Money and Capital

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Abstract

Ludwig Lachmann brings expectations and capital together by means of process analysis to study the dynamics of capital. Based on their expectations, Lachmann argues that entrepreneurs form plans, implemented as capital combinations, stressing the importance of plan complementarity and structural complementarity. The entrepreneur achieves plan complementarity by combining capital goods within one plan, while the market achieves structural complementarity through the interplay of mostly inconsistent entrepreneurial plans. Regarding capital goods as nodal points of input-output flows, he defines the emerging capital structure in terms of a changing complex of relationships. Change is consistent if these flows become arranged in such a way to meet expectations of service streams, inconsistent otherwise. The Stock Exchange promotes capital change, so there is an asset structure. We may understand capital as complementary with an investment portfolio. Money is an asset, but only capital by proxy, and storable, unlike factor services. Cash balances are essential for the success of plans, for instance in buying factor services. Lachmann makes a distinction between operating assets and securities. Money occurs in the former. The asset structure involves a plan structure based on technical complementarities, a control structure based on debt and equity, and a portfolio structure based on asset preferences. When an enterprise starts, all operating assets are money, during the production process gradually exchanged for capital goods and factor services. At liquidation, operating assets are turned into money and distributed to holders of securities. We see that as

production of money by means of money, which is a social institution, a clearing device. Monetary arrangements are complex, evolving systems. Entrepreneurs act upon their perceived purchasing power of a currency in terms of capital goods and services that can be bought for a medium of exchange, which represents a unit of account.

Keywords: Money, Capital, Process, Sequence

1. INTRODUCTION

Lachmann ([1956] 1978) develops a capital theory, which is process oriented rather than equilibrium oriented, involving heterogeneous capital resources, which makes complementarity essential to our understanding of capital. In his view, investment is no longer a change in capital stock, but a change in the composition of the capital stock, i.e. a change in the capital structure. Lachmann starts with heterogeneity in capital that leads to heterogeneity in use, in turn giving multiple specifity, which opens for complementarity of capital combinations that constitute capital structure. However, his theory is a monetary theory of production. Cash balances are essential to buy capital goods and factor services. Money is active when entrepreneurs buy new capital goods or scrap old capital, but idle when they spend on extant capital or finance losses from reshuffling (p. 50).

According to Lachmann, there is an asset structure, originating from the Stock Exchange, as a market for the titles to capital goods, in which money plays an essential role, as asset that is only capital by proxy, but storable (pp. 86ff). Consequently he considers three structures: the Plan structure, based on tehnological complementarities, the Control structure, based on the gear of the company's capital, and the Portfolio structure, based on people's asset preferences, which he integrates into the overall Asset structure (pp. 91f). Hence, the capital structure is an expression

of the asset structure. An enterprise can be understood as a sequence. Lachmann explains that when an enteprise starts, all the operating assets are money, which gradually is exchanged for inputs, capital goods and factor services, that form the plan structure, and when the enteprise finally is liquidated, its operating assets other than reserve assets are turned into money, which is distributed to the holders of the securities (p. 92). This process, we can see as production of money by means of money, thus making Lachmann's theory of production a monetary theory.

Money, however, is a social institution, a clearing device for the settlement of accounts, along the lines of the Wicksell-Mises-Schumpeter trajectory (Wicksell, [1906] 1966; Mises, [1912] 1924; Schumpeter, 1917-18, 1970), according to which money is regarded as a social institution rather than a commodity, thus involving a credit economy, such as settlement of bills of exchange, comparable with Keynes's (1930a,b) stress on bank money. In Lachmann's analysis, money acts throughout the production process; collection of money precedes the production plan, while the control structure may decisions about expansion and contraction (p. 36). Among theorists, who develop the process analysis, Lachmann mentions Lundberg (1937).

