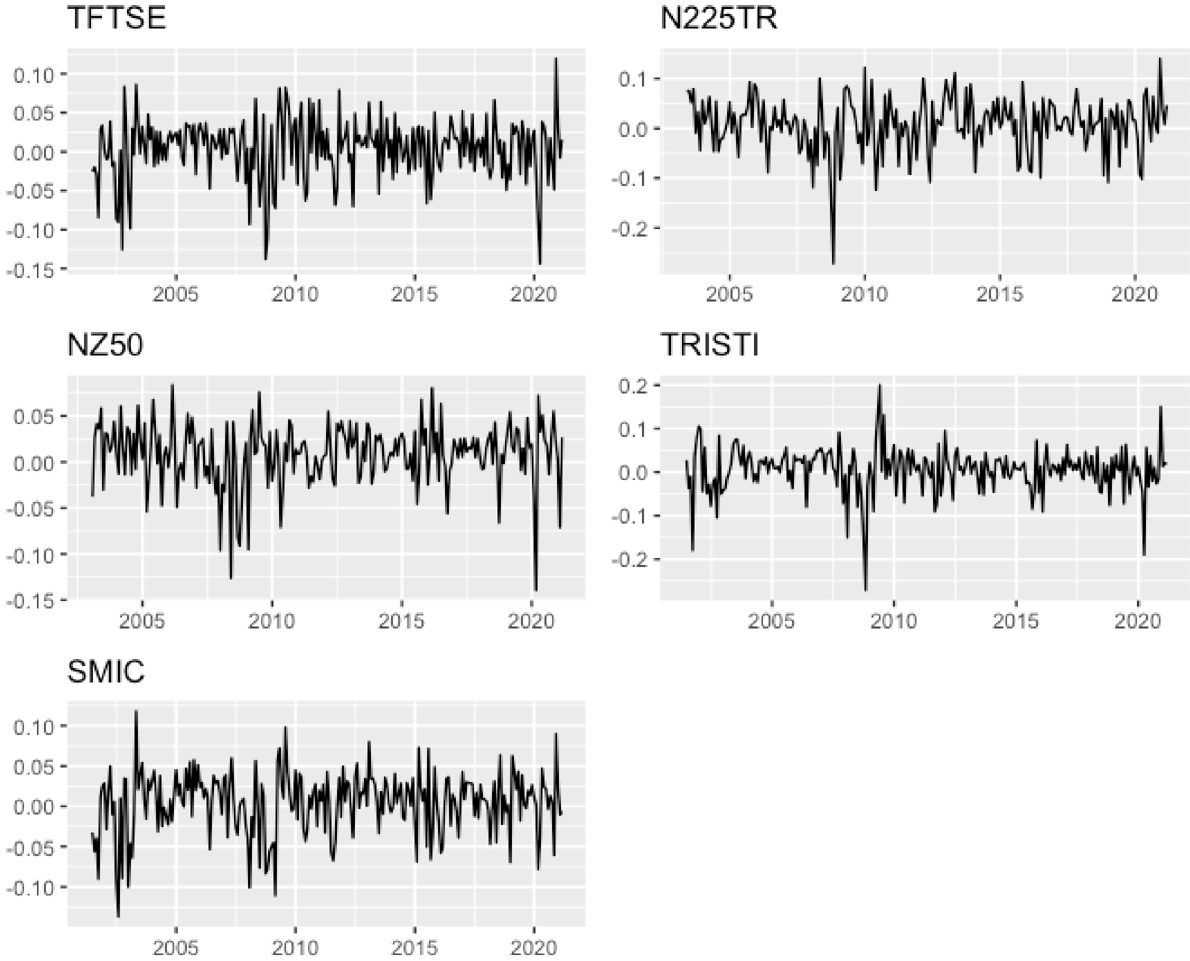


Figure C.6: First difference of logged stock indices of GBR, JPN, NZL, SGP & CHE.



D Appendix: Augmented Dickey-Fuller test

Table D.1: ADF input and test results for time period 1 (U.S.).

