Wilhelm Lautenbach's credit mechanics – a precursor to the current money supply debate

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Abstract: *This article assesses the theory of credit mechanics within the context of the current money supply debate. Credit mechanics and related approaches were developed by a group of German monetary economists during the 1920s-1960s. Credit mechanics overcomes a one-sided, bank-centric view of money creation, which is often encountered in monetary theory. We show that the money supply is influenced by the interplay of loan creation and repayment rates; the relative share of credit volume neutral debtor-to-debtor and creditor-to-creditor payments; the availability of loan security; and the behavior of non-banks and non-borrowing bank creditors. With the standard textbook models of money creation now discredited, we argue that a more general approach to money supply theory involving credit mechanics needs to be re-established.*

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1. Introduction

Central bank interventions during the 2007-9 Great Financial Crisis (GFC) and 2012 European sovereign debt crisis have led to a renewed theoretical interest in the role of banks and central banks in the money creation process[2]. A massive explosion in the monetary base did not promote an equivalent increase in the broader monetary aggregates, as would have been expected from the economic textbook money multiplier theory. This has discredited that standard academic approach and triggered a new debate about the determination of the money supply (Goodhart 2017). The debate has included leading central banks and central bank researchers, who felt compelled to educate the public about the impact of accommodative policies and the underlying mechanics of money creation (McLeay et al. 2014; Jakab and Kumhof 2015; Deutsche Bundesbank 2017, Kent 2018). This has rightly put back into focus the money creating capacity of banks. Central banks and commercial banks create new money when they grant loans or purchase assets and pay in their own notes or credit the amount as a sight deposit. Within this context, the debate arose as to whether the initiative for money creation is mainly on the side of the banks or whether the private non-bank sector plays the dominant role. A related discussion concerned the limitations to the private creation of money and credit (Goodhart 2017, Deutsche Bundesbank 2017, Kent 2018). These issues became significant in the context of recent institutional reform proposals that see the capacity of private banks to create money in the form of sight deposits as a fundamental institutional problem and seek to curtail this capacity by introducing a fully nationalized money stock or alternatively by imposing a 100% reserve requirement for sight deposits (Fisher 1934, Lutz 1936, Huber 2004; see Decker 2017 for a discussion; see also Benes and Kumhof 2012 presenting evidence from a DSGE model in

[2] For the purposes of this article the term 'money' refers to means of payment. This is normally defined as non-bank holdings of central bank notes and commercial bank deposits.

support of Fisher's proposal). A related proposal was the subject of an unsuccessful Swiss referendum in 2018 (Vollgeld Initiative 2017).

Interestingly, the current money supply debate is not new and has strong parallels with a discourse that took place among German monetary economists during the 1920s-1960s. This discourse provided a richer and much deeper analysis of the determinants of the money supply than contemporary approaches and has long been neglected. Of particular interest is the pioneering work of Wilhelm Lautenbach (1891-1948), a German government official, who developed a specific approach to explain changes in the aggregated bank credit volume, which became known as "credit mechanics" (Lautenbach 1952). Lautenbach's credit mechanics became the basis of the theory of "balances mechanics" by Wolfgang Stützel (1925-1987), who further developed and formalized Lautenbach's approach (Stützel 1958 [1978])[3]. Credit mechanics is arguably one of the more original contributions to monetary theory and represents an important analytical framework that deserves reconsideration in the current money supply debate. Other notable authors include Hans Gestrich (1895-1943), Otto Pfleiderer (1904-1989), Leonard Gleske (1921-2019) and Heinrich Rittershausen (1898-1984). While not forming a distinct school of economics, these authors are nevertheless connected. Lautenbach, Gestrich and Rittershausen attended the secret conference of the Friedrich List society in on 16-17 September 1931, a gathering of the leading German economists, government officials and Reichsbank officials to debate the possibilities and impact of a credit expansion to revive the German economy.[4] Lautenbach, Gleske, Pfleiderer and Stützel worked at predecessor

[3] See the recent publications by Schmidt (2017, 2019), and Sauer and Sell (2018) for an introduction to Stützel's approach.

[4] At the centre of this discussion was a memorandum by Lautenbach (Borchardt and Schötz 1991, 44, 309-325) that proposed to kick-start the German economy through a combination of central bank financed

organizations of the German Bundesbank. Gleske and Pfleiderer became high ranking Bundesbank officials.

The objective of this article is to present an overview of the theory of credit mechanics and to demonstrate that it provides an essential framework to consider the many varied forces that exert an influence over the money supply. While each bank loan creates a deposit, Lautenbach's credit mechanics shows that the impact on the money stock must remain undetermined as the breakup of payment flows between bank debtor and creditor accounts can result in very different, and at times counterintuitive outcomes. Credit mechanics shows that no priority can be given to either side of the bank balance sheet. The volume of loans and associated deposits reflected in the money stock are not unilaterally determined by the lending decisions of banks and bank debtors but are also strongly influenced by the decisions and requirements of deposit holders, for instance, arising from wage payments and savings. Both, the traditional money multiplier approach, which implies that the money stock is primarily determined by the central bank's monetary base[5], and the view that private commercial banks determine the money supply by their power to create new deposits through loans, represent only one-sided and partial views of money creation. The article is structured as follows. In Section 2 we outline the framework of credit mechanics. Section 3 covers how credit mechanics can help to explain the impact of wage payments, savings and investment spending on the credit volume. Section 4 explores Stützel's and Rittershausen's views on the role of banks and non-banks in the money creation process. Further applications of the frameworks are considered in

infrastructure programs, wage reductions, government interventions to breakup cartels and a reduction in cartel prices.

[5] See Goodhart (2017, 33-36, 37-39) for a critique of the money multiplier approach.

Section 5. This is followed by an assessment of the presented material within the context of the current money supply debate in Section 6. Concluding remarks are added in Section 7.

2. The framework of credit mechanics

Lautenbach's key insight was that changes in the credit volume do not simply reflect economic transactions, such as those arising from production activities such as commodity production and sales, 1936a, 135;1952, 80). The latter, according to Lautenbach, were governed by their own operational rules unrelated to the economic process. Therefore, the make-up of aggregated bank balance sheets did not allow inferences about the circulation of goods, movements of inventories or the level of investment spending (Lautenbach 1952, 191). In Lautenbach's view, "*mastery of the pure mechanics of credit is an elementary precondition for any analysis of the economic process"* and errors could be found in "dozens of theoretical works" because the authors had not mastered the "simple mechanics" that determined the demand for bank credit (Lautenbach 1952, 192; emphasis in original, authors' translation). Lautenbach and other authors refer to this approach as "credit mechanics" or the "mechanics of the credit volume" (Gleske 1954, 52; Pfleiderer 1943, 265).