Lundberg (1937) develops sequence analysis, using Wicksell's cumulative process as a starting point, arguing that the velocity of circulation of money has the same effect as an increase in money. This introduces credit money. According to Lundberg (1937, pp. 128f), in a well-developed credit system, bank clearing reduces the quantity of money required, so that the purchase and sale of goods in process takes place simultaneously in the beginning of each period with an arbitrarily small quantity of money, so credit arrangements reduces cash holdings needed. Bringing in credit, as used by Lundberg, into Lachmann's asset structure would allow consideration of the consequences of monetary arrangements as complex, evolving systems. Amendola and Gaffard (1988) use Lundberg's sequence analysis to analyze the economic

dynamics of innovation, considering both a human constraint and a financial constraint. While Lewin (1999) considers human capital within Lachmann's theory of capital structure and thereby addresses the human constraint, this paper focuses upon money and the financial constraint. Lewin views money from an exchange perspective and points out the role money has for economic calculation, but not the role of money in the asset structure, in which the capital structure is a part, money as the operating asset of the birth and of the death of an enterprise, while capital combinations exist in between the beginning and the end of the life cycle of the enterprise. Using a Wicksellian framework, money is not all that matters, as Lundberg (1937) points out, because credit makes the constraint provided by money a lose one. Hence, financial evolution matters. We have to consider the emergence of bills of exchange and credit, a shift from exogenous commodity money to endogenous credit money.

This paper considers the evolution of monetary arrangements within Lachmann's asset structure, using Lundberg's sequence analysis, which takes credit into account. First, expectations and process analysis are considered. Second, we turn to process analysis and capital theory. Third, we consider money and credit. Fourth, a historical sequence of monetary regimes is addressed.

2. EXPECTATIONS AND THE PROCESS ANALYSIS

Lachmann ([1956] 1978, pp.20f) finds expectations to be the outcome of subjective interpretations of entrepreneurs, which take place within a vast network of communication which we know as the price system, whose function is to transmit knowledge among market agents. He defines the market as a process of exchange and allocation that reflects the transmission of knowledge. This is to be understood as transmission of subjective interpretations through a

process of expectations. Lachmann draws some conclusion about this process: our past experiences form a sequence; there are problems of interpersonal and intertemporal consistency; and we learn from our mistakes by correcting previous malinvestment, acknowledging that heterogeneity of situations rule out any probability approach; instead, the market is the process of exchange and allocation reflecting the transmission of knowledge (pp. 24ff). Hence, the transmission of knowledge, a sequence of subjective interpretations is expressed in the evolutionary selection of capital combinations constituting the capital structure at any particular point of time.

Referring to Shackle (1949), Lachmann rejects the probability approach, but due to heterogeneity of situations rather than uniqueness of situations, since business situations generally are not unique. Furthermore, Lachmann points out that Shackle considers a suspended market rather than a market in operation, and Lachmann argues that we need to focus upon the market as an imperfect communication network, and the distinction of meaningful and meaningless price changes, the former being beyond the outer range and convey a message, while the latter are within the inner range (pp.27-33). What constitutes a meaningful price change? In order to answer that the distinction between stable and unstable production system may be helpful.

Lundberg (1937) acknowledges that production takes time and he addresses the difference between costs of production during a period and consumer outlays, explicitly stating that for a given day they are far from identical, and that the discrepancy is higher with a shorter period. He presents a model involving production time (t); rate of flow of finished consumption goods (a); a

finite unit-period (d); expenditure period (v);[1] the quotient of purchasing power (r) – the fraction of purchasing power during a given period which actually is derived from that period; purchasing power derived from costs paid out for production of consumption goods for the following period (r_f) and for the previous period (r_p), and degree of instability (δ) – the relation between the net profit/loss resulting from a given change; and a relative increase in output (ε). This gives a dynamic sequence of profits, involving eventual transfer from one unit-period to another.