	Lags	Intercept	Time trend	Stationary
<u>Natural Logarithm of The Variables</u>				
M2 U.S.	3	✓	✓	✓
S&P 500	0	✓	✓	×
Gold	3	✓	✓	×
WTI	0	✓	✓	×
XLP	0	✓	✓	×
IYR	0	✓	✓	×
XLY	0	✓	✓	×
<u>Δ of The Natural Logarithm of The Variables</u>				
	Lags	Intercept	Time trend	Stationary
M2 U.S.	0	✓	×	✓
S&P 500	0	✓	×	✓
Gold	0	✓	×	✓
WTI	0	✓	×	✓
XLP	0	✓	×	✓
IYR	0	✓	×	✓
XLY	0	✓	×	✓

Table D.2: ADF input and test results for time period 2 (U.S.).

	Lags	Intercept	Time trend	Stationary
Natural Logarithm of The Variables				
M2 U.S.	1	✓	✓	×
S&P 500	3	✓	✓	✓
Gold	0	✓	✓	×
WTI	2	✓	✓	✓
XLP	0	✓	✓	×
IYR	3	✓	✓	✓
XLY	0	✓	✓	×
Δ of The Natural Logarithm of The Variables				
	Lags	Intercept	Time trend	Stationary
M2 U.S.	0	✓	×	✓
S&P 500	0	✓	×	✓
Gold	0	✓	×	✓
WTI	0	✓	×	✓
XLP	0	✓	×	✓
IYR	2	✓	×	✓
XLY	0	✓	×	✓

Table D.3: ADF input and test results for time period 3 (U.S.).

	Lags	Intercept	Time trend	Stationary
	Natural Logarithm of The Variables			
	Lags	Intercept	Time trend	Stationary
M2 U.S.	2	✓	✓	×
S&P 500	0	✓	✓	✓
Gold	0	✓	✓	×
WTI	1	✓	×	✓
XLP	0	✓	✓	✓
IYR	0	✓	✓	✓
XLY	0	✓	✓	✓
	Δ of The Natural Logarithm of The Variables			
	Lags	Intercept	Time trend	Stationary
M2 U.S.	1	✓	×	✓
S&P 500	0	✓	×	✓
Gold	0	✓	×	✓
WTI	1	✓	×	✓
XLP	0	✓	×	✓
IYR	0	✓	×	✓
XLY	0	✓	×	✓

Table D.4: ADF input and test results for time period 1 (CHE, SGP, GBR, JPN & NZL).

	Lags	Intercept	Time trend	Stationary
	Natural Logarithm of The Variables			
	Lags	Intercept	Time trend	Stationary
M2 CHE	3	✓	✓	×
M2 SGP	0	✓	✓	×
M4 GBR	2	✓	✓	×
M2 JPN	0	✓	✓	×
BM NZL	3	✓	✓	×
SMI	0	✓	✓	×
STI	0	✓	✓	×
FTSE	0	✓	✓	×
N225	1	✓	×	×
NZX50	2	✓	✓	×
	Δ of The Natural Logarithm of The Variables			
	Lags	Intercept	Time trend	Stationary
M2 CHE	2	✓	×	✓
M2 SGP	2	✓	×	✓
M4 GBR	2	✓	×	✓
M2 JPN	0	✓	×	✓
BM NZL	2	✓	×	✓
SMI	0	✓	×	✓
STI	0	✓	×	✓
FTSE	0	✓	×	✓
N225	0	✓	×	✓
NZX50	0	✓	×	✓

Table D.5: ADF input and test results for time period 2 (CHE, SGP, GBR, JPN & NZL).

	Lags	Intercept	Time trend	Stationary
<u>Natural Logarithm of The Variables</u>				
	Lags	Intercept	Time trend	Stationary
M2 CHE	1	✓	✓	×
M2 SGP	0	✓	✓	×
M4 GBR	0	✓	✓	×
M2 JPN	0	✓	✓	×
BM NZL	0	✓	✓	×
SMI	1	✓	✓	×
STI	1	✓	✓	×
FTSE	0	✓	✓	×
N225	0	✓	✓	×
NZX50	1	✓	✓	×
<u>Δ of The Natural Logarithm of The Variables</u>				
	Lags	Intercept	Time trend	Stationary
M2 CHE	0	✓	×	✓
M2 SGP	0	✓	×	✓
M4 GBR	2	✓	×	✓
M2 JPN	0	✓	×	✓
BM NZL	0	✓	×	✓
SMI	0	✓	×	✓
STI	0	✓	×	✓
FTSE	3	✓	×	✓
N225	0	✓	×	✓
NZX50	0	✓	×	✓

Table D.6: ADF input and test results for time period 3 (CHE, SGP, GBR, JPN & NZL).