Lautenbach's starting point is Albert Hahn'smodel of a cashless economy[6], where all payment transactions are conducted through the books of a single bank ("general deposit bank"

[6] Hahn (1920, 24; 1930, 22; 2015, 23). Hahn's book is arguably one of the most important and influential books on monetary theory in the German-language area. Hahn is credited by Schumpeter (1954, 1116) as being the first to have succeeded in providing a complete theory of bank credit: "But it was not until 1924 [*sic*, 1920] that the theoretical job was done completely in a book by Hahn". Schumpeter (1917/18, 705) had argued earlier that the essential function of a bank was "money production" rather than the on-lending of previously collected customer money. See already Schumpeter (1912, 202-203) quoted in Hahn (1920, 29; 2015, 26). On Hahn, see Hagemann's introduction in Hahn (2015, v-xxiv) and Ellis (1937, 327-334); see also Lautenbach's endorsement of elements of Hahn's theory in Lautenbach (1937, 512). Thanks to Clemens Matt's

["Generaldepositenbank"]) and assumed that bank credit is the only form of credit (Lautenbach 1952, 44). Due to fundamental accounting rules, the sum of bank creditor accounts must be equal to the sum of bank debtor accounts and "loans and deposits appear and disappear simultaneously". In other words, "[d]ebtors can only come into existence to the extent that creditors emerge and vice versa." On this basis, Lautenbach argued that nothing could be said about the "priority of either side of the bank balance sheet" (Lautenbach 1952, 46, authors' translation). Lautenbach stressed that these attributes of bank credit made the interrelationships much more complex than they at first appeared. While the statement that "the demand for credit [loans] can only be fulfilled to the degree that bank creditors are created" was considered as common sense, the opposite and equally true statement: "the demand for credit [loans] *arises* only to the extent that bank creditors are created"[7] would be perceived by most readers as paradoxical or counter-intuitive (Lautenbach 1952, 46, emphasis in original, authors' translation). Hence, Lautenbach argued that the simultaneous creation of bank creditor (deposit) accounts and bank debtors (loan) accounts implied that the chain of causation can run both from the bank debtor and the bank creditor side. Loan demand was not unilaterally determined by bank debtors, for instance companies requiring funding for their investment plans. A critical determinant of the loan demand was the deposit holding requirements of bank creditors (e.g. wage recipients). In order to meet this demand for deposits, a corresponding volume of loans must be created and maintained.

efforts, Hahn's work is now available in an English translation (Hahn 2015) almost 100 years after its original publication in German!

[7] For instance, the credit demand resulting from the act of saving.

Having established the principle that no priority can be given to either side of the bank balance sheet, Lautenbach (1952) considered the operational determinants of the volume of bank credit. His main argument was perhaps most forcefully expressed in a letter he wrote to Walter Eucken in 1944. Eucken (1944, 215) had argued that changes in bank balance sheets could not be understood without the full knowledge of the associated production activities. By contrast, Lautenbach (1952, 191) argued that "the associated production activities are completely irrelevant and had nothing but nothing at all to do with the changes in bank balances" (authors' translation). Whether bank balances expand or contract was solely determined by a number of formal conditions, namely, as to whether the parties to the payment transaction were both creditors, both debtors or a combination of creditor and debtor (Lautenbach 1952, 48). Accordingly, bank balance sheet movements can be reduced to four possible cases that in turn govern the mechanics of the credit volume (Table 1). [8]

Table 1: **Four mechanical interrelationships governing the credit volume**

Case	***Payment flow***	***Bank balance sheet impact***
I	Debtor to creditor	Expansion - "bank money creation"
II	Creditor to debtor	Contraction - "bank money destruction"
III	Creditor to creditor	Unchanged
IV	Debtor to debtor	Unchanged

In order to further illustrate these important relationships, a series of simplified bank balance sheets are shown in Tables 2-6. We assume four bank customers: (i) two bank creditors with positive deposit balances of 5,000 each and no loans, and (ii) two bank debtors, who have drawn on their

[8] Based on Lautenbach (1952, 48), Gleske (1954, 52) and Stützel's commentary in footnote 3 in Lautenbach (1952, 45-6); see also Grass and Stützel (1988, 261 - 264).

lines of credit to the amounts of 5,000 each. Deposits were created as debtors utilized their lines of credit.[9]

Table 2: Initial state

Aggregated bank balance sheet

Assets	Liabilities	
0	5,000	Creditor 1
0	5,000	Creditor 2
5,000		Debtor 1
5,000		Debtor 2
10,000	10,000	

Table 3 illustrates case I, a payment flow from debtor 1 to creditor 1. The debtor 1 draws down the payment amount of 1,000 and transfers the funds to creditor 1. As a result, the aggregated bank credit volume increases by 1,000 from 10,000 to 11,000. This is the most commonly discussed case of bank money creation.

Table 3: Case I - debtor to creditor payment ('bank money creation')

Aggregated bank balance sheet

Assets	Liabilities	
0	**6,000**	Creditor 1
0	5,000	Creditor 2
6,000		Debtor 1
5,000		Debtor 2
11,000	11,000	

[9] Banks would hold additional assets as capital, which is not shown in order to keep the diagrams simple

Table 4 considers the opposite case II. Here, bank money is destroyed when the bank creditor 2 pays debtor 2 the amount of 1,000, whose loan balance is reduced as a result of the transaction.[10] The aggregated bank balance sheet and the associated bank credit volume decreases by 1,000 from 10,000 to 9,000.

Table 4: **Case II - Creditor to debtor payment ('bank money destruction')**

Aggregated bank balance sheet

Assets	Liabilities	
0	5,000	Creditor 1
0	**4,000**	Creditor 2
5,000		Debtor 1
4,000		Debtor 2
9,000	9,000	

Table 5 considers payment transactions between creditors, case III. As long as accounts are not overdrawn, payment amounts net each other off between accounts. For instance, a payment of 1,000 by creditor 1 to creditor 2 reduces creditor 1's deposit balance by 1,000, while it increases the balance of creditor 2 by the same amount. The operation leaves the size of the aggregated bank balance unchanged.

Table 5: **Case III - creditor to creditor payment**

[10] Based on the assumption that firms hold lines of credit any inflow will result in a repayment. However, different structures are possible where loans are not repaid and deposits are held in offset accounts.

Aggregated bank balance sheet

Assets	Liabilities	
0	**4,000**	Creditor 1
0	**6,000**	Creditor 2
5,000		Debtor 1
5,000		Debtor 2
10,000	10,000	

A similar relationship is found in transactions between debtors, case IV, as is illustrated in Table 6.

Table 6: **Case IV - debtor to debtor payment**

Aggregated bank balance sheet

Assets	Liabilities	
0	5,000	Creditor 1
0	5,000	Creditor 2
6,000		Debtor 1
4,000		Debtor 2
10,000	10,000	

The aggregated bank balance remains unchanged as both parties remain net debtors. Hence, economic transactions between debtors, for instance, inter-company transaction where both companies use overdraft facilities, have no impact on the size of the aggregated bank balance. This holds as long as there is a balance in the direction of transactions and neither party becomes a creditor in the process. This will be the case when debtor 2 makes a similar amount of purchases from debtor 1 over the reporting period and the individual transaction amounts are sufficiently small.

While the cases I and II are typically the focus of theoretical discussions of the money supply determination, one of Lautenbach's achievements was to identify the importance of cases III and IV

and to stress that many important economic transactions leave the credit volume unchanged, especially inter-company transactions. Leonhard Gleske (1954, 52), in his 1954 book on bank liquidity, noted that Lautenbach had been the first to identify these interrelationships. Gleske (1954, 53) argued that it was therefore not within the power of the banking system to create a pre-determined money supply volume. In support of Lautenbach, he noted that the bank money volume was the result of innumerable dispositions of creditors and debtors and that the statistically determined money supply could therefore reflect vastly different real economic circumstances. It was irrelevant for the production of economic income if an increase in credit activity manifested itself in the bank balance sheet or not.

3. The determination of the bank credit volume

The arithmetic relationships articulated in Lautenbach's credit mechanics show that the level of economic income generating activities is not necessarily correlated with changes in the bank credit volume. He demonstrated this, for many perhaps counter-intuitive, conclusion by an analysis of how wage payments, savings and investment spending influence the credit volume, and what factors influence changes to the credit volume during the stages of the business cycle. Moreover, Lautenbach identified that the prevailing conditions in share and bond markets also had a significant impact on the bank credit volume. In the following we consider each of these topics by drawing on the work of Lautenbach but also related contributions from Leonard Gleske.