Using Lundberg's sequence analysis, Lachmann's expectations can be viewed as expectations of the degree of instability when there are changes in output. The timing of purchasing power, when the firm receives its revenue is important in this context, which va be attributed to time lags in expenditure of workers. Lundberg (1937, pp. 98ff) considers two cases when the unit-period is the production period, so that $d = t$ and, and half of the purchasing power is created by the costs of production consumed during the period, so $r = ½$:

(i) $v = 0$: no time lags between work done, wage income, and consumption expenditure, the other half is created by the costs of production to be consumed during the following period, so $r_f = ½$ and $r_p = 0$; the desired instability is $\delta_1 = r_f\varepsilon = ½\,\varepsilon$ (a profit);

(ii) $v = t$: the expenditure period is equal to the production period, the other half is created by the costs of production to be consumed during the following period, so here $r_f = 0$ and $r_p = ½$, the desired instability is $\delta_1 = 0$; $\delta_2 = -r_f\varepsilon = -½\,\varepsilon$ (a loss).

[1] Lundberg defines the expenditure period as the sum of the time lags between productive input and its payment and between the payment of cost-income and its use for the purchase of consumption goods, that is between the time lag between work done and wage received and between wage received and consumption.

Hence, the instability is the same, the absolute distance to zero being the same, but without lags between work done, wage paid, and consumption expenditure made, there is a profit from increased production, while those lags being equal to production time means a loss. The reason is that purchasing power created through costs of future consumption would not affect this period. Consequently, failure to correctly anticipate the expenditure period could turn an expected profit to a loss.

Furthermore, we need to consider the amount of circulating capital needed. The expenditure period matters for expectations, but so does the amount of circulating capital required in production. Lundberg (pp. 109) points out that the production process is not given, because it takes time and requires some circulating capital, and that the value of the product increases towards the final stage, though the way remains unknown, but for simplicity the increase can be assumed uniform and represented by a triangle with the base representing output and the height production time for each consumption good, but Lundberg allows for heterogeneity. He considers a range from zero production time, when production and consumption coincide to, relatively long production time, so the height, the production time, varies for different consumption goods, as Figure 1 illustrates. The sum of the triangles gives the amount of circulating capital (p.110).

[Figure 1 about here]

As a simplification, Lundberg (pp.110ff) considers a uniform distribution of the production periods from 0 to t, for which total output is equal to $a = (t + 1)d$ and the value of circulating capital is equal to $(t + (t - 1) + \ldots + 1)d/2 = at/4$, so if $v = 0$, then $r_f = ¼$, so purchasing power determined by costs in the following period a half of the case when all goods have production period t. In this case, the unit-period is equal to the longest production period, giving a more stable equilibrium than we all production periods are equally long.

3. PROCESS ANALYSIS AND CAPITAL THEORY

The circulating capital is important as we noticed in the last section. Lachmann ([1956] 1978, pp. 35f) stresses that entrepreneurs make regroupings of heterogeneous capital goods to bring in some complementarity in the production plan, but every enterprise starts with homogenous money capital, 'free capital' to be collected from owners and creditors, preceding the making of the production plan, while investment means dehomogenization of money into heterogeneous capital. Similarly, Lundberg (1937, p. 117) observes a sequence of payments in time, expressed in the velocity of circulation of money, which is derived from the existence of expenditure time. While Lachmann starts with money capital, as exogenous, Lundberg allows for different velocity of money depending upon expenditure time.

Nevertheless, when money is transformed to capital, the quality of the capital is crucial, not the quanitity. As Lachmann points out, capital accumulation is not necessarily the way to economic progress, and he gives three reasons (p.37) :

(i) Capital accumulation, division of labor, and technical change may offset each other;

(ii) When capital accumulation seems to generate progress, it may be due to a change in the composition of capital rather than a quantitative increase;

(iii) Disregard of malinvestments and the loss of capital value over time.

