Kredit und Kapital, 44. Jahrgang, Heft 4, Seiten 491–507
Abhandlungen

The Equation of Exchange Revisited

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I. Introduction

1. History of Thought

A focal point in the development of modern macroeconomic theory is marked by the renewed interest which was paid at the end of the nineteenth and the beginning of the twentieth century to the equation of exchange. Even though, according to *Bordo* (2008), early suggestions of the concept can be traced back much further, it belongs to the chief merits of *Newcomb* (1886) to have focused on the importance of individual "exchanges"[1] and thus (in modern terms) the microeconomic basis of this macroeconomic equation. Let M be the total quantity of money which is provided by the monetary authorities and used for exchange purposes. The average number of times V at which units of this money stock turn over during a given time interval is then usually referred to as the (transactions-related) velocity of money. The product of both variables determines the monetary turnover of the economy in consideration. What the theory of the equation of exchange in its *transactions version* then stipulates is that any turnover of a monetary unit is paralleled by a turnover of equal value of a (comparatively broadly defined) exchange object. If different objects are exchanged in the economy, they will usually be of different dimensions (kilogram, kilowatt hours etc.). Accordingly, the prices of the different objects exchanged carry different dimensions as well (price per kilogram, price per kilowatt hour etc.). It is therefore convenient, in a multi-object economy, to figure Q as the vector of the exchange volumes of the different objects and P as the vector of the corresponding prices. The scalar product of both vectors determines the turnover of objects, which in itself equals the monetary turnover as defined

* The author is indebted to Carsten Vogt, Arnd Grimmer, John Howroyd, Linda Bierwulf and an anonymous referee for very helpful comments on an earlier draft.

[1] *Newcomb* (1886), p. 315.

above. This is the transactions version of the equation of exchange as it is presented in the subsequent equation:

$$M \cdot V = P \cdot Q \tag{1}$$

From a theoretical point of view, the obvious question is: Which set of elements should the vector of objects comprise in principle? This will be dealt with more explicitly in Part II of this analysis. In the field of applied macroeconomics, the availability of data is another issue. The *income version* of the equation of exchange as forwarded by the *Cambridge cash balance approach*[2] and applied by *Angell*[3] therefore substitutes the vector Q by the number Y representing the national income expressed in real terms and perceives P as the corresponding one-dimensional price deflator. As national account systems usually provide for a wide range of income figures, applicability is the decisive advantage of this version compared to the transactions version of the equation of exchange. Insofar, however, as national income accounting does not provide for the exchange of second-hand goods, intermediate input etc., substitution of Q by Y induces a loss of information, too. The formula for the income version of the equation of exchange reads as follows:

$$M \cdot V = P \cdot Y \tag{2}$$

To be sure, the symbol V does not represent the upper (transactions-related) velocity of money in this context, but has to be perceived in an income-related manner. However, due to the aforementioned loss of information induced by the transition from exchange transactions to income, a velocity interpretation of the term becomes a delicate issue. At first sight, it is nothing but a relation between nominal income and money stock. This caveat may be extended to a wide strand of empirical investigations[4] estimating "velocity" by means of said ratio. To make a long story short, the term velocity in the subsequent analysis is nevertheless used even in an income-related context.

[2] *Pigou* (1927), pp. 151–162.
[3] *Angell* (1941), pp. 130–157.
[4] The following references may serve as an example: *Friedman* (1959), p. 327; *Friedman/Schwartz* (1963), p. 34; *Rasche* (1987), pp. 10 et seq.; *Bordo/Jonung/Siklos* (1997), p. 713; *Caruso* (2001), p. 654.