Wage payments and savings

Lautenbach argued that the formal arithmetic relationships between bank creditor and debtor accounts have an important consequence for the functional relationship between credit volume and

wage payments, savings and investment spending. Lautenbach illustrated the relationships by using an idealized example where firms are assumed to be net bank debtors with an aggregated debt balance of 10 billion and the state as the creditor having received 10 billion in funds from the firms (Lautenbach 1949, 520; see also Lautenbach 1939, 117, which refers to the same example but uses the group of 'non-firms' as creditor instead of the state). These relationships are shown in a simplified aggregated balance sheet in Table 7.

Table 7: **Aggregated bank balance sheet in the initial state (units in million)**

Aggregated bank balance sheet		
Assets	Liabilities	
0	10,000	State
10,000	0	Firms
0	0	Wage recipients
10,000	10,000	Total

Lautenbach now assumed that in order to pay wages, the firms raise an additional 2 billion in loans each month and periodically increase their debt to 12 billion (Table 8). In Lautenbach's model, a wage payment triggers a transaction from a company debtor to a household creditor (case I) and thus leads to a net increase in the bank credit volume.

Table 8: Aggregated bank balance sheet after wage payments

Aggregated bank balance sheet		
Assets	Liabilities	
0	10,000	State
12,000	0	Firms
0	**2,000**	Wage recipients
12,000	12,000	Total

The bank credit volume increases with the amount of wage payments and decreases in line with the number of payment periods per year (Lautenbach 1939, 118; 1952, 47, 49). This expansion is then reversed by product purchases following wage receipts, which creates a creditor-debtor payment flow (case II) over 2 billion. By the end of the period, firms have received all their wage outlays back in revenues and repay their loans. The balance sheet returns to its initial position of 10 billion before the next 2 billion in wage payments is drawn. Lautenbach (1939, 118) stressed that given multiple wage payments are made per year, only a fraction of the annual wage sum is reflected in the credit volume. In his example, the annual wage sum is 24 billion while the outstanding loan balance is 2 billion (1/12) at its peak or 1 billion (1/24) on average over the year.

As a related example, Lautenbach considered household "savings", i.e. a situation where wage recipients spend less than the full amount of their wage money receipts (Lautenbach 1952, 48-9; 1939 117; 1949, 520). For instance, if 5% or 100 million of the monthly wage sum of 2 billion is saved, the credit balance at the end of the period, but before the next wage payment, only decreases to 10.1 billion rather than the original 10 billion. The total credit volume has increased by the amount of savings. An additional credit amount equal to the amount of savings at 1.2 billion p.a. must now be financed and maintained. Hence, the credit demand has increased due to an increased demand for deposits rather than loans.

Investment

While wage payments and savings out of wages increase the bank credit volume, a different situation arises in relation to investment spending. Lautenbach (1952, 48) argued that turn-over and payments between firms typically did not require additional financing beyond the loan amounts that firms would have already raised for wage payments. As wage payments flow back during the period

due to consumption expenditures, credit lines will become available to conduct inter-firm transactions. The latter will manifest themselves as pure book transfers between debtor accounts, leaving the credit volume unchanged (case IV). Specifically, Lautenbach (1937, 517) argued that as long as all firms held lines of credit and their debt balances stayed between 0 and D, with D at any chosen debt amount, inter-firm turnovers could be conducted at any volume without requiring additional bank credit. As long as companies remain debtors, transactions between companies "would only result in mutually compensating changes in debtor accounts, and therefore would not increase the aggregated credit balance or the total demand for credit" (Lautenbach 1952, 48; authors' translation). This holds as long as the individual spread between inter-firm payment inflows and outflows at any given point in time is sufficiently small.

The volume of investment is made up of the share of the wage sum that can be capitalized and the various capital inputs that firms purchase from other firms including inventory and fixed investments. Assuming (i) that all inter-firm purchases of investment goods are credit volume neutral debtor to debtor transactions and (ii) a fixed wage bill, Lautenbach concluded that "[t]he level of and the changes in *investment spending* are completely *without impact* on the volume of credit; they impact exclusively on the turnover rate in the bank accounts" (Lautenbach 1939, 118, emphasis in original; authors' translation). These conditions would be fulfilled most easily if all firm investments occurred in lockstep and the investment spending was limited to what could be self-financed out of profits, with neither firm experiencing net liquid surpluses or deficits after accounting for the investment spend (Lautenbach 1952, 50).

A somewhat different situation arises when the distribution of investments is unbalanced. Here some firms may emerge as net creditors as they invest less than their counterparties and their proceeds consistently exceed expenditures. Debtor to creditor payment flows then lead to an increase of the bank credit volume. Lautenbach argued that the bank credit volume required for

investment spending was therefore dependent on the degree companies reach uniformity in their pace of investment outlays and was lowest (i. e. near zero) when their investments were synchronized and occurred in lockstep. (Lautenbach 1952, 50-1). The important factor was not the quantum of investment but the degree of dispersion of the investment (Lautenbach 1949, 509). However, even when investments are dispersed, as Gleske (1954, 57) pointed out, the excess deposits of creditor firms "were not a yardstick for the size of the investment". This was due to the fact that the increase in the credit balance of firms with excess proceeds was only the incremental amount net any pre-existing debt balances. For instance, if debtor 2 made a purchase of capital equipment from debtor 1 of 6,000 and debtor 1 had a pre-existing debt balance of 5,000 the aggregated bank balance would only increase by 1,000 despite an investment amount of 6,000. In addition, it was feasible that investing firms could still have an inflow of profits, which suppressed their net investment credit demand. Gleske (1954, 57) concluded that, "one cannot get a picture of the extent of the economic net investment from bank balance sheets" (authors translation). Moreover, Lautenbach highlighted that firms with substantial credit balances would seek to deploy their bank deposits by investing in other firms. Deficit firms would issue shares that would be bought up by surplus firms. In this way, deficit firms would repay their excess loans and surplus firms would reduce their deposit holdings. The aggregated bank balance thus periodically "converges back towards its minimum" (Lautenbach 1939, 118; authors' translation).

Looking at the problem from a production perspective, Lautenbach explained that the volume of investment was decided by how many workers were employed in the production of investment relative to consumption goods. Different allocations between investment and consumption good

sectors were possible at the same wage and credit amount.[11] While the level of employment could fluctuate with the level of investment, one did not necessarily move in parallel with the other. For instance, Lautenbach pointed out that a drop in the savings rate and a corresponding increase in consumption expenditures could result in an increase in employment. In this scenario, the bank credit volume required to finance wages would increase at constant investment (Lautenbach 1937, 519).

Another illustration of the fact that the credit volume does not necessarily rise in line with the investment spending is provided by Lautenbach (1949, 521) within the context of government investment. Based on the citied examples illustrated in Table 7 and Table 8, Lautenbach considered a scenario where a state investment of 300 million per month would lead to a contraction of the credit volume by 200 million per month as the debtor-creditor flows from firms to savers of 100 million per month would be more than offset by the creditor-debtor flows from the state to the firms. Here, the credit volume shrinks despite an increasing investment volume. Not the volume of company investments but the bank deposits required for wage payments and the deposits accumulated as part of savings from wage money receipts were the key determinants of the bank credit volume.