Lachmann see that these aspects are particularly relevant in modern, industrialized economics with rapid technical progress and growing importance of durable capital equipment, a combination that may turn a lot of capital obsolete, so economics has to use process analysis, a causal-genetic analysis of change (pp. 38f). Lachmann refers to the process analysis of Hicks (1939), Lindahl (1939), and Lundberg (1937). While equilibrium analysis focuses upon mutual

consistency of plans, process analysis acknowledges interpersonal inconsistency, that is consistent firms in an inconsistent market, or in other words, firms in equilibrium operating on a market in disequilibrium, since the human mind can only bring into consistency what it controls, Lachmann argues (p. 40).

He illustrates the reshuffling of capital by considering a case, where A, B, C, and D are capital goods; k, l, m, and n are constants; and z is the firm's diminuition of its cash reserves (pp. 44f). He starts with the original capital combination: $kA + lB + mC$ that shifts into a new capital combination $l'B + m'C + nD$, so the firm sells $kA + (m - m')C$ and buys $(l - l')lB + nD$, because $l < l'$, $m > m'$, and there are neither net investments nor net divestments. If sales of capital goods do not match purchase of new ones, then $kA + (m - m')C + z = (l - l')lB + nD$. If n firms sell to each other when they reshuffle $z_1 + z_2 + \ldots + z_n = 0$. This seems to be open to equilibrium analysis, but Lachmann points out that regroupings between firms may be inconsistent and the actual draft on cash reserves, z, can differ from its planned level, since prices may be indeterminate and there is a capital goods may enter as new capital and exit as scrap, both having a particular price (pp. 46f). Here, Lachmann considers a floor 'scrap' price and a ceiling 'new' price that establish the band for trading capital goods in the second-hand market. Actually, he points out the disequilibrating nature of capital regrouping.

To illustrate how production may expand through reshuffling we turn to Lundberg's (1937) model sequences, starting with a description of his approach. He analyzes expansion of the production of consumption goods at a constant volume of investments, by investments in working capital, and investments in fixed capital (pp. 181-216).

3.1 Expansion at constant investments (Lundberg, 1937, pp. 181-197)

Increasing profits cause expansion of production and employment, which increases income and consumers' outlay, in turn making larger production feasible, as long as the nominal interest rate remains below the natural rate, or new investments exceeds new savings; a dynamic equilibrium requires sufficiently large new investments to balance forthcoming savings at full utilization of capital income, so new investments in each period need to be a fixed proportion of capital in the beginning of the period. The unit-period is the reaction interval from rise in demand to increase of production. Let R be total income earned from producing consumption goods during a unit-period, a the increase of consumers' expenditures, k the proportion of the increase in consumers' expenditures being an enlarged flow of consumers' outlay, C total calculated costs, S savings, and I investments. Effective demand increases from R to $(R + a)$, while $a + ka' = a'$, or $a' = a / (1 - k)$, "the space of expansion." Producers are assumed to anticipate effective demand to be equal to the receipts of the previous period and no new money is put into circulation, giving: $C_{t+1} = R_{t,,}$ which reflects the unanticipated increase in receipts, a, that gives $R_t = C_t + a$.

Costs can be income-generating (E) and non-income generating (N),[2] due to competition, so consumption goods production is no longer neutral to changes in flow money: $C_t = E_t + N_t$; while $C_{t+1} = E_{t+1} + N_{t+1}$. Savings are subtracted before consumer outlays: $C_{t+1} - C_t = E_{t+1} - E_t + N_{t+1} - N_t + S_{t+1} - S_t$. Given $S_t = \Lambda E_t$, the total expenditure for consumption goods, the receipts for the producers is: $R_t = (1 - \Lambda) E_t + C$, where C is consumption expenditure corresponding to investment I, which is constant. Limitation in free competition is expressed in $N_t = \alpha E_t$, (a proportional relationship). $R_t = C_{t+1}$ gives $(1 - \Lambda) E_t + C = (1 + \alpha) E_{t+1}$. Continued expansion

