From the Quantity Theory of Money towards the Functional Differentiation of Credit: The Role of Non-GDP transactions in Germany, Italy and Switzerland

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Abstract

Due to quantitative easing after the global financial crisis as well as rising inflation rates since 2021, economists worldwide are reconsidering the role of stocks and flows of monetary aggregates. In this context, quantity theories of money (QTMs, also known as monetarist theories) are often revived, according to which the amount of money determines inflation or nominal GDP. Against this backdrop, we review the origins of QTMs. Although these theories are often motivated by an indisputable identity, the equation of exchange, we show that they are empirically estimated with poor proxies and, furthermore, make causal statements that are theoretically false. While the theoretical critique of QTMs by Schumpeter and others has historically not been very successful, the decoupling between money and nominal GDP in the 1980s contributed to a decline of QTMs. The mainstream struggled to explain this decoupling through adjusted versions of QTMs. We investigate whether non-GDP transactions can explain the decoupling between money respectively credit and nominal GDP by using both the insight that money is created through bank credit, and the functional differentiation of credit developed by Schumpeter. The hypothesis is that if credit is created for unproductive rather than productive sectors, credit and money increase, but GDP does not. We find empirical support for this hypothesis, showing that the velocity of credit used for GDP-transactions (nominal GDP divided by productive credit) is relatively stable in the case of Germany and Italy, while in Switzerland additional open-economy effects have to be taken into account.

1 Motivation and introduction

Until the global financial crisis hit the world economy in 2008, central bankers around the world had almost exclusively focused on the idea that monetary policy affects inflation via current and expected changes in nominal interest rates, following influential works of Ireland (1994) and Woodford (2003). Monetary policy models were subject to the 'cashless limit', which suggests that predictions of monetary pol icy models do not change if the amount of money in an economy shrinks to zero. In the aftermath of the global financial crisis of 2008, central banks all over the world have lowered their interest rates to promote growth. This policy reached its limits when the zero lower bound was hit in the Eurozone and the United States without achieving the desired levels of inflation. As a result, central bankers reconsidered the role of flows and stocks of monetary aggregates, for example in the context of quantitative easing. More recently, high inflation rates since 2021 combined with large central bank balance sheets, i.e. large amounts of central bank money, have helped quantity theories of money (QTMs) become more prominent again.

Against this backdrop it might be fruitful to revisit quantity theories of money linking monetary aggregates to economic variables like output and price level. Such theories once built the core of monetary policy but became less important towards the end of the 20th century as the once stable empirical relationship between monetary aggregates and nominal GDP broke down. Yet, to date, no consensus has emerged amongst economists on how to explain this breakdown.

In order to understand what went wrong, we will step back and look at the origins of quantity theories of money. While revisiting these theories, we will focus on how the different theories define their variables and how these variables are measured in empirical work. We will show that theories sometimes do not state very clearly how the different variables should be measured and that empirical work often uses proxies for variables without sufficient justification.

These observations seem surprising at first glance, since Schumpeter already said that quantity theories of money should naturally define their concepts and empiricism in a precise way:[2]

> "[...] the obvious vicinity of its concepts to statistical material forces theorists to do what without this compulsion they often fail to do, namely, to define their concepts accurately and operationally" (p.1062, Schumpeter (1954))

The main idea of this paper is that a large part of the empirical work measures something very different from what is suggested by the theories they rely on. More specifically, many theories agree that money is, probably not uniquely, but definitely to some extent, needed for economic transactions. When economic activity is measured, however, scholars generally use GDP as a proxy, whereby effectively ignoring non-GDP transactions.

This paper attempts to answer the question of whether non-GDP transactions can explain the decoupling of M1 respectively M2 and nominal GDP. In particular, it will investigate whether non-GDP transactions can explain the decline in velocity in Germany and Italy since 1980. In order to do so, problems using the conventional proxies and solutions are discussed that might help bring monetary aggregates as well as its natural counterparties, namely credit aggregates, back to the economic stage.

This paper is organized as follows: section 2 reviews the rise of quantity theories of money by looking at Fisher's approach, the Cambridge school represented by Pigou's work and finally Friedman's version of the quantity theory of money. Section 3 summarizes the fall of the quantity theory of money both empirically and because of theoretical criticism of QTMs. Section 4 presents mainstream approaches that try to fix QTMs. Section 5 discusses the role of non-GDP transactions in explaining the decoupling between money and GDP, and section 6 applies the quantity theory of credit to Germany, Italy and Switzerland. Section 7 concludes.

2 Rise of the QTM: Three origins

In this section we present three early theories that use different quantity equations of money. We will show on which assumptions the theories are based and will put particular emphasis on analysing how the single components of the theory are defined and later on measured empirically. We will first

[2] See Schumpeter (1954)

present the influential work of Fisher (1911) who builds upon the equation of exchange and emphasizes the role of money to make transactions. Secondly, we will see how Pigou (1917) derives a different quantity equation focusing attention on money as a store of value. Finally, we will look at the work of Friedman (1956, 1973) who developed the probably most prominent contemporary quantity theory of money. Friedman treats money like any other asset in a portfolio optimization problem.

Note that the focus of our work here is not so much on implied causalities of the different theories, although those causalities, i.e. the predictability of inflation, is highly relevant for monetary policy. Instead, we will restrict ourselves to taking a closer look on what kind of equation the different theories imply and how the different components of the equation are measured in empirical work.[3]

In this sense, we look at an empirical aspect of QTMs that Schumpeter, as well as other critics, was aware of but often did not look at as closely.[4]

2.1 Fisher or the classical Quantity Theory of Money

2.1.1 Fisher's theory

Fisher (1911) builds his work upon the equation of exchange

$$MV + M'V' = PT \tag{1}$$

where M is the amount of coins and notes in circulation, V the velocity of circulation of M, M' is the amount of deposits subject to check, V' the velocity of circulation of M', P the price level and T are all economic transactions. The velocity of money is the rate of turnover per annum.

Fisher (1911) correctly states that "[...] it is true that the equation does not enable us to judge which of the magnitudes in it are causes, and which are effects." Indeed so far equation (1) is an identity without any causal implications - it is thus not yet a theory.

Fisher (1911) argues that an increase in M is followed by a proportional increase in P. Which assumptions are needed for this theory? First he assumes a constant V in the short-run by arguing that V depends only on the institutional framework (e.g. population density, habits) and is not affected by monetary expansion. Second, Fisher argues that T does not depend on the price-level P nor on the amount of money M. Instead, T is determined solely by "real" factors like the technological level.

In his point of view, P is the only variable not exogenously determined. Under these assumptions, the price level P is thus equal to a constant times the amount of money M. Put differently, money is neutral as it only affects the price level. According to Fisher, the only purpose of money is its use in transactions. Once a person has more money, he or she will use the money to buy goods and services and not leave it under his pillow. There is thus no use for money as a store of value in this theory. Fisher's theory is hence a theory of the price level P assuming M, V and T being determined exogenously:

$$P = (MV + M'V')/T \tag{2}$$

Although this equation is simply a rearrangement of the equation of exchange, the theoretical considerations can now be used to read it differently, with a causal direction: given values of M, V, T determine a price level P. Keeping these theoretical ideas in mind, a closer look on how Fisher estimates the theory empirically can be taken in the next section.

2.1.2 How Fisher's theory is tested

How do Fisher and his contemporary peers measure the predictions of their theory? Fisher (1911) calculates P according to equation (2) and subsequently compares the value with the standard statistics for the price level. It is thus important to understand how Fisher measures M, M', V, V' and T. These measurements are described in his book "The purchasing power of money" (Fisher 1912). The

[3] In section 5 and 6, we will attempt to find better proxies for Fisher's equation of exchange - an equation that holds true by definition without implied causalities.

[4] See for example Schumpeter (1954), p.1062: "«We cannot discuss or even list, but can only point to, all the problems that lurk behind the question which prices should, for the general purposes of the equation of exchange, be included in P, and consequently which transactions in T."

measurement of M and M' are not very problematic - but the measurements of T, V and V' deserve closer attention.

How can T be measured, i.e. the number of all transactions in the economy? Fisher admits that this is difficult and states that he is thankful for the work of Mr. Griswold who created an index of the volume of trade i.e. an index for T.[5]

The measurement of the velocities of money V and V' are particularly interesting because in the recent literature, the velocity is, to the knowledge of the authors, never measured directly, but always calculated from other variables in the associated quantity equation. Fisher (1911), however, calculates the rate of turnover of money directly. How is this possible?

Fisher (1909) describes a way to back out the velocity of coins and notes by using bank account data as well as data for wages. Today, however, wages are rarely paid in cash and the amount of coins and notes is small compared to the amount of deposits. Since this paper ultimately aims to comment on empirical measurements after the second world war, the measurement of the velocity of deposits subject to check is more interesting for our purposes: To measure the latter one, Fisher builds upon the work of Essars (1895) who presents directly measured numbers for the velocity of "the money employed in the bank" (Essars 1895). The idea is straight forward once one takes a closer look at what happens at a bank during economic transactions: If credit is defined as the amount of funds received at a bank account, a fraction of this credit can be transferred to another bank account via a clearing system. The amounts paid by such a transaction, e.g. via a check, are called debit. Finally, the balance of an account is defined as the sum of all credits minus all debits. A debit and the associated credit represents a completed payment between two individuals.