Lautenbach's analysis therefore highlights the importance of the deposit side of the bank balance sheet over the debtor side and the strong influence bank creditors exert over the volume of bank credit. Lautenbach stressed that in order to "develop a picture of the future development of credit, we should and must be on the look-out for future [bank] creditors even more so than future [bank] debtors" (Lautenbach 1952, 45-6; authors' translation). Commenting on the German money

[11] See also Gleske (1954, 56), who stresses that the credit volume requested by firms is dependent on the total production volume and not on the allocation of production factors to different sectors.

supply development in the 1920s, he argued that the decisive factors determining the volume of central bank money were the level of employment and wage rates (the majority of wage payment were made in cash at the time). Without changing wage rates, the volume of central bank money in circulation could only moderately increase. According to Lautenbach, continuously increasing wage rates were the "conditio sine qua non" for the "paper money deluge" experienced during the years of the German hyperinflation (Lautenbach 1936b, 240; 1952, 96).[12]

Lautenbach's insight that the credit volume was not a direct function of the quantum of investment was taken up by Wolfgang Stützel and forms a central part of his theory of "balances mechanics" ["Saldenmechanik"] (Stützel 1953 [1979], 1958 [1978]) [13]. Stützel considered the insight as so significant that he included it as one of the "main theorems of macroeconomic arithmetic" (Stützel 1954 [1979], 73-4; 1958 [1978], 73, 81). Stützel argued, at a more general level, that as long as non-firms spent all their proceeds, the aggregate of all firms could not experience any reduction of their monetary assets, defined by Stützel as the stock of means of payment plus other monetary claims less monetary obligations[14]. This held regardless of the size of the firm's collective

[12] It should be noted that during the 1914-1923 inflation period wage increases were lagging customer price increases. Cost of living index clauses were applied in the later inflation years (Pfleiderer 1976, 176, 180). Hence, price increases, predominately caused by the monetary financing of government expenditures, triggered increased wage demands, which resulted in ever increasing wage money volumes.

[13] Schmidt (2017, 52-4) provides an introduction to Stützel's balances mechanics and discusses the logical fallacies associated with savings and investment; see also Lindner (2015a, b)

[14] Means of payments are defined as central bank notes and bank deposits. Monetary claims and obligations include accounts receivable, accounts payable and other forms of debt (Stützel 1953 [1979], 55). We use the term "monetary assets" rather than the broader term "financial assets" to exclude equity

expenditures, including their investment expenditures.[15] According to Stützel, there was thus no direct relationship between the total investment demand and total credit demand (Stützel 1953 [1979], 74). While an individual firm might experience an increased credit demand as the result of its increased investment, this could not hold for all firms in aggregate. The net credit demand of all firms required to maintain their pre-existing levels of liquidity (e.g. net bank balance) had to be exactly equal to the non-firm's total excess of proceeds over expenditures, i.e. their savings out of wages. Consequently, for the economy as a whole, the demand for credit to maintain a pre-existing level of liquidity was always zero, regardless of any increase or decrease in expenditures. The sum of total sales / proceeds per period was necessarily equal to the sum of total purchases / expenditures per period (Stützel 1958 [1978], 73, 81; 1953 [1979], 59). The assumption that the credit demand would always rise with increases in investment spending was based on a fallacy of composition (see Appendix for a set of worked examples).

The importance of debtor to debtor transactions (case IV) and the modest impact that inter-firm transactions have on the credit volume is also reflected in Heinrich Rittershausen's (1956, 1962) "theory of debt repayment chains [Theorie der Entschuldungsreihen / Tilgungsreihen]"

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investments, options etc.. In order to simplify the terminology, monetary assets signify the net position of the associated assets and liabilities.

[15] We use the terms sales / purchases and proceeds / expenditures as translations of Stützel's "Verkäufe / Käufe" and "Einnahmen / Ausgaben". In Stützel's taxonomy, proceeds must increase monetary assets and are associated, for instance, with the sale of goods (incl. capital goods), and services. Expenditures must reduce monetary assets and are associated with the purchase of goods,services, wages etc. "Sachaktiva" (tangible assets)include items representing real capital or material wealth such as plant and equipment but as a special category also shares (Stützel 1953 [1979], 298-299)..

(Rittershausen 1962, 225). He stresses the self-liquidating nature of most credit relationships[16]. In Rittershausen's view, bank loans were in the first instance raised by debtors to settle payment obligations arising from the supply of production inputs including those for capital expenditures. In turn, payment recipients were often suppliers, who were also net debtors, that settled bank debts or supplier obligations with the payment proceeds. Hence, the creation of new bank credit typically triggered a "chain" or "wave" of payments and settlements that led to the subsequent destruction of the original credit (Rittershausen 1956, 22, 94). Consequently, Rittershausen criticized the simplistic view that interpreted every grant of bank credit as an expansion of the credit volume (case I). By contrast, bank customers used their inflows and loan proceeds to repay debts. Rittershausen regarded "only the excess of expansions (new grants of credits) over contractions (repayments of existing credits) as expansive" (Rittershausen 1962, 514). Rittershausen's reasoning therefore resembles that of Lautenbach, who had shown that payment flows between debtors (case IV) leave the overall credit volume unchanged.

4. Credit creation: who takes the initiative?

[16] Rittershausen's template was the Scottish system of free banking. According to Rittershausen, the main feature of the Scottish system was that bank credit was provided on a short-term basis and periodically sterilized at the end of the household / wage-earner to producer / retailer value chain. (Rittershausen 1954, 76-8).

Stützel's balances mechanics provides an interesting perspective on the credit creation process itself and the question as to whether the bank or the non-bank takes the initiative in the process. Stützel emphasised that any realized surplus and deficit in the balance of proceeds and expenditures presupposes the availability of credit. For instance, in a purchase transaction that is financed by bank credit, the buyer's deficit in the balance of proceeds and expenditures can only come into existence when she finds a seller who accepts the newly created bank deposits in payment and agrees, at least temporarily, to hold the deposits. Arguably, three parties, the buyer, the seller and the bank jointly create the new means of payment. Stützel (1953 [1979], 259) stressed that the decision as to whether a deficit and corresponding surplus in the balance of proceeds and expenditures could be realized or not was made in the very act of purchase. Consequently, Stützel argued that additional surpluses in sales proceeds over expenditures realized by a seller are not created in isolation but *uno actu* with the expenditure of a buyer. The "mysterious perception" that banks had the ability to create additional (net) monetary assets and therefore "purchasing power" *ex nihilo* was therefore a fallacy of composition. Newly created monetary claims were always matched by monetary obligations, with the sum of claims and obligations netting to zero (Stützel (1953 [1979], 259-260). Hence, the strong link between bank money creation and purchasing process brought out in the mechanics of balances highlights the critical role of non-bank buyers and sellers.

A related fallacy highlighted by Stützel was the view that new bank loans generally lead to an increase in the volume of bank credit. While for a subset of banks an increase in new lending could lead to an increase in their balance sheets and credit volume, this not necessarily had to be the case for the group of banks as a whole. Stützel (1953 [1979], 311) concluded that

> "there is absolutely no reason to assume that an increase in the number of new loans per period leads to an expansion rather than a contraction of the credit volume. And there are just as few reasons to

assume that a reduction of the number of new loans per period leads to a contraction of the credit volume rather than to its expansion." (authors' translation)

The underlying functional relationship between new loans and the volume of bank credit (central bank and banks) were formulated by Stützel in the following global theorem: the increase in new loans (banks and central bank) per period must coincide with an equal amplification of the flow of loan repayments and/or increase in the flow of newly created deposits. This led Stützel (1967, 597) to a specific way to define money creation ("Geldschöpfung"):

> "The volume of the aggregated stock of means of payment […*money volume*…] in an economy […] increases as soon as payments, through which the payer enlarges his bank debt or reduces his longer-term claims on banks (savings deposits etc.), go to recipients [payees], who neither use the funds for the repayment of bank debts nor invest them as long-term bank deposits." (emphasis in original; authors' translation).

