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Global monetary aggregates and their influence on price level and output

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On my honour as a student of the Diplomatische Akademie Wien, I submit this work in good faith and pledge that I have neither given nor received unauthorized assistance on it.

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Abstract

The focus of this paper lays in analyzing monetary aggregates from the narrowest (M1) to the broadest (M3) monetary aggregate, their influence on other economic indicators such as price level and output, and how they interact over both short and longer periods. For this purpose, an impulse-response function has been modelled closely following Zaghini and Sousa (2007) to disentangle the relationship between changes in GDP, short-term interest rates, the non-food non-energy consumer price, and the monetary aggregates M1 and M3. The data mostly stems from OECD and IMF databases and national statistics and covers 44 nations over a period of more than 40 years. The period under investigation (1980-2021) is particularly interesting as it covers a vast array of global economic happenings such as the oil crisis in the 1980´s, the dot-com bubble of 2001, the global financial crisis of 2008, the European sovereign debt crisis of 2009, and the Covid-19 pandemic of 2019 through 2021. Through the utilization of a structural vector autoregression model approach, shocks in the monetary aggregates M1, M3, and the M3/M1 ratio respectively, have been simulated and analyzed in a time series. The findings show that shocks in both monetary aggregates affect output, price level and the short-term interest rate. The simulations signal a consistent behavior compared to findings by Zaghini and Sousa (2007) and show corresponding tendencies, even though the consistency differs based on the analyzed period. At the 95 % confidence level, where tests were conducted, consumer price index and output were not reacting significantly different from zero to a shock in the monetary aggregates and short-term interest rates. The findings indicate a necessary differentiation in interest-rate driven changes, and effects from changes in the monetary aggregates. Here, the simulation finds contrary effects on output both in magnitude and duration for aggregates and interest rates respectively. These findings and their consistency across larger and more heterogenous groups of countries and economies, have implications for future policy making, especially regarding the emphasize on and importance of the size of and change in global monetary aggregates. This paper therefore gives new impetus to a discussion about useful indicators for conducting monetary policy before the backdrop of internationalization and a chance for thinking outside the box of conventional interest rate driven policy approaches with a strictly domestic focus.

Abstract

Der Schwerpunkt dieser Arbeit liegt auf der Analyse der Geldmengenaggregate M1 und M3, ihren Einfluss auf andere Wirtschaftsindikatoren wie Preisniveau und BIP und ihrer Wechselwirkung über unterschiedliche Zeiträume. Zu diesem Zweck wurde in enger Anlehnung an Zaghini und Sousa (2007) eine Impuls-Antwort-Funktion modelliert, um die Beziehung zwischen Veränderungen des BIP, der kurzfristigen Zinssätze, der Verbraucherpreise und den Geldmengenaggregaten M1 und M3 nachzuvollziehen. Die dafür benötigten Daten stammen aus Datenbanken der OECD und des IWF sowie aus nationalen Statistiken und decken 44 Länder über einen Zeitraum von mehr als 40 Jahren ab. Der untersuchte Zeitraum (1980-2021) ist besonders interessant, da er eine Vielzahl weltwirtschaftlicher Ereignisse wie die Ölkrise in den 1980er Jahren, die Dot-Com-Blase von 2001, die globale Finanzkrise von 2008, die europäische Staatsschuldenkrise von 2009 und die Covid-19-Pandemie von 2019 bis 2021 umfasst. Durch die Verwendung eines strukturellen Vektor-Autoregressionsmodells wurden Schocks in den Geldmengenaggregaten M1, M3 bzw. dem M3/M1-Verhältnis simuliert und in einer Zeitreihe analysiert. Die Ergebnisse zeigen, dass Schocks in beiden Geldmengenaggregaten das BIP, das Preisniveau und den kurzfristigen Zinssatz beeinflussen. Die Simulationen signalisieren ein konsistentes Verhalten verglichen mit den Ergebnissen von Zaghini und Sousa (2007) und zeigen entsprechende Tendenzen, auch wenn die Konsistenz je nach analysiertem Zeitraum unterschiedlich ist. Auf dem Konfidenzniveau von 95 % reagierten der Verbraucherpreisindex und das BIP nicht signifikant unterschiedlich von Null auf einen Schock in den Aggregaten und den kurzfristigen Zinssätzen. Die Ergebnisse deuten auch auf eine notwendige Unterscheidung zwischen zinsbedingten Änderungen und den Auswirkungen von Änderungen der Geldmengenaggregate hin. Hier zeigt die Simulation gegenläufige Auswirkungen auf das BIP sowohl in Bezug auf die Stärke der Reaktion als auch auf ihre Dauer. Diese Ergebnisse selbst und ihre Konsistenz über größere und heterogenere Gruppen von Ländern und Volkswirtschaften hinweg haben Auswirkungen auf die künftige Politikgestaltung, insbesondere im Hinblick auf die Betonung und Bedeutung der Größe und der Veränderung der globalen Geldmengenaggregate. Dieses Papier gibt daher der Diskussion über nützliche Indikatoren für die Durchführung der Geldpolitik vor dem Hintergrund der Internationalisierung neue Impulse und bietet die Möglichkeit, über den Tellerrand der herkömmlichen zinsorientierten Politikansätze mit reinem Inlandsfokus hinauszublicken.

1. Introduction

If one was to describe the last two to four decades in economic terms, especially on the money markets, one might say volatile out of habit, while thinking rollercoaster at heart. Unlike a real rollercoaster however, this ride may never stop. While the ordinary amusement park visitor usually has no intention to either control or alter the slope, steepness, and velocity of the ride, economists indeed have and central banks are mandated to do so. In economic terms this ride might be a suitable metaphor, only that you on the trolley want the thrill, and the economy would love the complete opposite, namely a steady, slightly upward sloped, ride that goes on indefinitely, while always under full control and with a secure degree of predictability. The main question, as it has substantial "real" economic implications (materialized economy), is how certain vital indicators, such as price level, employment, economic growth, and interest rates, behave and influence each other and how they may or may not be controlled via certain monetary policy tools. For the last 40 years and for most scholars, central bankers, and policy advisors, the tool of choice to affect output and unemployment as well as induce price stability was the interest-rate based approach. Here, a nation´s central bank sets deposit and lending rates, which are passed to public or private, ideally productive, entities via the use of financial intermediaries such as commercial, or universal, banks. Through second and third round passthroughs, the intended change in interest may foster or hamper investment, which in turn affects savings, output, growth, etc. This approach, usually coined conventional monetary policy in the literature, has been so universally recognized that there will rarely be a student in an economics undergraduate program that does know any other policy tool than moving the interest rate in an idealized IS-LM model.

Especially in the field of macroeconomics however, progress has been made in this regard. While Friedman, with the almost naïve assumption that every unit of dollar currency is made by and in Washington D.C., managed to bring discredit about almost any monetarist scholar and the very idea of monetarism, more recent events, especially the aftermath of the 2008 Financial Crisis in connection with the restriction in conventional monetary policy (the zero lower bound) have brought up monetarist ideas and policies again. Both FED and ECB utilized asset purchasing programs post 2008, which expanded their balance sheets and correspondingly the money supply significantly. By doing so, the intended money infusion of the economy could be achieved without having to rely on the marginal lending rate, which at this point was already trapped at the zero

lower bound. These purchasing programs with their confusing abbreviations, but arguable successfulness, have led to a revival of monetarist research and how money stock and growth can be utilized as a controlling variable, and thus a viable policy tool for inflation targeting. Recent research, such as Belongia and Ireland (2015), shows that there may be a stronger link between monetary aggregates, their relative change over time and changes in aggregates such as output and price level, than anticipated. Those studies mentioned, apart from the latest by Belongia and Ireland (2015), have one drawback however, and that is it´s national economic focus, meaning that money supply and demand is defined in a system of closed economies. As already touched upon, the author of this paper argues that money supply must be analyzed on a global (meaning all economically significant countries) and interconnected level, because economies are rarely isolated and closed, even though current trends may suggest otherwise. It follows the idea of a holistic approach to a world economy. The increase in interdependence and integration within sectors, companies and regimes is an ongoing, yet not one-directional process, which has implications for how one understands internationalized economies in the 21st century and how they interact with each other on the money markets. Studies that did analyze money markets internationally particularly, usually picked one or another region or economic cooperation and tried to reproduce those links. Often, it focused on the effect of US monetary policy on the rest of the world. This, again, is not international "enough" in the author´s understanding and requires further endeavors and larger datasets to work with.

For the reasons above, this paper gathered data from a total of 44 countries covering over 80 % of world GDP together with vital macroeconomic indicators such as output, interest rates, and price level. Using a structural VAR model, closely modelled after Sousa and Zaghini (2007) and the aggregated dataset constructed for this reason, the paper tries to reproduce prior findings, to test the short and long run effects of changes in monetary aggregates, and further analyze the relationship and causality between changes or shocks in world monetary aggregates and corresponding changes in world output and price level. Special emphasize is given to the need for reliable and robust findings, which is why a structural VAR approach is in use to econometrically avoid mistaking correlation for causation.

This paper is organized as follows: Chapter 2 provides the literature review to offer readers, especially the lesser specialized audience, with an overview over the current state of the literature.

The theoretical framework in chapter 3 offers an inquiry into the nature of the money supply, different approaches to formulating the money supply, definitions of monetary aggregates, and different policies that influence the money supply, particularly those employed by the FED and the ECB as well as the Bank of Japan. Chapter 4 focusses on the methodology in use, especially the process of data gathering and the structural vector autoregression, as well as necessary restrictions in the model. Chapter 5 analyzes the findings from simulations and corresponding testing focusing on the causal effects between monetary aggregates, and output and price level for the world level as well as in certain subsets. Subsets, which disaggregate into certain regions or levels of economic development, are introduced there as a highlighted case, wherever necessary to complete the broader picture. Chapter 6 will take the findings from the analysis of Chapter 5, combine it with context provided for in all the other chapters, and draw vital conclusions into how monetary aggregates influence the economy, both in output and in prices, especially regarding the long and short run effects thereof.

2. Literature Review

2.1. Monetary Aggregates and the World Money Supply

Early attempts in the literature about formulating the interaction between world money supply and other economic indicators stems from McKinnon (1982), who conducted research on how the global money supply affects the US price level. His research however was embedded in a very different economic environment. Following the gold standards final demise in the early 1970´s, different currency regimes emerged and experiments with different tools ranging from capital controls to pegged/semi-pegged/floating exchange rate regimes were put in place. The corresponding friction was also felt in the US and hampered the ongoing globalization in trade as the corresponding liberalization in capital lagged. The question of an international money supply then was not as international as it would be today. Hard borders, as one might argue, due to the lack of free transfer, low convertibility, and missing globalization in terms of money transfer were what McKinnon dealt with in his analysis. It is therefore a far throw to take his research as a basis for modern money supply theory, as its international component, as described above, must be explained in completely different circumstances. Additionally, McKinnon assumed a world that is mainly dollarized, a status that would only have partly materialized in future centuries. Since then, more econometrical research has been conducted with an emphasize on cross-country effects of the world money supply. Three prominent examples from this strand of research are papers by Holmann and Neumann (2002), Canova (2005), and Zaghini and Sousa (2007). While Holmann and Neumann focused on the effect of monetary shocks on labor market variables such as employment in a cross-country effect simulation (in their paper between the US and Canada), they also included data on GDP, consumption, and price level, which they estimated with a VAR approach. Their computed data showed spillover effects of monetary shocks on a foreign economy, particularly that the interaction between money growth in country A and GDP in country B was significant, and vice versa. Their research however focused on two economies that had for once long-lasting historical ties, not just in economic terms, but also highly liberalized trade in goods and services as well as capital transfers. Zaghini and Sousa (2007, 2008) were the first to move both in endogenous variables, as well as exogenous variables, to world level aggregate. Their approach following a SVAR showed that monetary policy shocks affect both world money aggregate, global output, and price level. Their data set contained data on the G5, where while a high degree of homogeneity could be witnessed, the theoretical idea was robust enough to also

be broadened to a bigger target area. Even more, they found that shocks in the monetary aggregate, which they coined liquidity aggregate, affect output temporarily, while changes in price level tend to stick. Their dataset focused, as briefly mentioned, on the G5, which is also where this paper picks up the methodology for the first part of the analysis, aiming to reproduce those findings on a larger scale.

In more recent years, the idea of monetary aggregates and they usability in influencing price level and output have become more fashionable. The most promising work in this field of macroeconomics stems from Belongia and Ireland (2015), which successfully established a link between monetary aggregates and their effect on output and the consumer price index, especially near the zero lower bound in which conventional inflation targeting via marginal lending rates has proven to not work. Their findings are especially interesting for this research, as they were able to find a statistical link between different monetary aggregates (they used Divisa aggregates in their research) and the nominal GDP. This link held consistently in their data set, which covers the period 1967-2015. Particularly interesting is that they concluded their link to hold up even in time of crisis, such as the Great Financial Crisis (2007-2008) and the following recession (2009). Garcia-Martinez (2020) picked up the idea of international Divisa aggregates and argued in a similar direction, focusing on the methodological flaws that a solely domestic monetary aggregates focus has brought about in terms of usefulness of those very aggregates. He found that, considering the international monetary aggregates, a balance-sheet focused monetary policy (meaning one that does consider the amount of money in the economy, not just the reserve or deposit facility) may be successfully utilized to influence inflation effectively.

2.2. Monetary policy shocks

Particularly interesting for estimating the influence of monetary policy shocks, which form the basis for the structural VAR approach of Zaghini and Sousa (2007, 2008), is the transmission channels that a shock passes on into other economies. Ever since the 2008 financial crisis it became critically clear that there are little places on earth that do not connect to the global financial markets and that spillovers do also affect the “real” economy, whether its via asset prices, defaults, refinancing costs, etc. Ehrmann and Fratzscher (2009) realized that the concrete channels for this passing on are yet to be determined precisely, which is what they essentially tried to analyze more closely in the above cited paper. Their research focused very much on the credit channel, which

emphasized the importance of US-set short-term interest rates and their spillover into sufficiently integrated markets. Their findings support the argument that changes in the US short-term interest alter the cost of refinancing dollar debt that leads to drops in equity returns, which in turn affect output due to the lack of reinvested gains. To put their findings in numbers, a mere 1% drop in US short-term interest rates leads to an average 3.8% drop in equity returns. The effect however varies greatly over different countries and sectors, depending on the integration of the respective economy and its reliance on US financial instruments and the dollar currency. The focus here, as most research to this point, is US centered, as it is still the main reserve currency and the biggest financial market in the world. Conover, Jensen, and Johnson (1999) argued in a similar direction, where they identified the US exchange rate as the main transition channel for monetary policy shocks. This again is an US centered approach, but as with Ehrmann and Fratzscher (2009), the dominance of US monetary policy is based on the US dollar, which is to this day the defining currency in the world monetary aggregate. A similar situation appears when researching for alternative approaches, which are however too regionally focused to be used for deriving lessons for global aggregates. Examples for this reach from analysis focusing on the eastern-pacific region, the BRICS countries, or the African Union. While being limited in scope especially the contributions from Kutu and Ngalawa (2016), who constructed identification schemes for monetary policy shocks in the BRICS countries to analyze how industrial output responds to such shocks, and Jarocinski (2010), who approached the identification matrix for monetary policy shocks by extensively relying on exchange rate mechanism to model responses in GDP in a comparative study between western and eastern Europe, are noteworthy.

3. Theoretical Framework

It is critically clear that economics do rarely respond to a question with a single, uniform answer. There are, at least two dominant perspectives on virtually every problem a modern economist faces. While it is true that there are various schools of thought, especially in the by now very old controversy between Keynesians and Monetarists and the question regarding what drives the price level and thus inflation, this chapter tries to find a common basis from which to depart from. It is necessary to point out what this paper is based on, particularly for the introduction of certain assumptions and restrictions in the econometric framework. It is also unavoidable to discuss questions of money creation, the role of the respective central bank, and a set of conditionalities between output, price level and monetary aggregates as well as interest rates.

3.1. The Nature of Money Supply

Before diving into an inquiry about the nature of the money supply, it is necessary to establish an approximate common ground with regards to what constitutes money. The quote “gold is money, everything else is credit” is attributed to the American financier John Pierpont Morgan, founder of one of the biggest financial institutions in American financial history, father of the federal reserve system of 1907, and the person who was supposedly booked on the maiden voyage of the Titanic but was unable to attend due to an acute illness (Alef, 2009). In a more scientific approach towards the definition of money, it may be most easily defined as a medium that can be used as a storage of value, a unit of account, and as a means of exchange. It is traditionally created and distributed by a country´s central monetary authority with or without intermediaries. The categorization of what defines money is borrowed from Krugman, Obstfeld, and Melitz (2021). Usually, and for most modern economies, the respective institution is one (or more) central banks. The central bank has the power to increase or decrease the money supply, as it (usually) has the sole legal right to print banknotes, mint coins, borrow and lend base money against collateral and create reserves in its balance sheets. It is therefore in direct control over the issuance of currency, and indirectly over checking deposits issued by banks. The monetary base (sometimes referred to as M0, base money or the narrow aggregate) is therefore either materialized “money” (coins, banknotes) or reserves held by a bank. It is also where this theoretical endeavor starts by formulating base money as the sum of currency in circulation and reserves held at the central bank:

$$B = C + R$$

where

$B = monetary\ base$
$C = currency\ in\ circulation$
$R = reserves$

Base money is the narrowest form of monetary aggregates established by the central bank and is the basis for additional money creation. Money, in more general terms, is defined as the sum of coins and banknotes held by the public and deposits held by banks:

$$M = C + D$$

where

$M = money\ stock$
$D = deposits\ held\ by\ private\ banks$

The connection between deposits on the one hand and reserves establishes via reserve requirements. Those requirements, most of which are regulatory heritage from the 2008 Global Financial Crisis, force banks to hold reserves equal to a fraction of the deposits it holds. Obviously, those requirements are of a legal and regulatory nature, which also means that they differ based on national legislation. The reserve requirement, in general, can be formulated as:

$$fD = R$$

where

$f = fractional\ reserve\ requirement$

In a hypothetical world, in which no currency is being held, the equation would be reduced to $B = R$ and $M = D$ respectively. This leads to the expression:

$$B = fM = M = \frac{B}{f}$$

This expression establishes the connection between monetary base and money supply and shows that money creation can be achieved by either broadening the base or reducing the reserve requirements for banks. In the economic literature, this process of money creation from reserves is called fractional reserve banking.