Based on this, Essars (1895) therefore concludes: "La demi-somme des crédits et des débits annuels est égale à la quantité de mouvement du solde moyen de l'année" (Translation of the author: "Half the sum of the total annual debit and credit of a bank expresses the yearly quantity of movement of the average balance.") Put differently, the velocity of deposit money i.e. the turnover per currency unit is thus

$$V = \frac{D + C}{2 * S} \tag{3}$$

where D is the total annual debit, C the total annual credit and S the average account balance. Essars (1895) calculates the velocity for non-interest bearing accounts as well as for interest bearing accounts for 1884-1894 for several countries. The data are provided by the central banks who act as clearing houses between commercial banks - very much like today. The measurement of V is surprisingly simple and, more importantly, it is exact and not an approximation.

To the knowledge of the authors, nobody in the recent literature used this method to calculate V, which is surprising. Why? The reason today is probably the same as the reason over 100 years ago given by Essars (1895) who did not include data for the United States and England: Essars himself wanted to calculate V for those two countries but the associated central banks did not publish the data. It might be interesting to consult this data again today and verify whether the simple method to calculate V could be applied.

Note that the way Essar calculated V, all kinds of financial transactions that are made via bank accounts are included - not only 'GDP-transactions' (compare section 5). Before coming back to Fisher's measurements, we quickly want to mention the empirical findings of Essars (1895): "the velocity of movement reaches a maximum at the moment a crisis appears and a minimum at the point of liquidation". This finding is interesting because it matches our more recent estimates (see section 6), where V is not decreasing in normal economic times.

Having discussed Fisher's (1911) empirics, his findings can be summarized as follows: The price level P which is measured directly and the one measured indirectly correlate very well. Furthermore V is found to be relatively constant in the United States between 1896 and 1909.

[5] Looking at this index in more detail might be fruitful, but is currently beyond the scope of this work.

Before moving on to discuss the Cambridge quantity theory, note that section 4 will show that part of the modern empirical literature on monetary aggregates uses Fisher's theory to motivate the empirical work, but afterwards uses GDP as a measurement for T without providing sound justification.

2.2 The Cambridge Equation

2.2.1 The Cambridge Equation theory

Another popular version of the quantity theory was developed in Cambridge. Pigou, who was part of this school of thought, defines money as legal-tender money. He emphasizes the need for money to make transactions but also "to secure [the agent] against unexpected demands" (Pigou 1917). He thus stresses that money is also used as a store of value with high liquidity. Money provides convenience and security. Pigou (1917) argues that people want to hold a constant fraction of the real value of all commodities in money. The demand for real money, defined as M^d/P is thus a constant times the amount of all resources R. The Cambridge equation of money demand is thus formally

$$\frac{M^d}{P} = k * R \tag{4}$$

where M^d is the demand for money, P the price level, k a constant and R the "total resources, expressed in terms of wheat, that are enjoyed by the community" (Pigou (1917)). The constant k is determined by the convenience obtained from holding money, the risk from holding only a fraction of his wealth in the liquid form of money and the opportunity cost of holding money as money could be used for productive purposes instead.

In order to find the equilibrium, an equation for the supply of money is needed. While Pigou (1917) discusses several supply equations, they all share the idea that some institution can set the supply of money at a desired level. A constant money supply M shall therefore be taken and in equilibrium it thus holds that M = P∗k∗R. The link to the equation of exchange is straight forward if equation (1) is solved for M/P :

$$\frac{\mathrm{M}}{\mathrm{P}} = \frac{T}{V} = k * R \tag{5}$$

or kV = T/R. If the total amount of financial transactions T is assumed to be proportional to the total resources R, i.e. if a constant T/R is assumed, it can be followed that kV is also constant. Pigou (1917) concludes that "when people decide to keep half as much of their resources than before in the form of titles to legal tender, this means that the velocity of circulation is doubled".

Pigou claims to provide a more intuitive equation, because k has a direct economic interpretation resulting from the microeconomic behaviour of agents, while the velocity V in Fisher's approach does not have this direct interpretation. Under the assumption of T/R being constant, the classical quantity theory and the Cambridge theory are not in conflict. However, Pigou (1917) emphasises that the agent chooses to hold a certain fraction of all resources in money as opposed to Fisher, who emphasises the role of money for transaction purposes only. Assuming exogenous k and R, the Cambridge equation also states a proportionality between the amount of money M and the price level P. Put differently, demand for real money is a function of resources. A change in M will be reflected by a proportional change in the price level.

2.2.2 How the Cambridge Equation theory is tested

When the Cambridge equation is estimated empirically, two issues deserve closer attention. First, we have just shown that the Cambridge equation is identical to Fisher's equation of exchange - if the Cambridge assumptions of real money demand being a constant times the available resources is assumed. The empirical measurement of the Fisher equation has already been discussed in the previous section. If V is assumed to be relatively stable, equation (5) directly gives us a proportional relationship between all resources R and all transactions T.[6]

Second, researchers often summarize Pigou's theory referring to PR as the nominal income instead of the nominal resources (see for example Sriram 1999). In a next step the nominal income is then typically measured with nominal GDP. Note, however, that income from house sales or financial speculation is not included in nominal GDP, as will be shown in detail in section 5. Two simple steps, first replacing the theoretical concept of "all resources" with nominal income and second, replacing nominal income with nominal GDP, can therefore move the empirics too far away from the theory.

2.3 Friedman

2.3.1 Friedman: The Quantity Theory of Money (QTM)

Finally, we will take a closer look at the Chicago version of the quantity theory of money, which is probably the most prominent version these days. The theory proposed by Friedman (1956) follows the Cambridge school in the sense that the theory is first of all a theory of the demand for money - people demand money as a store of value or to use it as a source of productive services. Money is treated as an economic good like any other commodity and its price is determined by supply and demand. The demand for money is now a function that depends on the agent's total wealth, on the prices and returns and degrees of liquidity of the different financial assets (money, bonds, stocks, goods and human capital) and on the individual preferences. The optimal amount of money an agent should hold is basically a portfolio optimization problem. Friedman (1956) proposes the following money demand equation

$$\frac{M}{P} = f(r_b, r_e, \frac{dP}{dt}\frac{1}{P}, w, \frac{Y}{P}, u) \tag{6}$$

or

$$\frac{Y}{M} = V\left(r_b, r_e, \frac{dP}{dt}\frac{1}{P}, w, \frac{Y}{P}, u\right) \tag{7}$$

where r_b is the bond yield, r_e the yield of equity, P the price level, w is the ratio of non-human to human wealth, u reflects the individual taste of the agent and Y is an index of wealth. Note that Friedman's theory - as opposed to Fisher's theory - does not include a variable T representing all transactions in the economy. Friedman does not use an equation that holds true by definition, but directly claims that the money demand depends, amongst other things, on a measure Y of the agent's wealth.

The idea is again that the money supply can be set by an institutional authority. A change in the money supply then initiates a change in prices and interest rates[7] - but ultimately, after some adjustment has taken place, neutrality in the sense of PY/M = V is restored. Hence, in the short-run, this theory predicts that if money supply goes up, inflation and real output (the latter one only changes if there is an output gap) will go up - often referred to as the Friedman-Schwartz stylized facts. In the long-run, however, money does not matter.

The important assumptions as stated by Friedman and Schwartz (1982) can thus be summarized by:

1) The demand for money is the demand for real money
2) The demand for real money is relatively stable
3) The supply of nominal money is independent of money demand (and determined by some monetary authority)

[6] However, in an economy becoming more capitalistic and vertically integrated, transactions T might increase faster than R.

[7] 'The transmission mechanism we have stressed can be described as operating through the balance sheet and through changes in interest rates', Friedman and Schwartz (1982)

This theory became very influential, often under the name monetarism, and became a key pillar of monetary policy.

2.3.2 How Friedman's theory is tested

In the previous section we have shown that one crucial assumption in the QTM, as stated by Friedman and Schwartz (1982), is that money demand is relatively stable, or that V defined by

$$V = PY/M \tag{8}$$

is relatively stable. The velocity V=PY/M can thus be calculated and it can be checked if it is relatively constant in order to support the theory. How did Friedman and his peers measure V? Selden (1956) measures V according to equation (8) in order to support Friedman's theory. The important question is once again: Which proxies are used? Selden uses M1 for M and national income data for the wealth index Y in Friedman's theory. Friedman (1956) does not question this method and thus implicitly agrees with Selden's method. Note that the QTM does not need the amount of all transactions T as opposed to Fisher's theory, which is based on the equation of exchange. The QTM needs an index for wealth and Selden (1956) chooses the national income to approximate this index of wealth. Along those lines, Schwartz (1973) looks at a sample with 40 countries over the period 1952-1969 and measures V. Money is again measured by cash plus demand deposits and Y is measured by national income data. Schwartz plots the rate of change in P and rate of change in M per unit of output. The data fit the angle bisector (where an x per cent change in P is associated with an x per cent change in M) with a R-squared of 0.942.[8]

Similarly, Friedman and Schwartz (1982) confirm the hypothesis that money demand is a stable function of income and interest rates using US data. Since then, a huge empirical literature has evolved. As an example we will consider Hallman et al (1991), who show that inflation and the monetary aggregate M2 (currency plus liquid balances and retail time deposits) are correlated in the long-run. Using GNP for Y and M2 for M Hallman et al (1991) find that the velocity is relatively stable in the US between 1955 and 1988.[9] These results made the QTM famous and rendered it a key element of monetary policy. Monetary aggregates served as the leading indicator for subsequent levels of inflation. In the next section we will show how the empirical evidence in later years questioned the QTM empirically – while theoretically, the QTM had already been criticized for a long time.