2. *The International Economic Crisis*

An interesting field for the application of the equation of exchange is the recent global economic downswing. Together with the extensive use of certain financial instruments (e. g. mortgage-backed securities, collateralized debt obligations, asset-backed commercial paper etc.), the easy monetary policy of the *Federal Reserve*[5] ranks among the most frequently quoted factors that purportedly caused the U.S. mortgage loan crisis[6], which became evident in 2007 and then quickly turned into a severe economic downturn. The end of the so-called “dot-com bubble” on the stock exchange (1998–2001) and the September 11, 2001 terrorist attacks had prompted the authorities to try to dampen expected recessional tendencies by means of monetary affluence between 2001 and 2004. And economic growth could, in fact, be observed. For the U.S. economy, Table 1 summarizes the annual growth rates of the M1 monetary aggregate and the real gross domestic product (GDP) for 2001–2007. The stop-and-go pattern in the monetary growth rates is evident: Four years with an average annual M1 growth rate of 6.0 % are followed by three years with an average annual decline of –0.2 %. In contrast to this, real GDP grew even more strongly in the years 2005–2007 at an average rate of 2.6 % compared to 2.1 % during the years 2001–2004.

Table 1

U.S.: M1 and Real GDP: Growth Rates 2001–2007[7]

Year	M1	Real GDP
2001	+8.7 %	+0.8 %
2002	+3.0 %	+1.6 %
2003	+7.0 %	+2.5 %
2004	+5.2 %	+3.6 %
2001–2004	+6.0 %	+2.1 %

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[5] *Martin* (2009), p. 400.

[6] *Bloss/Ernst/Häcker/Eil* (2009), pp. 155–159.

[7] M1: *Board of Governors of the Federal Reserve System* (2010); not seasonally adjusted; as of December of the corresponding year; growth rates calculated by author. Real GDP growth: *Organisation for Economic Co-operation and Development* (2010).

Table 1: Continued

Year	M1	Real GDP
2005	−0.3 %	+2.9 %
2006	−0.7 %	+2.8 %
2007	+0.5 %	+2.0 %
2005−2007	−0.2 %	+2.6 %

The obvious question is where the monetary surplus generated during the years 2001–2004 has gone. The equation of exchange would, in its income version, immediately allow for two loopholes. Whilst *Keynesians* often stress the potential of a reduced velocity of money, the (*Neo-)Quantity Theory of Money* stipulates its long-term stability and focuses on inflation. In this context, Table 2 presents the growth rates of the GDP deflator for the time interval analysed here. An average annual growth rate of 2.3 % for the years 2001–2004 is followed by 3.1 % for the years 2005–2007. Apart from this slight inflationary tendency, the empirical example in the annex to this article supports the hypothesis that the income-related velocity of money decreased during the years 2001–2004, whereas it increased during the years 2005–2007.

Table 2

U.S.: GDP Deflator: Growth Rates 2001–2007[8]

Year	GDP Deflator
2001	+2.4 %
2002	+1.8 %
2003	+2.1 %
2004	+2.9 %
2001–2004	+2.3 %
2005	+3.3 %
2006	+3.2 %
2007	+2.7 %
2005–2007	+3.1 %

[8] *Organisation for Economic Co-operation and Development* (2010).

Has the velocity of money which is used for the exchange of goods and services really to follow stop-and-go patterns of the monetary authorities as mechanically as the upper empirical application of the status quo version of the equation of exchange suggests? In order to deal with that question, the subsequent analysis (Chapter II. of the paper) does not contradict the concept of an equation of exchange but rather offers a more general version of it, separating different temporal patterns of exchange: spot contracts, financial contracts and (for information only) forward contracts.

With regard to the equation of exchange, these different temporal patterns have until now been dealt with more or less implicitly. When in the nineteenth century *Newcomb* set his sights on the topic[9], his version of the equation of exchange was in principle based on spot contracts (section 1. of the subsequent Chapter II.). Even in a simple temporal structure, however, providing for nothing more than two points in time, financial contracts represent an alternate temporal pattern of monetary exchange featuring a characteristic risk as well as a characteristic pattern of money usage. Financial contracts may therefore have an additional explanatory force for the equation of exchange, which is described in section 2. of Chapter II. Subsequently, the specific aspects of monetary exchange induced by spot contracts and financial contracts, respectively, are aggregated (section 3.). This way, it becomes apparent that different authors had suggested different approaches to the problem of integration of the financial sphere. *Fisher* (1922) and *Friedman* (1987) had opted for an enlargement of the entire set of objects exchanged, whereas *Newcomb* had suggested a second summand on the money side of the equation. Some implications of the more general version of the equation of exchange for monetary policy are addressed in section 4. of Chapter II. Chapter III. of the analysis at hand summarizes the results obtained and suggests topics for future research in the field.