It must be mentioned that technological innovation and digitalization led to many new forms of money. Some of which, cryptocurrencies for example, do not obey the rules of money creation or fractional reserve banking, as they often operate outside of regulatory and legal frameworks. Those crypto assets might be used just like a bank account in transactions, or crypto exchanged and withdrawn from an ATM, which makes them "moneyish", because of the inherent liquidity, their partial ability to be used as a storage of value, and obviously the possibility to exchange them. Many scholars however tend to view them as speculative assets, much like stocks, with little properties of a hard currency. That they are highly popular is without doubt. If they are popular as a currency as well, is another question which has been answered to an extend by a survey conducted by the Bank for International Settlement (BIS) in 2022. The representative survey asked numerous central banks about developments in crypto asset payment for both private and business entities. They then analyzed the usefulness and grade of adoption of crypto assets as a means of payment. The findings were interesting as most respondents classified the use of crypto in payment as either trivial or irrelevant and mainly used by "niche" groups (Kosse and Mattei, 2023). Another field where money is created and institutions like CB´s are bypassed is private money. That is either platform-based money, such as Facebooks´ attempts with LIBRA, or fully privatized payment and credit services such as KLARNA, PAYPAL, ALIPAY, APPLE PAY, etc. There, scholars such as Bilotta and Botti (2022) see a significantly greater threat to undermining classical centralized money creation than cryptocurrencies pose, as it profits off a network and distribution effect that may be able to keep up with the penetration conventional currencies currently have and are backed by enterprises with great resources.

3.1.1. Endogeneity or Exogeneity in the Money Supply

The causal and direct relationship between money supply and changes in output and price level is not undisputed. In textbooks and neoclassical economics changes in money supply are explained as consequences of changes in money demand, which in turn is conditional to the interest rates set by the central bank or other authorities. This is the underlying idea behind conventional

monetary policy and the relationship between the quantity of monetary aggregates and output and price level have not been asked for a while. With central banks facing the lower zero bound in recent years, they actively started to pursue unconventional policies such as quantitative easing (QE) which increased the reserve supply to facilitate production, economic growth and by that an upward pressure on the price level. This policy however falls outside of the classical neo-Keynesian framework and reminds scholars of ideas the monetarists brought up in their quantity theory of money. As a matter of fact, central banks, pursuing quantitative easing, actively engaged in a policy of broadening the monetary base by purchasing securities and other assets.

In establishing a framework for the theory of money supply, one must consider different, sometimes conflicting, approaches. A fundamental issue in assessing a suitable model for money supply lays in approaching money supply as endogenous or exogenous. Exogenous money supply is independent of demand and determined by outside forces, namely the state and/or the central bank. Endogenous money supply on the other hand is determined by money market forces, namely the money demand from economic agents. There is an ongoing debate into this question with some making vital arguments in favor of a more endogenous theory of money supply (Dyson et al., 2019), while others argue that it can be either or depending on the situation (Sieron, 2019).

The orthodox money multiplier model, also dubbed the portfolio choice money multiplier model (Palley, 1992), can be considered the most basic approach to theorize the relationship between money supply and demand and is commonly utilized in the standard IS-LM-model and is therefore a basis for conventional monetary policy. It´s theoretical structure is laid out below to grasp on relations and dependencies more closely between variables.

$$H^s = NBR + \max[0, BR(i - i_d)] \quad (1) \qquad (+)$$

$$D^d = D(i, y) \quad (2) \qquad (-+)$$

$$C^d = C(i, y) \quad (3) \qquad (-+)$$

$$T^d = T(i, y) \quad (4) \qquad (++)$$

$$R^d = k_1 D^d + k_2 T^d$$

-+

$$E^d = E(i, i_d)$$

$$H^d = R^d + C^d + E^d$$

$$H^s = H^d$$

$$M = C^d + D^d$$

where

$H^s = supply\ of\ base\ money$
$NBR = non - borrowed\ reserves$
$BR = borrowed\ reserves$
$i_d = discount\ rate$
$D^d = demand\ for\ checkable\ deposits$
$C^d = demand\ for\ currency$
$T^d = demand\ for\ time\ deposits$
$R^d = required\ reserves$
$E^d = demand\ for\ excess\ reserves$
$H^d = demand\ for\ base\ (money)$
$i = nominal\ interest\ rate$
$y = nominal\ income$
$k_1 = required\ reserve\ ratio\ for\ demand\ deposits$
$k_2 = required\ reserve\ ratio\ for\ time\ deposits$
$M = M1\ money\ supply$

Money supply in this model is a function of borrowed and non-borrowed reserves. It is based on three fundamental relations. First, the supply of base money constraints the money supply. This is the inherent idea of fractional reserve banking, where creating deposits is necessarily tied to the amount of base (money) issued. Secondly, lending by intermediaries, namely banks in this model, creates inside balances which must be either held or spent. The ladder of which causes

shifts in output, price level, or interest rate. This implies that an equilibrium outcome on the money market necessarily lays on the money demand function.

A more structural "post-Keynesian" approach is derived from Pally (1987). It differs from the orthodox model in accounting for the influence of bank lending on the money supply but does also imply the money supply to be endogenous. It also reflects the banking system's ability to accommodate beyond the rate stance of the monetary authority by actively managing their asset and liability positions. Therefore, Palley (1992) refers to this model as the mixed portfolio-loan demand model.

$$\overset{\quad - \quad - \quad - \quad +}{C^d = C(i_d, i_T, i_B, Y)}$$

$$\overset{\quad + \quad - \quad - \quad +}{D^d = D(i_d, i_T, i_B, Y)}$$

$$\overset{\quad - \quad + \quad - \quad +}{T^d = T(i_d, i_T, i_B, Y)}$$

$$H^d = C^d + kD^d$$

$$\overset{\quad + \quad + \qquad\qquad +}{H^s = NBR(i_F, A_1) + BR(i_F - i_d)}$$

$$H^d = H^s$$

$$\overset{\quad - \quad + \quad +}{L^d = L(i_L, i_B, A_2)}$$

$$MR_B = i_B + p$$

$$MR_L = i_L - c_L$$

$$MC_F = MR_F = i_F$$

$$MC_D = (i_D + c_D)/(1 - k)$$

$$MC_T = i_T - c_T;\ c_T < c_D$$

$$MC_{BR} = i_d + v(BR)$$

$$MR_B = MR_L = MR_F = MC_F = MC_D = MC_T = MC_{BR}$$

$$Y = Y(L^d)$$

$$L^s + S + kD^d = D^d + T^d$$

$$L^s = L^d$$

where

$i_d = interest\ rate\ on\ deposits$
$i_t = interest\ rate\ on\ time\ deposits$
$i_b = interest\ rate\ on\ bonds$
$A_1 = expansionary\ monetary\ policy\ variable$
$A_2 = positive\ loan\ shift\ variable$
$MR_J = marginal\ revenue\ on\ asset\ j$
$MC_j = marginal\ cost\ of\ liability\ j$
$p = liquidity\ premium\ on\ bonds\ relative\ to\ loans$
$c_L = constant\ marginal\ cost\ per\ \$\ loaned\ of\ monitaring\ loans$
$c_D = constant\ marginal\ cost\ per\ \$\ deposited\ of\ administering\ deposit\ accounts$
$Y = nominal\ income$
$S = bank\ holdings\ of secondary\ reserves$

This model´s implications for the money supply are not straightforward, as money supply is not directly proportional to an increase in bank-lending. This also means that the effect on the money supply through increases in bank lending is ambiguous and not necessarily proportionate. On the one hand does an increase in bank lending increase consumable income, which in turn increases demand for checkable deposits. This however influences the corresponding interest rate, which rises and thus reduces demand for checkable deposits. The same ambiguous effect can be wit-

nessed with currency demand. Assuming now the money supply (currency and checkable deposits) rises, this can only be explained by increasing non-borrowed and borrowed reserves as well as reduced currency holdings. This finding is corresponding with the classical money multiplier monetarism proposed, which is also where the last piece of theoretical framework necessarily comes into play.

3.1.2. Money Multiplier

While the classical monetarist approach assumes the velocity of money to be constant, which in turn justifies the conclusion of the price level being directly proportional to changes in money supply, more neo-classical approaches account for changes in the velocity of money. The multiplication effect is a consequence of the above-mentioned requirements in fractional reserve banking. Depending on the fraction that must be held in proportion to what may be lent out, the money stock increases. The identity derived from chapter 3.1.1. can rewritten to:

$$M = \frac{1 + \frac{C}{D}}{\frac{R}{D} + \frac{C}{D}} B$$

The money multiplier is then the expression:

$$\frac{1 + \frac{C}{D}}{\frac{R}{D} + \frac{C}{D}}$$

with the simplified textbook version (also assumed in chapter 3.1.1.) of cash not existing the expression reduces to:

$$\frac{1}{\frac{R}{D}}$$

It shows that money supply is a multiplier proportional to the monetary base and can thus be interpreted as a function giving the additional money created from a one unit increase in the

monetary base. Empirically, the multiplier is the ratio of M3 to M1, which is also how it has been calculated in this research paper.

3.1.3. Money Supply in the Short and Long Run

Money supply has different effects on prices and output depending on the time lag. The argument on money supply in the short run is the following: Increasing or decreasing the money supply leads to a short-term excess or lack of currency or deposits to be spent or invested. If there is an increase in money available, a corresponding increase in demand and a corresponding increase in prices can be witnessed, if the opposite is the case, a downward pressure on prices can be witnessed. This swing in the money supply and accompanied by a swing in the price level has been identified to hold consistently in the period from 1980 to 2014 for Latin American countries (Krugman, Obstfeld, and Melitz; 2021). The identity for the money supply follows the assumption that in the short run neither price level nor output can instantaneously adapt to a monetary shock, which is why the identity is formulated as follows:

$$M = L(R, Y)P$$

In the long run, one may use the theory on the neutrality of money (Hayek, 1931), which argues that changes in the money stock only affect nominal variables such as currency exchange rates, price and wage levels. “Real” variables, such as employment, consumption, and real GDP, however, are not affected. In the original theory, there was even the thesis that it would not even alter parameters in the short run, which however has been retracted by more modern approaches to this theory. The main reasoning for this theory and the seeming irrelevance of the money supply in the long run stems from the idea, that altering the money supply does not alter the underlying economy, therefore does not alter any of the defining parameters of that economy. This is also the main motivation why this research will focus on the short-run effects of changes in the money supply and assume as Krugman, Obstfeld, and Melitz (2021) did, that “a change in the supply of money has no effect on the long-run values of the interest rate or real output”. It is necessary to mention however, that this statement refers to changes in the level of the nominal money supply, not changes in the growth rate, which in fact may alter the long run equlibirium.

3.2. Definitions of Monetary Aggregates

The data gathered for analyzing the relationship between changes in the world money supply underlays some constraints as to the clear definition of what those aggregates constitute. The main idea behind defining aggregates is that monetary aggregates are supposed to acknowledge different levels of liquidity for different "moneyish" assets. Holding a time deposit at a commercial bank is an asset less liquid than holding cash, a government bond or treasury bill even less so. The obvious reason for differences in liquidity in the above-described example is the need for an intermediary in the latter cases, which cash does not require. The corresponding economic impact is that not all storages of value and means of exchange, as money is sometimes technically described, is equally impactful on the economy. To account for this, CBs all over the world have come up with different definitions and measurements and due to technological and financial innovations those definitions have been adapted over time. The differentiation in aggregates of different liquidity also follow the idea, that money with its three intended purposes (storage of value; medium of exchange; unit of measurement), does serve different purposes in different aggregates. The more liquid aggregate may be mainly used as a medium of exchange, while the less liquid aggregate may be used more as a storage of value. This gives different aggregates also different economic meaning, which is yet another reason to differentiate them.

The most commonly used definition of monetary aggregates is that of the European Central Bank (ECB), which borrowed much of the definitions from the US-based federal reserve banking system. While the narrowest aggregate M1 only comprises currency in circulation and overnight deposits, the next, slightly broader, aggregate M2 contains M1 as well as deposits with an agreed maturity of up to two years and deposits redeemable at notice of up to three months. The broadest aggregate in the euro system is M3, which combines both M1 and M2 as well as other assets such as repurchasing agreements, money bonds, etc. Looking at world aggregates however means that one must also account for other definitions, which sometimes diverge substantially. To give the reader a feeling for just how complicated and flexibly defined those measures are and were the author gathered an overview (see table 1.1. and table 1.2.) over changes in aggregates and their definitions over time for a selected set of countries.

The first country, necessary to look at is the US and its federal reserve system itself. For once, they contribute greatly to the world economy and the global monetary aggregates (measured in share

of world GDP and currency in circulation). Secondly, their definitions are regularly picked up by other central banks and national statistics bureaus in other countries, or at least show great consistency with them. Below, table 1.1. offers a historic overview over major changes in monetary aggregates for the US.

Table 1.1. Federal Reserve Board Definitional Changes of Monetary Aggregates (USA)

Year	Aggregate	Definition
1944	Monetary Base	currency and coin in the hands of the nonbank public; coin in bank vaults not used; reserves of depository institutions held with the FED banks; vault cash used to satisfy reserve requirements
	M1	currency outside banks; demand deposits
1971	M1	currency outside banks; demand deposits
	M2	M1; savings deposits at commercial banks; time deposits at commercial banks except large negotiable certificates of deposits
	M3	M2; deposits at mutual savings banks
1975	M1	
	M2	
	M3	
	M4	M2; large negotiable certificates of deposits
	M5	M3; large negotiable certificates of deposits
1980	M1A	former M1
	M1B	M1A; negotiable order of withdrawal accounts; automatic transfer to checking accounts
	M2	M1B; overnight repurchasing agreements issued by commercial banks; overnight Eurodollars
	M3	M2; large-denomination time deposits; time repurchasing agreements
1982	M1	M1B
	M2	
	M3	

Source: Walter, John R. "Monetary aggregates: A user's guide." FRB Richmond Economic Review 75, no. 1 (1989): 20-28.

Even more interesting and volatile are developments in another major player in the data set, namely the United Kingdom and the pound sterling, especially for the earlier periods in this inquiry. Table 1.2. offers a comprehensive overview over changes in monetary aggregates, which perfectly illustrates the ongoing development of them as a reaction to technological and regulatory changes in the globalizing financial markets of the years 1980 and thereafter.

Table 1.2. Bank of England Definitional Changes in Monetary Aggregates

Year	Aggregate	Definition
1970	M1	notes and coins in circulation with the public; non-bank private sterling current accounts held with UK banks
	M2	M1; non-bank private sector sterling time deposits held with deposit banks, and similar accounts held with discount houses
	M3	notes and coin in circulation with the public; UK private and public sectors' sterling and non- sterling deposits held with the UK banking sector
1972	M1	
	M2	Distinction between deposit accounts with deposit banks and discount houses, and similar deposit accounts with other banks was no longer valid
	M3	
1975	M1	'Current accounts' replaced by a more precisely defined category of sight deposits, which included money at call and money placed overnight
	M2	
	M3	
1977	M1	
	M2	
	M3	
	£M3	M3, excluding foreign currency deposits

1980	M1	
	PSL1	M1; UK private sector's sterling time deposits with an original maturity of up to two years held with banks in the UK; UK private sector's holdings of sterling bank certificates of deposit, money market instruments (banks bills, Treasury bills, local authority deposits) and certificates of tax deposits.
	PSL2	PSL1; UK private sector's holdings of building society deposits (excluding term shares); UK private sector's holdings of National Savings instruments (excluding certificates and other long-term deposits); Building societies' holdings of bank deposits and money market instruments were excluded
	M2	
	M3	
	£M3	
1981	Wide Monetary Base (M0)	notes and coin in circulation with the public; Banks till money; plus Banks' operational balances with the Bank of England
1982	M0	
	M1	
	PSL1	
	PSL2	
	M2	M1; UK private sector's interest-bearing retail sterling deposits with banks in the UK
	M3	
	£M3	
1986	M0	
	M1	
	PSL1	
	PLS2	Former PSL2; building society term shares; UK private sector's sterling deposits with an original term longer than two years held with banks in the UK

	M2	
	M3	renamed M3c
	£M3	new M3
1987	M0	
	M1	
	PSL1	discontinued
	PSL2	Renamed M5
	M2	
	£M3	
	M4	UK private sector's (for first time defined as the non-bank non-building society private sector) holdings of: Sterling notes and coin; Sterling deposits (including certificates of deposit) with banks in the UK; Building society shares, deposits, and sterling certificates of deposit
1990	M0	
	M1	discontinued
	M2	
	£M3	
	M3c	discontinued
	M3	discontinued
	M4	
	M4c	M4; UK private sector's foreign currency deposits with banks and building societies in the UK
	M5	
1992	M0	
	M2	
	£M3	
	M3H	M4; UK private sector's foreign currency deposits held with banks and building societies in the UK; UK public corporations' sterling and foreign currency deposits held with banks and building societies in the UK

	M4	
	M4c	discontinued
	M5	
1993	M0	
	M2	
	£M3	
	M3H	
	M4	
	M5	
	Divisa	The Divisa index is based on the components of M4, weighted according to their liquidity

Source: "UK Monetary Aggregates: Main Definitional Changes." Monetary and Financial Statistics: July 2003. Accessed May 3, 2024. https://escoe-website.s3.amazonaws.com/wp-content/uploads/2019/01/30142031/UK-monetary-aggregates-main-definitional-changes-since-1970.pdf.

As can be seen from the tables above, there is much leeway for regulatory inconsistency, time inconsistency, as well as a technological inconsistency when trying to expand and compare different national aggregate definitions. It is also rather clear that countries with more financial innovation, such as the US and the UK, have a higher paced regulatory environment trying to keep up their legal and statistical definitions with technological progress. Other countries, outside of the US, the UK, and the Euro system, may have not just a different approach towards aggregates, but a possible blind spot that is hard to estimate in actual size, thus making the aggregate on a global level somewhat imprecise. None of the countries in the data set seem to have yet figured out how to statistically record and incorporate private money and crypto currencies properly, which is also part of a more recent discussion in the scientific community. Agarwal et al. (2018) have made a valuable contribution in this regard by developing a monetary aggregate M5 that includes crypto currency and forms of private money. Their volume would likely suffice to make the effort worth as some analysts argue, while others reduce those currencies to always be generated out of and based on hard currencies or deposits and thus somehow implicitly in the numbers. Besides the different drawbacks and imprecisions, the aggregates recorded from the OECD and national statistics inherit, this paper allocated a great deal of time in combining the appropriate aggregates

to have as little as possible deviations between national accounts and the global aggregate constructed out of them.

3.3. Unconventional Monetary Policy

For policy makers and readers alike the question about the actual usefulness of conducting monetary policy via monetary aggregates may arise. Especially in the context of a globalized money supply this question makes sense, as it is not the usual approach to conducting domestic monetary policies, and there is also no "world central bank" to conduct global monetary policy as such. Traditionally, conventional monetary policy offers the tool of setting interest rates which then, via intermediaries, gets passed on to privates and enterprises and thus influences the economy, particularly output, price level, and the exchange rate. The mechanisms behind have been elaborated in chapters 3.1.1. and 3.1.2. Thanks to Taylor (1931) and his Taylor-Rule, this interest rate-based approach has become the standard repertoire in virtually every central bank worldwide (Woodford, 2001). However, as has been repeatedly stated in this paper, conventional monetary policy can get trapped at their zero lower bound, a problem usually referred to as the liquidity trap in the literature. When the situation post-2008 arose, it became clear that conventional tools are of little use in this particular situation (Gagnon, 2016). Both FED and ECB, the central banks most intensely utilizing conventional monetary policy instruments to that point, then engaged in more unconventional ways of influencing price-level and output via what is now known as quantitative easing. QE is an unconventional monetary policy tool which, via open market purchases, extends the money supply, provides liquidity to the market, and inflates the CB´s asset side of the balance sheet. By doing so it influences the economy through different channels, which will be elaborated in the following. While it is true that there are other forms of extending the money supply, most prominently the idea of Helicopter Money, the purchasing policy coined quantitative easing is the one utilized most broadly.