[2] Lundberg (1937, p.162) defines income-generating costs as wages (W), interests and dividends on extant capital, and the purchase of goods in process, etc. (U), and non-income generating costs as amortizations (A), interests and dividends on newly formed capital, and estimated profits (Q).

requires $C \geq (a + \Lambda)\, E_t$, since $C_{t+1} \geq R_{t+1}$ if $C < (a + \Lambda)\, E_t$, so income from reinvestments must be larger than savings and deficit items in production, but over time C cannot be kept sufficiently large, since constants cannot be maintained with expansion, eventually making $E_{t+1} = E_t$.

3.2 Expansion determined by investments in working capital (Lundberg, 1937, pp. 197-204)

Next Lundberg turns to the determination of investment in the model sequence. He sees the connection between the expanding consumption of consumption goods and the increase in the demand for working capital, and that an increase in working capital is an income-generating investment, like the production of new machines. Entrepreneurs try to keep working capital a certain proportion of production and employment, so any increase represents new investments.

Let I_t be the costs for the enlargement of working capital, E'_t income-generating calculated production costs, E''_t income-generating investment costs, K_t working capital, and k the proportion of working capital to production. Since $C_t = R_{t-1}$, calculated costs are equal to receipts in the previous period, $C_t = (1 + a)\, E'_t$, and investments in working capital is $I_t = k\, C_t - K_{t-1}$. Initial working capital depends upon initial plans and the actual development, where the planned value is $k\, C_{t-1}$, while the decrease in the stock of consumption goods is $(R_{t-1} - C_{t-1})$, where R_{t-1} is sales and C_{t-1} is planned production, thus giving $K_{t-1} = k\, C_{t-1} - (R_{t-1} - C_{t-1})$. Investments involve some income-generating costs: $I_t = (1 + a)\, E''_t$,

Realized sales in period t becomes: $R_t = (1 + \Lambda)\, (E'_t + E''_t) + C$, where C is the expenses from a constant investment activity. This gives a cyclic variation in income and production rather than successive steps towards equilibrium.

3.3 Expansion determined by investments in fixed capital (Lundberg, 1937, pp. 204-216)

While the preceding model sequence shows that the selfreinforcement of an expansion process slacks when investments in working capital only was considered, so incentives to invest in fixed capital increases with the decrease in unused capacity. Consider the building of new houses to satisfy a growing demand for housing. Calculated costs generate income and a fixed proportion is saved. Assume consumers rent their housing.

Let $1/\sigma$ be the proportion of consumers' outlay spent on rents for housing, D^h_t the total sum of rents paid during period t, μ the ratio of income from building a house to expected rent payments, which covers normal costs of housing, h the fixed proportion of consumers' expenses on rent that does not become income in the following period, and E^h the income generated in the current running of houses. An increase in the supply of housing, ready to use in the beginning of period $(t + 1)$ is brought about by new investments during period t, which generates income I_t.

The increase in current costs of the investment is covered by an increase in consumers' expenses on housing $(D^h_{t+1} - D^h_t)$, so that $(D^h_{t+1} - D^h_t) = (1/\sigma)\, I_t$, so $I_{t+1} = \mu\, (D^h_t - D^h_{t-1})$, but conditions may change during $(t + 1)$. Consider therefore, $I_t = (\mu/\sigma)\, (R_{t-1} - R_{t-2})$, since $R_t = \sigma\, D^h_t$. Income determined by production of consumption goods is $E'_t = R_{t-1}\,(1 - b)$ and (R_t/σ) are paid to rents and thus not transformed to income to the same extent as other receipts.

