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WHAT DRIVES MOVEMENTS IN THE INCOME VELOCITY OF MONEY? A CASE STUDY OF THE U.S.

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ABSTRACT

In their efforts to stabilize the price level, central banks often rely on the growth rate in the stock of money as an intermediate target variable. Usually, the premise underlying this approach is that the income velocity of money, defined as the ratio of nominal GDP to the stock of money, either randomly fluctuates around a constant mean or can, at least, be predicted with sufficient accuracy. The purpose of this paper is to put this assumption to the test. We do so by applying a first-order autoregressive model, supplemented by a set of lagged exogenous regressors, to the quarterly changes in velocity in the U.S. Our results confirm previous findings that dynamic dependencies exist between changes in the income velocity of money over successive periods of time. They also support the assertion that rising long-term interest rates lower the demand for money. Perhaps most importantly, however, we find that all else being equal, the degree of financialization in the economy, measured by the ratio of financial assets to GDP, has a positive and statistically significant effect on velocity. A possible explanation of this finding is the increasing availability of tradable, non-monetary financial instruments that are close substitutes for bank deposits.

INTRODUCTION

In most countries of the global West, a key objective of monetary policy is to control inflation (see, e.g., Teles, Uhlig, and Valle e Azevedo, 2016). In their efforts to keep the rates of change of the relevant price index within its specified target range, decision-makers at central banks often consider the growth rate of a commonly used monetary aggregate an important intermediate target indicator of the strength of the inflationary pressures prevailing in the economy, as stated by in European Central Bank (2001) and Bernanke (2006).

The idea underlying this way of proceeding is that if the income velocity of money, i.e. the ratio of nominal GDP to the money stock, is either constant or predictable, expectations of future inflation rates can be based on projected growth rates of the money supply and potential output.

Yet from today's perspective, the perception that the changes in income velocity over time can be reasonably modeled as short-term random fluctuations around a constant mean, which formed the basis of Friedman's (1956) adaptation of the Quantity Theory of Money and its interpretation by Lucas (1980), can no longer be regarded as tenable. Figure 1 shows this, using the US monetary aggregate M2 as an example.

The income velocity of money serves as a critical indicator within economic frameworks, reflecting the frequency with which a unit of currency is used for transactions in a given period. Understanding the dynamics behind movements in the income velocity of money is essential for policymakers, economists, and investors alike, as it provides insights into the overall health and efficiency of an economy. This study delves into the intricacies of income velocity, with a specific focus on the United States, aiming to unravel the multifaceted factors that drive fluctuations in this pivotal economic metric.

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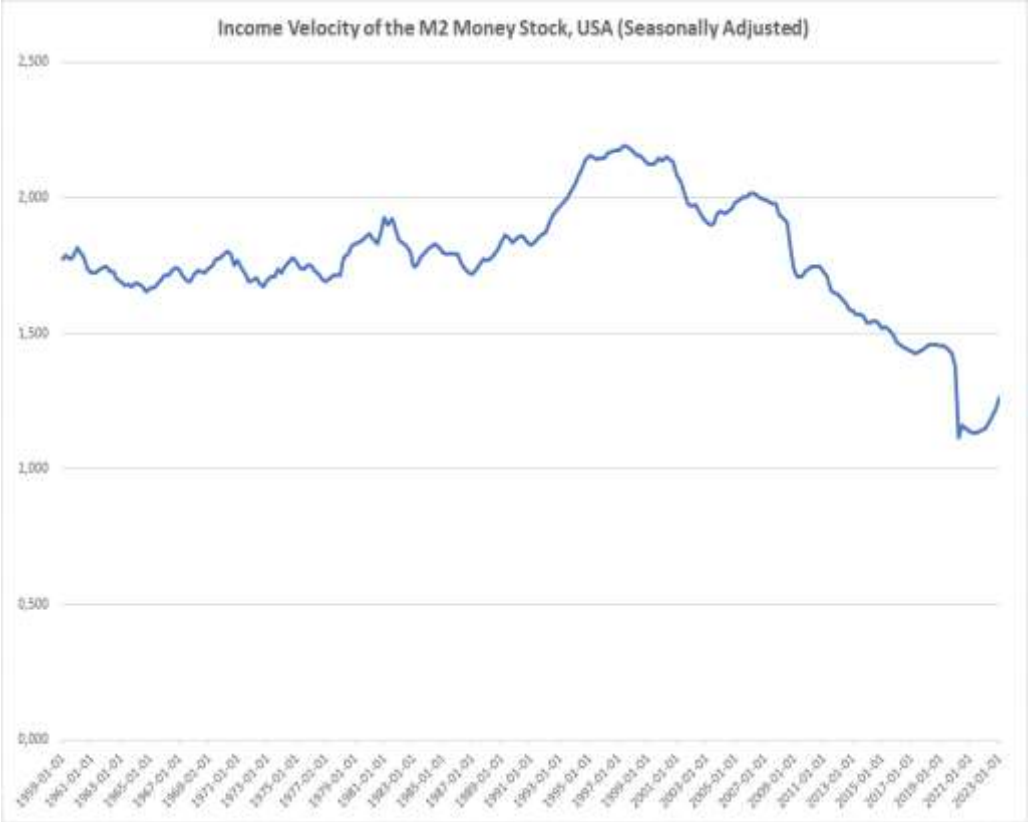