II. Monetary Exchange in a Contractual Analysis

In the course of this exploration, two points in time will come under scrutiny: $t = 0$ represents the present and is the reference point of the analysis, $t = 1$ stands for the future. There is correspondingly one period of time $[0, 1]$ with one unit in length facilitating the calculation of figures relating to time intervals (like velocity). As the freedom of exchange reflects

[9] *Newcomb* (1886), p. 328.

	$t = 0$	$t = 1$
spot contract	signing consideration quid pro quo	
financial contract	signing consideration	quid pro quo
forward contract	signing	consideration quid pro quo

Figure 1: Temporal Patterns of Exchange Contracts

a fundamental decision of regulatory policy, the state, by means of its legal system, protects the economic activity of exchange and the concept of contracts ("pacta sunt servanda"). Exchange contracts may be signed in $t = 0$, but not in $t = 1$, and they are synallagmatic in the sense that they provide for both a consideration and a quid pro quo, which may each be effected in $t = 0$ or in $t = 1$. As figure 1 illustrates, there are accordingly three temporal patterns of exchange possible in the economy described:

Financial contracts like credit, shares, corporate bonds, asset-backed commercial paper etc. are special in two ways. On the one hand, they differ from spot contracts and forward contracts by their characteristic temporal difference between consideration and quid pro quo giving rise to a specific financial risk. On the other hand, the patterns of money usage implied by the different temporal patterns of exchange contracts are not identical:

- Spot contracts and forward contracts usually follow the pattern of money usage 1 (PMU 1), which reads "output (goods and services) versus money". Be it the purchase of bananas on the spot or the forward sale of copper, transactions of this type are mostly characterised by PMU 1.
- Financial contracts may basically be characterised by the pattern of money usage 2 (PMU 2), which reads "money versus money" (or, to be more precise, "present money versus future money"). Credit, for instance, is usually paid out in money in the present and entitles the creditor to a future monetary receipt of redemption plus interest.

As forward contracts are similar to spot contracts insofar as they do not feature a temporal difference between consideration and quid pro quo and basically follow the same pattern of money usage, their integration into a contractual analysis of monetary exchange is left to future research. Instead, the subsequent analysis starts off from spot contracts, and is widened by financial contracts afterwards.

1. Spot Contracts

An arbitrary one of the $s = 1, ..., \ddot{s}$ spot contracts that are signed in $t = 0$ will be represented by the symbol SC_0^s. As spot contracts are characterised by PMU 1, the transaction of exchange underlying any of them may be depicted as follows:

$$SC_0^s = SC_0^s\left(P \cdot q_0^s \leftrightarrow m_0^s\right) \tag{3}$$

In equation (3), P stands for the price level of the homogenous output and q_0^s for the amount of this output traded in $t = 0$ via spot contract s. (The analysis could in due course be extended to different kinds of output being exchanged at differing prices. Rather than generating relevant additional content, however, this would make the notation unnecessarily complex.) m_0^s is the amount of money paid in $t = 0$ for the output transferred via spot contract s.[10] In equation (3), the reverse arrow (which reads "versus") reflects the synallagmatic character of the contracts in consideration. Of course, only output purchases (i.e. $q_0^s > 0$, $m_0^s < 0$) are assessed within the series of spot contracts. In order to avoid double counting, the corresponding output sales on the spot (i.e. $q_0^s < 0$, $m_0^s > 0$) are neglected. The determination of the aggregate turnover of output Q now calls for a summation over the quantities implied by the various spot contracts:

$$Q = \sum_{s=1}^{\ddot{s}} q_0^s \tag{4}$$

In a similar manner, the aggregation over the entire set of spot contracts as defined in equation (3) results in a relation between the turnovers of output and money if the latter is taken in absolute terms. Both

[10] The endpoint problem (*Samuelson* (1958), p. 467) is ignored in order to allow for a strictly positive money stock kept by the decision-making entities.

turnovers refer to the same point in time $t = 0$ and must necessarily be equal in value.