A related and equally problematic issue in monetary analysis, identified by Stützel, is implicit assumptions about the buyer-seller relationship between bank and non-bank. An important instance is the (incorrect) assumption that central banks and commercial banks could create new loans and associated deposits without active participation of the non-bank public (Stützel 1953 [1979], 214). By contrast, Stützel argued that there were always two parties to any credit contract. The initiative to enter into the contract could at times originate from the bank and at times from the non-bank customer. Hence, statements that "'central banks could 'pump' money into the economy" and commercial banks "could create credit and respectively increase sight deposits (without 'active' participation of the public)" made the critical but often unstated assumption that the market for central bank money and bank deposits was a seller's market. Here, the demand for means of payment was always greater than the supply and the banks "asymmetrically" determined any increases in the volume of the supplied means of payment (Stützel 1953 [1979], 214; authors'

translation). However, Stützel argued that this was not always the case. For instance, periods of booming capital markets and strong levels of consolidation of deposit holdings into security holdings could create a buyer's market. In this situation the original initiative to enter into individual credit contracts had to be taken by banks, who faced strong pressure to maintain the volume of their lending business. The non-banks decided how much of the offered supply of bank loans was taken up (Stützel 1953 [1979], 214).

Rittershausen also discussed the relationship between banks and non-banks in the money creation process. He regarded this relationship as intrinsically "bipolar". Both the creditor and the debtor created (bank) money (Rittershausen 1956, 49). A bank could not regulate whether their creditors withdrew (activated) or kept (neutralized) their deposits. The same principle held with respect to bank debtors. Not bank management but debtors decided when they utilized their lines of credit (Rittershausen 1956, 35). Hence, Rittershausen criticized the notion that banks would always strive to maximize the volume of short-term credit based on profitability considerations as "illusionary" (Rittershausen 1962, 222). Any attempt of an individual bank to rapidly expand would fail due a lack of solvent debtors. Any one-sided theory that assumed the always dangerous and cumulative nature of bank credit was mistaken (Rittershausen 1962, 224). Rittershausen argued that the formula of the money multiplier theory was silent about the availability of real debtors, loan conditions and loan security (Rittershausen 1962, 122-3). Consequently, Rittershausen criticized Lutz (1936), who asserted that the reliance on private "money" in the form of bank deposits represented a core institutional problem that could be overcome by a prohibition of private deposit creation via a sovereign money scheme[17]. In Ritterhausen's view, Lutz was "overstepping the mark" and had

[17] Lutz considered the Chicago plan (Fisher 1935) as a possible solution. He summarized the required reforms as follows: i) the central bank obtains full control over the money supply; ii) 100% backing of bank

overlooked that “the great inflations and credit disruptions in world history have been created by states” (Rittershausen 1956, 123; authors’ translation).

5. Further applications

Lautenbach applied the principles of credit mechanics to explain the changes in the credit volume during the depression and subsequent upswing in Germany 1929-1936 (Lautenbach 1936a, 1936b; 1952, 80-108). In both of his 1936 articles, Lautenbach stressed the seemingly paradoxical relationship between credit demand and volume of investment. He argued that at the onset of a crisis credit became scarce because there was a drop-off in investment spending. Employment and income in capital goods production decreased, which led to a reduction in the demand for consumption goods. As a result, loans could not be repaid and froze. Bank customers demanded more credit, while the turn-over in bank accounts decreased (Lautenbach 1936a, 135-6; 1954, 80-1). In a similar fashion, Lautenbach (1936a, 137, 145;1954, 82, 92) concluded that the credit volume

cheque deposits by central bank money, iii) prohibition of private bank deposit creation. Bank credit only on the basis of own capital and deposit holdings (Lutz 1936, 89-90). However, Lutz also considered an alternative arrangement to safeguard private bank deposits whereby the central bank would provide a guarantee to accept all commercial bank assets in a liquidity crisis, including assets that were under normal circumstances not considered eligible collateral. In addition, banks would be required to have high levels of capital and transfer high-risk assets to dedicated non-deposit taking institutions (Lutz 1936, 94). Note the similarity with the proposals made by Mervyn King, the recent Governor of the Bank of England, in Chapter 7 of his book, The End of Alchemy (King 2016).

would not automatically shrink when production and turn-over declined as the amount of credit that was directly tied into income producing activities was relatively small due to its high turn-over rates. However, once bank interest rates had sufficiently declined, depositors increasingly employed their funds in capital markets. Hence, Lautenbach argued that any observed decrease of the bank credit volume during a depression was predominately caused by the 'consolidation' of bank deposits into bonds and stocks. In this process, bank creditors with excess deposit holdings purchase primary issues of bonds and shares from bank debtors, who make bank loan repayments with the proceeds.[18] Bank balances contract due to financial processes that have nothing to do with changes to production activities (Lautenbach 1936a, 136, 146-7; [1954, 82, 93-4]).

Lautenbach argued that the sluggish reaction of the credit volume in a recession was mirrored by a low visible increase in the bank credit volume during an upswing, even in an environment with large scale investment spending. His case in point is the credit expansion and upswing in Germany after 1933. Here, the aggregated balance of the banking system increased from 1932 to 1936 by only 15%, while the GDP increased by half (Irmler 1976, 324-5). Loan repayments offset new loans as bills issued to finance public employment programs (Öffa-Wechsel) started to displace private trade bills (; Lautenbach 1936b, 241, 244; 1952, 98, 101). The massive public investment and credit activity of the German banks after 1933 demonstrated that the employment of credit and not the volume of the money supply was the decisive factor (Lautenbach 1939, 119, Gleske 1954, 53).

In 1936, when Lautenbach published his articles in the journal "Wirtschaftskurve", Hans Gestrich, a friend of Lautenbach's, published his work "Neue Kreditpolitik" (new credit policy) (Gestrich 1936). Following Lautenbach, Gestrich highlighted in his writings that errors and doubts

[18] A case II creditor-to-debtor payment flow.

could easily arise, when conclusions were drawn from the size of bank balance sheets. He emphasized that bank balances were stock variables and therefore only represented snapshots in time. It was therefore important to recognize that movements in bank balances could compensate each other and become invisible. Moreover, strong movements in previously static accounts could create phenomena, the significance of which were the opposite of what was commonly expected (Gestrich 1936, 31-33). Gestrich's prime example is the "invisibility of a credit expansion". In a situation, where there is a large number of impaired loans, freshly created sight deposits only temporarily appear in the sight deposit accounts and are shortly thereafter used by the recipients to repay their existing loans. While the credit expansion is effective, the process only creates a transfer of funds between debtor accounts and remains invisible in the aggregated bank balance. Similar to Lautenbach, Gestrich pointed to the financing of the German public employment programs in 1933/34. Gestrich's second example concerns the case, where credit creation is occurring but bank balance sheets are shrinking because bank creditors purchase shares and bonds and their issuers repay their bank loans from the proceeds. Alternatively, creditors who hoarded deposits during the crisis may reactivate these at the beginning of an economic upswing by carrying out commodity purchases, while the recipients of these funds repay their bank loans. As a result, bank balances contract, while the employment of credit expands. A further example given by Gestrich concerns the paradoxical case, where bank balance sheets further expand during the transition from boom into recession. Gestrich noted that at the onset of a recession, bank creditors begin to 'hoard' their deposits, which means that firms experience a decrease in their incoming payments. Hence, firms are forced to maintain or even expand the volume of bank credit as the result of depositor actions.