Figure 1. Shows this, using the US monetary aggregate M2
Source: Federal Reserve Bank of St. Louis, 2023a

This gives rise to the question of whether it is possible, at least in retrospect, to find economically plausible and empirically substantiated explanations of the fluctuations in the income velocity of money observed in the past.

The current paper examines this topic using the income velocity of the monetary aggregate M2 in the USA, abbreviated as M2V in the following, as an example. The monetary aggregate M2 was chosen because, unlike the narrower measure M1, it includes savings deposits, small time deposits, and shares in retail money market mutual funds (source: Federal Reserve Bank of St. Louis, 2023b), and can thus be expected to have a higher informational content regarding the liquidity position of the economy. The even broader monetary aggregate M3, is not used because the Federal Reserve System ceased its publication in 2006; see Board of Governors of the Federal Reserve System (2006).

LITERATURE REVIEW

The theoretical basis of the assumed connection between money circulation, income, and prices was laid by the quantity theory of money. This theory states that, at any given level of real income, the general price level of goods and services is directly proportional to the amount of money in circulation. According to the historical records Blaug et al. (1995) examined, its origins can be traced back to the 16th century. Aubin (2021) argues that Fisher's (1911) equation of exchange was a decisive step towards formalizing this approach. This equation expresses the hypothesis that the mathematical product of the amount of money and its speed of circulation, or velocity, equals the sum of the volumes of all transactions. The latter, in turn, can be expressed as the product of the price level and the aggregated transaction volume. However, the originator of this theory already recognized that a rigorous verification of this hypothesis would require information about the prices and volumes of transactions in all goods, services, and assets, which would be an impossibility under the conditions that existed then and now (see Fisher, 1911, pp 218 and 215). Hence, since the seminal works by Pigou (1917) and Marshall (1923), it has become more common to model the demand for money as the mathematical product of aggregate nominal income and a proportionality factor that can be interpreted as the inverse of the income velocity of money. From there it is only a tiny step further to the highly influential work of Friedman (1956, 1970), who not only assumed a long-term stable relationship between the money supply and nominal GDP but also maintained that in the long run, changes in the growth rate of the money supply only affect the rate of inflation, rather than having a lasting impact on real income. The corresponding theoretical school of thought, monetarism, arguably enjoyed the peak of its popularity in the inflationary period of the 1970s and 1980s, during which the Federal Reserve System and many other central banks in the global West attempted to contain inflation by setting target corridors for monetary growth (see Bernanke and Mishkin, 1992). Looking back, however, several authors, including Isard and Rojas-Suarez (1986), Ford and Mullineux (1996), and Anderson, Bordo, and Duca (2017), have concluded that the assumption of a constant long-term velocity of money cannot be held empirically. Attempts to explain these observations in a theoretically and empirically plausible way often rely on the idea that the opportunity costs of holding money increase with the (nominal) rates of return on highly liquid, interest-bearing bonds from fail-safe issuers. Hence, many earlier studies of the factors influencing the velocity of money have almost consistently

included interest rates in the set of explanatory variables; see, e.g. Chow (1966), Latané (1954), Meltzer (1963), Brunner and Meltzer (1963), Teigen (1964) and Tobin (1965). Further empirical evidence in favor of this idea has been found, inter alia, by Lucas (1988), Katsimbris and Miller (1993) as well as Basu and Dua (2010).