$$P \cdot \sum_{s=1}^{\ddot{s}} q_0^s = \sum_{s=1}^{\ddot{s}} \left| m_o^s \right| \tag{5}$$

Given that the length of the time interval in consideration is 1, a suitable definition of the factor V^S operated on the money stock M^S that is in usage on the spot seems to be as follows:

$$V^S \equiv \frac{1}{M^S} \sum_{s=1}^{\ddot{s}} \left| m_0^s \right| \Big/ 1 = \frac{1}{M^S} \sum_{s=1}^{\ddot{s}} \left| m_0^s \right| \tag{6}$$

Insertion of the aggregate turnover of output on the spot (4) as well as of the velocity of money on the spot (6) into the aggregated spot contracts (5) immediately leads to the equation of exchange as already described in the nineteenth century (*Newcomb* (1886), p. 328):

$$P \cdot Q = V^S \cdot M^S \tag{7}$$

In a very basic version of the equation of exchange, money stock and velocity are apparently figures originating from transactions on the spot. Put simply, the turnover of money on the spot equals the turnover of output on the spot in monetary units of account.

2. *Financial Contracts*

Shortly after the pure spot version of the equation of exchange, *Newcomb,* in his *Principles of Political Economy,* addresses the issue of financial contracts by introducing a second summand on the money side of the equation.[11] In contrast, *Fisher* increases the set of objects traded by property rights[12] and *Friedman* by securities[13], but both leave the algebraic structure of the spot version of the equation insofar unchanged.

[11] The second summand is christened "the loss from bankruptcy" (*Newcomb* (1886), p. 332). The name results from the fact that the author starts off from financial contracts which (more or less as the exception to the rule) follow PMU 1: "When a debt is incurred, a transfer forming a part of the industrial circulation is made without any corresponding transfer of money in the other direction. (...) But since, as a rule, the debt is paid at some time, it follows that in the long run the balance will be made good" (ibd.).

[12] *Fisher* (1922), p. 5.

[13] *Friedman* (1987), p. 4.

In order to integrate finance into the contractual analysis of monetary exchange at hand, it is assumed that, in addition to spot contracts, $f = 1, ..., \ddot{f}$ financial contracts FC_0^f providing each for a present consideration and a future quid pro quo are signed in $t = 0$. Apart from this temporal difference, financial contracts differ from spot contracts by their characteristic PMU 2. The transaction underlying an arbitrary one of these contracts may accordingly be expressed as follows:

$$FC_0^f = FC_0^f(m_0^f \leftrightarrow m_1^f) \tag{8}$$

Due to the synallagmatic character of exchange contracts, the series of payments induced by a financial contract necessarily provides for a change of sign. (In a more complex temporal setting, even more changes of sign would be possible.) To avoid double counting, only financing measures (i.e. $m_0^f > 0$, $m_1^f < 0$) are assessed, whereas the corresponding financial investments (i.e. $m_0^f < 0$, $m_1^f > 0$) are neglected. Let F be the aggregate turnover of money in $t = 0$ that is induced by the signing of the financial contracts in consideration. It may be calculated by means of summation over the first arguments of all financial contracts and must necessarily equal the money stock M^F which is in usage in the financial sphere of the economy times its specific velocity V^F:

$$F = \sum_{f=1}^{\ddot{f}} m_0^f = M^F \cdot V^F \tag{9}$$

3. *Aggregation*

Aggregation of equations (7) and (9) leads to an equation of exchange that covers transactions on the spot as well as in the financial sphere:

$$P \cdot Q + F = V^S \cdot M^S + V^F \cdot M^F \tag{10}$$

The separation of different money supplies and corresponding velocities in equation (10) has, in principle, already been accepted by economic theory: *Fisher* followed a similar path by distinguishing cash and checkable bank deposits. Had there been more than just one kind of output in the upper analysis, it would, of course, have been possible analogously to separate the turnovers of bananas, copper etc. From a theoretical perspective, however, the separation of the entire financial sphere in equation (10) differs fundamentally from the separation of certain kinds of output due to the different pattern of money usage that financial contracts feature compared to spot contracts. According to the *Fisher Equation,* financial contracts are able to protect themselves against inflationary (deflationary) tendencies by means of a premium (discount) in the nominal interest rate.