The critical importance of considering deposit creation and repayment flows at the same time is demonstrated by Stützel. An example are two paradoxical cases, where (i) an increase in new loans supports the contraction of the credit volume; (ii) a restraint in new lending facilitates the expansion

of the credit volume (Stützel 1953 [1979], 312-7). Both cases are similar to those discussed in Lautenbach (1936a,b, 1952) and Gestrich (1936) but more nuanced. In the first case, Stützel considers a scenario with favourable economic conditions characterized by high expected dividend payments and capital gains on equity investments, and with rates of return greatly exceeding interest rates on bank savings deposits. Stützel assumed that this favourable investment climate would trigger a shift from bank savings deposits into shares, resulting in a contraction in the size of bank balance sheets and a corresponding increase in the liquidity of the banking system as a whole. Stützel argued, that in this situation banks would seek to increase their lending including loans for speculative purposes. However, despite the banks' attempt to increase their loan portfolios, bank funds arising from new loans would be used by their recipients for commodity or share purchases until they would be received by someone who used the funds for loan repayments. As nobody wanted to increase their deposit holdings, even a strong increase in the volume of new loans per period would not lead to an increase in the bank credit volume. Banks would in fact accelerate this trend by accommodating more loans (Stützel 1953[1979], 313). Indirect, bank intermediated, credit relationships were replaced by direct credit relationships in the process. Stützel therefore argued that an important role of bank credit was to provide the underlying mechanism to create the necessary temporary funding flows between security issuers and purchasers. The latter flow from bank creditors to debtors, which trigger loan repayments and a reduction of deposit holdings.[19] Stützel (1958 [1978], 217; 2017, 29) noted this as one of the most "obvious" situations, where the money-multiplier theory did very little to illuminate the interrelationships.

Stützel's second paradoxical case is concerned with the difficulties associated with the interpretation of an expansion of the bank credit volume. The latter was in his view often incorrectly

[19] See also Rittershausen (1956, 84) on the role of banks as "anticipators" of security issues.

interpreted as the "cause or at the very least as a symptom of a demand increase" (Stützel 1960, 16; authors' translation). By contrast, Stützel argued that credit was not only required to fund increased expenditures but also performed a critical role as a buffer to compensate for a slow-down in sales proceeds. In this situation, an increase in the volume of outstanding bank credit was an indicator of a decrease in revenues rather than an increase in expenditures. Moreover, a slowing in the rate of new lending could be more than offset by an even greater slowing of credit repayments. In this case, an increase in the credit volume was an indicator for a tightening of conditions and a signal that bank loans had a tendency to "freeze" (Stützel 1960, 17). Similarly, Stützel argued that restrictions imposed on new lending could lead to the hoarding of liquid funds in the form of bank deposits (see already Gestrich 1936, 32, who referred to the "hoarding of deposits"). The proceeds from the few remaining new loans were used to expand liquid deposit holdings and were withheld from loan repayments (Stützel 1953 [1979], 315). Similar to Lautenbach, Stützel argued that there was no strict interrelationship between the expansion of the bank credit volume and the expansion of aggregate expenditures. This had important implications for the conduct of monetary policy as a change in credit volume was neither a necessary nor a sufficient condition for the successful implementation of such policies (Stützel 1959, 72). By contrast, Stützel (1959, 71) argued that the change in the scope of available financing options was the critical indicator. He pointed out that the borrowing capacity of the individual business was always limited. The capacity to take on debt depended on both the credit rating demanded by the lender and the status of the borrower. Stützel highlighted that the latter was determined by the value of the borrower's assets and the degree to which an individual asset could be monetized and deployed as collateral[20]. Hence, restrictive monetary

[20] Stützel (1958 [1978], 174-175) emphasized that a currency must be backed by assets. The full economic significance of such security has only more recently been asserted by the German economists Heinsohn and Steiger (2013); see also Decker (2015). The premise of their approach is that genuine money creating

policies that led to reduced bank liquidity and tighter credit conditions would limit the individual borrowing capacity of businesses and governments and could thereby trigger a significant reduction in aggregate expenditures. In Stützel's view, restrictive policies could have an even stronger, i. e. moderating, impact on the ongoing rate of consolidation and repayment of bank loans than on the volume of new loans (Stützel 1959, 72-3). Hence, restrictive monetary and credit policies could facilitate an expansion of the bank credit volume. Stützel (1964 [1983], 10-11) was therefore very critical of what he referred to as naïve quantity theoretical approaches, which argued that the "banking apparatus" required state control because it could unilaterally determine the money stock and thus provided a "gear-lever" to control aggregate expenditures and the volume of employment.[21]

transactions between banks and non-banks usually involve property assets. A borrowers' debt capacity critically depends on the available assets that she can furnish as loan collateral, while banks require sufficient capital as a buffer for unforeseen losses. The availability of solvent debtors with suitable collateral together with bank capital requirements, therefore, impose constraints on the volume of money that banks can create.

[21] See also the discussion of Stützel's business cycle theory and "full money" proposals in Schmidt (2019, 1331-1334).

6. Assessment within the context of the current money supply debate

In the previous sections we have outlined the elements of credit mechanics and related theoretical approaches. It should be evident by now that we believe that this theory is highly attractive, as it can integrate the perspective of the individual banker with the forces that drive the determination of the aggregated money stock. Because bank creditors and debtors appear and disappear simultaneously in the act of bank money creation and destruction, the money supply must be determined by the individual dispositions of banks, bank debtors and bank creditors. The volume of new loans, loan repayment rates and the breakup of payment flows into debtor to debtor, creditor to creditor, creditor to debtor and debtor to creditor streams determine the volume of bank credit and thus the quantifiable, and statistically determinable, money supply in an economy. While it is true that each individual bank loan creates a new deposit, the impact on the overall money stock remains undetermined. The money supply is an aggregated stock variable and thus involves a summation over all other possible bank debtor / creditor actions, which include the destruction of bank money. A higher rate of loan repayments can offset an increased inflow of new loans. Conversely, repayment flows may slow down more quickly than the experienced decrease in the rate of new loans.

Credit mechanics brings into focus the role of the depositor and the impact of different types of payment flows. Bank deposit liabilities that are left standing due to saving, liquidity, transactional and other considerations require a matching level of bank assets to be maintained. Payment flows where both parties are debtors or creditors leave the bank credit volume unchanged. Therefore, many payments across an economy's supply chain can be self-liquidating with very little impact on

the volume of bank credit. This includes payment flows associated with investments. Similarly, the credit volume can remain unchanged, when new loans are fully offset by loan repayments, despite very high account turn-over rates. Hence, the employment of credit is the decisive economic variable.

The recent theoretical debate has not taken much, or any, notice of the developments in German monetary economics since Hahn (1920). For instance, Werner's comprehensive review of the theories of banking, which covers a whole century, does not mention Lautenbach or Stützel (Werner 2016). The important and influential contributions of McLeay et al. (2014) and Jakab and Kumhof (2015) arguably place a strong emphasis on debtor to creditor payment flows (case I) and focus on the money creating capacity of individual banks. McLeay et al. (2014, 17) stress bank profitability, lending risks, regulatory constraints, and monetary policy as limits of money creation. Customer loan repayments (case II creditor to debtor flows) is one of the few factors mentioned where non-banks take the initiative and exert influence over the money supply. Jakab and Kumhof (2015, i, 30) state that banks "fund the additional lending by creating additional deposits" and assume that bank money creation is "mainly constrained by profitability and solvency considerations" of individual banks. In their dynamic stochastic general equilibrium model, banks "technically face no constraints on increasing their loan volume" and the "banks' main constraint is economic, it is the expected profitability and risk of lending".