Moreover, several studies have highlighted the likely importance of financial deregulation and innovation for the demand for money. Examples include but are by no means limited to, the contributions by Akhtar (1983), Arrau and De Gregorio (1991), Ireland (1995), and Glennon and Lane (1996). However, since "financial innovation" is an umbrella term comprising a variety of instruments, technologies, institutions, and markets, the above sources do not allow a clear conclusion to be drawn as to whether the overall effect of these innovations on money demand is positive or negative in the long term. On one hand, it could be argued that increasing issuance and trading volumes for numerous new investment and hedging products are likely to prompt an increase in the transaction demand for monetary balances, mirrored by a decline in the income velocity of money, as argued by Aubin (2021). Yet at the same time, increases in the variety and popularity of financial products having money-like properties without being included in the usual monetary aggregates can reduce the demand for money, which, viewed in isolation, would translate into an increase in velocity (see, e.g. Boughton, 1981). In both cases, it is reasonable to suspect that the behavioral changes resulting from such innovations are neither precisely nor fully measurable.

MATERIALS AND METHODS

This paper aims to explain, at least in retrospect, the observed variation in the quarterly changes in M2V with the help of a linear, autoregressive model with additional explanatory variables. Since the present work aims to identify variables that could have functioned as early indicators of future changes in M2V in the past, all explanatory variables used here are lagged by one quarter.

Regarding the storage-of-value function of money, treasury bills and bonds are arguably the closest substitutes for cash and cash equivalents, and the return on these virtually failsafe investments can be interpreted as the opportunity cost of holding money. Therefore, we include the lagged quarterly changes in the ten-year U.S. Treasury bill rate and the three-month U.S. Treasury bond yield in the set of candidate regressors. Since the monetary aggregate M2 includes some interest-bearing instruments, we also examine whether lagged changes in the slope of the yield curve (referred to as "SLOPE" below), as measured by the difference between the two above quantities, had a statistically significant predictive power for M2V in the past.

Moreover, it must be considered that cash and cash equivalents are not only needed for the purchase of goods and services but also required for trading in financial instruments. Against this background, recent research by Aubin (2021) suggests that all else being equal, rising trading volumes of marketable financial assets will increase the demand for money and, hence, tend to lower velocity. However, the presumption of a positive correlation between the demand for money and the aggregate value of tradeable, nonmonetary financial instruments is not self-evident. It could just as well be argued that increasing amounts of non-monetary financial instruments that can be exchanged for cash equivalents easily and at minimal cost tend to diminish the extent to which the public still needs to hold money as a store of value. If taken by itself, this viewpoint suggests that an increased financialization of the economy tends to increase, rather than decrease, velocity. Therefore, another question addressed in this paper is whether these two countervailing effects cancel out, or whether one of them outweighs the other if the effects of the remaining explanatory variables are accounted for.

Truly comprehensive and accurate data on trading volumes in dollar-denominated financial assets does not appear to be readily available; however, the Board of Governors of the Federal Reserve System (2023c) has published historical data on the level of total U.S. financial assets that can be re-expressed as multiples of GDP; see Figure 2. Given the absence of a better indicator of changes in the degree of financialization of the US economy, the lagged first differences of this ratio have also been included in the set of explanatory variables.