The question is obvious: what are the factors that have, or may have, an impact on $V^S$and V^F respectively? With regard to V^S, the direct determinants according to equations (5) and (6) are as follows: (i) the aggregate turnover Q of goods and services on the spot in real terms; (ii) the price level P of goods and services, i.e. the exchange rate between goods and services on the one hand and present money on the other; (iii) the fraction M^S of the money stock which is used for spot transactions. Factors influencing V^S indirectly will be numerous. The accumulation of goods in the past (together with current output forming the set of goods and services available for exchange now) is one example. The fractions of "exchange" settled externally via markets and internally via institutions is another. When it comes to V^F, the direct determinants are according to equation (9): (i) the aggregate amount F of exchange transactions directed at future money (financial contracts); (ii) the fraction $M^F$of the money stock which is in usage in the financial sphere. Indirect factors will again be numerous. The rates of time preference of the decision-making entities and the rate of interest equilibrating the financial market should be two of them.

4. Monetary Policy Implications

The aggregate money stock M *is* one of the predominant instruments of monetary policy. It is given by the sum of the money stocks that are in usage on the spot (M^S) and in the financial sphere (M^F):

$$M = M^S + M^F \tag{11}$$

Insertion of equation (11) into the more general version of the equation of exchange (10) and differentiation with regard to the money stock M leads to the following monetary policy equation:

$$\begin{aligned} &\frac{dP}{dM} \cdot Q + P \cdot \frac{dQ}{dM} + \frac{dF}{dM} = \\ &\qquad \frac{dV^S}{dM} \cdot M + V^S \cdot \left(1 - \frac{dM^F}{dM}\right) \\ &\qquad - \frac{dV^S}{dM} \cdot M^F + \frac{dV^F}{dM} \cdot M^F + V^F \cdot \frac{dM^F}{dM} \end{aligned} \tag{12}$$

As the subsequent chain of relations (13) translates into algebraic terms, the money stock that is in usage in the financial sphere shall not decrease if the total money stock is increased. In addition, it is assumed that the maximum increase in the financial money stock is restricted by the increase in the total money stock.

$$0 \overset{!}{\leq} \frac{dM^F}{dM} \overset{!}{\leq} 1 \tag{13}$$

Two special scenarios and a view to some empirical investigations of the past shall now help to assess the monetary policy implications of the more general version of the equation of exchange.

a) The *(Neo-)Quantity Theory of Money*

(Neo-)Quantity theory approaches to monetary policy usually start off from the assumption of a constant velocity of money (in the "spot" sense of the upper analysis) and claim that a monetary stimulus which does not affect real output must necessarily result in inflation.[14] Should this argument be straightforward, the following chain of equations providing for a constant velocity of money on the spot, a constant real output and a constant price level would necessarily have to drive the monetary policy equation (12) into inconsistency:

$$dV^S = dQ = dP \overset{!}{=} 0 \tag{14}$$

Given the assumptions (14), the monetary policy equation (12) reduces to the following:

$$\frac{dF}{dM} = V^S \cdot \left(1 - \frac{dM^F}{dM}\right) + \frac{dV^F}{dM} \cdot M^F + V^F \cdot \frac{dM^F}{dM} \tag{15}$$

Due to the chain of relations (13), the derivative in brackets in equation (15) must vary between zero and one. As velocities may never be negative, the first summand on the right-hand side of the equation is therefore certainly positive. Based on the same argument, the third summand on the right must be positive, too. Consequently, the chain of assumptions (14) must not necessarily result in logical inconsistency: Apart from other possible solutions, equation (15) may be equilibrated by a positive

[14] *Fisher* (1922), p. 14; *Friedman* (1987), p. 17.

left-hand side or a negative second summand on the right. All in all, the more general version of the equation of exchange (10) illustrates that a monetary stimulus need not, even in the presence of a constant velocity of money in the real sphere and a constant level of the aggregate turnover of output, be accompanied by inflation. Growth of the financial sphere or a decrease of the velocity of money in the financial sphere would be other possible scenarios – a result that contradicts the position of the *(Neo-)Quantity theory of money* and helps to explain the expansion of the financial sector in the U.S. between 2001 and 2004. Furthermore, if expansionary monetary policy has an inflationary potential, at least in the long run, the integration of securities (and other financial contracts) into the aggregate output Q as proposed by Neoquantity theorist *Friedman*[15] would be a distortive element: An increase in the price of securities and inflation are different phenomena.