The work of McLeay et al. (2014) and Jakab and Kumhof (2015), and the underlying concept that "loans create deposits" was critically reviewed by Goodhart (2017, 33, 41-2). He argues that this concept is at best "partially true" and "exaggerates the role of banks in initiating private sector credit expansion". By contrast, Goodhart (2017, 33) emphasizes the role of private sector non-banks, with the banking industry in his view merely setting "the terms and conditions whereby the private sector can create additional money for itself". Goodhart notes that loans to the non-bank private sector are

commonly negotiated in advance in the form of overdraft and stand-by, or credit, limits. The subsequent activation of such arrangements, the actual drawing of the loan, is then left entirely in the hands of the borrower. Then the bank is forced to write up its loan book and, in those cases where the payment by the borrower ends up in another bank, face an outward net payment flow, after the event, which it does not control. Nor is the balance of power in the prior negotiation entirely in the hands of the bank. Competition and regulation constrain the power of each bank to fix loan terms, just as the availability of collateral security limits the ability of the borrower to obtain credit. Banks also hold claims on the public sector, which is, usually, a large bank debtor. The idea that banks unilaterally decide on the volume of bank credit to extend to the public sector is risible. More often, especially at times of crisis, such as wars, the public sector unilaterally determines the volume of public sector debt, via regulation and repression, that the commercial banking sector is forced to take up. Lautenbach, Gestrich, Stützel and Rittershausen argued along similar lines and criticized asymmetrical approaches that overemphasised the role of banks. Lautenbach, Gestrich and Stützel also pre-empted Goodhart's observation that cash shortfalls at turning points in the business cycle are often met by calling on unused overdraft facilities and that changes in the GDP and in bank lending are often countercyclical (Goodhart 2017, 45).

Publications by the German Bundesbank and the Reserve Bank of Australia have put a stronger emphasis on the role of the private non-bank sector. For instance, the Bundesbank (Deutsche Bundesbank 2017, 15, 21, 23) characterizes the interactions between banks, non-banks and central bank that give rise to changes in the money supply as "highly complex". Rather than taking a bank centric view of money creation, the authors stress that "[bank] loans are normally granted on the initiative of non-banks" and highlight the role of (non-borrowing) deposit holders. The bank is also critical of proposals to introduce a 100% reserve requirement for sight deposits (Deutsche Bundesbank 2017, 30-3). In an educational speech, the assistant Reserve Bank of Australia governor

Christopher Kent agrees that "[m]oney can be created […] when financial intermediaries make loans". However, he adds that the stock of broad money was "the result of a myriad of decisions, including those of banks, their borrowers, creditors and shareholders" and that the "process of money creation is constrained in numerous ways" and requires "[i]n the first instance […] a willing borrower" (Kent 2018). Jakab and Kumhof (2019, 2), in response to an earlier version of this paper (Decker and Goodhart 2018), now more strongly highlight the importance of non-banks in their updated Bank of England staff working paper and now characterize "the creation and destruction of deposits by banks […] as the outcome of the *simultaneous* solution of the profit maximization problems of banks *and their customers*" (*emphasis added*) and note that their modelling approach is consistent with the principles of credit mechanics advocated by us in Decker and Goodhart (2018).

Interestingly, none of the contributions discussed in this section have highlighted the strong linkage between the money supply and wages, which was central to Lautenbach's analysis. Arguably, one of the key reasons why the monetary aggregate M3 did not significantly increase despite the rapid increase of central bank reserves following the great financial crisis was limited wage growth. Greater competition from global low-cost producers and technology advances have so far contained the demand for deposits. A different environment, for instance, one that is characterized by strong labour pricing power and monetary financing of growing public sector employment could have delivered a very different outcome. Overall, recent contributions to the money supply debate suggest that the role of non-banks and other factors that constrain the money supply are becoming more strongly recognised. However, the full recognition and systematic application of the elementary mechanics of credit are still at the beginning.

7. Conclusions

Theoretical analysis of the determination of the money supply in the USA and UK has for too long been based on misleading partial equilibrium approaches. Until quite recently it was based on the money multiplier; which implied that the money stock was driven primarily by changes to the central bank's monetary base. This ignored the fact that, if the central bank wanted to fix a short-term interest rate, which it generally did, then the base had to adjust to commercial banks' need for base money, rather than the reverse.

Subsequently the divorce between the recent explosion in bank balances at the central bank and the sluggish growth in the broader money stock has scuppered the money multiplier approach. But this void must not be filled by yet another 'partial equilibrium' analysis, whereby the emphasis is focused entirely on the, supposedly unilateral, ability of the individual bank to create loans, and money, *ex nihilo*.

In contrast, we argue here that 'credit mechanics', originally developed by Wilhelm Lautenbach in the 1930s, should be an important contribution to monetary economics and money supply theory. The theory overcomes a one-sided view of money creation, as often encountered in monetary theory, occurring when the analytical focus remains limited to the actions of an individual bank. By considering the arithmetic relationships amongst bank accounts and accounting identities that must hold between bank creditor and bank debtor accounts, credit mechanics provides an essential framework to consider systematically the many varied forces that exert an influence over the money supply. Driving forces that must be recognized include the actions of banks, non-bank borrowers and non-bank deposit holders at an individual as well as an aggregate level. With the standard textbook models of money creation (monetary multiplier story) and banking (banks as financial intermediaries) now discredited, a 'general equilibrium approach' to money supply theory involving

credit mechanics and the influence of all those participating, bank debtors and creditors, both the non-bank private and the public sector, needs to be re-established.

Appendix: Stützel's balances mechanics of credit volume and investment

While representing trivial accounting identities, the presentation of the arithmetic relationships between investment spending and credit volume by Stützel involve some complexities and differs from Lautenbach's presentation. It is thus worthwhile to illustrate the central concepts in a simplified example. We assume an economy with three firms, representing the aggregate of all firms, receiving and providing goods and services to each other and the non-firm public. Non-firms offer services in return for wages and purchase consumption goods. Firms purchase wage-labour from non-firms. Firms 1 and 2 produce consumption goods, while firm 3 produces capital goods. Following Stützel (1953 [1979], 60), and Stützel, Bitz and Cezanne (1976, 146, 184), we define a change of monetary assets (ΔGV, "Geldvermögen") as the difference between the proceeds from sales (S) per period and the expenditures arising from purchases (P) per period; with $\Delta GV = S - P$. In this model of a closed economy, the sum of all sales must be equal to the sum of all purchases. Therefore, the sum of all monetary assets across the economy is zero. The firm profit is defined by as $Q = I + C_F + \Delta GV$, where C_F is the consumption by firm owners and I is the value of the investment spending (see Stützel 1958 [1978], 76) and Stützel, Bitz and Cezanne 1976, 184). The investment I includes the additional assets that firms hold at the end of the period less depreciation and asset disposals. In the following, C_F is assumed at zero. Moreover, we assume that all sales and purchases are paid for in bank deposits and are transacted through a single bank. Bank claims and obligations are the only forms of debt.

In line with Lautenbach's original analysis, we include the working bank balance or technical liquidity requirements to deal with temporary intra-period flows and assess the additional credit

demand resulting from the mechanics of balances under different economic scenarios against this baseline.[22] In following examples, we assume an annual wage bill of 36,000 and monthly wages payments at 36,000/12 = 3,000.[23] Each firm shares a third of the wage bill. It is assumed that the maximum temporary spread between individual firm outflows and inflows due to wage and inter-firm payments is 1,000, which is also the limit of the overdraft facility. As deposits flow back from wages recipients to firms, available loans facilities are utilised to make inter-firm payments. The resulting balance sheet position just after the payment of wages is shown in Table 9.