Taking into account the differences in income-generating capability of economic activities: $E^h_t = (R_{t-1}/\sigma)\,(1 - h)$, while the remainder is: $E'_t = (R_{t-1} - (R_{t-1}/\sigma))\,(1 - b)$ where $h > b$. Total income is: $E_t = E'_t + E^h_t + I_t = (R_{t-1} - (R_{t-1}/\sigma))\,(1 - b) + (R_{t-1}/\sigma)\,(1 - h) + (\mu/\sigma)\,(R_{t-1} - R_{t-2})$. New investments in housing cannot rise continually to such an extent to keep the receipts sufficiently large. Let S^B be gross savings, being the sum of voluntary savings, S_t, plus the difference between realized receipts in the previous period, R_{t-1}, and current income payments, $(E'_t + E^h_t)$, and I^B be

gross investments. Planned savings is given by $S^B = S_t + [R_{t-1} - (E'_t + E^h_t)]$, while planned investments are given by $I^B = I_t + C$. The difference between gross investments and gross savings represents the addition of purchasing power, $(I^B - S^B) = I_t. - S_t - [R_{t-1} - (E'_t + E^h_t)] + C$. This is positive in earlier periods, when there is expansion, but become negative in later periods, when there is a downturn. When new investment is dependent on consumer demand and the size of the investments constitutes a necessary condition for sufficient demand, there will be an expansion where investment exceeds savings, which gives way to a downturn, when savings exceeds investments. However, increasing μ, the ratio of income from building a house to expected rent payments, and/or decreasing Λ, the share of income saved, or σ, the inverse of the proportion of consumers' outlay spent on rents for housing, could give continuous expansion in the model, which then requires additional variables, as that would be unrealistic.

3.4 Lachmann's heterogeneous process in light of Lundberg's model sequences

There are similarities between Lachmann and Lundberg, since the former takes the latter as a point of departure for process analysis, and both consider money as important to capital. However, there are some fundamental differences. This can be attributed to their apparently different views on capital accumulation. Lachmann states three reasons why capital accumulation may not necessarily yield economic progress, where his second reason that the composition rather than the quantity of capital matters is of particular importance, thus opening for microeconomic heterogeneity, while Lundberg has a clear macroeconomic perspective, giving a dynamic alternative to Keynes.

How would it be possible to reconcile these two approaches? The obvious connection is the time dimension, which is expressed as capital reshuffling in Lachmann's analysis. Some capital

goods are sold and finances the purchase of new ones, but there may be a need to use extant cash reserves, his z. Allowing for inconsistency, the sum of cash reserves used will differ from zero. Capital regrouping is a disequilibrium phenomenon. Hence, we may think in terms hoarding from which cash reserves can be distracted. Let H be liquid balances at the end of the period, so cash reserves[3] used to finance the part of capital reshuffling not covered by sales of capital goods is represented in a change in liquid balances ($H_t - H_{t-1}$). Similarly, let K be fixed and working capital at the end of the period, B total liabilities at the end of the period, and G net capital value in the end of the period. Then we may use the simple balance sheet, based upon Lundberg (1937, pp. 157f) of the firms in Figure 2 to see that $(K_t - K_{t-1}) = (B_t - B_{t-1}) - (H_t - H_{t-1})$, namely a reshuffling involving net increase in capital, which is financed by increasing liabilities or using liquid assets, such as cash reserves. If the reshuffling is successful, thus increasing net capital value, then $(K_t - K_{t-1}) = (B_t - B_{t-1}) - (H_t - H_{t-1}) + (G_t - G_{t-1})$, where the increase in net capital value, $(G_t - G_{t-1}) > 0$, at least partly restores any increase in total liabilities or decrease in cash balances. The reason is profits, operational surplus, originating in capital reshuffling.

[Figure 2 about here]

Making a distinction between operating costs and capital costs. Lundberg develops a more complicated analysis (pp. 158ff), where capital expenditure consists of wages (W_i) and purchase of capital (U_i), being equal to amortization (A) and operating surplus (Q) plus the change of total liabilities minus the change of cash balances, so that $(W_i + U_i) = A + Q + (B_t - B_{t-1}) - (H_t - H_{t-1})$. Amortization can be assumed equal to depreciation of capital, which gives the net expenditures for new increase of capital, $(W_i + U_i - A)$, funded by $Q + (B_t - B_{t-1}) - (H_t - H_{t-1})$. We may see that

[3] We consider cash reserves as a part of liquid reserves, H, which consists of cash, bank deposits, and securities, so we are actualy considering the use of liquid balances rather than cash.