3 The fall of the QTM

3.1 Mainstream empirics

Starting in the 1970s and 1980s the empirical literature finds that monetary aggregates do not always move along very well with inflation. A famous article is Goldfeld (1976)'s "The case of the missing money", in which the author attempts to explain a shortfall in money demand and admits that he did not succeed in explaining it. Since then a huge empirical literature has evolved.[10] As an example, we want to mention recent results by De Grauwe et al (2005) who look at cross-sectional data, i.e. 160 countries over 30 years and find only a weak relationship between inflation and money growth once high-inflation countries are excluded.

Which theory do the authors have in mind and which data do they use? They start with Friedman's theory but directly use real output for the Y in Friedman's money demand equation.[11] Furthermore, M1 and M2 are used for M and the consumer price index for P.

De Grauwe et al (2005) conclude that inflation and output growth are exogenously driven phenomena for low inflation countries. As a consequence of such empirical studies, the QTM lost importance since the 1980s. Blinder (1999) observes that "no sturdy long-run statistical relationship

[8] This result might rely on the inclusion of hyperinflation countries: De Grauwe et al (2005) also find a stable relationship between money growth and prices for a different time period - but once hyperinflation (more than ten per cent inflation) countries are excluded, the relationship breaks down.

[9] The velocity however becomes more volatile shortly after 1988.

[10] See De Grauwe et al (2005) for an overview.

[11] As has been shown above, Friedman originally proposed Y to be a measure of wealth without being precise on how it should be measured.

exists between nominal GDP and any of the Federal Reserve's three official definitions of M for any sample that includes the 1990s."

This inability to identify stable relationships between monetary aggregates and nominal GDP led to a loss of importance of the quantity theory of money and is reflected in the behaviour of central banks, which no longer targeted monetary aggregates. In the United States, the target growth rate for M1 was formally dropped in 1987. Moreover, in 1993, Greenspan announced that less weight is given to monetary aggregates as guides to policy. Instead, interest targeting monetary policies won the race i.e. economists focused on the interest channel to target inflation or nominal GDP.[12]

3.2 Credit theory of money

The empirical collapse of the QTM should not have been surprising, because theoretically the QTM was criticized and refuted much earlier. However, this theoretical criticism was apparently not successful in burying the QTM. As we will see in chapter 4, this theoretical criticism did not reach the mainstream even after the empirics stopped to seemingly support the QTM. Instead, the mainstream tried to or tries to save the QTM by various modifications. So what was the old-fashioned criticism of the QTM?

The main criticism of the QTM or monetarism is that M is not exogenous because the central bank does not control the amount of money mechanically. In other words, M in the equation of exchange is endogenous and cannot be separated from output (the "reverse causation argument"). Output and money might rise due to entrepreneur's borrowing for productive investments, or prices might rise due to money printing in supply-constraint economies. Or, if new money is directed towards non-GDP transactions and does not boost actual output via productive investments, consumer prices might not be affected, but asset prices might rise.

As described by the Bank of England (McLeay et al 2014), the majority of money is created by commercial banks making loans. Indeed, whenever a commercial bank provides a credit, new money is created.[13] This empirical fact has already been observed by Keynes, Schumpeter and Minsky. Schumpeter (1954) argues that if an element of the equation of exchange is to be explained, say the price level, "the others drop naturally (though illogically) into the role of its 'causes'—and the Equation of Exchange, in itself nothing but the statement of a formal relation without any causal connotation, then turns or may turn into the Quantity Theory." (p. 1062). Schumpeter consequently rejects the quantity theory of money: "Without a meaningful measure of the supply of money, the quantity theory of money and all of the associated apparatus surrounding must also be abandoned." We agree with Schumpeter's credit theory of money, although "the associated apparatus" should not include the analysis of the equation of exchange because, as we will see in section 4 and 5, looking closer at different economic transactions can shed light on macrofinancial developments.

Besides criticizing the determinant of M, the mechanism by which prices change in the QTM has also been rejected. For the most part, monetarists did not have a short-run or microeconomic price theory (See Goodfriend and King 1997, part 3.2). For monetarists, prices adjust according to the equation of exchange with M being exogenous and V being mostly stable.[14] In contrast, Gardiner C. Means (1935) emphasizes pricing outside markets done through strategic decisions: "a price which is set by administrative action and held constant for a period of time." In contrast, a market price is made from the interaction of buyers and sellers. Building upon these distinctions, Nicholas Kaldor (1976) argues that, in the primary sector, the market price is given to the individual producer (e.g., a certain corn price), and pricing works as described by Adam Smith: Changes in prices act as signals to increase or decrease production. However, in the industry sector, prices are administered. Production is

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[12] Consider for example the influential work of Woodford (2003) where money does not play any role and which quickly became the standard reference for monetary policy. See Senner and Sornette (2019) for a critique of interest rate based monetary policies.

[13] Note that this view contradicts the wide held belief that banks need savings/deposits first in order to then lend them out again, i.e. contradicts money multiplier theories.

[14] Neoclassical economists later on filled this gap by postulating that the price is set so that marginal returns equal marginal costs, building on the marginal revolution in economics from the late nineteenth century. However, John Maynard Keynes (1939) argues that it is "rare for anyone but an economist to suppose that price is predominantly governed by marginal cost."

dominated by large corporations, which set prices, and they are therefore cost-determined, not "market-determined." Luigi L. Pasinetti (1981) also finds that "prices are completely determined by labor costs", which is not surprising because labor costs are, from a global perspective, besides raw materials the only cost factor to firms.

More recently, Lavoie (2001) argues that "firms fix prices based on some measure of costs, rather than as a reaction to demand fluctuations." See also Alfred Kleinknecht and Robert Vergeer (2014) for a recent contribution regarding the markup pricing theory, as well as Senner and Sornette (2019) for a more detailed discussion of the role of labor costs in explaining inflation.

4 After the fall: Mainstream approaches to fix the QTM

The once stable relationship between money growth and inflation or nominal GDP broke down. We have seen that this empirical decline was not surprising from a theoretical point of view. However, the theoretical critique in the spirit of Keynes and Schumpeter was not heard by the mainstream, even in the aftermath. How did the mainstream deal with the empirical results?

In this section we will briefly review the mainstream literature on monetary aggregates. We show that there is substantial discussion and not yet a consensus on how to treat and evaluate quantity theories of money.

The crucial questions will be: Which theory do the authors have in mind and which proxies do they use in order to check the theory? We will for example show that many authors use GDP in their empirical work. The question will then be, whether the theory used by the author indeed needs GDP or rather the total number of economic transactions or rather a measure for the agent's wealth - and whether the author convincingly justifies the use of GDP as a proxy.

Broadly speaking, there are two approaches to 'fix the quantity theory of money': The first approach is to argue that a modified theory is needed that can explain the decoupling of money and inflation. The second approach is to argue that, for example due to financial innovation, it became increasingly difficult to measure the variables used in pre-existing theory - and that it is therefore needed to work on finding and compiling different data.

Overall we will see that much work has been devoted to measuring monetary aggregates differently and to explaining variations in the velocity of money. Yet, these attempts have not provided conclusive answers. Along these lines, N. Gregory Mankiw and Ricardo Reis (2018) recently summarized the state of the art of the mainstream and explained why monetary targeting is not a good strategy: "The economy is subject to many types of shocks, such as oil price changes, financial crises, and shifting animal spirits of investors." Put differently, targeting M is supposed to be a bad idea because the velocity of money is unstable, and because real GDP is unpredictable. While the just mentioned economic shocks clearly matter, Mankiw and Reis (2018) fail to mention why other economists have been rejecting the theory for over a century now, as discussed in section 3.2.

4.1 Mainstream approach I: A modified theory can explain the volatility in V

One part of the literature argues that the empirical de-coupling between money growth and inflation is logical and can be explained applying different (new) theoretical considerations. In the spirit of Fisher, authors like Hallman et al (1991) try to explain the volatility in the velocity with institutional changes. Makram et al (2010) distinguish between changes in velocity that are due to institutional developments and changes that reflect movements in money demand. It is argued that a velocity decline could be due to increased risk aversion of banks. Other attempts to explain the velocity of money include DSGE models like the one studied in Benk et al (2009). Here the authors set up a model with shocks to good and credit productivity. This model is then used to back out the necessary shocks which then finally fit the data by construction. Yet other authors re-interpret the monetary aggregate M: Svensson (2003) argues that M is an indicator of inflationary pressure and does not have to co-move with inflation.

Another important part of the literature argues that the correctly specified money demand function is still stable, but does not only depend on GDP but also on other factors. Traditionally, in the spirit of Friedman, the money demand function includes GDP and often also short- and long-term interest rates. The latter ones are included to capture the opportunity cost of holding money. When money demand functions specified in this way were no longer stable, researchers added new variables hoping that they could explain the volatility in money demand – continuously ignoring the endogeneity of money as discussed in section 3.2. Stock et al (2003) for example try to use asset prices to predict inflation. The authors find that some asset prices have statistically significant predictive power for output and inflation for some countries for some time periods. This idea is in line with Friedman's argument and says that asset prices should also be included to get a good proxy for wealth. Money demand is then higher if asset prices increase. Similarly, Santis et al (2010) try to explain the unstable money demand not only by including asset prices but also by adding a second country and setting up a portfolio allocation model where agents choose to hold more money to make the portfolio less risky. Including these new factors, the authors find a relatively stable money demand.