b) Output Effectiveness

In contrast to the first scenario, output reactions to a monetary stimulus in the second shall not be ruled out by assumption but rather be the focus of the analysis. Instead, to keep things simple, it is assumed that the velocities of money on the spot and in the financial sphere as well as the price level are constant, leading to the following chain of equations:

$$dV^S = dV^F = dP \stackrel{!}{=} 0 \tag{16}$$

On the basis of these three assumptions, the monetary policy equation (12) facilitates as follows:

$$P \cdot \frac{dQ}{dM} + \frac{dF}{dM} = V^S \cdot \left(1 - \frac{dM^F}{dM}\right) + V^F \cdot \frac{dM^F}{dM} \tag{17}$$

Due to equation (9) and the assumption of constant velocities (16), the following must be valid, too:

$$\frac{dF}{dM} = \frac{dM^F}{dM} \cdot V^F \tag{18}$$

In the light of (18), the already simplified monetary policy equation (17) may be further reduced to the subsequent result:

[15] *Friedman* (1987), p. 4.

$$\frac{dQ}{dM} = \frac{V^S}{P} \cdot \left(1 - \frac{dM^F}{dM}\right) \tag{19}$$

Here, the induced increase in the money stock in the financial sphere becomes the strategic variable for the effectiveness of monetary policy. As assumed before, the corresponding derivative in brackets shall vary between zero and one. If it equals unity, a monetary stimulus will be entirely absorbed by the financial sector and real output will not react at all in this scenario. If, on the other hand, the derivative in brackets is equal to zero, the financial sector will remain completely unaffected and the monetary stimulus attains its maximum impact on real output.

c) Empirically Unstable Velocity

As noted before, empirical estimates of the (income-related) velocity of money usually start off from the ratio of nominal income to money stock. In contrast to the postulates of the *(Neo-)Quantity theory of money,* significant disturbances in the velocity behaviour have been observed since the middle of the 1980s or even earlier.[16] If the term $P \cdot Q$ is interpreted as nominal income and V^S as the income-related velocity, the more general version (10) of the equation of exchange may help to explain these unstable trend figures: For a constant nominal income, a constant financial turnover of money and constant money supplies in the real as well as in the financial sector of the economy, for instance, the more general version would be compatible with a fluctuating income-related velocity if this were offset by countercyclical movements in the financial velocity. Monetary stop-and-go policy may even enhance the instability of the income-related velocity of money.

III. Summary and Conclusions

The impact which the easy monetary policy enacted by the Federal Reserve between 2001 and 2004 had on the financial sphere in the U.S., particularly on the granting of subprime mortgage loans and their securitization via asset-backed commercial paper and similar constructions,

[16] For the U.S.: *Rasche* (1987), p. 14; *Baba/Hendry/Starr* (1992), p. 25; *Ball* (2001), p. 40; *Rudebusch/Svensson* (2002), p. 424; *Wang/Shi* (2006), p. 538. An asset-oriented theoretical background is provided by *Laidler* (1969), pp. 37–76.

advocates the application of a more general version of the equation of exchange as described in this paper. Instead of reaching the real hemisphere, a monetary impetus may get "stuck" in the financial layer of the economy in consideration.

Due to their characteristic pattern of money usage and their delayed exchange between consideration and quid pro quo, forward contracts usually exhibit derivative characteristics. The integration of forward exchange into a contractual monetary analysis could therefore represent an interesting field for future research. The same holds true for the microstructure of financial stocks and flows. As it appears, too little diversification led to substantial financial clusters in recent years and increased the potential of chain reactions. It is interesting to note in this context that the sovereign supervision schemes valid for banks and for insurance companies, respectively, often follow different systematic approaches when it comes to enforcing minimum diversification of the investments.