$Q > 0$ implies $(K_t - K_{t-1}) > (B_t - B_{t-1}) - (H_t - H_{t-1})$, because $(G_t - G_{t-1}) > 0$. Hence, successful capital reshuffling funds itself to some extent through profits increasing net capital value, while failed capital reshuffling contributes to losses, reducing cash balances if total liabilities remain constant.

Now, suppose capital reshuffling takes place under expansion of working capital. Then capital reshuffling brings net investments when $I_t = k\, C_t - K_{t-1} = k\,(C_t - C_{t-1}) + (R_{t-1} - C_{t-1})$. There are some income-generating production costs, $C_t = (1 + a)\, E'_t$, and some income-generating investment costs, $I_t = (1 + a)\, E''_t$. Note that operating profits are non-income generating, but contribute to investments, which represents a production cost, because it enhances investment. This illustrates how capital reshuffling contributes to expansion through net investment.

4. MONEY AND CREDIT

Money, as asset, plays a crucial role to the evolution of the capital structure. Lachmann ([1956] 1978, pp. 86ff) introduces the asset structure, which is related to the capital structure and where money is an element as asset. He argues that money is an asset, but not capital, because cash balanced are used to buy labor and services from capital that is not controlled by the producers, so money is used to buy factor services and constitutes thereby capital by proxy. He makes a distinction between operating assets - capital goods and money complementary to them – and securities – titles embodying the control of production, giving rise to two spheres of the market economy: one where the asset preferences of the holders of titles shape production, the other where technological exigencies of production planning shape the asset holdings (p. 89). Hence, there is interaction between operating assets and securities.

Among the operating assets, Lachmann distinguishes between three types (p. 90):

(i) *First-line assets*: capital goods used in production from the start;

(ii) *Second-line assets*: spare parts and money planned to be used during the production period;

(iii) *Reserve assets*: cash reserves and reserve stocks kept for unexpected contingencies, being supplementary to first- and second-line assets; a measure of success and failure of plans, success if they are not used, failure if they are used, extreme failure if exhausted.

Among securities Lachmann makes a standard distinction, which gives the control structure (pp. 90-91):

(i) *Debt*: the right to a specific income in currency units:

(ii) *Equity*: the right to participate in control and to residual income.

The operating assets and securities give, according to Lachmannn, rise to three interdependent kinds of structure, each one having its own foundation (p. 91):

(i) *Plan structure*: technical complementarities:

(ii) *Control structure*: high or low gear of capital, the leverage:

(iii) *Portfolio structure*: asset preferences.

He describes the interdependence of these structures in terms of the viability of a production plan, which depends upon the willingness of people to hold the securities necessary to its realization, and the offer of such securities.

Next, Lachmann explains the dynamics that bring these three structures into an overall asset structure (p. 92): When a new enterprise is established all operating assets are money assets, which gradually are exchanged for capital goods during the production period, so the plan

structure emerges, and when the enterprise is liquidated all first- and second-line assets are turned into money. He considers three cases: success, unexpected success, and failure (pp. 92ff):

(i) *Success*: production proceeds according to plan and a steady stream of money flows from cash balances to the holders of securities, who maintain their portfolios;

(ii) *Unexpected success*: unexpected profit may turn into higher dividends, which yield capital gains that change the portfolio structure, be ploughed back inducing a new plan structure, or serve to pay off debts, which modifies the control structure;

(iii) *Faiilure*: reduction of cash reserves that may disturb operating assets, which induces a higher demand for money to reshuffle capital, which in turn gives a decline in capital value possibly forcing creditors to take over or liquidate.