Along those lines, Dreger et al (2009) try to explain the empirical fact that in the Eurozone before 2001 the standard money demand function, which includes GDP and short-and long-term interest rates only, is relatively stable, but breaks down afterwards. The authors basically regress the velocity on wealth, defined by stock and house prices, and can thereby explain the velocity. Rising stock and house prices correlate with a decline in the velocity. Hence, in this view, increasing wealth leads to higher money demand, an argument already made by Pigou (1917) and Friedman (1956).

4.2 Mainstream approach II: Better empirics can explain the volatility in V

A second stream in the mainstream literature argues that a decoupling between M and, depending on the theory in mind, nominal GDP, wealth or the amount of transactions, does not make sense theoretically and that consequently the proxies used for M must be misleading.

Interestingly, to our knowledge, there have been no attempts to find better ways to measure the amount of economic transactions in the economy, following Fisher's approach. In this section we will therefore only present attempts to find explanations for the idea that the usual monetary aggregates M1, M2 or M3 cannot be used as appropriate proxies, or have to be re-interpreted once used. So basically, this literature always works with GDP as a proxy for the associated variable in their theory and focuses only on a variation of M.

The most popular idea related to the difficulty of measuring monetary aggregates is the one that financial innovations make it difficult to find appropriate proxies for 'money'. Greenspan (2003) argues along those lines but does not propose a way to solve this problem. Instead, he proposes to bypass the problem by no longer putting strong emphasis on monetary aggregates but instead on interest rates. Different authors propose specific ways to construct new monetary aggregates: Along these lines, Aksoy (2006) corrects the widely used aggregate M1 in the United States for dollars held abroad and finds that domestic money predicts inflation and output to some extent.

Similarly, Lucas et al (2015) create a new monetary aggregate which performs better than the traditional M1 for the period 1915-2012 in the United States. In 1980, a new regulatory framework was introduced that allowed banks to pay interest on personal checking accounts. These new accounts, called NOW accounts, are not included in M1. The newly constructed aggregate NewM1 therefore includes cash, traditional checking accounts but also NOW accounts. The authors conclude that "[the] new aggregate does about as well on low and medium frequencies over the period 1915-2013 as M1 did from 1915 to 1990, and about as poorly on high frequencies".

Finally, we want to review a literature that also proposes a different measurement of money, but in a more fundamental way: Werner (1997, 2005) proposes a new 'Quantity Theory of Credit' which is based on the idea that i) money can be used for transactions not included in GDP and that ii) money is mainly created by commercial banks, in line with the credit theory of money presented in section 3.2. Werner (1997) applies his theory to the case of Japan in the 1980s and 1990s and finds that his newly defined velocity of money respectively credit used for GDP- transactions is stable.

Since then, the theory has, to our knowledge, only been applied to Iceland (see Sigurjonsson 2015). In the next section we will build on the Quantity Theory of Credit (QTC), discuss it in detail and apply the theory to the case of Germany, Italy and Switzerland in section 6.

5 Towards a new approach: Theoretical considerations

In the last section we have shown that a consensus has not yet emerged in the mainstream literature on how to explain the decoupling of monetary aggregates and inflation. In this section, motivated by the idea to measure components of the equation of exchange in more detail, we will end up having a closer look at credit creation as well as at the separation of credit into productive and non-productive credit. This credit theory of money as well as the functional separation of credit is connected to at least four streams in the economics literature.

First, credit creation is important in the finance and economic growth literature, which goes mainly back to Schumpeter (1911, 1954). Bezemer (2012) builds on Schumpeter and shows how central the functional separation of credit is to understand GDP growth as well as speculation. Callegari (2018) investigates the role of credit creation in innovation and Bofinger et al (2021) shows that credit growth supports GDP growth.

Second, strongly related to this literature and motivate by the US housing bubble, there is growing interest in analyzing mortgage credit separate from other forms of credit. See for example Bezemer (2020), Jordà et al (2016) and Mian et al (2017) for how mortgage growth can have limited or negative effects on growth and also drive housing crises.

Third, different forms of credit flows and stocks become more important in the asset pricing literature, whereby money creation for speculative purposes tends to increases certain asset prices while leaving the real economic fundamentals unchanged (see for example Fabozzi et al 2017 and Gabaix and Koijen 2021 for recent work in this direction).

Finally, with the growing political importance of financial stability after 2008, credit-to-GDP-ratios have become the most widely used indicator to guide macroprudential policies. The Basel Committee for Banking Supervision (BCBS) singled out the credit-to-GDP gap put forward by the BIS as a useful guide for making countercyclical capital buffer decisions (BCBS, 2010, see also Hiebert et al 2020 for more recent work in this field). Note that we will later on procy productive money with productive credit, and divide GDP by this productive credit to get a more accurate estimate of the velocity – this velocity is then nothing but the inverse of a credit-to-GDP ratio. It appears therefore useful to connect these different streams in the literature to avoid duplication of work and the repetition of mistakes.

5.1 The hypothesis: Non-GDP transactions are responsible for the decoupling between M and PT

We argue that once the amount of money M and the amount of all transactions T is measured correctly, a velocity, i.e. a ratio of PT divided by M can be calculated that is relatively stable or at least does not decline in normal economic times or during an economic boom. Indeed, we argue that an increasing velocity could be reasonable in the absence of an economic recession - motivated by the fact that Essars (1895) observed an increase in the velocity during booms.[15] The key idea and our hypothesis is that the velocity, measured traditionally, ignores the fact that money can be used for transactions that are not included in GDP - an idea that will be discussed in detail at a later stage.

As opposed to these theoretical considerations we have depicted in section 4 that conventional measurements of V indicate a decline in V during normal or good economic conditions. Indeed, Werner (1997) observes a decline in the traditional velocity in Japan during an economic boom. Furthermore Sigurjonsson (2005) observes that growth of M2 is significantly higher than the growth of inflation in Iceland since the 1990[16] and at relatively extreme high rates in the years before the financial crises. Similarly, Dreger has shown that the velocity in Europe has declined since 2000 (see Dreger et al 2009). Finally, we want to introduce the examples of Germany, Italy and Switzerland in more detail in section 6. Figure 1 shows the velocity in these three countries since 1980 respectively 1995, which has gone down continuously. We calculated the velocity traditionally by dividing nominal GDP by M2.

So how can one test if our hypothesis is correct, namely that transactions not included in GDP are responsible for the decline in velocity? One way is to assume that V is constant, and then argue that if V goes down, this indicates that money is used for non-GDP transactions. Theoretically, however, there might be several reasons for a decline in V. In order to exclude such alternative explanations as a main driver of the decoupling of money and nominal GDP, we need to find a way to quantitatively test the hypothesis.

One fruitful way might be to revisit the equation of exchange as stated by Fisher (1911) and see if there are alternative, better ways to calculate the velocity of money - either directly or indirectly through a better measurement of the other variables M, T and P.

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[15] Remember that Essars did measure the velocity directly and exactly.

[16] Note that, before 1990, both growth rates move together very closely.

In order to do this we will take a closer look at the single components of the equation of exchange:

$$MV = PT \tag{9}$$

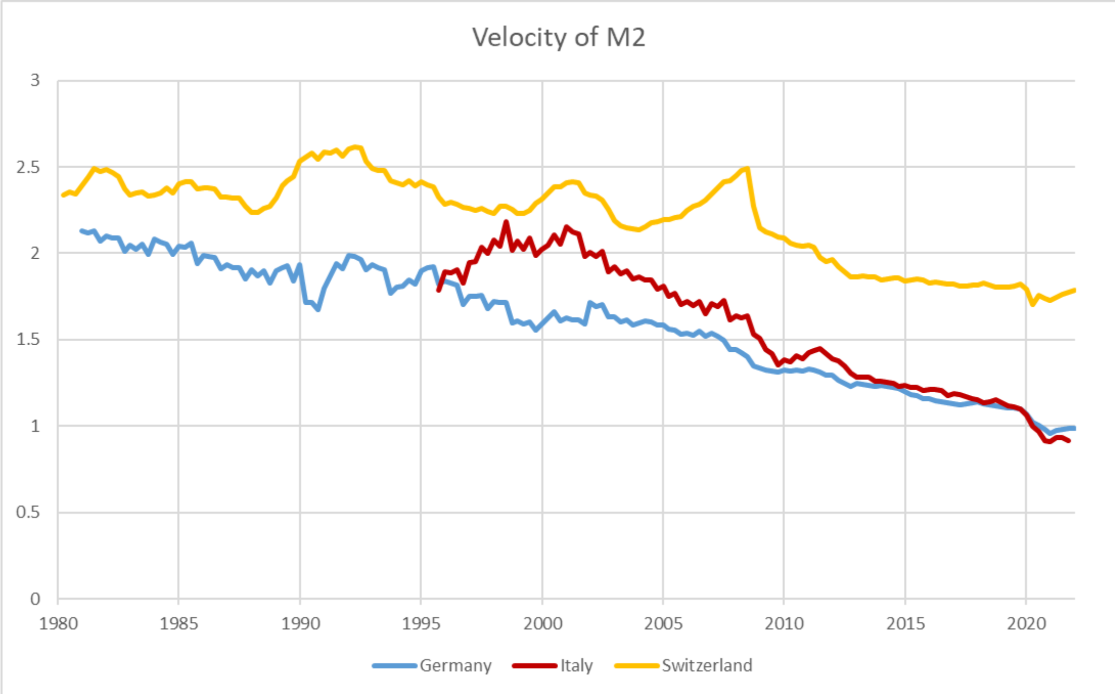

Fig. 1: Velocity M2 for Germany, Italy and Switzerland; quarterly data. Source: Deutsche Bundesbank, SNB, Banca d'Italia, own calculations

Using this identity, we will first discuss how to best measure each single component. Ideally we would be able to measure the left- and right-hand side independently and then compare both measurements. If both sides do not coincide empirically, it can be followed that there is some measurement issue because the equation holds true by definition. We will therefore discuss how the single variables can best be measured and afterwards apply the findings of this analysis to the case of Germany, Italy and Switzerland.