	Lags	Intercept	Time trend	Stationary
Natural Logarithm of The Variables				
M2 CHE	3	✓	✓	×
M2 SGP	0	✓	✓	×
M4 GBR	1	✓	✓	×
M2 JPN	0	✓	✓	×
BM NZL	2	✓	✓	×
SMI	0	✓	✓	×
STI	0	✓	×	×
FTSE	0	✓	✓	×
N225	0	✓	✓	×
NZX50	0	✓	✓	✓
Δ of The Natural Logarithm of The Variables				
	Lags	Intercept	Time trend	Stationary
M2 CHE	2	✓	×	✓
M2 SGP	0	✓	×	✓
M4 GBR	0	✓	×	✓
M2 JPN	1	✓	×	✓
BM NZL	1	✓	×	✓
SMI	0	✓	×	✓
STI	0	✓	×	✓
FTSE	0	✓	×	✓
N225	0	✓	×	✓
NZX50	0	✓	×	✓

E Appendix: Results of VAR models in time period 1, 2 & 3

Table E.1: Regression results for time period 1, 2 & 3 (M2 U.S. and Gold).

	TP1 Gold		TP2 Gold		TP3 Gold	
	m_t	r_t	m_t	r_t	m_t	r_t
Constant	0.005***	0.016*	0.003***	0.003	0.002***	-0.004
	(0.001)	(0.007)	(0.001)	(0.013)	(0.000)	(0.005)
m_{t-1}	0.085	0.053	0.302*	-0.397*	1.108***	0.943
	(0.147)	(1.214)	(0.126)	(1.971)	(0.254)	(0.722)
m_{t-2}			0.190	0.765	-0.615 .	-0.776
			(0.147)	(1.485)	(0.361)	(1.167)
m_{t-3}					0.134	1.431
					(0.169)	(0.936)
r_{t-1}	-0.023**	-0.120	-0.001	-0.236*	0.010	-0.062
	(0.008)	(0.082)	(0.007)	(0.116)	(0.012)	(0.114)
r_{t-2}			-0.023*	-0.114	0.009	-0.069
			(0.010)	(0.137)	(0.016)	(0.121)
r_{t-3}					0.020	-0.201
					(0.020)	(0.127)
N	78	78	77	77	76	76
R^2	0.073	0.014	0.222	0.064	0.640	0.107

Significance level: '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1

Standard errors are in the parentheses

Table E.2: Regression results for time period 1, 2 & 3 (M2 U.S. and S&P 500).

	TP1 S&P 500		TP2 S&P 500		TP3 S&P 500	
	m_t	r_t	m_t	r_t	m_t	r_t
Constant	0.005***	0.007	0.004***	0.025**	0.003**	0.005
	(0.001)	(0.007)	(0.001)	(0.009)	(0.001)	(0.007)
m_{t-1}	0.046	-0.668	0.243*	-3.640**	0.929***	0.649
	(0.174)	(0.949)	(0.113)	(1.174)	(0.101)	(0.860)
m_{t-2}					-0.281***	0.705
					(0.068)	(0.776)
r_{t-1}	-0.013	0.113	-0.021**	0.140	-0.055	-0.172
	(0.013)	(0.137)	(0.007)	(0.132)	(0.044)	(0.143)
r_{t-2}					-0.031	-0.207
					(0.022)	(0.135)
N	78	78	78	78	77	77
R^2	0.023	0.018	0.151	0.138	0.682	0.124

Significance level: '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1

Standard errors are in the parentheses

Table E.3: Regression results for time period 1, 2 & 3 (M2 U.S. and WTI).

	TP1 WTI		TP2 WTI		TP3 WTI	
	m_t	r_t	m_t	r_t	m_t	r_t
Constant	0.005***	0.037**	0.004***	0.008	0.002***	-0.046**
	(0.001)	(0.012)	(0.001)	(0.017)	(0.001)	(0.017)
m_{t-1}	0.049	-5.003*	0.193	-1.387	0.642***	6.352***
	(0.178)	(1.967)	(0.157)	(2.596)	(0.090)	(1.748)
r_{t-1}	-0.004	0.117	-0.014*	0.387 .	-0.024**	0.362 .
	(0.005)	(0.107)	(0.006)	(0.197)	(0.008)	(0.220)
N	78	78	78	78	78	78
R^2	0.012	0.070	0.174	0.173	0.667	0.227

Significance level: '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1

Standard errors are in the parentheses

Table E.4: Regression results for time period 1, 2 & 3 (M2 U.S. and IYR).