3.3.1. Quantitative Easing:

The first to adopt QE as a formal policy was in fact the Bank of Japan in early 2006. Interestingly, it did so before the Great Financial Crisis of 2008, which had much to do with the very special status of the Japanese economy and its stagnating economy and deflationary tendencies at that

time as well as the special demographic structure of its people. Quantitative easing is implemented by a central bank buying financial assets from governments, banks, corporations, etc. to achieve a desired goal. The idea behind it is that by buying those assets, which due to the unsterilized nature of the purchase does extend the central bank's balance sheets, increases the money supply, lowers the yield of those assets, and raises their price. The effect can be separated in different channels, the main mechanism however is the credit channel: The liquidity quantitative easing provides can be directly transferred by banks into credit for consumers and enterprises, while simultaneously lowering borrowing costs. The result is an extension in loans provided, which in turn makes it possible to invest productively, thus increasing output and economic growth. The second highly important channel of quantitative easing is closely tied to the credit channel. The fact that investment and spending increase due to increased liquidity also puts upward pressure on prices, which is also precisely why it is utilized to escape deflationary tendencies. The third effect is also where most critique is coming from, namely that specifically buying government bonds in an assert purchasing program distorts the financial market the asset would otherwise be valued at. This leads to a situation in which governments can very cheaply extend their debt by issuing newly created government bonds, which are then bought up not by investors or privates, but by the CB. This very cheap debt has its drawbacks, especially for those who were invested in those bonds before they were "artificially" altered in their returns. That affects mainly insurance and pension funds, indirectly however, it leads to a situation in which return from bonds are so low that it encourages risk-seeking behavior by agents, which creates risk and unpredictability in the financial markets. The fact that QE lowers interest rates on assets in their purchasing program has yet another consequence, which is again tightly connected with the credit channel: it benefits the debtor, while it damages the creditor.

3.3.2. Helicopter Money

The idea of helicopter money stems from a debate about literally dropping money onto people, indifferently who it may collect or if the person that collected the money was in actual need for it. It is a very interesting metaphor, because of its telling nature. The idea to simply increase money supply by just giving everybody $USD 100 more to spend makes a thought experiment possible in which one may grasp the idea of what would happen next. The term stimulus check is more broadly adopted for this idea, and it usually is either a governmental spending program, or a form of tax rebate. A prime example for helicopter money would be the Economic Stimulus Act

of 2008, where the US authorities granted universal tax rebates to privates and enterprises. This example, and the idea to use tax policy or government spending to increase the money supply, is also one of the main reasons why scholars argue that this is a clear example of fiscal policy but has little to do with monetary policy. For this reason, the subchapters below will focus very much on the utilization of quantitative easing and how it is best implemented before the backdrop of global monetary aggregates on the example of the two biggest currency areas and their respective central authorities: the dollar (FED) and the euro area (ECB).

3.3.3. The FED and Quantitative Easing

The FED utilized quantitative easing as early as 2008. The economic outlook at that time has been elaborated many times: stagnation, recession, and deflation. To avoid this outlook the FED realized that altering the federal funds rate, the main interest rate indicator set by the FED, would not alleviate the pressure on the economy and would not lead to a recovery due to the liquidity trap. To give the reader an overview the work of Neely and Brett (2013) as well as Webster (2022) have been utilized in the following paragraph to provide figures, context, and a timeline.

When the FED first announced an asset purchasing program in November 2008, the FED held around $USD 700 billion of treasury notes on her balance sheets. When it started with “QE1”, the first purchasing program, an estimated $USD 600 billion was being bought extending the FED´s balance sheet to a staggering $USD 2.1 trillion by mid 2010. Once the economy showed signs of recovery, the ongoing purchases were halted. However, the trend was not robust enough for the FED´s board of governors, which is why they announced in November 2010 to further extend their purchases for another $USD 600 billion in treasury securities. By 2012, some of the debt bought had matured, which was compensated by additional purchases of $USD 30 billion in treasury securities monthly. In late 2012 the FED held around $USD 2 trillion in treasury notes, securities, bonds, etc. When the FED decided that additional programs were necessary, especially since recessional tendencies did not disappear and were projected to increase in likelihood by 2014-2015, they set up “QE3”, yet another asset purchasing program, with a volume of $USD 40 billion monthly without a predefined threshold or ending date. The public at the time dubbed this policy “QE-Infinity”. Only a month into the program, in December 2012, the Federal Open Market Committee (FOMC) announced to further increase purchases from $USD 40 to $USD 85 billion monthly. When QE3 was discontinued in 2014, the FED had bought a total of $USD 4.5 trillion in

assets. The, as of now, last program after “QE3” was “QE4”, a program set up to relieve pressure from supply shocks due to the COVID-19 pandemic. When it was set up in March 2020 it was announced that an additional $USD 700 billion in assets would be bought via the program. This initial purchase resulted in an additional $USD 2 trillion in assets held by the FED, which brought the balance sheet back to its peak extension levels of 2010.

3.3.4. The ECB and QE

The ECB, who had a little time left before the Great Financial Crisis would fully hit the European economy. They faced a very similar situation and opted for a similar solution as the FED. However, they were at first hesitant to call the policy quantitative easing. In the following paragraph, the timeline is again borrowed from Neely and Brett (2013), figures and context are derived from Reisenbichler (2021).

In early 2009, the ECB engaged in its first asset purchasing program with a volume of around €EUR 250 billion, which specifically targeted government bonds from a selected set of member states. This has brought in much critique about competitiveness and indirect state financing, which is however far beyond the scope of this chapter. The program was called “Securities Markets Program” (SMP) and was later extended to include all member state bonds in their purchases. In 2015, the then president of the ECB, Mario Draghi took a turn and publicly announced that the ECB would extend their asset purchasing programs in an attempt to provide liquidity and better borrowing conditions for the European economy. The purchases were then extended to around €EUR 60 billion monthly but were still restricted by the assets to be bought. Also in Europe, the recession predictions for 2015 were taken seriously which is why the program was extended beyond the €EUR 1.1 trillion threshold in total asset purchases and the end date, which was set to be around September 2016. In early 2016 inflation did not follow the path the ECB predicted, which is why they increased purchases to €EUR 80 billion monthly to put further upward pressure on prices. They also extended the range of assets to also include corporate bonds, which again brought up discussion about market neutrality, green financing, etc. to name only some of the key words from the discussion that followed. By 2019, the ECB had reduced the monthly purchases back to €EUR 20 billion monthly to not overshoot the inflation targets for 2020. However, when the COVID-19 pandemic reached Europe and the European markets, a supply shock with little precedent (apart from maybe the oil crisis in the 80´s) fostered fears for a renewed recession

and the by now well-known consequences of that. The ECB reacted unconventional, because supply shocks are difficult to correct for in conventional monetary policy, and set up yet another purchasing program with the sounding name “Pandemic Emergency Program”. With a volume of €EUR 750 billion and the very same aims the post 2008 programs had, namely lowering borrowing costs, providing liquidity, and avoiding deflation, the program was the one of the biggest in the ECB´s history. The abbreviation for this program (PEPP) has become synonymous since then with quantitative easing in Europe and beyond.

4. Methodology

In an initial step this chapter will focus closely on the actual data computed, the aggregation, as well as certain restrictions within the data and the corresponding drawbacks it has for the analysis in chapter 5. It will also provide an in-depth explanation of the econometric framework, as well as certain specifications for the structural vector autoregression (SVAR), such as modes used, model specifications, robustness checks and the level of significance within the model.

4.1. The Data Aggregation and Quality of Data

The dataset used for the analysis comprises over individual 28.000 data points from 44 nations over a time horizon of 40 years. The quarterly variables collected include data on the M1 and M3 aggregates, nominal and real GDP data, quarterly CPI data (non-food, non-energy), short-term interest rates derived from interbank rates, and the M3/M1 ratio. The data in use can be retrieved from OECD, IMF, and FRED databases, which has also been the main source for this paper. Where relevant currency has been converted into $US based on the quarterly averaged spot-exchange rates between the respective currencies. Where seasonally adjusted data was available, it has been used. Weighting was applied to all variables according to the respective countries´ economic weight, measured the share of world GDP in the respective year.

Covering such a long period of time has its drawbacks, especially in terms of quality and quantity of data. As already mentioned, definitional changes in the aggregates might alter the size of a certain aggregate for a certain period, without there being an economic reasoning or cause. Different systems of accounting produce different results and the quality of the data measured by national authorities might also differ from country to country. Since all the countries in the dataset are OECD members and thus obey certain standards in data collection and aggregation, this error might however be neglectable. More significant for the analysis is the quantitative restriction. Not all countries provide for all data points over the whole period. For some countries like Russia, Poland, or the Czech Republic (and every other member of the former USSR or its satellites), it is rather obvious why the data before 1991 is lacking, incomplete, or only estimated based on later available data, and in any way hard to compare to those numbers from non-socialist economies. For other countries, like the US, Canada, and the UK, there is data available for virtually any given variable at any given time in the last 40 years. This of course brings about

restrictions in terms of global aggregates, which become less precise the further the time series goes back. Another drawback of mainly utilizing the OECD dataset is the unavailability of data for monetary aggregates on the African subcontinent and central/south-eastern Asia. Those regions taken together do account for roughly 14 % of world GDP (IMF, 2024) and are omitted from the data set. Alternative approaches towards integrating the data for those regions (or at least a handful of countries from those regions) were unsuccessful due to the lack of consistence in the recording methods and statistical reporting as compared to the OECD requirements. Especially with regards to Egypt and Indonesia, who account for more than 3,5 % of world GDP (IMF, 2024), a future integration into the data set would be desirable.

Another important factor to pay attention to is the actual weighting of the indicators at hand. Since the analysis focusses on global aggregates, which are based on national figures, it is necessary to disclose the relative weight attributed to each of the nation states in the data set. Below in figure 1.1., you may find a pie diagram displaying the average weight assigned to each nation based on their GDP as a share of world GDP as calculated annually by the IMF. The average for this plot is the mean calculated for each country based on the annual share of world GDP data from 1980 to 2021. The weight applied in the dataset is based on the share of world GDP calculated separately for each year and each country and thus of a rolling nature. This method has been applied to indicators such as the quarterly M1 aggregate, the quarterly M3 aggregate, the non-food non-energy quarterly CPI, the quarterly short-term interest rate, and the quarterly nominal GDP. This decision is based on the fact, that within a set of very heterogenous countries, some countries may distort the data with outliers in certain time periods, without having an equivalent economic weight or impact with their respective currency. As quickly mentioned above, the weighting is attributed in a rolling matter, meaning that for each year the relative distribution changed and is correspondingly weighted. This resulted in, for example, Russia and Japan losing relative weight in the aggregate over time, while China gained weight year by year. Below in figure 1.1., you find a pie chart with the respective average weight of the countries in the data set over the complete timeframe. The residual captures the share of the world economy missing in the data set.

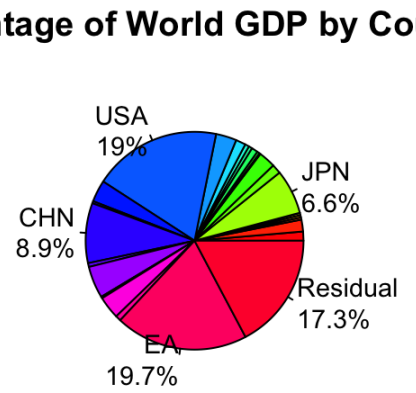

Figure 1.1. Average weight per country as a share of world GDP; Source: own calculations

4.2. The Econometric Framework

Using a structural vector autoregression approach (SVAR) following Sims (1980) has, as briefly mentioned, numerous advantages vis-à-vis other regression models, especially when modelling non-recursive economic structures with a parsimonious set of variables (Zaghini and Sousa, 2007). It also enables the researcher to properly interpret contemporaneous correlations among disturbances.

The model for the base VAR is based on the classical reduced-type VAR. It follows:

$$u_t = \Gamma(L)Y_t$$

where Y_t is the variable vector and $\Gamma(L)$ the matrix with a polynomial lag operator L with the assumption $\Gamma(L) = I$.

For Y_t, the vector comprises four endogenous variables: quarterly nominal GDP; quarterly consumer price index (non-food; non-energy); quarterly short term interest rate; the monetary aggregates M1 and M3 respectively. All aggregates are compiled into world levels or in subsets laid out in the analysis part.

Expressed as a vector Y_t looks the following:

$$Y_t = [Y, CPI, STI, M]$$

where

$$YRL = quarterly\ nominal\ GDP$$
$$CPI = consumer\ price\ index\ (non - food; non - energy)$$
$$STI = short - term\ interest\ rate$$
$$M = \ monetary\ aggregate$$

Testing the standard hypothesis for the residuals, where the expected value of the error vector is normally distributed and to be equal 0:

$$E(u_t) = 0$$

as well as

$$E(u_t u_s') = \begin{cases} \Sigma \dots when\ t = s \\ 0 \dots when\ t \neq s \end{cases}$$

The condition above allows the model for contemporaneous correlation, while avoiding serial correlation between the disturbances. Transforming the standard VAR approach into a SVAR in which disturbances are orthogonal gives us the following dynamic model:

$$K(L)Y_t = e_t$$

$$K(L) = K + \sum_{i=1}^{k} A_i L^i$$

where K is a symmetrical non-singular matrix, in which the contemporaneous correlations are to be explained.

Combining the dynamic model above with the standard reduced VAR following $u_t = \Gamma(L)Y_t$ the following expression arises:

$$K_i = -K\Gamma_i$$

$$Ku_t = e_t$$

as well as

$$E(Ku_t u_t' K') = E(e_t e_t') = I$$

The identification scheme following $Ku_t = e_t$ is characterized as follows:

$$\begin{bmatrix} 1 & 0 & 0 & 0 \\ k_{21} & 1 & 0 & 0 \\ k_{31} & k_{32} & 1 & k_{34} \\ 0 & 0 & k_{43} & 1 \end{bmatrix} \begin{bmatrix} u_t^Y \\ u_t^{CPI} \\ u_t^M \\ u_t^{STI} \end{bmatrix} = \begin{bmatrix} e_t^Y \\ e_t^{CPI} \\ e_t^M \\ e_t^{STI} \end{bmatrix}$$

While the first two rows give the lagged equation for nominal GDP and price level, which are considered non-policy variables, the third row expresses the monetary aggregate without a lag. The fourth row expresses conventional monetary policy intervention, which links the short-term-interest rate with contemporaneous changes in the monetary aggregate and the price level. The policy reaction function in row three is assumed to include a delay following Sims and Zha (1998). The consumer price index in use here is already reduced to only capture core inflation, which makes computing commodity prices as yet another endogenous variable somewhat superfluous, which is why there is no fifth row as opposed to Zaghini and Sousa (2007). The idea to add the exchange rate as an endogenous variable instead has been forfeit, because of the inapplicability of a world average exchange rate due to the lack of a counterpart.

When looking again at the identification matrix above, one might see that the direction of contemporaneous movement is a-priori defined. This is one of the biggest drawbacks of utilizing a SVAR in general. However, it is also the reason why it is relatively straight-forward in terms of evaluating results and is being utilized so frequently by the scientific community in this context,

as opposed to large macroeconomic models which are relatively hard to redesign and compare and whose findings may be altered significantly by ex-post decisions from the researcher. To assume the relationship between endogenous variables in such a way does however imply that it is highly restrictive in terms of other possible relationships and susceptible to omitted variable biases. If it weren´t for the track record of robust findings this specific ordering in the identification matrix has, and the good correspondence it has with state-of-the-art economic theory, it would be thinkable to utilize different arrangements for the analysis as well.

5. Analysis

The chapter “Analysis” is structured the same way the research has been approached in terms of analyzing and contextualizing the data. The first subchapter will provide an overview over the most important indicators and how they behaved over the respective period. The monetary aggregates (M1 and M3) and their relation (M3/M1 ratio), nominal GDP, short-term interest rates, as well as the consumer price index will be dissected and put into context as the data processed covers 40 years with many distinct events. The second subchapter (chapter 5.2.) will then describe the findings of the impulse-response function testing conducted with the SVAR on the global aggregate. Those findings will then be further elaborated in subchapter 5.2.1., which will focus on the timeframe 1995-2018, where testing and the corresponding findings are superior in terms of quality of data available thus provides for additional robustness. This chapter is supposed to follow the idea of cutting the tails to provide the statistically most significant findings generatable with this type of time series data. Subchapter 5.2.1. will then specifically focus on the Euro area and the US, each given special emphasize due to their economic size, the status of their respective currency in world economics, and the influence their monetary policy has over global indicators. This chapter will also pose as a comparative study and quality check to the findings in the greater data set. With subchapter 5.2.2. the evaluation and analysis will be finished by also testing the M3/M1 ratio as yet another measure of liquidity.

5.1. Overview over vital Global Indicators

In a first step the aggregated data is to be analyzed for possible outliers, which, even in the weighted average and with applying the logarithm on the endogenous variables, might distort findings significantly. When discovered, they are necessarily compensated for by using dummy variables in the structural VAR model to provide for robust analysis. It is also necessary to not overemphasize the edges of the sample, namely the 80´s in which the data is incomplete for already mentioned reasons, and the period post 2018, in which several countries stopped reporting to the OECD and corresponding national data shows unexplainable jumps or strongly deviating reporting. Looking at the stock data, there is a clear positive trend in global M1, M3 and GDP. While it must be kept in mind that valuation effects such as changes in the foreign exchange rate, the introduction of new countries to the data set, and the like are contributors to some of the movement and variability in the below plotted graph, the relationship between M1 and M3 and

especially the comparison in size to the nominal GDP reported for the same period are of particular interest and are at least in a general trend not completely distorted by the factors just described.