5.2 Masurement of V

Ideally we would like to measure the rate of turnover of money directly, i.e. we would like to know how often an average Euro or Swiss Franc changes hands during one year. Then we would like to have the time series of such a measurement. As mentioned earlier, the large part of our money consists of electronic money at some bank account. In theory, data on all financial transactions made with this money are available, similar to the data used by Essars (1895).

Central banks, which act as clearing houses between commercial banks, should, in principle, possess these data. Unfortunately such data are not publicly available. Consequently, V has to be measured indirectly through the other three variables.

5.3 Measurement of T

Since Fisher's early works, where one of his students created an index for the amount of transactions T, most scholars simply used GDP as a proxy for T. Although it might be possible to develop a new index for all transactions, creating such an index is currently beyond the scope of this research.

At this stage we therefore use GDP, as most people do, but we will adapt the left-hand side of the equation, i.e. we will use a different proxy for M in order to hopefully get a more accurate measurement of V. Although GDP is used extensively, a clear understanding is needed of what GDP is in order to distinguish transactions that are part of GDP and those that are not. In other words, a way to divide the amount of all transactions T into GDP- and non-GDP-transactions has to be known. Once this matter is better understood, ways might be found to adapt the amount of money M later on.

So what is GDP? GDP is a measure of production and refers to the flows of final goods and services produced within one country over the course of one year. The value of those goods and services is defined by final prices as observed in market transactions. For a detailed description on how it is measured, see System of National Accounts (1993).

Note that intermediary goods do not count, only final goods and services. On top of that, the sales of used goods do not count because no value has been added here in the current period. Summing up, the following transactions are therefore not included in GDP:

- intermediary goods sales
- used goods sales
- purely financial transactions
- welfare and transfer payments
- parallel, illegal market activity

Against this backdrop we can now specify what we mean by 'non-GDP transactions': While all of the above mentioned points deserve closer attention, especially intermediary good transactions[17], we argue, very much in the spirit of Werner (1997) and Sigurjonsson (2005), that financial transactions and used goods transactions are responsible for the large part of the decoupling between money and nominal GDP. For simplicity we will refer to these transactions as non-GDP-transactions in the following. Financial transactions include for example the purchase of stock and bonds. Used goods transactions include for example the sales of old cars and houses that have been produced in earlier years. Bitcoin and other used or pre-existing goods can also be attributed to this category.

5.4 Measurement of P

In the equation of exchange, P is defined as the price level associated with T, the amount of all transactions. Since we have chosen to use GDP as a proxy for T, we will measure PT by nominal GDP.

5.5 Measurement of M

Since we chose to use nominal GDP as a proxy for PT, we have to find a different proxy for M in order to hopefully get a better result for V. Note that using M1 or M2 is now problematic if the amount of money used for non-GDP transactions does play a non-negligible part. What could be used as a proxy for M? This is once again a question of available data. Ultimately we want to apply my findings to the case of Germany, Italy and Switzerland, and therefore have to check what kind of data is available.

We would like to know where the money comes from and for what kind of transactions t the money is used. Ultimately we would then take the total amount of money used for GDP-transactions as a proxy for M in the equation of exchange.

The approach proposed by Werner (1997), namely using GDP-credit as a proxy for M, is helpful in this regard. In order to see why it might make sense to use the amount of credit as a proxy for money, let us quickly recap section 3.2, where we described that money is credit through bank credit. Werner (1997) argues that the sort of credit provided by commercial banks allows us to infer if the newly created money is used for GDP- or non-GDP transactions. On the one hand, a credit to a medium-sized firm is for example defined to be a GDP- credit because it is expected that this firm will use the money to pay wages and invest in physical capital. On the other hand, a credit given to a speculative firm investing in real estate is called a non-GDP-credit because this firm is expected to use the money to speculate with pre-existing real estate; and the purchase of pre-existing real-estate is not included in GDP. Another stylized example might illustrate the core idea: If one group of agents borrows large amounts of money to trade financial products with claims to existing assets amongst themselves, new money has been created but this new money does not appear in any GDP-relevant transaction. Instead, the newly created money circulates in an economic area where no new goods and services are produced. This newly

[17] This point seems to receive remarkably little attention in the literature. It appears very reasonable that as an economy moves towards a more capitalistic, vertically integrated one, the number of intermediary transactions increase relative to GDP. Nevertheless, motivated by the work of Werner (1997) and Sigurjonsson (2005), we will put our attention on financial and used goods transactions.

created money only enters the 'real economy' once financial speculators buy increasing amounts of consumer products - which in the case of Iceland has been limited to few luxury goods.

Nevertheless, money created for financial speculation might eventually end up in the 'real economy' at a later stage - and vice versa: money created for productive investment purposes might enter the non-GDP area once a firm owner for example uses his profits for financial speculation. A more detailed theoretical discussion of this aspect lies out of scope of this research. However, we point the reader to dynamic models which include the financial and the real sector to investigate this interaction in more detail (see for example Godley and Lavoie 2007 and Senner and Sornette 2018).

With these shortcomings in mind, we will use GDP-credit as a proxy for money used for GDP transactions as it appears reasonable in a first approximation.

5.6 The Quantity Theory of Credit

The objective is to apply Werner's Quantity Theory of Credit to Germany, Italy and Switzerland. Before doing so in the next section, we will take a closer look at the so-called Quantity theory of Credit: Following Werner (1997) we divide the total amount of credit C into credit C_R provided for the 'real' economy i.e. for economic activity related to GDP, and into credit V_F used for financial transactions:

$$C = C_R + C_F \quad (10)$$

Focusing on the GDP-part of the economy, the following equation can thus be formulated which is at the core of the Quantity Theory of Credit:

$$C_R * V_R = P_R * Y \quad (11)$$

or

$$V_R = \frac{P_R * Y}{C_R} \quad (12)$$

where V_R is the velocity of credit-money used for GDP, and $P_R * Y$ is nominal GDP. The advantage of this equation is that it does not look at the total amount of money, but only at money used for GDP which is proxied by the GDP-credit. Our original hypothesis of non-GDP transactions explaining the decoupling of M and nominal GDP (or put differently, of the velocity not going down in normal and boom times) can now be restated: Our hypothesis is that V_R does not go down in normal times.

Before applying the quantity theory of credit empirically, let us briefly mention that this theory is very much in line with the previously discussed credit-view literature, where credit creates money, and matters for GDP as well as speculative asset prices.

Interestingly, the QTC also offers alternative explanations for the empirical findings mentioned in the mainstream literature in section 4: The finding that rising asset prices predict inflation to some extend (Stock et al 2003), goes along well with the quantity theory of credit: rising asset prices might reflect the fact that more (newly created) money is used for non-GDP asset-transactions and thus the increasing amount of money is necessary to make those transactions feasible, without affecting nominal GDP. Similarly, Dreger et al (2009) show that rising asset and house prices can explain the declining V in the Eurozone. Dreger et al (2009) argue that rising asset and house prices reflect increasing wealth of the agents who then want to hold more money. This theory fits the data but might not be the exclusive explanation: The quantity theory of credit would again argue that an increasing amount of money is needed for non-GDP transaction and not as a store of value for wealthier individuals.

6 Application of the Quantity Theory of Credit

In this section we apply the Quantity Theory of Credit to Germany, Italy and Switzerland. Taking a European perspective, we choose Germany because it is the largest economy of the European Union. We choose Italy for two reasons. First, it is also a major economy of the EU and second, in contrast to

Germany, Italy experienced large current account deficits in the past. Finally, we added Switzerland to the sample as a small open economy to see whether the quantity theory of credit does also apply here.

We calculate the velocity of money according to equation (12). We use the amount of total loans to domestic non-banks and total loans to banks as C. C_R, the amount of credit to the 'real economy', can be calculated via

$$C_R = C - C_F \tag{13}$$

where C_F is the amount of credit-money used for non-GDP activity. In the nominator of equation (12) we use nominal GDP minus net-exports. We exclude net-exports in order to get the best measure of the transactions within the respective country, excluding the effects of foreign money creation used to pay for current account surpluses.

6.1 Germany 1980-2015

In this section we apply the Quantity Theory of Credit to Germany. We use lending to housing firms, lending to financial institutions, lending to holding companies as well as mortgage loans to domestic enterprises and residential individuals as a proxy for C_F.[18] Unfortunately, these data are not available prior to 1980. We therefore use quarterly data starting in 1980 until the fourth quarter of 2021.

Figure 2 shows the time series of the velocity of GDP-credit as well as, once again, the velocity of M2. Contrary to the velocity of M2, the velocity of GDP-credit does not show a clear downward trend. Indeed, the velocity of GDP-credit looks relatively stable over the period considered. The series only shows higher volatility around 1990, which might be due to the German reunification and again in 2020 due to the Covid-19 pandemic. Interestingly the GDP-credit velocity started to increase in the early 2000s and did increasingly so after the global financial crisis. One explanation is an increase in construction sector activity, which might explain the relative increase in nominal GDP.