Table 9: Aggregated bank balance sheet – technical liquidity baseline

Assets	*Liabilities*	*Party*
1000	0	Firm 1
1000	0	Firm 2
1000	0	Firm 3
3000	0	Total firms
0	3000	Non-firms
3000	3000	Total

The first example considered is the "proceeds-expenditures lockstep" case, where neither individual firms nor non-firms have any surpluses or deficits in their balance of proceeds and expenditures over the period. Each individual or group spends as much as it receives. Consequently, the change in monetary assets for firm 1, firm 2, firm 3 and non-firms is zero and there is no change

[22] See Stützel's discussion of intra-period spreads between payment outflows and inflows that are not visible in the difference between start and end of period balances (Stützel 1958 [1978], 229).

[23] If wage recipients spend their wages in full, all wage payments are received back by firms. In this case, the liquidity requirement for wage payments approaches zero when the number of payment periods is sufficiently large (Stützel 1958 [1978], 233).

in bank balance of either party at the end of the period (Stützel 1958 [1978], 73). Stützel considered the lockstep case as an important, albeit theoretical, benchmark because it demonstrated that the additional credit demand to maintain constant liquidity status could be zero at any volume of turnover and investment spending as long as each party balanced their proceeds and expenditures. [24]

Table 10 shows an idealized worked example of the balances mechanics for the lockstep case. Non-firms receive 36,000 in wages, which are spent on consumption goods creating an equal amount of sales for firms 1 and 2. These firms make purchases of capital goods of 6,000 from firm 3 each, with total turn-over of firm 3 assumed at 12,000. For simplicity, it is assumed that this is equal to the amount of gross investment. We assume that firm 3 creates its own plant and equipment valued at 3,000. Depreciation is calculated at 60% of gross investment. The resulting change in monetary assets for firms and non-firms is zero because all individual sales and purchases are balanced. Total firm profits are 6,000 and equal to the net investment, signifying that investments have been self-financed out of profits.

Table 10: Balances mechanics for the proceeds-expenditures lockstep case

Party	*Sales to other firms*	*Purchases from other firms*	*Sales to non-firms*	*Purchases from non-firms*	*Change to monetary assets (ΔGV)*	*Gross investment*	*Depreciation*	*Net investment (I)*	*Profit (Q)*
Firm 1	0	6000	18000	12000	0	6000	3600	2400	2400

[24] According to Stützel (1967/68), an important application is the case of a self-financing boom where the influence of monetary factors is very low, see also Schmidt (2019, 1319-1321, 1326-1328) for a discussion.

Firm 2	0	6000	18000	12000	0	6000	3600	2400	2400
Firm 3	12000	0	0	12000	0	3000	1800	1200	1200
Total	**12000**	**12000**	**36000**	**36000**	**0**	**15000**	**9000**	**6000**	**6000**

The bank balance sheet position remains the same. While a gross investment of 15,000 took place there is no credit demand in addition to the technical liquidity requirement at 3,000. This illustrates Stützel's point that under lockstep conditions, the additional credit demand is zero at any level of investment spend. [25]

Table 11 shows a scenario where the investment spend is no longer synchronized and firms experience surpluses and deficits in their balances of proceeds and expenditures. It is assumed that firm 2 purchases 9,000 in capital goods from firm 3 and adds these to its assets. Firm 1 has reduced its purchases from firm 3 and only adds 3,000 to its assets. As a result, proceeds of firm 1 exceed expenditures by 3,000 (positive change in monetary assets), while firm 2 has a corresponding deficit. The total gross investment amount is unchanged at 15,000.

Table 11: Balances mechanics with uneven investment spend

Party	*Sales to other firms*	*Purchases from other firms*	*Sales to non-firms*	*Purchases from non-firms*	*Change to monetary assets (ΔGV)*	*Gross investment*	*Depreciation*	*Net investment (I)*	*Profit (Q)*
Firm 1	0	3000	18000	12000	3000	3000	1800	1200	4200
Firm 2	0	9000	18000	12000	-3000	9000	5400	3600	600
Firm 3	12000	0	0	12000	0	3000	1800	1200	1200

[25] This assumes that the existing credit limit of 1,000 for each firm is sufficient to deal with all intra-period spreads between individual bank deposit outflows and inflows.

Total	**12000**	**12000**	**36000**	**36000**	**0**	**15000**	**9000**	**6000**	**6000**

The uneven distribution of investment expenditures between firms 1 and 2 has impacted on the aggregated bank balance sheet. Firm 2 has increased its bank debt by 3,000. By contrast, firm 1 has now become a net bank creditor with a deposit balance of 2,000. As a result, the bank balance sheet just after the wage payment has increased by 2,000 to 5,000, as the pre-existing debt balance of firm 1 at 1,000 has offset some of the inflows received from firm 2 (Table 12). The scenario provides an illustration of Lautenbach's observation that the credit demand was dependent on the dispersion rather than the volume of the investment spending (Lautenbach 1952, 50-51).

Table 12: Aggregated bank balance sheet – with uneven investment spend

Assets	*Liabilities*	*Party*
0	2000	Firm 1
4000	0	Firm 2
1000	0	Firm 3
5000	2000	Total firms
0	3000	Non-firms
5000	5000	Total

While total bank credit volume has increased to 5,000, the net debt balance of the combined firms, with 5,000 in loan liabilities and 2,000 in deposits, is unchanged and remains at the baseline level of 3,000. The original liquidity position of both firms could be restored, if firm 2 issued 3,000 in shares that were purchased by firm 1, utilising its deposit holdings and overdraft facility, and firm 2 repaid part of its loan with the proceeds.

Saving by non-firms is introduced in Table 13. Non-firm wage recipients are assumed to save 2,000 (5.5%) of their annual wage receipts. This creates a surplus of proceeds over expenditures for non-firms of 2,000 and a corresponding deficit for firms 1 and 2, who must now continue to finance this amount while their revenues from the sale of consumption goods have declined from 36,000 to 34,000.[26]

Table 13: Balances mechanics with uneven investment spend and savings

Party	*Sales to other firms*	*Purchases from other firms*	*Sales to non-firms*	*Purchases from non-firms*	*Change to monetary assets (ΔGV)*	*Gross investment*	*Depreciation*	*Net investment (I)*	*Profit (Q)*
Firm 1	0	3000	17000	12000	2000	3000	1800	1200	3200
Firm 2	0	9000	17000	12000	-4000	9000	5400	3600	-400
Firm 3	12000	0	0	12000	0	3000	1800	1200	1200
Total	**12000**	**12000**	**34000**	**36000**	**-2000**	**15000**	**9000**	**6000**	**4000**

The decline in sales proceeds trigger a corresponding decline in the total firm monetary assets of 2,000. The bank credit volume just after the wage payment has increased by 6,000, or 3,000 above the baseline technical liquidity requirement, as shown in Table 14.

Table 14: Aggregated bank balance sheet – with uneven investment spend with savings

Assets	*Liabilities*	*Party*
0	1000	Firm 1

[26] The example assumes a corresponding unit price decrease and zero inventory build-up.

5000	0	Firm 2
1000	0	Firm 3
6000	1000	Total firms
0	5000	Non-firms
6000	6000	Total

The net debt balance of the combined firms, with 6,000 in loan liabilities and deposit holdings at 1,000, has also changed to 5,000 as the firms now have to finance wages at 3,000 (technical liquidity) and savings at 2,000 (permanent change to period balance).

These simplified examples clearly illustrate why Lautenbach's focus was on bank creditors. The economic implications of credit mechanics and the mechanics of balances are that wages and savings out of wages are structurally set-up to have a much stronger impact on the credit volume than company investments. As Stützel noted, Lautenbach's works had shown that

> "particularly for the aggregate economy, deposits can very well be a decisive factor in determining how much of any new lending actually shows up as an expansion in the volume of credit" (Stützel 2017, 31; 1958 [1978], 219).

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