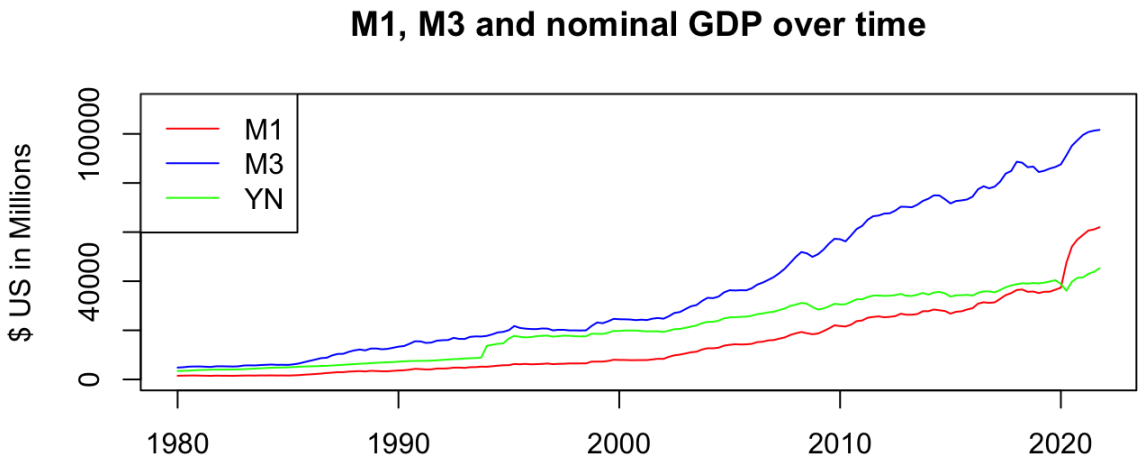

Figure 1.2. M1, M3 and nominal GDP over time; Source: own calculations

As can be seen above in figure 1.2., the trend is rather consistent and clear. This is unsurprising because the period under analysis is generally seen as an expansionary chapter in economic history. The “bumps” of 2001 and 2008 are hardly recognizable in the aggregate and the trend line, both linear and in gliding average, has a positive coefficient for all three variables. Interestingly, GDP and it´s trend line stays well within M1 and M3, a relationship that only breaks after 2018, which is not due to any real economic shocks, but due to the availability of data in that period, price effects stemming from devaluation of national currencies vis-à-vis the USD, and an increase in the US money supply. Another interesting takeaway from this plot is that there is no recognizable downturn in the mid 80´s as would be expected due to the 1986 oil price collapse and its effect particularly on western economies. In the aggregate for this period, the witnessed contraction in GDP for major economies such as the US, European countries, and Japan were compensated by a set of developing countries who entered the data set around that time. The period in which all countries in the data set have entries, which would be the period from 1995 to 2015, is to be analyzed in its own subchapter due to the robustness of the data, and the vital findings of how aggregates interacted with the economy during exogenous shocks (such as 2001 and 2008/2009). As briefly mentioned in the chapter describing the data aggregation, there is a clear dominance of the Euro Area and the US in the data and in the corresponding weighting. Periods of recession or extraordinary growth outside of the main economies or more regional economic

crisis such as on the African subcontinent or central and south-eastern Asia are blind spots in this dataset and are therefore not part of the analysis.

Additionally, to the above shown absolute values of M1 and M3, the quarterly change of those variables is also of interest for this inquiry. In the structural VAR simulation, the quarterly change is a vital variable to test any impulses from the monetary aggregates M1 and M3, besides obviously the short-term interest rate. Below, a corresponding plot (Figure 1.3.) is shown to illustrate the behavior of the M1 and M3 monetary aggregates over time.

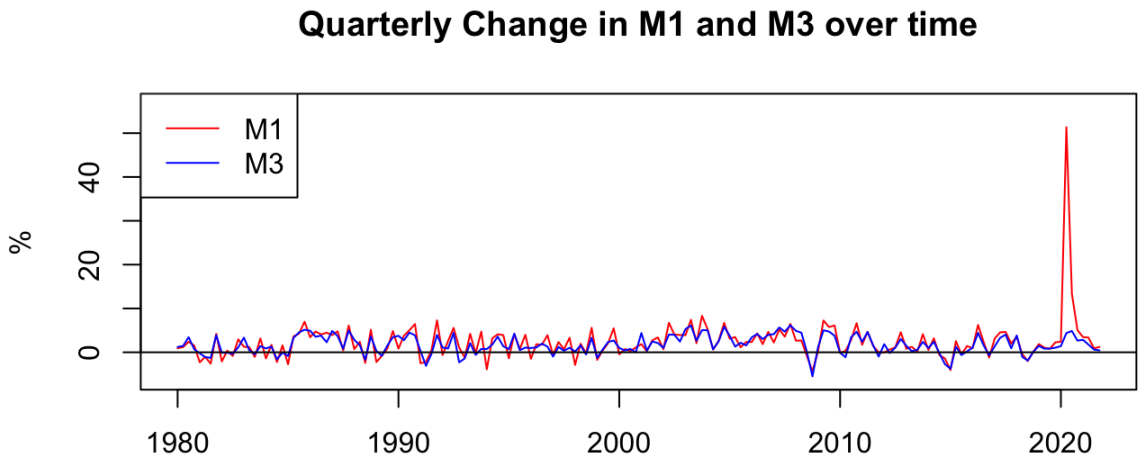

Figure 1.3. Quarterly change in M1 and M3 over time; Source: own calculations

There are little surprises within this plot, besides maybe the sheer magnitude of the, already explained, FED induced jump at the beginning of 2020. The monetary aggregates M1 and M3, which entered the simulation in absolute quarterly values, have been smoothened through a logarithmic function to enable more stable and robust findings. The average change for both M1 and M3 has been calculated and is positive indicating average growth in M1 and M3 for the period in question to be positive. The argument of a rather consistent upward trend in both monetary aggregates is also supported by the overwhelming portions of the above graph being strictly above the x-axis.

As nominal GDP has already been illustrated above in absolute terms, a more in-depth analysis of the behavior of this variable is necessary to understand the need for corrective measures in certain periods, especially around 1995 in which many additional countries entered the data set. The only slightly visible jump in the aggregated nominal GDP graph above for example, becomes significantly more fundamental when looked at from a quarterly change perspective. Below in

figure 1.4., quarterly change in nominal and real GDP is plotted to illustrate the outliers in nominal and real GDP. It will then become clear why this paper uses absolute numbers for GDP, instead of the change in nominal or real GDP, in the structural VAR simulation.

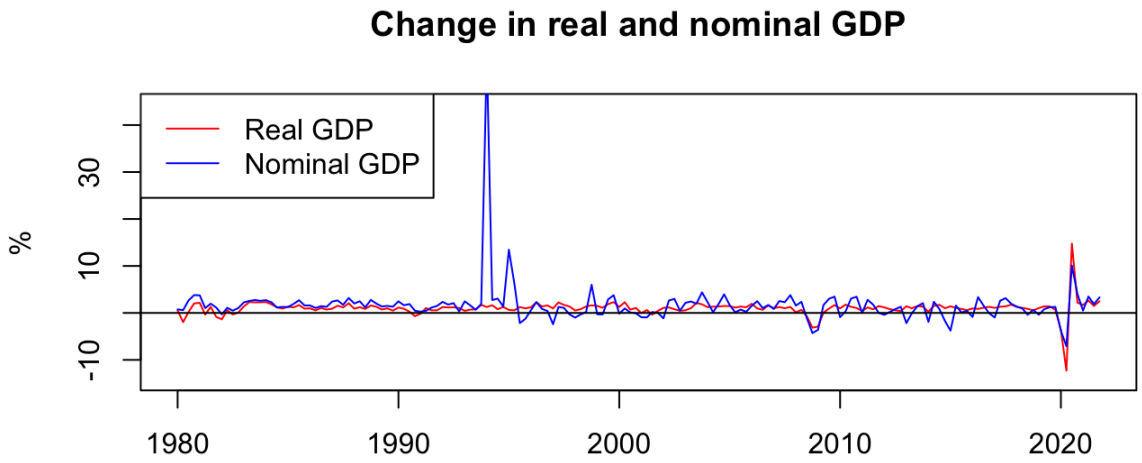

Figure 1.4. Change in real and nominal GDP; Source: own calculations

The next vital indicator to be analyzed here, and more closely as a respondent to different shocks in different aggregates in the subchapters to follow, are short-term interest rates and the non-food, non-energy consumer price index. As can be seen further below (Figure 1.5.), when plotting the world average quarterly short-term interest rates (STI) a consistent, slightly negative, trend can be witnessed, with quarterly interest rates moving between 2 % and 20 % over time, as well as quarterly changes in short-term interest rates, which deviated even less in a bandwidth of +/- 0.4 % over the same respective timeframe. The same cannot be said for the quarterly consumer price index data (CPI). High deviations in the period 1985-1995 in the world average CPI data leave us with outliers that alienate any clear trend. When excluded from the dataset, CPI also shows a slightly negative trend over time, both in linear regression and in a glided-average calculation. The problem here however is that especially for the 1990´s several countries in the data set just reached their independence or transitioned into a different economic system. The likelihood for these outliers having a monetary policy cause, or in fact any causal relationship with the monetary aggregates, is not to be overestimated. When looking at quarterly change in the CPI data, a higher deviation is visible in the bandwidth of +- 1% in quarterly change. Keeping in mind that the short-term interest rates have been a main indicator reacting almost instantaneously to monetary policy shocks, it has always been the go-to variable to look at. Below, both the consumer price index and the short-term interest rates are plotted, and as can be seen relatively clearly, they are not without significant deviations from the center line.

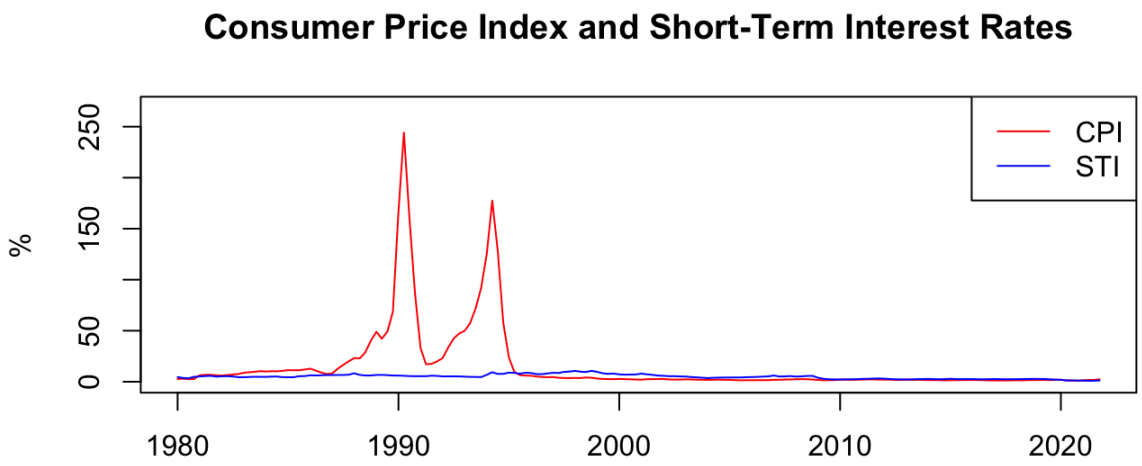

Figure 1.5. Consumer price index and short-term interest rates; Source: own calculations

While the plot above (Figure 1.5.) clearly shows the recorded consumer price data per quarter, which is essentially the change in price level compared to the same quarter in the previous year, the plot below (Figure 1.6.) is of better use for an illustration, as it shows the actual quarterly change in the price level as a percentage change in the non-food, non-energy consumer price index. The corresponding plot (Figure 1.6.) can be seen below.

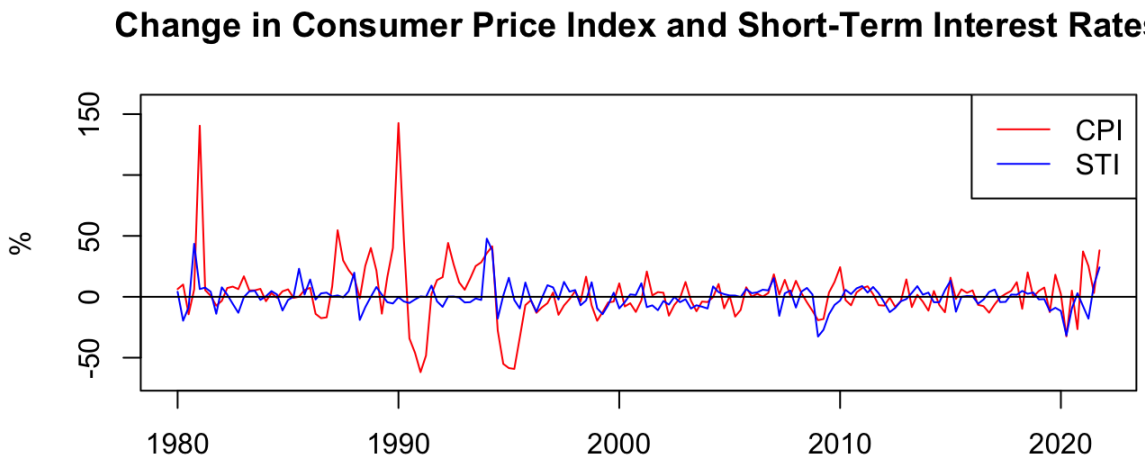

Figure 1.6. Change in consumer price index and short-term interest rates; Source: own calculations

Comparing figure 1.6. and 1.5. however also reveals why the author decided to enter quarterly absolute consumer price index and short-term interest data, rather than the quarterly change of those variables. While short-term interest rates entered the simulation where indeed the only endogenous variable to not be transformed into logarithmic form, the consumer price index has been transformed and outliers have been smoothened sufficiently through that operation, there-for leaving a much more stable and predictable path.

When looking into the aggregates M1 and M3, especially their ratio, an interesting observation can be made. For most parts of the 20th century, the ratio between M3 and M1 stayed relatively constant and above 3, meaning that the amount of money in the broad aggregate superseded the amount in the narrow aggregate threefold. While it might be less intuitive to interpret than the aggregates separately and in absolute values, one must consider this ratio as a liquidity indicator. The seemingly steady relationship between M1 and M3 however broke after the beginning of the new century, where the relation between those two aggregates reduced to 2,5 and after 2019 it reduced even further to about 2. This rather sudden drop after 2019 corresponds is explained by a stark increase in the world M1 aggregate, mostly induced by the US M1 aggregate, which increased significantly after a policy change and a corresponding emergency purchasing program initiated by the FED as a reaction to the economic turmoil at the beginning of the COVID-19 crisis. Below in figure 1.7., there is a graph illustrating the described relationship as well as the clearly visible trend towards a lower ratio between the M1 and the M3 monetary aggregate.

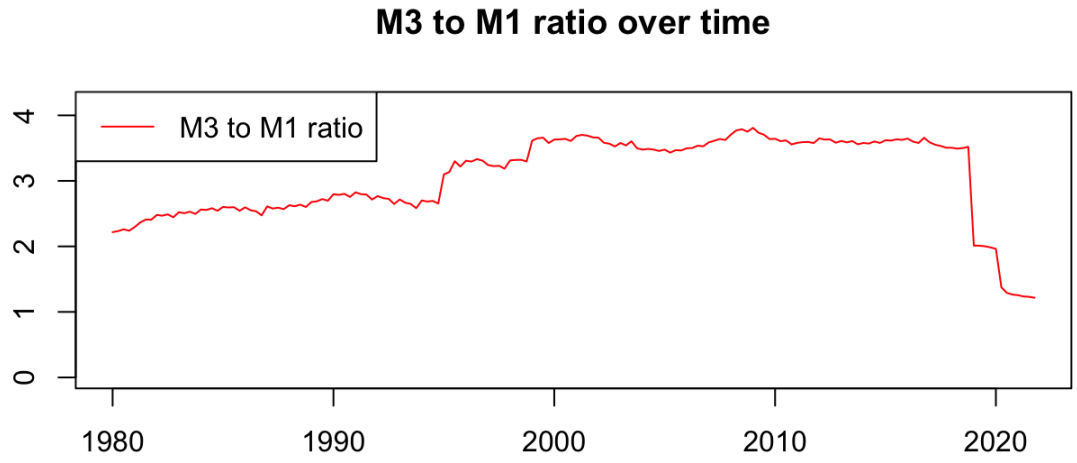

Figure 1.7. M3 to M1 ratio over time; Source: own calculations

There are multiple reasons in need for further investigation as to why this rather consistent negative trend seems to persist over the last 30 years. One of the more recent approaches for explaining this trend stems from Cagan (2017), who builds his argument mainly on the definitional characteristics of the aggregates, rather than their actual relationship with each other and the economy. He argues that aggregates are always, and always have been, lacking behind the actual economic development. He offers the example of Eurobonds in Cayman Island accounts, which will never attribute to any aggregate, let alone be statistically recorded. This argument does not even implicate another previously touched upon topic, namely that of private money and crypto

assets, but it is not very hard to tell how this would then translate into consequences for the precision of the aggregates and any meaningful conclusion drawn from them. His argument is of course difficult to rebut, yet it is true, as we have already seen in the introductory chapter describing the evolution of monetary aggregates, that monetary aggregates need to constantly evolve to be an actual display of a certain level of liquidity in the economy. If we follow his argument further, we might make a case that financial innovation, from the 1960´s onwards, has led to a constant pressure to adjust aggregates towards capturing more modern financial instruments such as the appearance of credit cards and corresponding financial enterprises. Paired with the more general trend towards financial market liberalization and internationalization, what the ratio might tell us, is more a story about a growing blind spot of monetary aggregates, a trend that seems both stable and progressive.

It is however a far throw to establish such a causal relationship solely based on statistical errors and imprecision in recording, as there are still plausible alternatives, and it is rather unlikely that errors of such nature would persist uncorrected for a sustained period. A prominent alternative reasoning is that the decreasing ratio between M1 and M3 is an indicator for a decreasing pass-through of central bank money into the economy. This means that there is a bottleneck somewhere down the credit channel, for reasons much debated in the current literature. The logical start of this inquiry is in the intermediary system, namely with the commercial banks. As with the introductory notes on endogeneity and exogeneity of the money supply, this is a contested argument. Whether or not this decreasing ratio is due to the lack of demand from consumers and enterprises, intended monetary policy decisions from the central monetary authorities, inefficiencies in distribution, or cost-structure-based problems is a question outside the scope of this paper and a final answer is highly questionable, if found at all. It is however possible to at least state that the above-mentioned variables logically affect M1 differently to M3. Taken even further with aggregates reaching even less liquid assets, such as M4 or M5 the ratio may look very different again and thus the above paragraph and the findings it discusses could be interpreted in a different light. This question however may stay unanswered, at least on a global aggregate, as there are only a handful of countries that do report aggregates beyond M3.

5.2. SVAR Impulse-Response Findings and Global Aggregates from 1980 to 2020

In this subchapter a set of plots from impulse response functions will be examined and analyzed. Starting with the maximum available timeframe (1980-2021), one must keep in mind that the data is quarterly harmonized, weighted, in logarithmic form for all variables but the short-term interest rate, and converted into $US. Below, we see the first vital indicator, namely the simulated shock in the monetary aggregate M3 on output as the response variable. The shock in this simulation constitutes a rapid expansion in the monetary aggregate M3, while the impact lag for the VAR model is set to one period, which is derived from the SIC/BIC information criteria in the model estimation. A period in this case is a quarter of a year. The dotted line indicates the 95 % confidence interval for any given period.