	TP1 IYR		TP2 IYR		TP3 IYR	
	m_t	r_t	m_t	r_t	m_t	r_t
Constant	0.005***	0.019*	0.004***	0.043***	0.003**	0.001
	(0.001)	(0.009)	(0.001)	(0.011)	(0.001)	(0.008)
m_{t-1}	0.060	-1.740	0.271*	-7.192**	0.885***	0.936
	(0.174)	(1.332)	(0.113)	(2.140)	(0.099)	(0.949)
m_{t-2}					-0.290***	-0.074
					(0.076)	(0.810)
r_{t-1}	-0.013	-0.042	-0.010 .	0.085	-0.051	-0.137
	(0.009)	(0.124)	(0.005)	(0.103)	(0.038)	(0.140)
r_{t-2}					-0.024	-0.008
					(0.017)	(0.093)
N	78	78	78	78	77	77
R^2	0.031	0.019	0.131	0.151	0.680	0.052

Significance level: ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1

Standard errors are in the parentheses

Table E.5: Regression results for time period 1, 2 & 3 (M2 U.S. and XLP).

	TP1 XLP		TP2 XLP		TP3 XLP	
	m_t	r_t	m_t	r_t	m_t	r_t
Constant	0.004***	0.008	0.004***	0.022***	0.003**	0.006
	(0.001)	(0.006)	(0.001)	(0.005)	(0.001)	(0.006)
m_{t-1}	0.056	-0.852	0.272*	-2.451**	1.000***	-0.084
	(0.166)	(0.757)	(0.120)	(0.848)	(0.142)	(0.603)
m_{t-2}					-0.387**	0.700
					(0.129)	(0.649)
r_{t-1}	-0.014	0.002	-0.020*	-0.019	-0.046	-0.156
	(0.010)	(0.148)	(0.010)	(0.087)	(0.045)	(0.127)
r_{t-2}					-0.022	-0.234 .
					(0.025)	(0.122)
N	78	78	78	78	77	77
R^2	0.015	0.012	0.123	0.082	0.654	0.082

Significance level: ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1

Standard errors are in the parentheses

Table E.6: Regression results for time period 1, 2 & 3 (M2 U.S. and XLY).

	TP1 XLY		TP2 XLY		TP3 XLY	
	m_t	r_t	m_t	r_t	m_t	r_t
Constant	0.004***	0.004	0.004***	0.040**	0.003***	0.002
	(0.000)	(0.009)	(0.001)	(0.013)	(0.001)	(0.009)
m_{t-1}	0.050	-0.398	0.221	-5.449**	1.011***	1.752
	(0.165)	(1.554)	(0.136)	(1.634)	(0.141)	(1.121)
m_{t-2}			0.049	0.364	-0.420*	-1.228
			(0.144)	(1.759)	(0.176)	(1.467)
m_{t-3}					0.144	2.205**
					(0.113)	(0.822)
r_{t-1}	-0.004	0.120	-0.010	0.060	-0.048	-0.264 .
	(0.011)	(0.116)	(0.007)	(0.147)	(0.034)	(0.137)
r_{t-2}			-0.012	-0.233 .	-0.028 .	-0.243
			(0.010)	(0.139)	(0.016)	(0.153)
r_{t-3}					0.002	-0.095
					(0.012)	(0.097)
N	78	78	77	77	76	76
R^2	0.005	0.015	0.161	0.170	0.695	0.211

Significance level: '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1

Standard errors are in the parentheses

Table E.7: Regression results for time period 2 & 3 (M4 GBR and FTSE).

	TP2 FTSE		TP3 FTSE	
	m_t	r_t	m_t	r_t
Constant	0.003 .	0.006	0.003***	0.002
	(0.002)	(0.005)	(0.001)	(0.006)
m_{t-1}	0.086	-0.235	0.260**	-0.103
	(0.129)	(0.523)	(0.091)	(0.529)
m_{t-2}			0.054	0.500
			(0.092)	(0.510)
r_{t-1}	-0.007	0.013	-0.001	-0.002
	(0.031)	(0.120)	(0.032)	(0.157)
r_{t-2}			-0.054**	-0.085
			(0.017)	(0.093)
N	78	78	77	77
R^2	0.009	0.005	0.174	0.016

Significance level: ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1

Standard errors are in the parentheses

Table E.8: Regression results for time period 1, 2 & 3 (M2 SGP and STI).