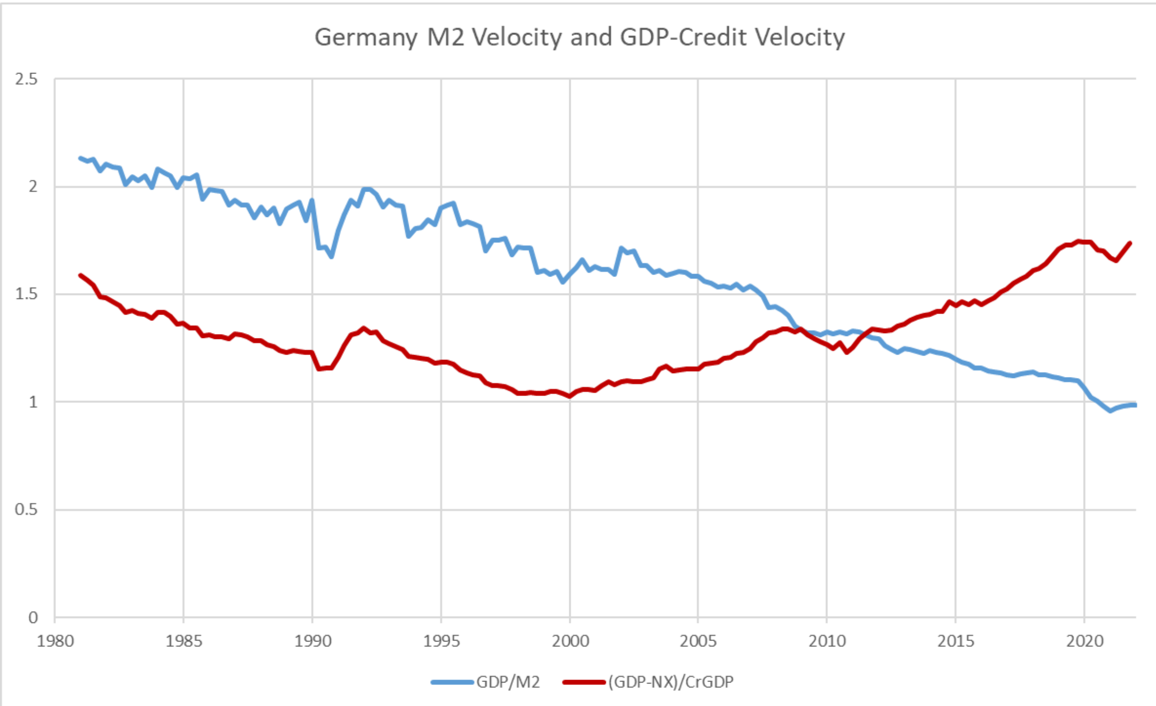

Fig. 2: Velocity of M2 (blue) calculated as annualized nominal GDP divided by M2. Velocity of GDP-

[18] Ideally, we would like to separate mortgage loans into those that are used to renovate buildings or finance other real economic activity, and those that are used to purchase existing real estate. However, such data is not available. See also discussion around Switzerland in part 6.3. for a more detailed discussion of this challenge.

Credit (red) calculated as nominal GDP excluding net-exports divided by GDP-credit. GDP-Credit is defined as total loans to banks and non-banks minus lending to housing firms, lending to financial institutions, lending to holding companies as well as mortgage loans to domestic enterprises and residential individuals. Source: Deutsche Bundesbank, Destatis, own calculations.

6.2 Italy 1999-2021

For Italy we use lending to housing firms, lending to financial institutions and pension funds as well as mortgage lending to domestic enterprises and residential households to estimate C_F. Due to limited data availability the series starts in 1999. We observe a similar pattern for the M2 velocity as in Germany. The M2 velocity has been declining continuously since the end of the 1990s. On the other hand, the velocity estimated using GDP-credit remained more stable and even rose in recent years. The dent in 2020 is most likely due to a drop in GDP because of the Covid-19 pandemic.

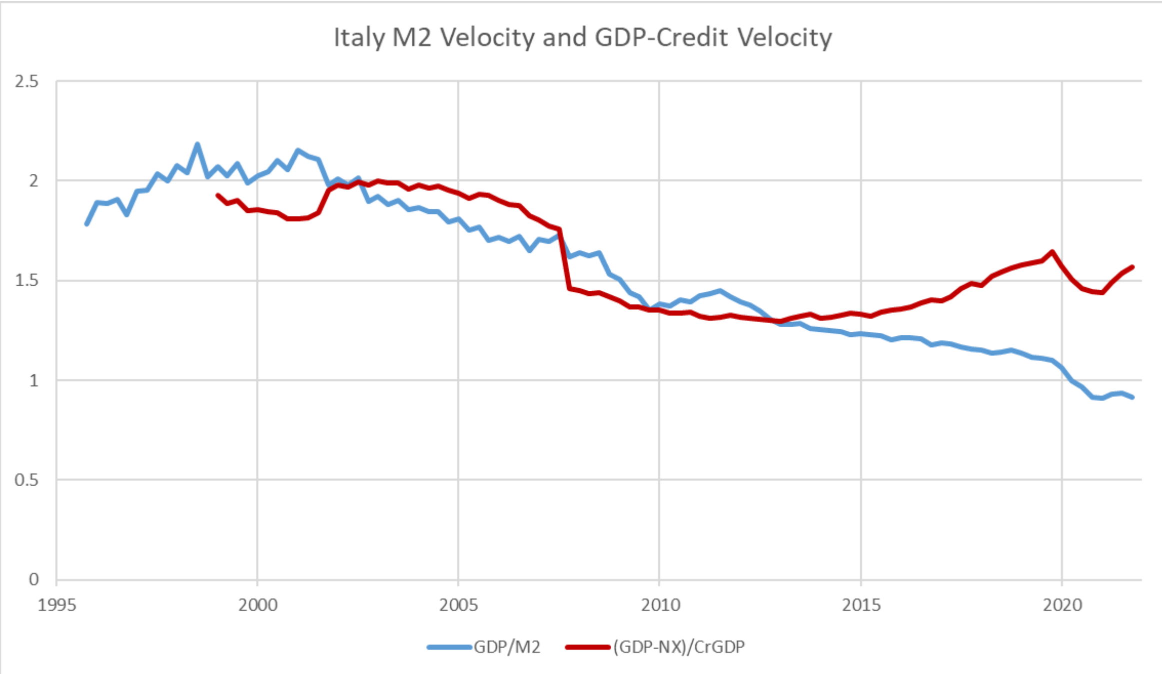

Fig. 3: Velocity of M2 (blue) calculated as annualized nominal GDP divided by M2. Velocity of GDP-Credit (green) calculated as nominal GDP excluding net-exports divided by GDP-credit. GDP-Credit is defined as total loans to banks and non-banks minus lending to housing firms, lending to financial institutions, lending to pension funds as well as mortgage loans to domestic enterprises and residential individuals. Source: Banca d'Italia, own calculations.

6.3 Switzerland 1981 - 2021

For Switzerland we use total bank credit to domestic non-financial firms and households minus mortgage lending to domestic enterprises and residential individuals as a proxy for C_R. Given the data availability we use quarterly data starting in 1981. The velocity of M2 has decreased as well, although not as dramatically as in Germany or Italy.

On the other hand, the GDP-credit velocity is less stable. It has increased between 1990 and 2007, and especially so after 2000. Explaining the movements in the GDP-credit velocity is not trivial. Coming back to the literature following Schumpeter, according to which (productive) credit enhances GDP, it appears puzzling how GDP in Switzerland increased during that time while Swiss Franc credit did not go up.

We have analyzed different possible explanations for how GDP can grow without growth in Swiss Franc credit, but many of them are either small in magnitude or empirically not existent (see Appendix

Switzerland). What might be the most promising explanation is that for sectors, that are globally active and mainly export their goods and services respectively whose goods never enter Switzerland, foreign currencies play an important role. These companies' business activity is often financed with foreign currency loans, and their earnings are often held in foreign currency.[19] These earnings, in turn, influence the measurement of GDP. Put differently, Swiss firms can increase Swiss GDP through the use of foreign currency – independent of Swiss Franc credit creation. This explanation appears theoretically sound. Figure 5 further supports it by showing that banking and merchanting activity, both sectors that are likely to have a significant non-Swiss Franc financial structure, have become more and more important in Switzerland, raising from roughly 4% of GDP in 1990 to about 14% today. Note that the upward shift in GDP-credit velocity plateaued after around 2005, at the same time when the share of banking and merchanting in GDP did no longer increase. Pharma is another industry segment that is active globally and makes up an increasing share of GDP, but for which we do not have the associated data.

However, we do not have data to empirically estimate the effect related to non-Swiss Franc financing activities of Swiss firms. In particular, the Swiss Statistical Office does not collect data on the currency holdings and denominations of Swiss companies when estimating GDP through their accounting statements.