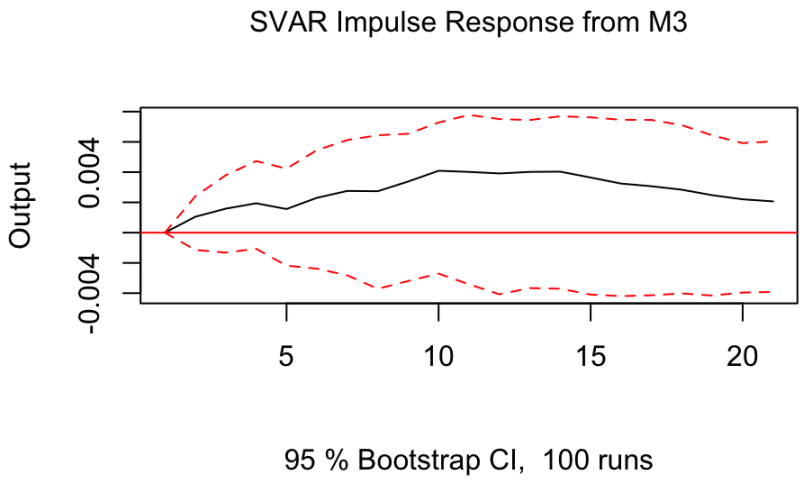

Figure 1.8. Output response from a shock in M3; Source: own calculations

As can be derived from the plot above (Figure 1.8.), the initial impact of a shock in the M3 aggregate leads to a positive response in the output, even though it is not significantly different from zero at the 95 % confidence level. Its impact does peter out after approximately 25 periods, which would translate to a measurable maximum response duration of more than five years following the shock. Consequently, it is consistent with the findings of Zaghini and Sousa (2007) and Belongia and Ireland (2015) both in duration as well as in the reaction´s direction. The apparent insignificance on the tested confidence interval however may be due to the imprecision of the data for the given time frame, especially towards both ends of the set, namely the period between 1980 and 1995, and then the period after 2015. For those ends, the available data lacks for a significant number of countries in the set and correcting is therefor hard to achieve in a statistically sound manner.

To complete the picture of responses in output following a shock in the monetary aggregate, one may also compare this with the effect of a shock in short-term interest rates. The illustration (Figure 1.9.) below shows the impact graphically and gives a clearer picture of the difference in response as opposed to shocks in the liquidity aggregate.

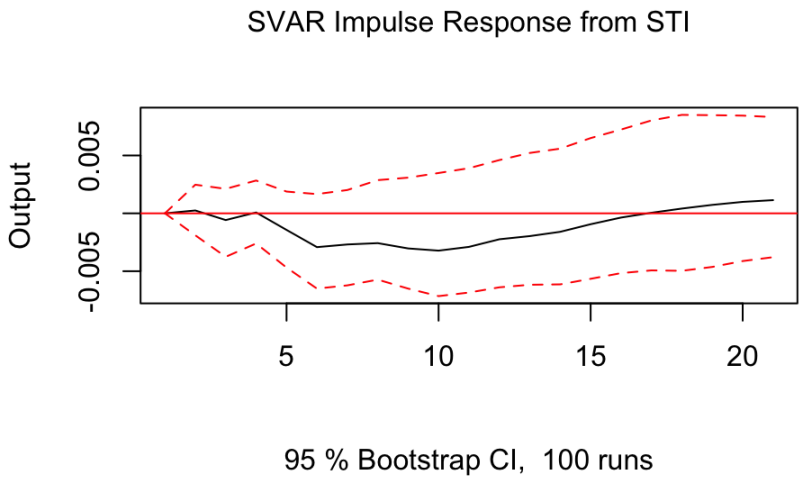

Figure 1.9. Output response from a shock in M3; Source: own calculations

The impact of a shock in short-term interest rates is ambiguous from the very beginning. There is no clear trend visible and a divergence from the x-axis is only visible after approximately five periods or a year of time. This finding is still insignificant statistically speaking, yet it corresponds with findings by Zaghini and Sousa (2007) in the general direction of the response, who found a temporary negative output response, and compatible with economic theory.

After analyzing the effect on output, which seems to only be affected in the short term, one might also look at how the non-food, non-energy consumer price index reacts to a shock in M3. Keeping in mind the contrary reaction to output the literature suggests, the following can be found in figure 1.10.

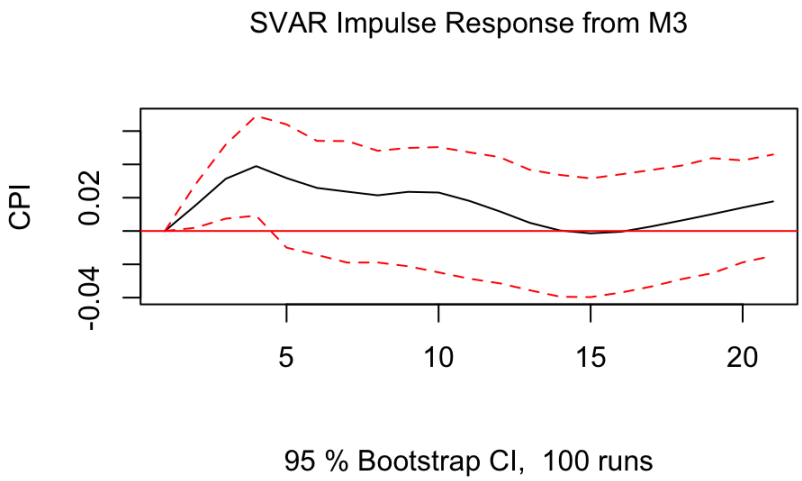

Figure 1.10. CPI response from a shock in M3; Source: own calculations

Consequently enough, the consumer price index reacts positively to a shock in the M3 liquidity aggregate. This reaction, even though of little significance given the deviation from the x-axis in both directions, is consistent with what the literature suggests for smaller samples. The general direction indicates that a sudden increase in the money supply, as indicated here with the M3 aggregate affects the consumer price index positively. More interesting for this inquiry, however, is the temporary nature for the shock. After only 15 periods or approximately four and a half years, the initial impact has returned to normal levels, giving this shock only a short to medium term nature. Correspondingly, a shock in short-term interest rates has a positive effect in the short run, which only peters out after approximately 30 periods. The initial reaction must be carefully analyzed as it indicates the mere opposite of the usual working mechanism of interest rate based monetary policy, it is however consistent with what Zaghini and Sousa (2007) described as the “price puzzle”. See below in figure 1.11. for an illustration of the impact on the consumer price index for shocks in the short-term interest rate.

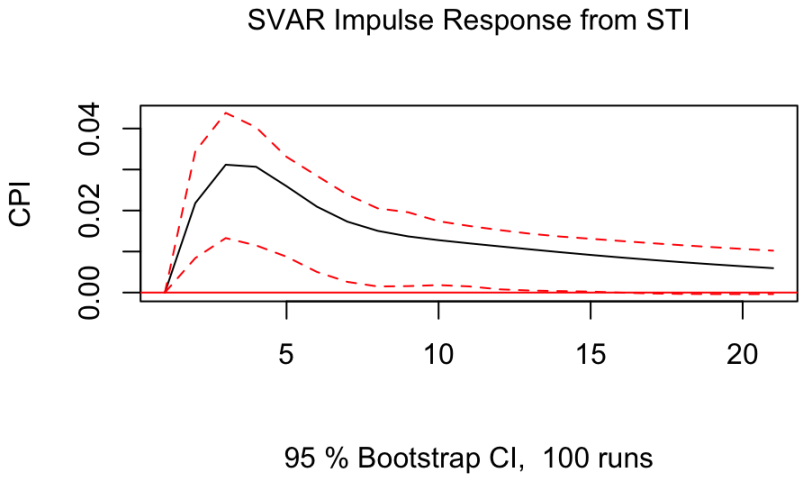

Figure 1.11. CPI response from a shock in STI; Source: own calculations

As can be seen in the initial reaction of the consumer price index, the effect is strictly positive and significant. This is again consistent with Zaghini and Sousa (2007) and is initially a counterintuitive reaction. One would assume a positive shock in interest rates to have a negative impact on changes in the consumer price index. This however is an appearance commonly found in studies utilizing VAR approaches as it indicates the omission of a variable useful in forecasting inflation, for example the commodity price index, which implies that endogenous responses to expected inflation increases will mistakenly be taken as monetary policy shocks (Giordani, 2004).

Yet another interesting interaction to analyze is that of the monetary aggregate M3 and the short-term interest rate itself. Here, the relationship is particularly interesting as this paper has touched the topic of monetary policy intervention and the exogeneity or endogeneity of monetary aggregates on multiple occasions, and each time there was more or less of a standoff between the interest rate driven and the aggregate driven approach. As can be seen in figure 1.12., a shock in the monetary aggregate does, with the specifications in the identification model, have a significant impact on short-term interest rates.

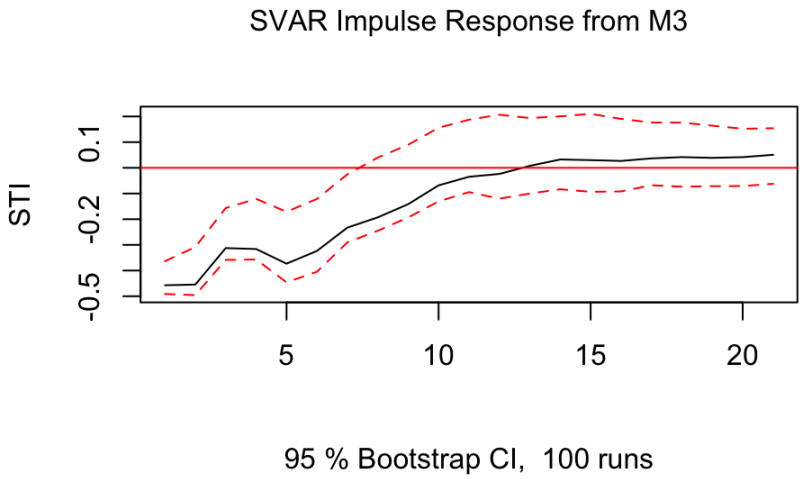

Figure 1.12. STI response from a shock in M3; Source: own calculations

The short-term interest rate is a variable directly linked with the monetary aggregate. The initial reaction to a shock in the monetary aggregate is strictly negative and statistically significant, which is difficult to disentangle with the theoretical framework established in previous chapters as well as unlike the findings by Zaghini and Sousa (2007). The reaction is rather persistent in its nature and only peters out after about 12 periods or approximately three years after the initial impact. This is an interesting observation, but one must be careful to derive any meaningful conclusions from this. In turn, the impact of shocks in the short-term interest rates do affect M3 as well. Here, the impact is illustrated in figure 1.13. indicating the opposite trend between those two variables, where the short-term interest rate affects the M3 aggregate positively and statistically significant different from zero.

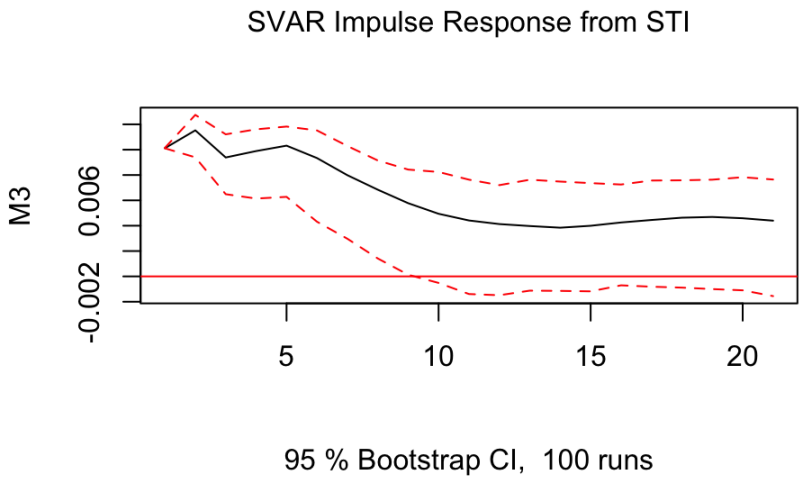

Figure 1.13. M3 response from a shock in STI; Source: own calculations

This finding is also inconsistent with Zaghini and Sousa (2007) but may ultimately be explained by the divergent nature of the definition of liquidity aggregate in their paper, the summation of world M3 aggregates utilized in this paper, and certain model specifications. The effect does last for more than 20 periods or five years after the initial impact and can therefore be described as lasting in the longer term.

Looking at another liquidity aggregate with otherwise unchanged model specifications, the M1 monetary aggregate may deliver slightly diverging results from the broader M3 aggregate. The first simulation to look at again is the effect of a shock in the M1 aggregate on output and how it behaves over time (see figure 1.14.). Of especial interest for the analysis is finding a significant difference from what has been simulated and observed for the M3 aggregate impulse response function.

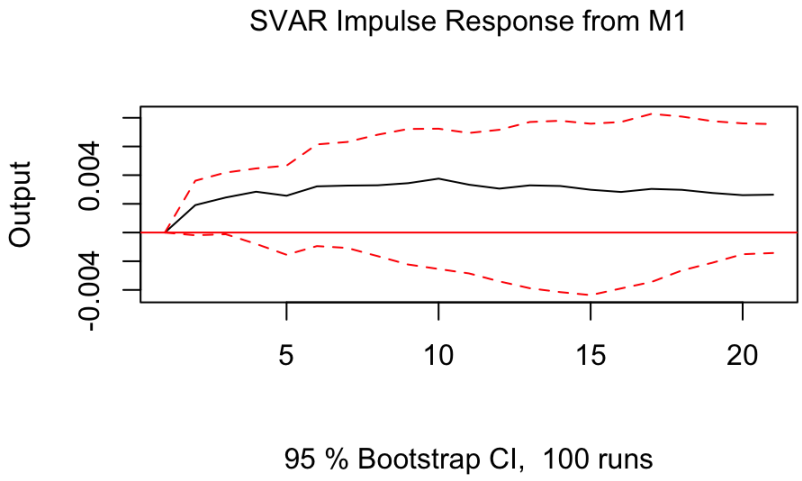

Figure 1.14. Output response from a shock in M1; Source: own calculations

After an initial positive response from a sudden shock in M1, the output seems to recover only slowly to the pre-shock level. After approximately 40 quarters or more than 10 years the effect has all but diminished. Interestingly however is the immediate reaction, which is similar to the findings of Zaghini and Sousa (2007) and also corresponds nicely with Belongia and Ireland (2015). Even though it is not significantly different from zero on the 95 % confidence level, output increased as a reaction to a shock in the M1 aggregate. One plausible reason for that is that M1, even more so than the M3 aggregate, has a direct impact on the economy through its high degree of liquidity, which may translate into increasing private consumption and corporate spending

more immediate. The fact that the effect peters out only slowly supports this assumption. The idea of stimulating the economy through direct transfers and the provision of immediate liquidity, or as described in the unconventional monetary policy chapter as helicopter money and quantitative easing, may have found an argument in defense of those measures right there with this plot.

Another important finding however is the impact the M1 aggregate has on the consumer price index, precisely the non-food, non-energy consumer price index. See figure 1.15. below for the simulation of shocks in the M1 aggregate and the corresponding reaction in the non-food, non-energy consumer price index.

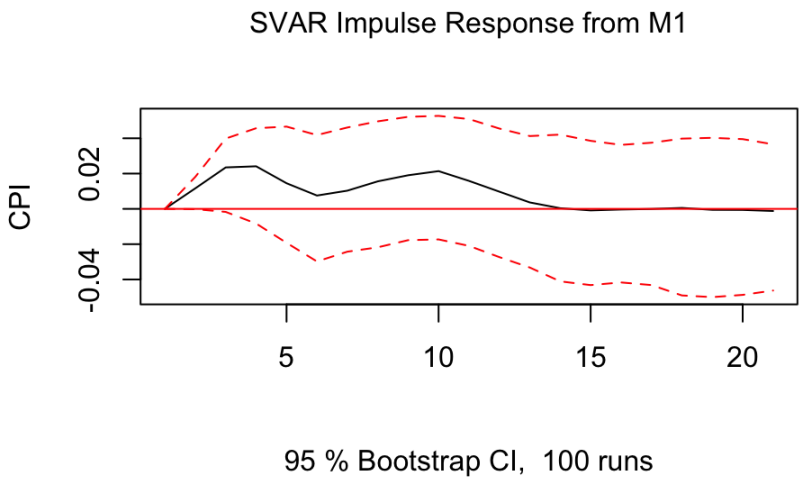

Figure 1.15. CPI response from a shock in M1; Source: own calculations

With an immediate positive effect as reaction to a M1 aggregate shock this comes as a relatively unsurprising finding considering the same observation in the M3 aggregate. The positive reaction is again observable as well as the seemingly temporary nature of the impact, which only peters out after approximately 15 periods or almost four years. This is, as with the observation in the reaction to a M3 aggregate shock, consistent with economic theory. The most plausible reason for the low degree of significance in these finding however lays in the inadequate quality of the data, especially towards the tails of the dataset, which leads to highly insignificant findings in the overall simulation. Still, and independent of the lack of statistical significance of the impact on the consumer price index, the directional coherence can be witnessed, which is again consistent with the literature.

Finally for this broad data set, a closer look at the relationship between M1 and short-term interest rates may be of interest as it is an indication for the relationship between the monetary aggregates and their impact on financial markets. See figure 1.16. below for the corresponding impulse response function.

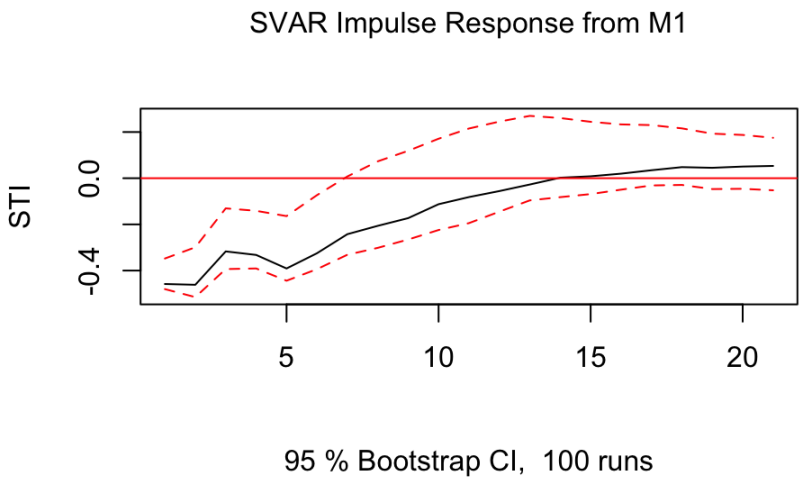

Figure 1.16. STI response from a shock in M1; Source: own calculations

The short-term interest rate reacts initially negative, does change into a positive reaction however after 12 periods or three years' time. This is at most consistent with the reaction of short-term interest rates to M3. The persistence of the effect which only peters out after approximately 25 periods of the simulation however is quite surprising. It is, while only statistically significant in its initial reaction, still interesting to see any impact at all, especially since this rapid shift due to changes in the most liquid aggregate is difficult to contextualize with economic theory. Contrary to the impact on the short-term interest rate, testing a shock in the M1 aggregate following an impulse from the short-term interest rate delivers different results. The results here are as illustrated below in figure 1.17.