Annex

An empirical example directed at the income-related velocity of money benefits from a translation of the equation of exchange in its income version (2) to the level of finite increments.

$$\Delta M \cdot V + \Delta V \cdot M + \Delta V \cdot \Delta M = \Delta P \cdot Y + \Delta Y \cdot P + \Delta P \cdot \Delta Y \tag{20}$$

This leads immediately to the subsequent equation for changes in the velocity of money:

$$\Delta V = \frac{\Delta P \cdot Y + \Delta Y \cdot P + \Delta P \cdot \Delta Y - \Delta M \cdot V}{M + \Delta M} \tag{21}$$

For the period 2001–2004, it can be gathered from Tables 1 and 2 that money stock, income and prices all increased. The condition for a decrease in the income-related velocity of money is therefore as follows:

$$\begin{aligned} &\Delta V^{01-04} < 0 \qquad \Leftrightarrow \\ &\Delta P^{01-04} \cdot Y^{00} + \Delta Y^{01-04} \cdot P^{00} + \Delta Y^{01-04} \cdot \Delta P^{01-04} < \Delta M^{01-04} \cdot V^{00} \end{aligned} \tag{22}$$

As we know from Table 1, M1 increased between December 2000 and December 2004. To be more precise, it rose from USD 1,111.7 billion to USD 1,401.3 billion and thus by $\Delta M = 289.6$. Table 3 now gives the gross domestic product for the U.S. from 2000 to 2007.

In the year 2000, the income-related velocity of money was therefore as follows:

$$(23) \qquad V^{00} = \frac{P^{00} \cdot Y^{00}}{M^{00}} = \frac{9,764.8}{1,111.7} = 8.8$$

Condition (22) was for that reason apparently fulfilled:

$$(22') \qquad 1,866.1 < 289.6 \cdot 8.8 = 2,548.48$$

Table 3

U.S.: GDP in USD Billions: 2001–2007[17]

Year	GDP
2000	9,764.8
2001	10,075.9
2002	10,417.6
2003	10,908.0
2004	11,630.9
2001–2004	1,866.1
2005	12,364.1
2006	13,116.5
2007	13,741.6
2005–2007	2,110.7

The data therefore support the hypothesis that the income-related velocity of money decreased from 2001–2004. For the period 2005–2007, on the other hand, Tables 1 and 2 reflect an increase in income and prices, whereas the money stock decreased (but remained positive). The condition for an increase in the income-related velocity of money is therefore as follows:

$$(24) \qquad \begin{aligned} &\Delta V^{05-07} > 0 \quad \Leftrightarrow \\ &\Delta P^{05-07} \cdot Y^{04} + \Delta Y^{05-07} \cdot P^{04} + \Delta Y^{05-07} \cdot \Delta P^{05-07} > \Delta M^{05-07} \cdot V^{04} \end{aligned}$$

As the income-related velocity of money may never be negative and the money stock decreased from 2005 to 2007, the right-hand side of condition (24) must be

[17] *Organisation for Economic Co-Operation and Development* (2010).

negative. In the light of the increase in nominal GDP deductible from the data in Table 3, the condition for an increase in the income-related velocity of money is therefore fulfilled.

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Summary

The Equation of Exchange Revisited

The article presents a more general version of the equation of exchange providing separately for a financial turnover of money as well as a corresponding financial velocity of money. This sheds a special theoretical light on the easy monetary policy implemented by the Federal Reserve between 2001 and 2004 and the enlargement of the financial sphere in the United States, which persisted until the recent financial crisis broke out – to become an international economic crisis in due course. (JEL E40, E52, G01, N12)

Zusammenfassung

Die Verkehrsgleichung wieder aufgenommen

Eine allgemeinere Version der Verkehrsgleichung wird vorgestellt, die zusätzlich einen finanziellen Umsatz und eine finanzielle Umlaufgeschwindigkeit des Geldes vorsieht. Hierdurch erscheinen die leichte Geldpolitik der Federal Reserve in den Jahren 2001 bis 2004 und die Vergrößerung des Finanzsektors in den Vereinigten Staaten, die bis zum Ausbruch der jüngsten Finanzkrise und der sich anschließenden internationalen Wirtschaftskrise andauerte, in einem speziellen theoretischen Licht.