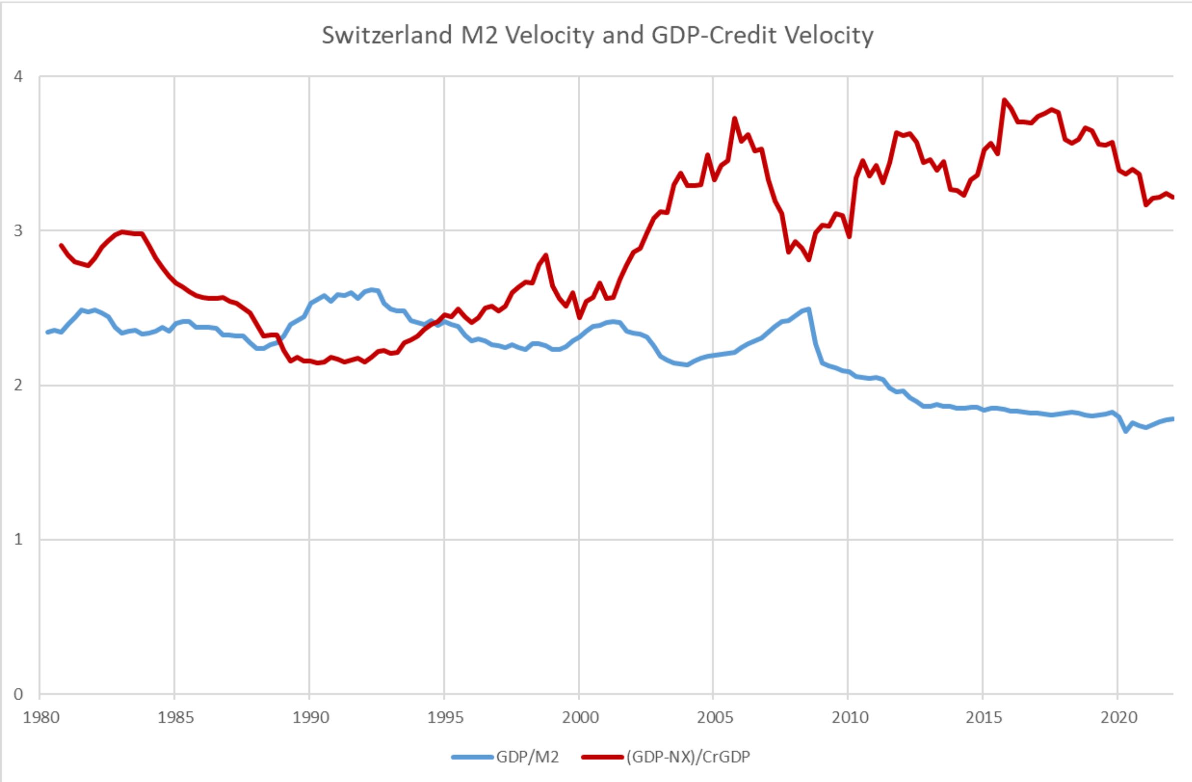

Fig. 4: Velocity of M2 (blue) calculated as annualized nominal GDP divided by M2. Velocity of GDP-Credit (red) calculated as nominal GDP excluding net-exports divided by GDP-credit. GDP-Credit is defined as total loans to banks and non-banks minus lending to banks and mortgage loans to domestic enterprises and residential individuals. Source: Swiss National Bank, own calculations.

[19] Salaries in Switzerland, as well as rents will again have to be paid in Swiss Francs, but these magnitudes might be small compared to the overall balance sheet and profits of the companies.

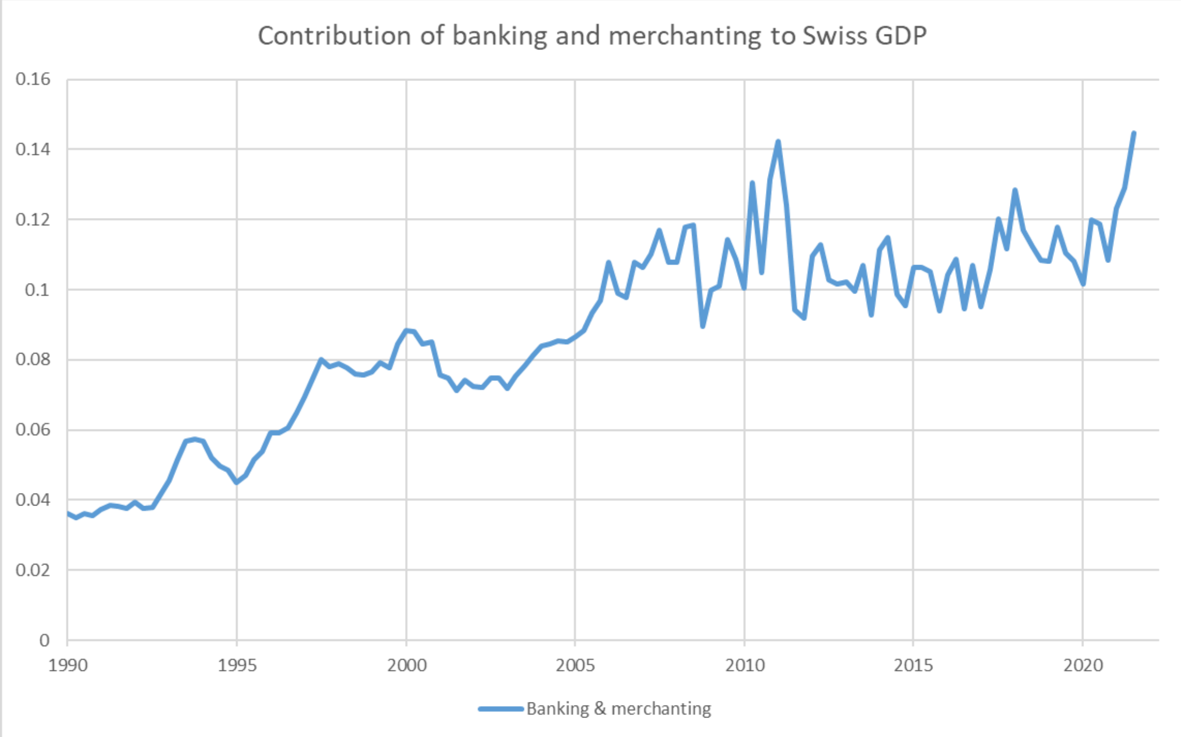

Fig. 5: The contribution of banking and merchanting to GDP are calculated as the sum of value added by the banking sector and net revenue of the merchanting sector. Source: Swiss National Bank, own calculations.

Summing up our observations from the three countries, the descriptive statistics support our hypothesis that the velocity of money, more accurately measured using the Quantity Theory of Credit, does not show a downward trend. Note that while the theory suggests a causal relationship, namely that bank credit creation should have a direct impact on transaction volumes and prices, i.e. on GDP, we only consider correlations of nominal GDP and credit-money.

7 Conclusion

This paper argues that comparing the (origins of) quantity theories of money with how they are measured empirically reveals a certain discrepancy: When scholars calculate the velocity of money using GDP and M1 or M2, they usually ignore non- GDP transactions. This ignorance of non-GDP transactions might be responsible for the decoupling of M1/M2 and nominal GDP since the 1980s, which conventional theories fail to explain in a satisfactory manner.

Taking a careful look at the definitions of GDP and the origin of money, we depicted different approaches to tackle this problem. Given data limitations, we chose to focus on the Quantity Theory of Credit - a theory where credit provided by commercial banks is used to infer whether newly created money is used for GDP- or non-GDP transactions. Applying this theory to Germany and Italy shows that the velocity of credit used for GDP is relatively stable. In the case of Switzerland, special small open economy effects might be present that make our estimations an insufficient proxy as they do not correct for GDP generated with foreign currencies.

Future research should investigate these findings in more detail. Particularly two points deserve closer investigation: First, the role of intermediary goods transactions have to be studied, which are also part of non-GDP transactions. Empirically, an index in the spirit of Fisher (1911) might provide new insights. Second, the assumption that money created via non-GDP credit does not, or in constant pro portion, flow into GDP-transactions has to be discussed in more detail. Here, the development of an index for house and pre-existing asset purchases might be helpful.

On a more general note, dynamic theories with causal relationships are needed to analyse whether for example GDP-credit can predict nominal GDP and might therefore serve as a target variable for monetary policy.

Finally, from the perspective of 'history of economic thought', we believe that the criticisms of QTMs have long been known, but still have not been effective because monetarist ideas are still very present in today's discussions around inflation. This may also be due to the fact that the criticism did not deal sufficiently with the Equation of Exchange, an equation that intuitively probably drove many economists in the direction of QTMs. Put differently, this paper has tried to show that rejecting QTMs should not result in throwing out the baby with the bath, i.e. should not result in stopping to analyze the equation of exchange, or credit and money aggregates more generally to better understand monetary economies.

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Appendix

Switzerland

As shown in section 6.3, it is surprising at first glance how GDP in Switzerland continued to rise in the 1990s even though productive credit did not follow suit. Here, we will briefly outline various hypotheses under investigation that may help explain this. The most promising hypothesis concerning fx financing was discussed in the main text.

1) Increase in construction activity?

An increase in construction activity, which is financed by mortgages, could possibly lead to an increase in GDP-credit velocity. However, in Switzerland the share of construction in total GDP declined between 1990 and 2000 following a real estate crisis and remained stable thereafter. Thus, construction activity fails to explain the increase in GDP-credit velocity before the Great Financial Crisis.