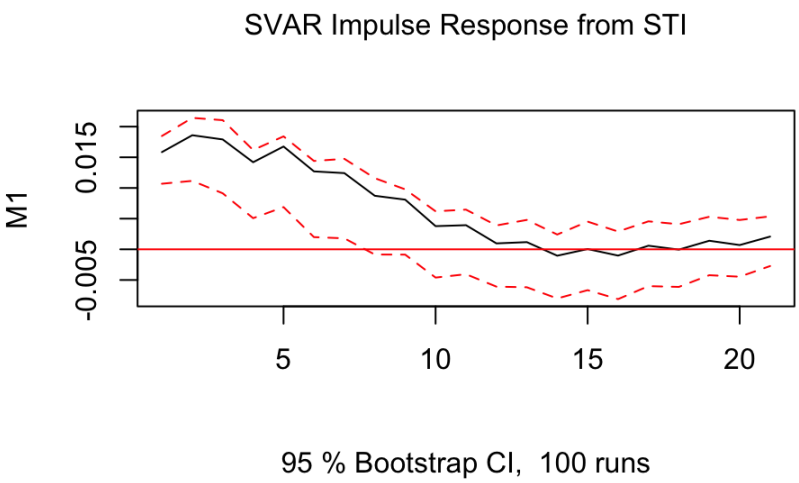

Figure 1.17. M1 response from a shock in STI; Source: own calculations

In this case, similarly to the response in the M3 aggregate, the effect is positive and significant. This is inconsistent with Zaghini and Sousa (2007), but most likely based in the definitional differences between liquidity as put forward by Zaghini and Sousa (2007) and the M1 monetary aggregate in this paper. It is to a degree reasonable for the same reasons as in the M3 aggregate, particularly considering that short-term interest rates do also affect overnight and checking deposits which are, even though of different holding duration, entailed in both the M1 and the M3 aggregate. On the one hand, it is possible that this finding indicates a behavior where rising interest rates attract savings and may through signaling effects also lead to a spike in market demand and a corresponding increase in endogenous money creation through the excess of possibly created reserves. On the other hand, historically speaking and in the data, increases in the short-term interest rates usually occurred where price levels were rising and had to be dampened, which may lead to an increased liquidity demand and reorganization of capital from less liquid aggregates towards more liquid ones, especially currency.

5.2.1. Spotlight: 1995 to 2015

This period is where the data is firstly complete for all 44 countries in the sample, and secondly a degree of homogeneity has been established, both in recording and reporting the data to the OECD and the IMF, as well as the status of their respective financial markets, economies, and the definitional cohesion between central banks and national statistics bureaus. Again, as with the period from 1980 to 2021, the monetary aggregates M1 and M3 will be separately analyzed. The

impulse-response function stays otherwise the same. The response variables are the output, the non-food, non-energy consumer price index, and the short-term interest rate. The data is again weighted according to the country´s respective share of world GDP as an average of their respective shares over the period 1980 to 2021.

In an initial step the M3 aggregate and its interaction with the response variables described above is to be analyzed and contextualized both with state-of-the-art economic theory and the corresponding literature, as well as the author´s judgement. Below in figure 1.18., the simulation for inducing a shock in the M3 aggregate with output as the response variable is plotted.

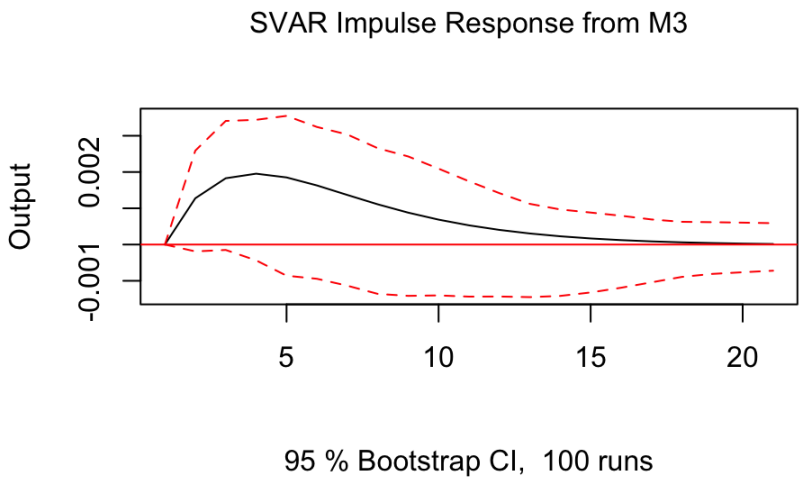

Figure 1.18. Output response from a shock in M3; Source: own calculations

In the smaller data set compared to the one analyzed in the chapter above, a trend consistent with findings from Zaghini and Sousa (2007) and Belongia and Ireland (2015) can be observed. Output reacts positively to a shock in the M3 aggregate with its peak being reached after two periods, followed by a relatively steady recovery which returns to the x-axis after approximately 20 periods or five years of time. This is especially interesting as it is a reproduction of models and methods previously deployed to significantly smaller sets of countries. The consistency goes well beyond that as it also displays a non-permanent nature. Interestingly, the effect of the monetary aggregate on output is of a positive nature, the impact of a shock in the short-term interest rate however has quite the opposite effect. Below in figure 1.19., an additional plot showcases the contrary impact the short-term interest rate has on output for the same simulation specifications.

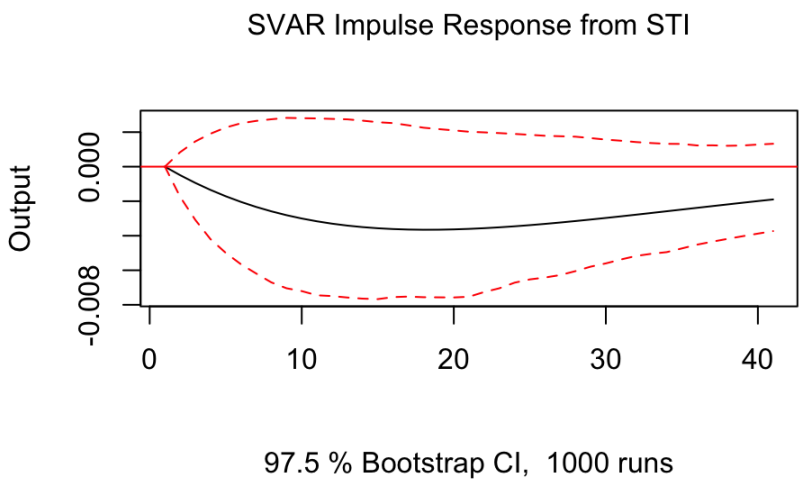

Figure 1.19. Output response from a shock in STI; Source: own calculations

The impact of a shock in short-term interest rates is significantly longer lasting and does not return to zero for more than 40 periods, which would mean that the petering out of the effect does not happen within the first 10 years after the initial impact. This finding is however still insignificant statistically speaking, yet it corresponds with findings by Zaghini and Sousa (2007) and does indicate a longer lasting impact compared to a shock in the M3 aggregate initially.

To deepen this inquiry the response of the non-food, non-energy consumer price index to a shock in the M3 aggregate has also been simulated. The response variable here is significantly less stable than the output data analyzed above, which is, as already described, a derivation of quarterly real GDP data. Below in figure 1.20., one may find the graphical result from the simulation plotted.

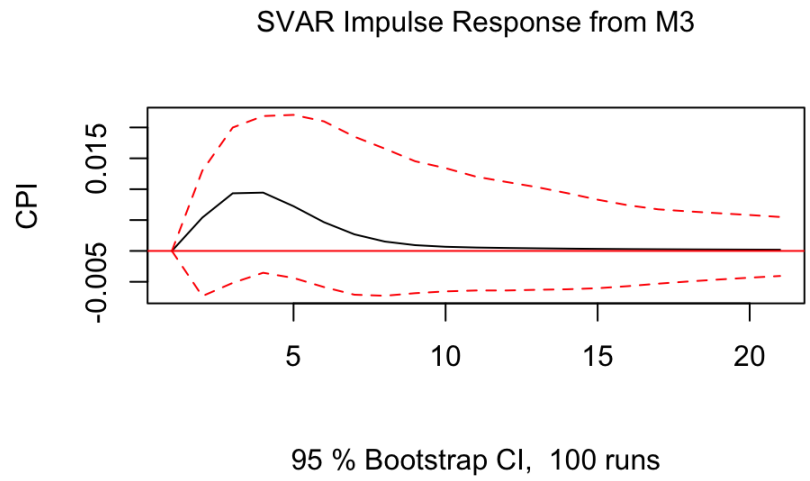

Figure 1.20. CPI response from a shock in M3; Source: own calculations

The non-food, non-energy consumer price index reacts positively to a shock in the M3 aggregate, which is consistent with the finding of Zaghini and Sousa (2007) and Belongia and Ireland (2015) in the direction of the reaction, but not in the duration. In the simulation, the positive effect peaks two periods after inducing the shock in the M3 aggregate but disappears within 10 periods. The statistically significant derivation from zero in the first three quarters also indicates a bouncing effect being induced through the monetary aggregate. Unlike the bigger dataset, where the observation was both more unstable and longer lasting in terms of duration, these findings are supported by economic theory and the existing literature. While output in the plot (Figure 1.19.) above reacted comparably less stark, the consumer price index seems to react stronger in magnitude. Another interesting observation to be made is that both output and CPI do peak around the same period after a shock and have a similar time of recovery from it. Here, plotting the effect of a shock in short-term interest rates is obsolete as it follows the same direction and magnitude a shock in the M3 aggregate has.

A third vital indicator to analyze is the relationship between short-term interest rates and the M3 aggregate. Here, the short-term interest rate is again the response variable, and a shock is induced, as above, via the M3 aggregate. Below in figure 1.21., one may find the corresponding plot from the simulation.

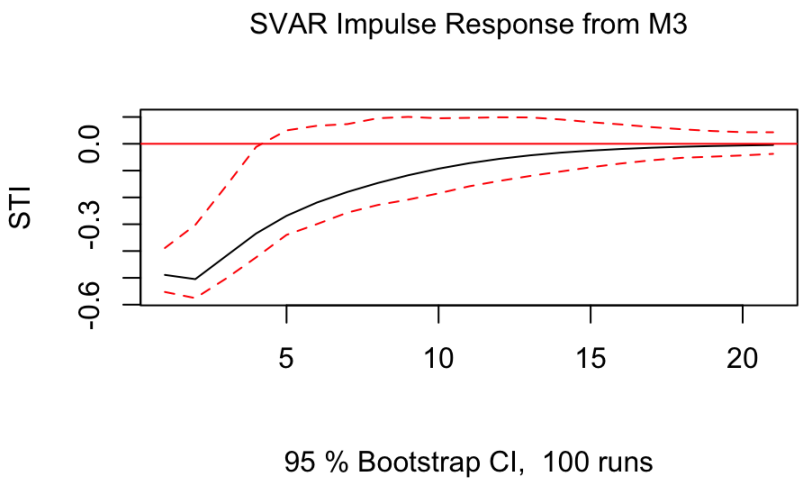

Figure 1.21. STI response from a shock in M3; Source: own calculations

The short-term interest rate initially reacts negative and does recover relatively slowly reaching the x-axis after approximately 20 periods or five years. The effect has a peak after three periods

and slowly moves back to a neutral position. This is at most consistent with the reaction of short-term interest rates in the larger set. The fact, that the movement itself is statistically significant for the initial response is also consistent with findings from the larger data set. With the relationship between short-term interest rates and the monetary aggregate, again a fundamental theoretical clash arises, especially since conducting the simulation in the opposite direction, namely shocks in the interest rate and how they affect the monetary aggregate, provides similar results. See below in figure 1.22. for a closer look at how the M3 aggregate behaves following a shock in short-term interest rates.

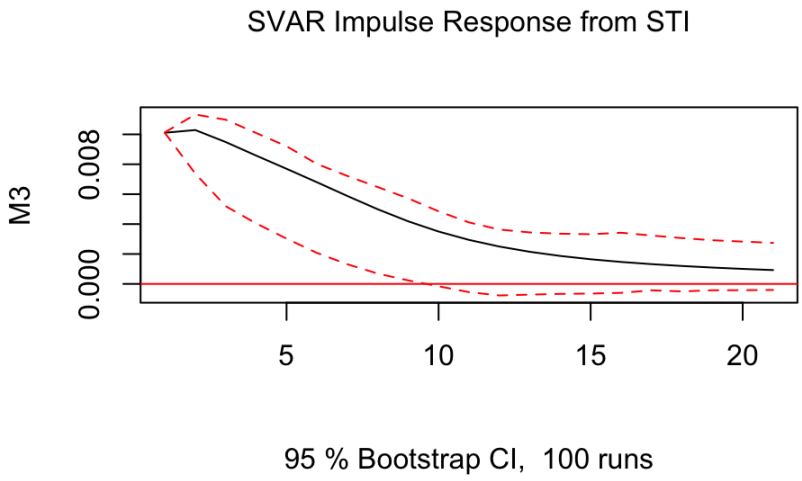

Figure 1.22. M3 response from a shock in STI; Source: own calculations

ıever, it displays a shorter lasting impact. Remember, in the larger data set there was no sign of recovery after 20 periods, while here a clear trend of returning to the x-axis can be witnessed. Even more interesting is the statistically significant nature of the initial impact, which has already been witnessed with the larger data set.

While the M3 aggregate and shocks therein simulate a situation where a comparatively broad aggregate moves rapidly, the simulation with the more liquid M1 aggregate may bring different observations to consider. Again, shocks in the monetary aggregate are to be tested upon response variables. The response variables are the output measured in GDP, the non-food, non-energy consumer price index, and the short-term interest rate. Both model specifications, restrictions, and the testing process are the same as with the evaluations above.

In an initial step the M1 aggregate and its interaction with the response variables described above is to be analyzed and contextualized both with state-of-the-art economic theory and the corresponding literature, as well as the author´s judgement. Below in figure 1.23., the simulation for inducing a shock in the M1 aggregate with output as the response variable is plotted.

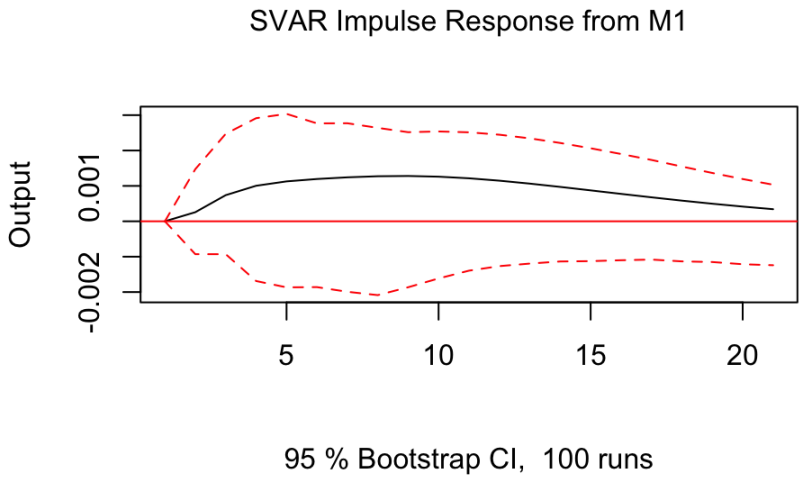

Figure 1.23. Output response from a shock in M1; Source: own calculations

Here in figure 1.23 it can be seen that after an initial positive response from a sudden shock in M1, the output seems to recover only slowly to the pre-shock level. After approximately 25 quarters or more than 10 years the effect has all but diminished. Interestingly however is the immediate reaction, which is similar to the findings of Zaghini and Sousa (2007) and also corresponds nicely with Belongia and Ireland (2015). Even though it is not significantly different from zero on the 95 % confidence level, output increased as a reaction to a shock in the M1 aggregate. The high degree of uncertainty, indicated by the high deviation of the confidence intervals indicates that this effect may be neglectable. Also considering the effect of short-term interest rates, which although statistically insignificant yet strictly negative for at least four periods, show the negative impact of a monetary policy shock on output.

Another important finding however is the impact the M1 aggregate has on the consumer price index, precisely the non-food, non-energy consumer price index. See below in figure 1.24. for the simulation of shocks in the M1 aggregate and the corresponding reaction in the non-food, non-energy consumer price index.

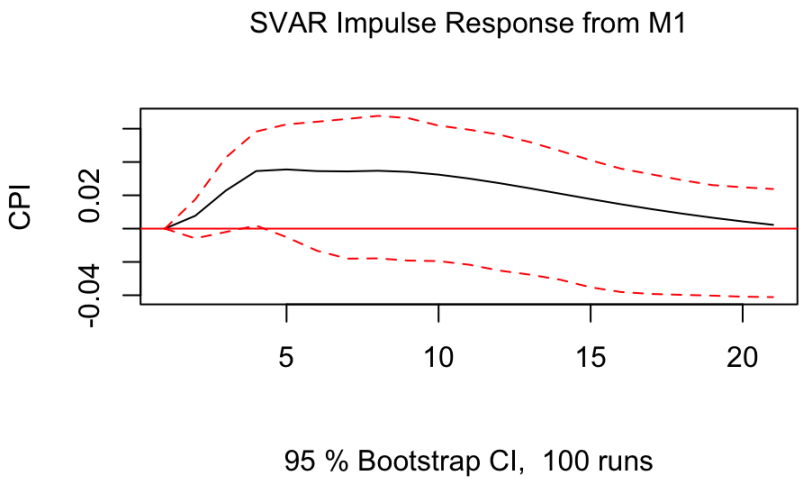

Figure 1.24. CPI response from a shock in M1; Source: own calculations

With an immediate positive effect as a reaction to a M1 aggregate shock this comes as a relatively unsurprising finding considering the same finding in M3, where the reaction was positive as well. The effect here peaks within the third quarter and returns to zero within the first 20 periods or five years after the initial impact. In terms of duration of the shock the M1 aggregate has a similar impact as the M3 aggregate, even though both findings were insignificant and statistically speaking not different from zero. It does constitute an intuitive relationship between the most liquid of all aggregates, namely M1, and the consumer price index. One does assume a positive relationship, which however depends on the circulation speed of those currencies and whether a sudden increase would contribute to a pressure on prices. Assuming circulation is very low, an impact would at best be non-existent, what this finding theoretically speaking indicates.

Third and finally for the inquiry into the M1 aggregate in the period from 1995 to 2015 is a closer look at the relationship between the M1 aggregate and short-term interest rates in figure 1.25. Findings may be utilized as a vital indication for the relationship between the narrow monetary aggregate M1 and its impact on financial markets.

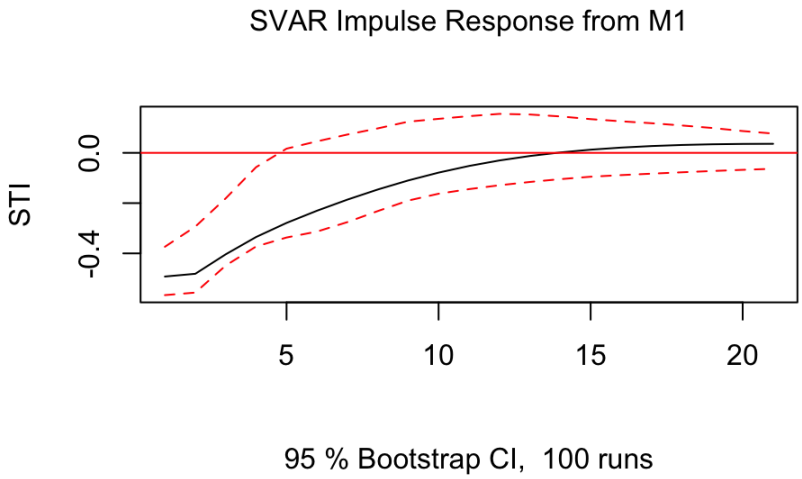

Figure 1.25. STI response from a shock in M1; Source: own calculations

The short-term interest rate reacts negatively and does so statistically significant and different from zero. The effect recovers to a neutral position within the first 15 periods or approximately four years. This is at most consistent with the reaction of short-term interest rates in the larger set and it does not turn into a persisting effect. It is also consistent with the literature and reproduces Zaghini and Sousa´s (2007) findings on the world level. The fact, that the movement itself is statistically significant is yet another indicator for a relationship to pay closer attention to. Conducting the simulation in the opposite direction, namely shocks in the short-term interest rate and how they affect the monetary aggregate, the simulation provides the opposite results. Figure 1.26. displays the response of M1 to a shock in the short-term interest rate.