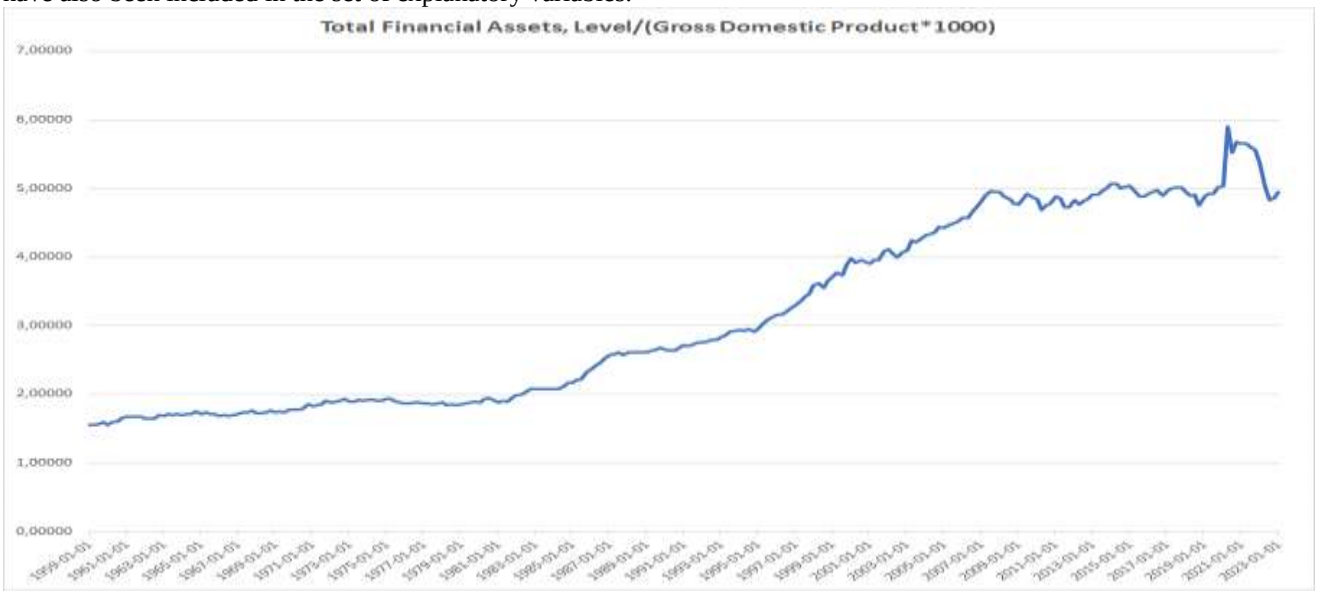

Figure 2. Total financial Assets, Level/(Gross Domestic Product*1000)

Finally, there are good reasons to assume that dynamic dependencies exist between changes in M2V over successive periods of time. For example, the time it takes for a change in the stock of money to fully unfold its effects on prices and real aggregate income may very well extend over several quarters, as has been assumed, for example, in the partial adjustment models by Feige (1967), Darby (1972) and Santomero and Seater (1981). Moreover, financial innovations in the form of near-monies like, e.g., asset-backed commercial papers, which are close substitutes for short-term bank deposits but not included in existing monetary aggregates, may fundamentally alter the money holding practices of the public but need time to be established on the market. By including one or more lagged differences of M2V in the set of candidate regressors, such dynamic dependencies can be captured, at least in an approximate manner.

The sampling period extends over the time period from the 1st quarter of 1959 up to and including the 1st quarter of 2023. Descriptive statistics of the variables in use are given in Table 1.

Table 1. Descriptive Statistics ("Δ" meaning "quarterly change in")

	Δ M2V	**Δ 3M T-Bill yield**	**Δ 10Y T-Bond yield**	**Δ SLOPE**	**Δ [Fin. Assets / (1000 × GDP)]**
Mean	-0.00200	0.00672	-0.00191	-0.00863	0.01324
Standard deviation	0.02641	0.77438	0.52501	0.62236	0.07868
Minimum	-0.26800	-5.14000	-3.04000	-2.58000	-0.37241
1% quantile	-0.16766	-4.27000	-2.37300	-2.27840	-0.36565
5% quantile	-0.03850	-1.28500	-0.85800	-0.88200	-0.06747
10% quantile	-0.02500	-0.94200	-0.67000	-0.66600	-0.04240
25% quantile	-0.01300	-0.15000	-0.27000	-0.33000	-0.00923
Median	0.00000	0.01000	0.05000	-0.03000	0.01262
75% quantile	0.01250	0.32000	0.27000	0.25000	0.03737
90% quantile	0.02300	0.70400	0.57200	0.68000	0.06892
95% quantile	0.02710	0.92500	0.86100	0.91500	0.09213
99% quantile	0.05110	2.85480	1.27460	2.34720	0.15568
Maximum	0.06700	3.56000	1.50000	3.92000	0.85228

RESULTS

We estimated a number of different model variants, four of which are summarized in Table 2 below. The decision on how many lagged values Δ M2V (i.e. the quarterly change in M2V) to include is based on the outcome of the Ljung and Box (1978) test statistic for autocorrelation, applied to the regression residuals, with the number of lags to be tested being set to 12. (Choosing a smaller or larger value for this number did not have a substantial impact on the results obtained).

Table 2. Ordinary Least Squares Estimation results

Ordinary Least Squares Estimation results (heteroskedasticity-consistent t-statistics in parentheses) Dependent variable: Quarterly change in M2 Velocity				
Model variant	I	II	III	IV
Explanatory variables in use				
Constant	-0.002463	-0.002398	-0.002496	-0.006006
	(-1.556385)	(-1.505406)	(-1.597132)	(-1.917207)
Δ M2V$_{t-1}$	0.361876	0.402645	0.355358	0.323766
	(2.570113)	(3.129243)	(2.595790)	(2.503005)
Δ 3M Treasury yield$_{t-1}$	0.002994			0.000812
	(0.837306)			(1.419020)
Δ 10Y Treasury yield$_{t-1}$			0.006631	0.006199
			(1.984825)	(1.780469)
Δ SLOPE$_{t-1}$		0.000300		
		(0.094431)		
Δ [Fin. Assets / (1000 ´ GDP)]$_{t-1}$	0.090146	0.092846	0.092480	0.085727
	(2.343519)	(2.329366)	(2.412222)	(2.269984)
R^2	0.116	0.110	0.125	0.134
p-value of Ljung/Box statistic	0.766807	0.696551	0.759002	0.607110