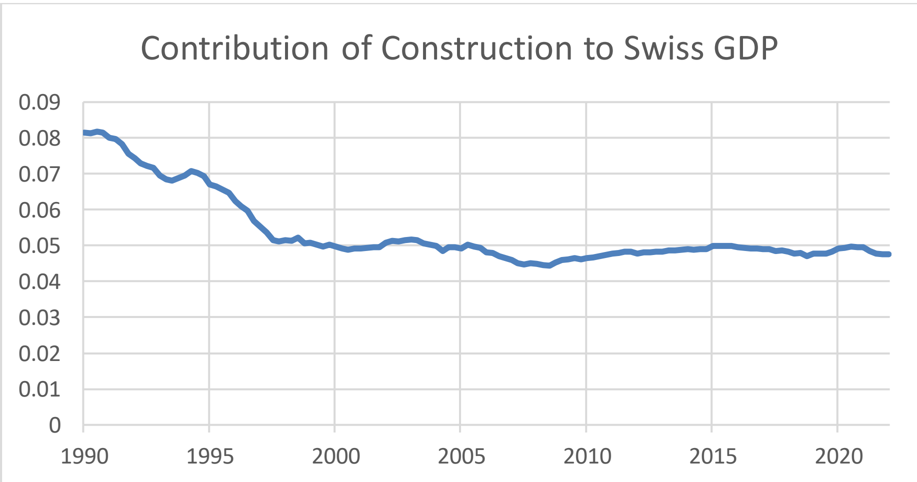

Fig. A1: Construction share of GDP. Source: SECO, own calculations.[20]

[20] https://data.snb.ch/en/topics/uvo/cube/gdpap?fromDate=1980-Q1&toDate=2021-Q4&dimSel=D1(PHPOE,S,T0,B,A,T1,T2,WG0,D0,T3,T4,WG1,D2,T5,BBIP),D0(WMF,VVP)

2) Increase of liquidity through unconventional monetary policy?

This Hypothesis cannot explain the dynamics because before 2008, because the SNB had a small balance sheet, and only started to intervene on the fx market after 2008.[21]

3) Shift from household mortgages to business mortgages?

A possible explanation could be that firms shifted towards mortgages in order to finance their business. However, the data does not support this hypothesis. From 2003 to 2008, business mortgages only increased from CHF 140 billion to CHF 150 billion (see Fig. A2).

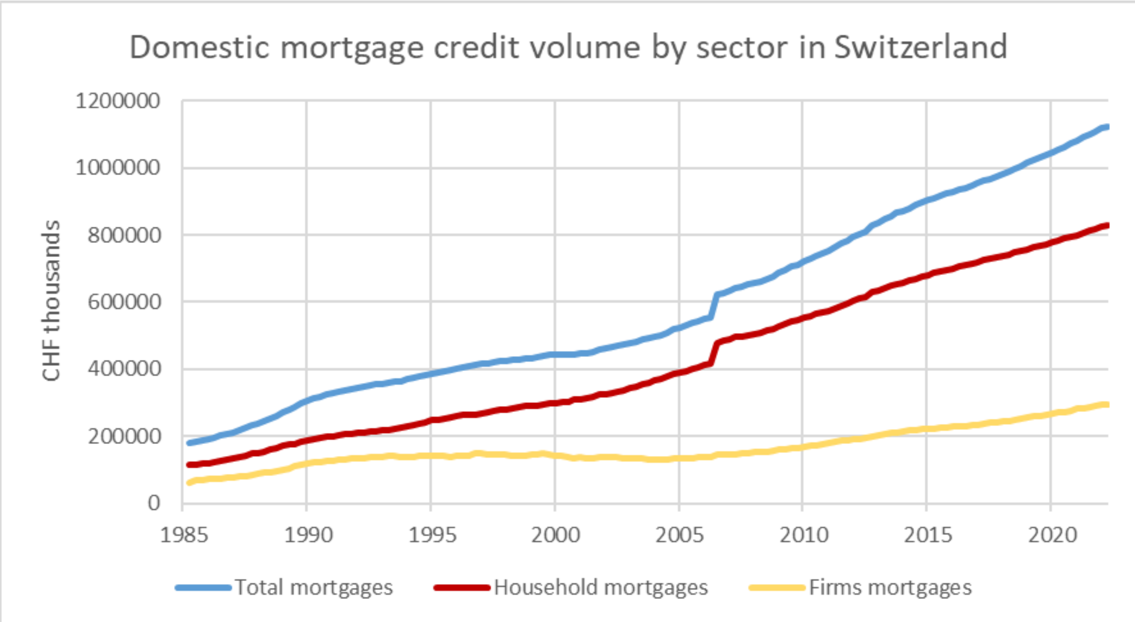

Fig. A2: Domestic mortage credit by sector, in thousands. Source: Swiss National Bank, own calculations.

4) Increased capital-based financing?

Although capital markets can, in contrast to banks, not create money, it is possible that capital markets in Switzerland became "deeper", so that firms increasingly financed their activities with non-bank credit. However, debt securities of Swiss non-financial corporations did not increase significantly over the considered period, and is small in magnitude.[22]

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21 Source: https://data.snb.ch/en/topics/snb/cube/snbbipo

22 Source: Swiss National Bank: snb.ch; https://data.snb.ch/en/topics/uvo/chart/frseknfuvch

Data sources

Table A.1 Data Sources

Variable	Data Source	Ticker	Weblink	currency
Germany[1]				
GDP (before 1991 West Germany)	Statistisches Bundesamt	Gross domestic product (seasonally adjusted)	Volkswirtschaftliche Gesamtrechr	bn eur
GDP (from 1991)	Bundesbank	BBNZ1.Q.DE.Y.G.0000.A	| Deutsche Bundesbank	bn eur
M2	Bundesbank	BDM2....B	| Deutsche Bundesbank	bn eur
M2	Bundesbank	BBK01.TXI302	| Deutsche Bundesbank	bn eur
Lending to banks	Bundesbank	BBK01.OU0081	| Deutsche Bundesbank	bn eur
Lending to other financial institutions (non MFI) & insurances	Bundesbank	BBK01.PQ3026	| Deutsche Bundesbank	bn eur
Lending to Housing firms	Bundesbank	BBK01.PQ3185	| Deutsche Bundesbank	bn eur
Lending to Holding Companies	Bundesbank	BBK01.PQ3189	| Deutsche Bundesbank	bn eur
Mortgages to domestic firms and household:	Bundesbank	BBK01.PQ3008	| Deutsche Bundesbank	bn eur
Domestic lending to non-banks (non-MFI)	Bundesbank	BBK01.OU0115	| Deutsche Bundesbank	bn eur
Italy				
GDP	Istat	Gross domestic product (seasonally adjusted)	Gross domestic product, expendit	bn eur
M2	Bank of Italy	BAM_AGGM.M.1020001.M2XC.3.101.EMUBI4.SBI138.1000	Bank of Italy - Statistical Database	bn eur
Loans to banks	Bank of Italy	BAM_BSIB.M.1070001.52000700.9.101.IT.S122.1000.997	Bank of Italy - Statistical Database	bn eur
Loans to other financial institutes	Bank of Italy	BAM_BSIB.M.1070001.52000700.9.101.IT.S12P.1000.997	https://infostat.bancaditalia.it/in	bn eur
Loans to insurance and pension funds	Bank of Italy	BAM_BSIB.M.1070001.52000700.9.101.IT.S12Q.1000.997	https://infostat.bancaditalia.it/in	bn eur
loans for house purchase >5 years	Bank of Italy	BAM_BSIB.M.1070001.52000700.17.101.IT.SBI71.1000.212	https://infostat.bancaditalia.it/in	bn eur
loans for house purchase up to 5 years	Bank of Italy	BAM_BSIB.M.1070001.52000700.401.101.IT.SBI71.1000.212	https://infostat.bancaditalia.it/in	bn eur
Real estate activities	Bank of Italy	BAM_ATECO.M.1070001.52000700.101.IT.SBI25.L	https://infostat.bancaditalia.it/in	bn eur
Loans to domestic counterparties except government and MFIs	Bank of Italy	BAM_BSIB.M.1070001.52000700.9.101.IT.S1P.1000.997	https://infostat.bancaditalia.it/in	bn eur
Loans to other domestic government	Bank of Italy	BAM_BSIB.M.1070001.52000700.9.101.IT.S13BI24.1000.997	https://infostat.bancaditalia.it/in	bn eur
Loans to domestic central government	Bank of Italy	BAM_BSIB.M.1070001.52000700.9.101.IT.S1311.1000.997	https://infostat.bancaditalia.it/in	bn eur
Switzerland				
Due from (non-financial) customers	Swiss National Bank	BSTA@SNB.MONA_U.BIL.AKT.FKU{U,I,T,T,T,T,A40}	https://data.snb.ch/en/warehous	th chf
Due from customers long series	Swiss National Bank	Domestic due from customers	Swiss National Bank (SNB) - Histor	mn chf
M2	Swiss National Bank	EPB@SNB.snbmonagg{B,GM2}	Swiss National Bank (snb.ch)	mn chf
Sight Deposits	Swiss National Bank	EPB@SNB.snbmonagg{B,S0}	Swiss National Bank (snb.ch)	mn chf
Banking Services	SECO	Financial service activities	Data (admin.ch)	mn chf
Transit trade	Swiss National Bank	EPB@SNB.bopcurrq{T3,E}	Aussenwirtschaft (snb.ch)	mn chf
Net Exports	SECO	Trade balance (goods and services)	Data (admin.ch)	mn chf
GDP	SECO	Gross domestic product	Data (admin.ch)	mn chf

[1] converted to euro