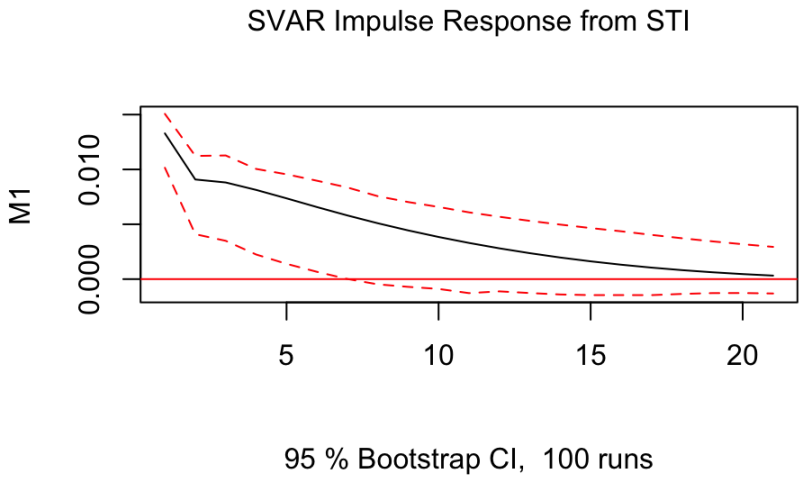

Figure 1.25. M1 response from a shock in STI; Source: own calculations

In this case (Figure 1.25.), similarly to the response in the M3 aggregate, the effect is positive and significant. This is again inconsistent with Zaghini and Sousa (2007) for the same reasons as already elaborated in the analysis of the larger data set. Again, this finding is most likely based in the definitional differences between liquidity as put forward by Zaghini and Sousa (2007) and the M1 monetary aggregate in this paper. It is reasonable for the same reasons as in the M3 aggregate, particularly considering that short-term interest rates do also affect overnight and checking deposits which are, even though of different holding duration, entailed in both the M1 and the M3 aggregate and become significantly more attractive with rising interest rates. This positive reaction however is not persistent in its nature.

5.2.2. Spotlight: The M3/M1 ratio

The M3/M1 ratio as a variable has been introduced in the theoretical chapters already. The reason why it is given a separate subchapter in the analysis lays in its usefulness for economic evaluations and monetary policy. While on the surface it simply assesses the relative proportions of narrow money (M1) to broad money (M3), a deeper understanding of the ratio can provide insights into the liquidity and money supply structure of an economy, or in our case the world economy. Since it is being utilized already by policy makers and central banks to better assess spending behavior and confidence in the economy, as well as liquidity in the broader sense, it is only reasonable to also include this measure as a separate inquiry next to the two aggregates that constitute the ratio, namely M1 and M3. To better illustrate how sudden changes in this ratio might affect other variables such as consumer price index, output, and to a lesser degree the short-term interest rate, several simulations have been conducted. The data set in the analysis for this inquiry is the reduced one from 1995 to 2015, as it has proven to deliver more consistent and stable results. Modes and testing are otherwise unchanged as well as the nature and compilation of the aggregated data. For interpreting the results of this chapter appropriately, it is necessary to understand that an increase in the M3/M1 ratio means that M1 grew in relative terms compared to M3. Whether that is due to an actual increase in M1 or a decrease in M3 is not relevant for the ratio, it is however for the analysis, which is why both levels and relative change have been plotted in the introductory chapter of the analysis.

In an initial step, the M3/M1 ratio is being shocked and the corresponding response in output being plotted in figure 1.26.

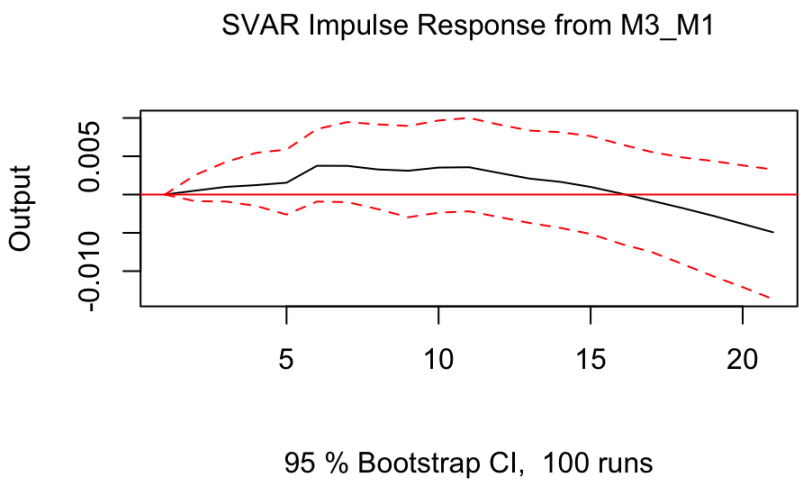

Figure 1.26. Output response from a shock in the M3/M1 ratio; Source: own calculations

As can be seen from the plot above, the positive relationship between a shock in the M3/M1 ratio and output is similar in result to shocks in M1 and M3 separately. This is both trivial and interesting. Trivial, because the relationship tested here is simply a transformation of the already simulated relationship with the monetary aggregates. Interesting, as it the ratio is significantly less stable than the level data of the monetary aggregates. In both cases, a positive response can be witnessed, only that with the ratio there is a point where the shock converses into the negative. This however only manifests after 15 periods, which means that the positive relationship can be upheld for almost four years following the impact, a finding that is consistent with previous findings and does seem sound before the backdrop of economic theory.

In a second step, the relationship between the M3/M1 ratio and the consumer price index may be tested and analyzed. Here, a shock in the M3/M1 ratio delivers the following results from the impulse-response function as being displayed in figure 1.27.

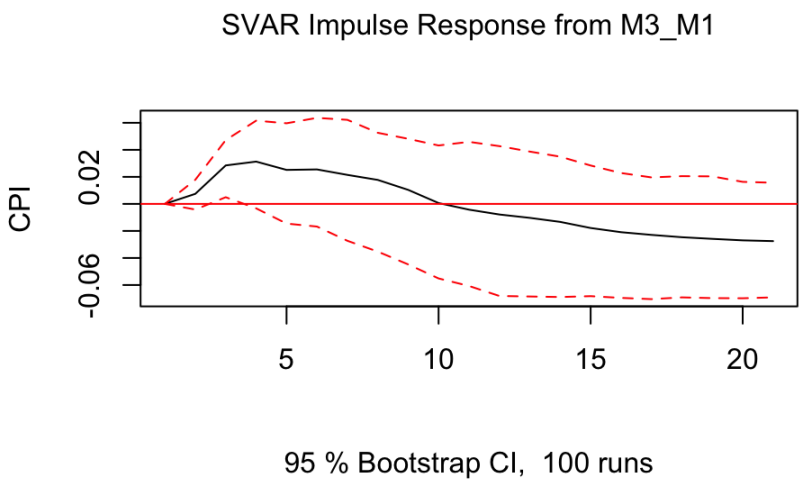

Figure 1.27. CPI response from a shock in the M3/M1 ratio; Source: own calculations

Again, a similar pattern as with the M3 and M1 aggregates separately arises. However, the longer lasting effect and the change in signs of the response direction do diverge from previous findings. While the initial positive response peaks after approximately four periods, or a years' time, it takes another six periods to return to the x-axis. After that however the effect seems to carry on and even with longer simulations conducted, the full convergence does not happen until around 65 periods after the initial shock. This timeframe however is as long as the actual data set, so no meaningful conclusion can be derived from this pattern in the long run. One might state that the effect is of a long lasting, cyclical, and bidirectional nature.

In a third step, the relationship between the M3/M1 ratio and the short-term interest rate may be tested and analyzed. Here, a shock in the M3/M1 ratio delivers the following results from the impulse-response function as being displayed in figure 1.28.

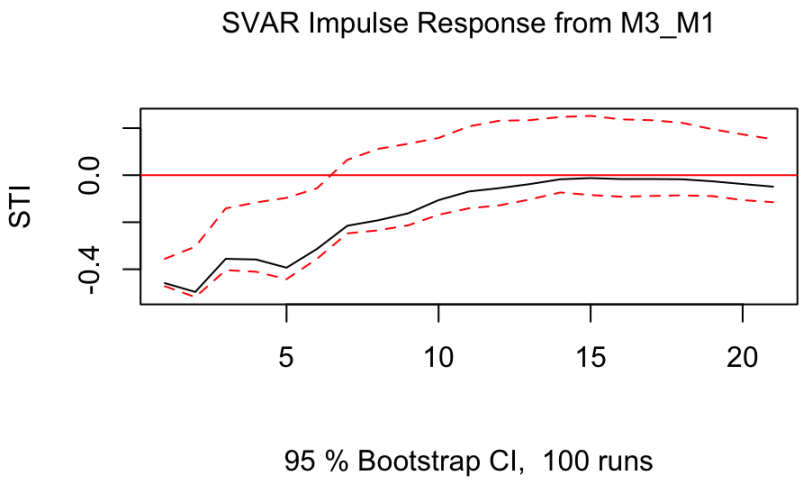

Figure 1.28. STI response from a shock in the M3/M1 ratio; Source: own calculations

The short-term interest rate reacts negatively and does so statistically significant and different from zero. The effect recovers to a neutral position within the first 15 periods or approximately four years. This is at most consistent with the reaction of short-term interest rates in the M1 and M3 aggregates separately. The effect is of temporary nature, which is a further indication of the consistence with the before tested aggregates. Interestingly it is relatively strong in magnitude initially and does oscillate at that level for at least five periods. Conversely the reaction of the M3/M1 to a shock in the short-term interest rate leaves us with the following results. Plotted below in figure 1.29. is the response function of the M3/M1 ratio to a shock in the short-term interest rate.

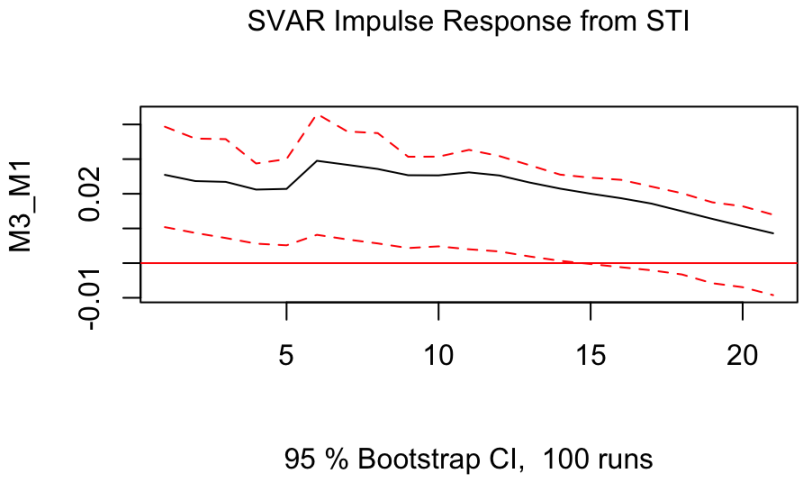

Figure 1.29. M3/M1 ratio response from a shock in STI; Source: own calculations

In this case (Figure 1.29.), similarly to the response in the M3 and M1 aggregate separately, the effect is positive and significant. It is also statistically significant for a prolonged period considering the effect lasting for at least 20 periods or five years. Interestingly though, with the M3/M1 ratio being shocked, the actual peak of the response is not until around six periods after the initial impact, peaking approximately one and a half years after being shocked. While the effect, much like with M3 and M1 previously, diminishes over time, it keeps a plateau for quite some time, which is contrary to previous findings. The overall statistically significant and positive trend in the reaction is overall comparable with what has been established in the previous analysis. This is also what may be taken from this chapter in a more general sense, namely that the M3/M1 ratio behaves similarly to the aggregates M1 and M3 when being tested accordingly.

5.2.3. Spotlight: Euro Area and the US

The decision to subset the Euro Area and the US is two things at once. For once, they compose about half of the weight in the data set analyzed so far as measured in share of world GDP. This is naturally an average over the last 40 years, but since in total about 80 % of world GDP is being covered in the complete data set, and a close 40 % of it stems from those two players, it may well be used as a close estimate. The second reason is that in terms of currency in use, the dollar is the most widely utilized reserve currency, and the Euro is second to it. Together they make up for approximately 80 % of reserve currency held. It is a problematic approach to solving the question of how global aggregates behave, because all the other 24 countries that now are missing in the subset do attribute to the global economy as well. However, the weighting process, foreign exchange and other valuation effects may disproportionally distort findings, something that can only be checked when considering the next best estimator, which does not have the above-described problems due to its stable exchange rate and interest rates, domestic inflation rates and output being relatively steady and predictable, etc.

Below in figure 1.30., we see the first vital indicator, namely the simulated shock in the monetary aggregate M3 on output as the response variable. The shock in this simulation constitutes a rapid expansion in the monetary aggregate M3, while the impact lag for the VAR model is set to two period, which is derived from the SIC/BIC information criteria in the model estimation. A period in this case is a quarter of a year. The dotted line indicates the confidence interval for any given period. The plot below is again based on data from 1995 to 2015.

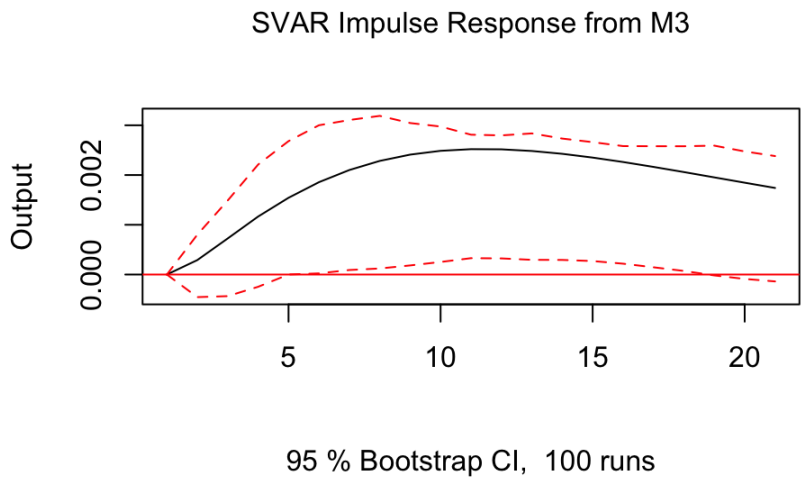

Figure 1.30. Output response from a shock in M3; Source: own calculations

ggregate leads to a positive response in the output, even though it is only significantly different from zero at the 95 % confidence level after approximately five periods. It´s impact seems to reach a plateau after approximately 10 periods, and only slowly returns to the x-axis. In the observation above there is no complete recovery after 20 periods and simulations conducted over longer horizons indicate a convergence time of over 60 periods, meaning that the effect a shock in the M3 aggregate has on output is of a long-lasting nature. This is a similar reaction compared to what was observable in the world aggregate and both magnitude and duration are not significantly different. The effect peaks only after a prolonged period, and ultimately has a persistent character over a longer observation period. Similar findings have been made with the reduced data set ranging from 1995 to 2015, which did not include the extraordinary divergencies in economic indicators following the oil shock in the 1980´s and the Covid-19 pandemic after 2019. When also regarding changes in the short-term interest rates, it is a consistent reproduction of the findings of Zaghini and Sousa (2007) and Belongia and Ireland (2015). When considering the negative response of output towards an unexpected positive short-term interest shock, disentangling the contrary movements becomes methodologically difficult. Below in figure 1.31., the plotted response of output from a shock in short-term interest rates is to illustrate the contrary effect.

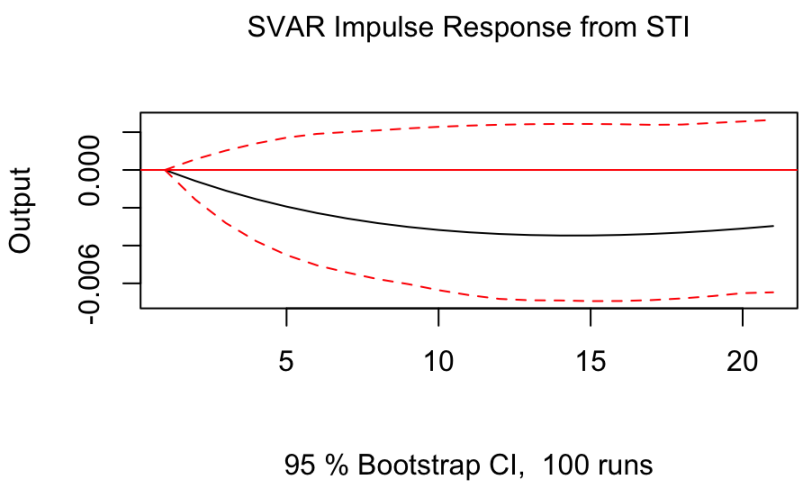

Figure 1.31. Output response from a shock in STI; Source: own calculations

Here, it again becomes critically clear that while still considered insignificant on the tested level, both direction and intensity is a close mirror of the shock simulated in the M3 and M1 aggregate before, as well as the observations made with the M3/M1 ratio. This is a consistent trend, that has also been witnessed in the literature and with findings in the world level aggregate tested in the chapter above.

Looking at the narrower, more liquid aggregate, a similar picture emerges. Here, testing a monetary aggregate shock in M1 on output as the response variable leads to findings, which closely mirror the results of Zaghini and Sousa (2007) and Belongia and Ireland (2015), but are different in magnitude and duration. Below in figure 1.32, one may find a plot capturing the reaction of output to a shock in M1.