	TP 1 STI		TP 2 STI		TP 3 STI	
	m_t	r_t	m_t	r_t	m_t	r_t
Constant	0.004*	0.001	0.006***	-0.005	0.004***	-0.006
	(0.002)	(0.009)	(0.002)	(0.009)	(0.001)	(0.008)
m_{t-1}	0.184 .	0.470	-0.065	0.357	0.043	1.653*
	(0.098)	(0.413)	(0.109)	(0.826)	(0.107)	(0.809)
m_{t-2}	0.064	0.832	-0.090	0.655	-0.002	-0.850
	(0.110)	(0.658)	(0.108)	(0.997)	(0.123)	(0.982)
m_{t-3}	0.235*	0.237	0.174	0.285	0.024	0.950
	(0.105)	(0.464)	(0.118)	(0.931)	(0.094)	(0.737)
r_{t-1}	-0.004	0.079	-0.014	0.255	-0.053	-0.010
	(0.020)	(0.137)	(0.017)	(0.182)	(0.039)	(0.127)
r_{t-2}	-0.028	0.118	0.005	0.006	-0.033 .	0.139
	(0.034)	(0.136)	(0.013)	(0.126)	(0.019)	(0.107)
r_{t-3}	0.045 .	-0.135	-0.015	0.069	-0.022	0.007
	(0.023)	(0.117)	(0.013)	(0.100)	(0.015)	(0.116)
N	76	76	76	76	76	76
R^2	0.175	0.114	0.066	0.086	0.142	0.132

Significance level: ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1

Standard errors are in the parentheses

Table E.9: Regression results for time period 2 & 3 (M2 CHE and SMI).

	TP2 SMI		TP3 SMI	
	m_t	r_t	m_t	r_t
Constant	0.005**	0.006	0.002*	0.001
	(0.002)	(0.006)	(0.001)	(0.007)
m_{t-1}	0.655***	-0.533	-0.017	1.443
	(0.173)	(0.368)	(0.100)	(1.177)
m_{t-2}	-0.122	0.179	0.024	0.904
	(0.140)	(0.589)	(0.123)	(1.159)
m_{t-3}			0.302*	-0.141
			(0.136)	(0.961)
r_{t-1}	-0.088 .	0.249 .	-0.013	-0.143
	(0.045)	(0.126)	(0.016)	(0.141)
r_{t-2}	-0.068*	-0.039	-0.047***	-0.172
	(0.027)	(0.112)	(0.012)	(0.108)
r_{t-3}			-0.001	0.038
			(0.010)	(0.096)
N	77	77	76	76
R^2	0.59	0.099	0.206	0.081

Significance level: '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1

Standard errors are in the parentheses

Table E.10: Regression results for time period 1 & 3 (BM NZL and NZX50).

	TP1 NZX50		TP3 NZX50	
	m_t	r_t	m_t	r_t
Constant	0,009***	0,006	0,010***	0,010
	(0,002)	(0,006)	(0,001)	(0,007)
m_{t-1}	-0,188	-0,147	-0,135	0,088
	(0,133)	(0,520)	(0,111)	(0,663)
m_{t-2}			-0,410***	0,268
			(0,102)	(0,381)
r_{t-1}	-0,005	0,140	-0,021	-0,012
	(0,020)	(0,119)	(0,034)	(0,100)
r_{t-2}			-0,057	-0,104
			(0,038)	(0,102)
N	71	71	71	71
R^2	0,038	0,022	0,240	0,014

Significance level: '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1

Standard errors are in the parentheses

Table E.11: Regression results for time period 1, 2 & 3 (M2 JPN and N225).

	TP1 N225		TP2 N225		TP3 N225	
	m_t	r_t	m_t	r_t	m_t	r_t
Constant	0,001***	0,006	0,002***	0,014	0,001*	0,008
	(0,000)	(0,008)	(0,000)	(0,011)	(0,001)	(0,008)
m_{t-1}	0,102	-3,985	0,204 .	-0,773	0,645**	-0,228
	(0,138)	(3,483)	(0,121)	(4,198)	(0,194)	(1,357)
r_{t-1}	0,001	0,259 .	0,009**	0,058	0,007	-0,000
	(0,003)	(0,147)	(0,003)	(0,115)	(0,006)	(0,117)
N	70	70	71	71	70	70
R^2	0,013	0,070	0,175	0,004	0,451	0,000

Significance level: '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1

Standard errors are in the parentheses