DISCUSSIONS

In each of the four variants of which the results are shown, including a single, one-quarter lag of the dependent variable was sufficient to remove the autocorrelation that would otherwise have prevailed in the regression residuals. The coefficient estimate referring to the lagged value of $\Delta M2V_{t-1}$ is positive and statistically significant on a 95% confidence level, which is compatible with the perception that in the past, the level of M2V showed trend-following behavior at times.

The idea that the slope of the yield curve, as measured as the difference between the ten-year and the three-month Treasury yields, might have some predictive power with respect to future changes in M2V is not supported by our results, as the low absolute value of the associated t-statistic in model variant II indicates. In contrast, at least the size and direction of the changes in the yield on the ten-year T-bill do appear to have had some prognostic value with regard to the change in

velocity, as the associated t-statistic exceeds the critical value for the two-sided 95% confidence interval in model variant III.

With respect to the lagged difference in the three-month Treasury yield, the results obtained are somewhat more ambiguous. If this is the only interest-related measure included in the set of regressors, as in variant I, the related coefficient bears the expected positive sign but turns out to be statistically insignificant. Yet if this variable is added to a set of regressors that already includes the lagged difference of the ten-year Treasury yield, as in the case of model variant IV, this further improves the fit of the model. However, a comparison of two competing specifications III and IV based on an F-test reveals that the more restrictive of these two variants (i.e. III) cannot be rejected on a 90% confidence level (with the associated p-value standing at 0.11637). So, although it cannot be ruled out that both the three-month and the ten-year treasury rate, taken in combination, impact future changes in velocity, model variant III apparently represents a slightly better compromise between the conflicting goals of parsimony and goodness-of-fit.

As far as the financialization indicator is concerned, our results indicate that in the sampling period, the overall impact of the growth in financial assets relative to GDP on the demand for money was negative, if seen in isolation, which translates into a higher income velocity of M2. A possible explanation of this finding is that the process of financialization experienced in the past four decades has been accompanied by an increasing availability of tradable, non-monetary financial instruments that are comparable to bank deposits in terms of nominal value retention while offering higher returns or, at least in some cases, even improved protection against inflation. Examples of such instruments include high-grade floating rate or inflation-linked bonds, commercial paper, and – more recently – privately issued quasi-monies backed by pools of reference assets with a pre-defined composition. (An overview of the technical and legal issues associated with the last-mentioned class of instruments is given in Garcia-Teruel and Simòn-Moreno, 2021). Given the still high pace of innovation in the financial markets and the near-constant change in the macroeconomic environment, it is not possible to assess at this point whether the relationships observed here will continue to prevail in future.

A somewhat sobering realization is that despite the purely retrospective nature of the present study, none of the model variants examined can explain more than 15 percent of the total variation of the dependent variable. Apparently, the predictability of money demand growth is far too limited to justify the idea that a stable growth rate of the money supply alone is sufficient to effectively prevent the inflation rate from missing its target range.

CONCLUSIONS

In their efforts to stabilize the price level, many central banks rely on the growth rate in the stock of money as an intermediate target variable. This approach is often based on the idea that the velocity of money, defined as the ratio of nominal GDP to the stock of money, can be predicted with sufficient accuracy. By applying a linear time series model to the velocity of the monetary aggregate M2 in the USA, the current paper seeks to identify factors that can retrospectively contribute to an explanation of the observed fluctuations in this quantity. In line with earlier research, we find that past changes in both long-term interest rates are positively related to current changes in the income velocity of money. Our results are also compatible with the perception that random "shocks" affecting velocity may take several quarters to fully unfold their economic effect, which is captured by the positive correlation observed between subsequent realizations of the dependent variable.

Perhaps most importantly, we find that past changes in the degree of financialization of the economy, as captured by the ratio of financial assets outstanding to GDP, have a significant impact on current changes in velocity. However, it needs to be admitted that the last-mentioned financialization indicator only is a very imperfect measure of the way in which events on the financial market affect aggregate money demand. Seeking to identify or develop metrics that enable a far more differentiated view of different instrument classes and their respective characteristics is therefore a promising challenge for future research.

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