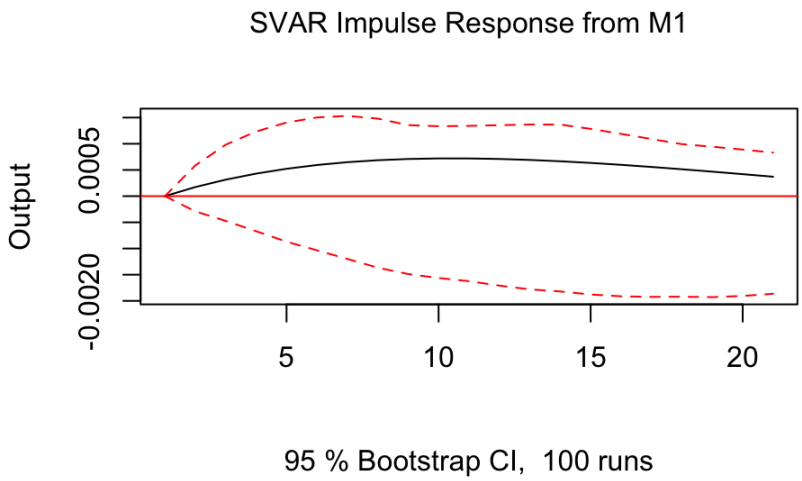

Figure 1.32. Output response from a shock in M1; Source: own calculations

As can be seen, after the above-described positive reaction at first peters out after approximately 25 quarters, which for once indicates a medium-term reaction of the output in response to the M1 aggregate shock, and secondly a strictly positive overall impact of the shock, even though of little statistical significance. In this case, unlike with the M3 aggregate, a faster recovery can be witnessed. The complete return to the x-axis in the simulation was visible after 25 periods of observation, which would constitute a total recovery duration of approximately five years after the initial shock.

After analyzing the effect on output, which seems to be affected in the short and medium term by both the M3 as well as the M1 aggregate, the next important simulation to analyze is how the M3 and M1 aggregate may affect the non-food, non-energy consumer price index as depicted in figure 1.33.

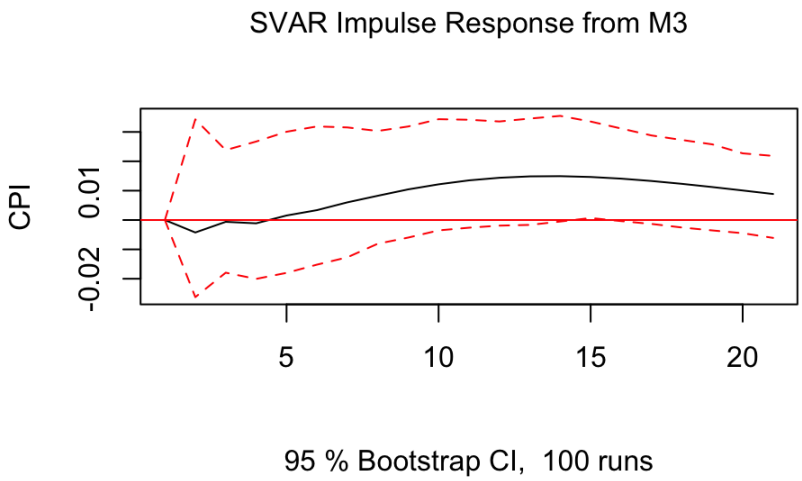

Figure 1.33. CPI response from a shock in M3; Source: own calculations

The initial impact of a positive shock in the M3 aggregate affects the consumer price index with a negative response that recovers and turns into a positive response after four periods, or approximately one year. This is different from previous findings in this simulation, but the pattern is consistent with findings in Zaghini and Sousa (2007) and after the initial response the effect reaches it plateau around 15 periods after the shock. Here, even though being statistically insignificant, the effect is again consistent in its medium-term nature with Zaghini and Sousa (2007) and Belongia and Ireland (2015). The high degree of uncertainty again makes drawing a conclusion very difficult. Since the deviation from zero can only not be rejected at confidence levels of about 75 %, it is scientifically speaking also impossible to make a definitive statement, even for the very limited data set at hand and the long period it tries to cover.

To also make the inquiry into the consumer price index´s reaction complete, the M1 aggregate may also be analyzed and tested for. Here, findings are different to the situation described above. Below in figure 1.34., you may find the reaction of the consumer price index to a shock in the M1 monetary aggregate.

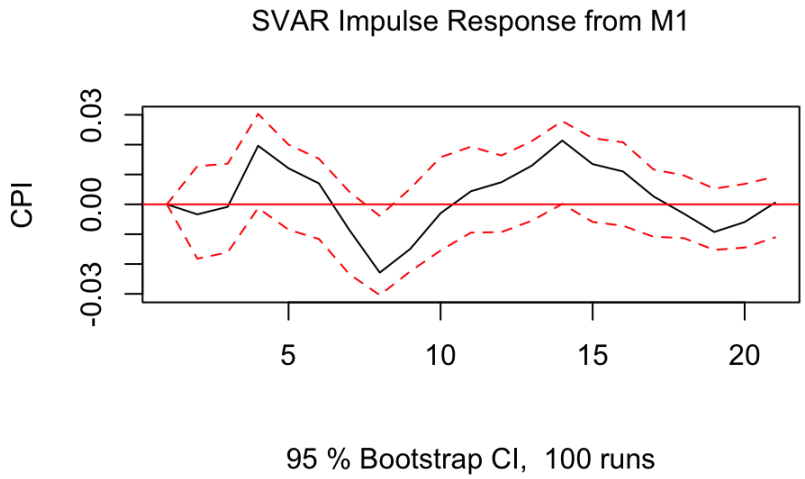

Figure 1.34. CPI response from a shock in M1; Source: own calculations

price index with a positive response that peaks after four periods but starts to oscillate thereafter. This behavior has not been witnessed before, neither in the previous simulations, nor in the M3 aggregate tested above in figure 1.33. Here, even though being statistically insignificant, the effect is highly volatile and seemingly oscillating around the x-axis for at least another 20 periods where it converges. This is a surprising finding, as it is only consistent with other findings in the immediate short-term response.

Consequently, the consumer price index reacts negatively to a shock in short-term interest rates. As can be seen below in figure 1.35., the somewhat ambiguous impact that has been observable with the impact of shocks particularly in the M1 monetary aggregate is fortunately not present here. The response is not persistent and converges to the x-axis relatively quickly.

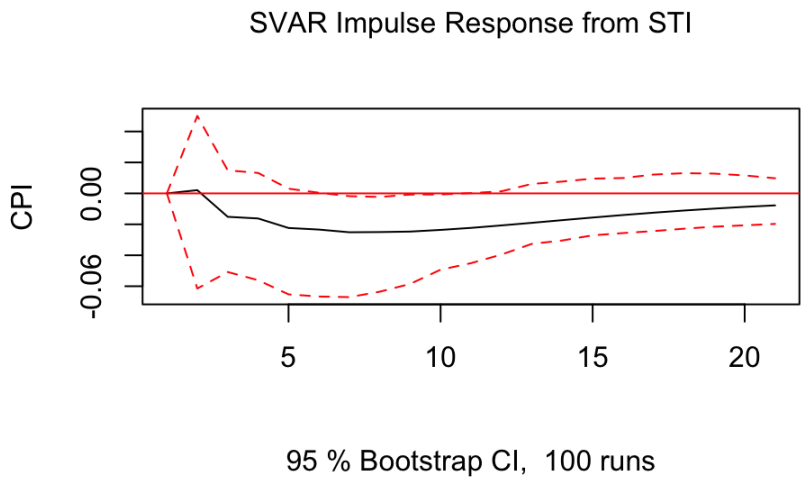

Figure 1.35. CPI response from a shock in STI; Source: own calculations

displays a temporary negative reaction of the consumer-price index to a shock in the short-term interest rate. It reaches a plateau after about eight periods, which would translate to four years after the initial shock, meaning that also the duration is consistent with previous findings.

As a last question to be answered a more thorough inquiry into the behavior of the short-term interest rate following a shock for the selected subset may be undertaken. It is unlikely from previous findings that shock in the M1 monetary aggregate would affect short-term interest rates differently than shocks in the M3 monetary aggregate would, it is still necessary to analyze it accordingly. Below in figure 1.36. is a plot drawing the response of short-term interest rates following a shock in the M3 monetary aggregate.

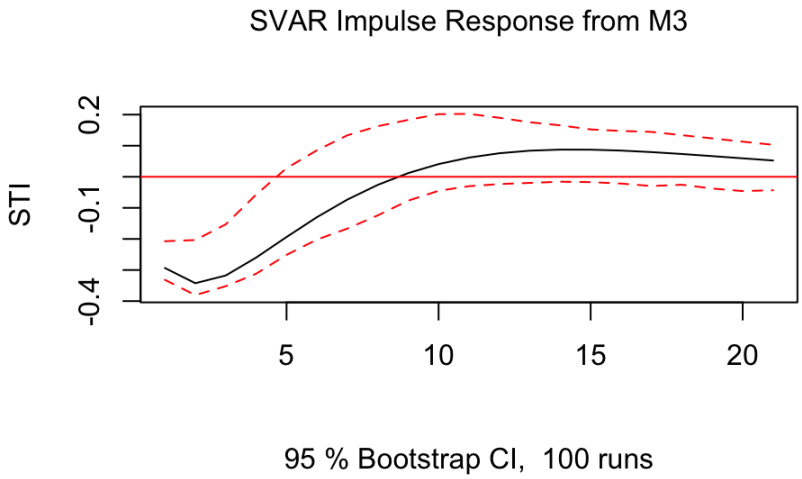

Figure 1.35. STI response from a shock in M3; Source: own calculations

The imminent response is strictly negative, statistically significant, and does not recover for another eight periods. After approximately two years, the response would change signs and turn positive, however this reaction is not of a permanent nature. Longer running simulations showed that the positive response, which converges quickly thereafter, lasts for another 12 periods, meaning that a complete recovery in the simulation was only achieved after approximately 32 periods or eight years. This is consistent with previous findings from the larger aggregates, which however differed as to the duration of the impact and the movement of the short-term interest rates above the x-axis. In any case, it holds perfectly with previous observations in terms of short-term effects of a shock on short-term interest rates.

The M1 monetary aggregate, and how the short-term interest rates react to a corresponding shock in it, is consistent with the findings in the M3 aggregate. Below in figure 1.36., the impact of a shock in the M1 aggregate on short-term interest rates is being plotted for the timeframe 1995 to 2015. It draws a very similar picture to figure 1.35.

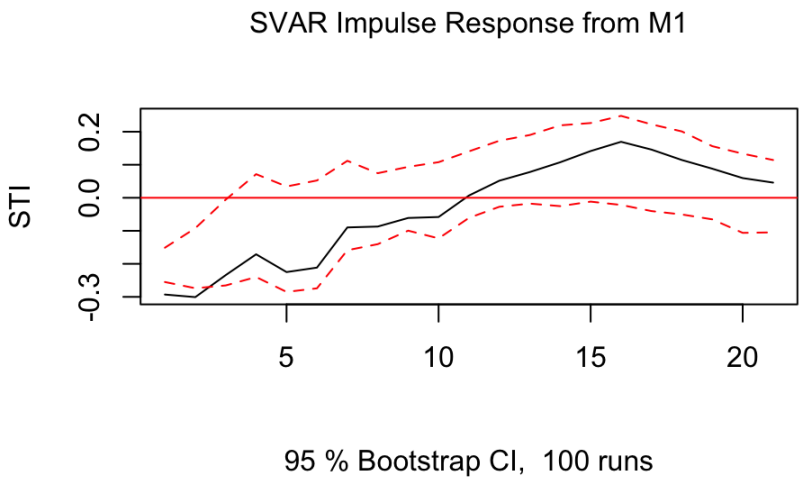

Figure 1.36. STI response from a shock in M1; Source: own calculations

The imminent response is again strictly negative and does not recover for another 12 periods in this example. After that it does, as with the impact of the M3 aggregate, turn into a positive reaction which reaches a plateau after approximately 16 periods and thereafter converges back to the x-axis after about 25 periods in total. This means that a complete recovery in the simulation was only achieved after approximately six years following the impact. This is consistent with previous findings from the larger aggregates and matches those findings in a similar manner as with the reaction to a shock in the M3 aggregate above. It however differed again as to the duration of the impact and the movement of the short-term interest rates after the initial impact.

In a last step the analysis for how the short-term interest rate affects both M1 and M3 in this restricted subset may be of particular interest. It is therefore, that a separate simulation has been run to disentangle this relationship as well. As can be seen in figure 1.37. and 1.38. respectively, the reaction of the M1 and M3 aggregate to a shock in the short-term interest rate for the Euro Area and US subset in the timeframe 1995 to 2015 is similar to how the more general aggregate on the world level behaved, both in magnitude and in duration.

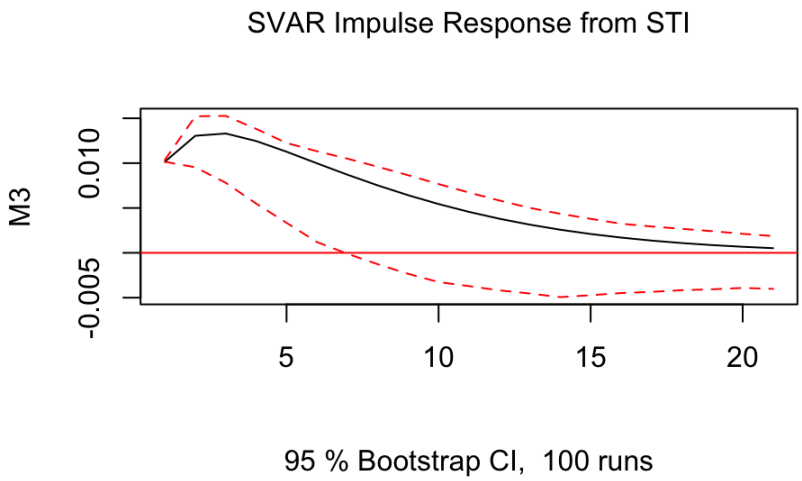

Figure 1.37. M3 response from a shock in STI; Source: own calculations

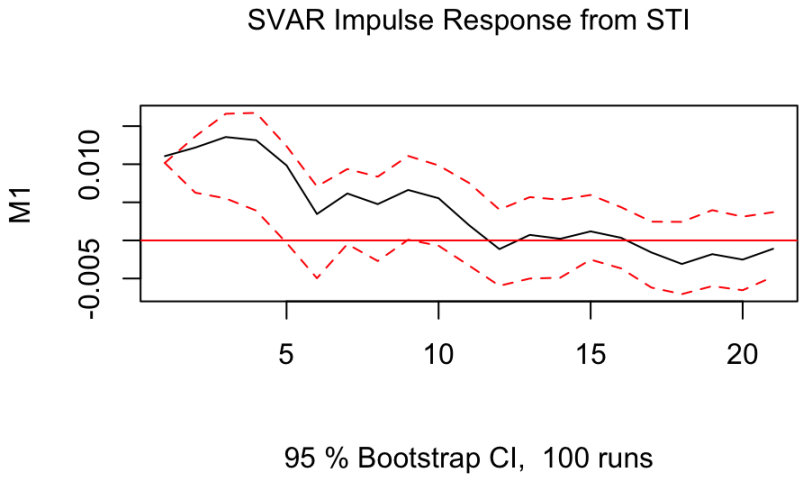

Figure 1.38. M1 response from a shock in STI; Source: own calculations

As can be clearly seen from both plots above, they show a similar pattern and a smooth recovery after the initially strong positive reaction to the shock in the short-term interest rates. While the M1 aggregate shows a slightly quicker convergence to the x-axis and shortly undershoots it, the M3 aggregate is considerably more stable in its recovery path. This may for once be an indication that the M1 aggregate is reacting more erratic to a change in the short-term interest rate, or simply a question of larger deviation in the actual data frame. As elaborated before, this reaction is consistent with previous findings and therefor considered a useful check as to the precision of the much larger world data set, both in the M1 and the M3 aggregate.

6. Conclusion

A topic as ambitious as the one discussed in this piece of work is of a very distinct nature. Inquiries on the macroeconomic level are often plagued with methodological questions that, as has been discussed extensively, may alter both findings as well as the conclusions one might draw from them. This paper took an approach that is based to scaling up and adapting previous work. Assumptions that held nicely in a more restricted setting with a limited data set were only marginally altered and methods that proved to work better and more transparent than the typical large-scale macroeconomic models were employed. It has been an inquiry in a field where only little work has been done, and as quickly pointed out, it may not be solely due to the monetarist idea being buried under a mountain of interest rate driven command and control policies in the field of monetary policy. The data set that has been used has had many particularities, not all of which are simply corrected for with methodological measures, and some of which may have distorted the findings. The idea that the world economy might be as homogenous as it is in the G5 is an illusion, the idea that monetary aggregates capture the same thing in every country likewise. Set aside the precision in the data available at such a level and the limitations in compiling those aggregates, monetary aggregates, and their intrinsic meaning itself have been criticized for their shortcomings many times. Belongia and Ireland (2015) even went above and beyond and created their own measurements of liquidity in Divisa aggregates aiming to correctly capture liquidity as a useful indicator. As has been discussed in the methodological section of this paper, different aggregates not only differed from country to country in what they include and what not, they even changed, sometimes significantly, over time. Accounting for all those specialties has been an especially difficult task, and it is not ultimately clear whether the precision aimed for was sufficiently achieved, when considering the significance of certain findings in the analysis. However, this paper took a big step in aggregating data from over 44 countries over a period of 40 years, analyzed it with the upmost precision, sound methodology, and the suitable econometric tools and derived scientifically meaningful insights from it. While this conclusion may not contain the ultimate and definitive answer to many of the issues and questions raised during this inquiry, it did shed some light on a part of world economy and still contributed to the scientific community with a set of interesting observations. From those findings, a set of conclusions can be taken, even though testing macroeconomic time series data on a 95 % confidence level may probably be a little too restrictive in retrospective. The first and most important of which is that there is a positive reaction in output measured in GDP, the non-food, non-energy consumer price index, as well

as the short-term interest rate for shocks in both the M1 and the M3 aggregate as well as shocks in their ratio. It was also possible to test how shocks on short-term interest rates affect the other endogenous variables in the simulation reproducing findings from Zaghini and Sousa (2007) for both output and the consumer price index. While the statistical significance was not always given, the general direction and behavior closely reassembles previous findings and for the most part corresponds with the literature and economic theory. Also, and this is as critical as findings in the aggregate, the impact of the short-term interest rate must not be overseen and consequently analyzed in tandem with the monetary aggregates. Especially within the narrower subsets, there is a clear connection between the monetary aggregates, short-term interest rates and the other endogenous variables (such as consumer price index and output). The dedicated spotlights on both the narrower time frame from 1995 to 2015 and the US and Euro area showed how consistent the larger set simulations were, but also how prevalent the US and the Euro area are, as the world aggregate´s behavior is closely mirroring that of those two countries. The weight put on those two countries makes their contributions weight in heavier than other countries in the world aggregate, however considering them being weighted according to their share of world economy, it is the statistically sound mechanism to assess their impact. Yet it is true that the aggregates in use are far from perfect. In currency converted numbers, no other economy, neither China, Japan, Russia, nor India was able to contribute closely as much to the aggregates and consequently to the findings than the US and Euro Area. However, looking at shifting weights over time in favor of other players, those findings might grow old sooner than later, and the world economy grows not just in absolute figures, but in available data on sound and precise macroeconomic indicators for an even larger number of countries. Again, there is much room for improvement, particularly in understanding the precise mechanisms and interactions between truly global aggregates and other economic indicators. The quality of the data collected, as described above, will hopefully be greatly improved in future inquiries simply due to the better availability of data worldwide. Finally, this paper is meant to give an impulse aiming to achieve a corresponding positive response in the ongoing scientific discussion about the importance and usability of monetary aggregates in the world economy.

7. Bibliography

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