Lachmann gives an essential role to capital gains and losses, since they reflect within the portfolio structure the success or failure of production plans (p. 94). Enterprises are born, operate, and die, since success cannot be assumed to last forever without continuous adaptation. Consequently, we may view Lachman's asset structure as involving production of money by means of money process with capital as a middle form during the life of the enterprise.

Bringing his analysis together, Lachmann gives the following conclusions (pp.95ff):

(i) Reserve assets, in particular cash reserves, serve as primary criteria of success and failure: money flows to title holders leaving undepleted cash balances indicates success, increased flows decreasing cash reserves unexpected success, while ceasing flows means depleted cash reserves indicating failure;

(ii) Transmission of knowledge modifies the control structure and portfolio structure, involving revaluation of the assets;

(iii) Asset holders have to interpret and apply learnt facts;

(iv) Failure means loss of assets and need to create new assets, close to complete liquidation, but it requires money, 'money for use' to sustain production by correcting mistakes, involving substantial reshuffling, or in case of crisis even more.

Finally, Lachmann states that the function of the entrepreneur is specify the concrete form of capital resources, where the specification of the capitalist precedes the specification of the manager (p. 99). Hence, the capitalist defines the game for the manager.

Here, we may think in terms of a capitalists defining a combinatorial game for managers. We may then use the concept heat of the battle (Berlekamp et al., 2001, chapter 6), which refers to a game that is hot for some time, meaning that players can make substantial gains for a durable period of time, as opposed to a cold game. They start with the game Snort, which is a game of putting cattle in the right herd, black bulls in their herd and white cows in their herd. We may think of these herds being two different sets of complementary technologies, plan U and plan V, where plan U consists of the old capital combination and plan V of the new capital combination. Concerning the control structure and portfolio structure, there is external finance through debt and equity, various securities, which define the portfolio structure. There may be more or less money available to the two plans, depending upon what control structure and portfolio structure they require. One plan may involve more control, that is relatively more equity. Liquid assets provide reserve assets, which debt may give.

When it comes to the heat of the battle, the stopping rules of the games are essential. There are left stops and right stops, set by the left player and the right player. Following Berlekamp et al. (2001), there is a game J = $a \mid b \parallel c \mid d$, where $a \geq b > c \geq d$, which is equitable, when for the sum $s = a + b + c + d$, $3b + c > s > b + 3c$, say $a = 4$, $b = 3$, $c = 2$, $d = 1$, meaning gote, not having initiative, while $s > 4b$ or $4c > s$ is excitable, meaning sente, having initiative, thus representing a

successful plan, say $a = 7$, $b = 3$, $c = 2$, $d = 1$, being left-excitable, or $a = 4$, $b = 3$, $c = 2$, $d = -3$, being right-excitable. In the former case the left player's plan has initiative, putting pressure on the right player, in the latter the right player has the initiative. The player having the initiative maintains undeleted cash reserves and title holders get their money flows, while the other player faces reduced cash reserves, and needs funding to reshuffle. The liquidity of the economy is of importance to such firms.

In this context, the focus is upon the flows of payments. Lundberg (1937, p. 117) considers the velocity of circulation, as crucial to the sequence. He finds that cash balances used to fund an expansion in capital causes increased turnover that eventually would rise the velocity, and an increased velocity has the same effect as an increase in the quantity of money, since the period of circulation is fixed to make income equal to the quantity of money during the period (p. 121). Lundberg also considers credit as extending money, since a firm may finance expansion by cash balances or bank deposits, sale of liquid assets, use of overdraft facilities, new bank loans, and the issue of stocks or bonds (p. 133). Sente, or being excitable, implies competitive pressure to which the other player may respond in different ways, depending on financial institutions.

5. HISTORICAL MONETARY ARRANGEMENTS

In the Hanseatic trading network, Bruges was the focal point, where merchants from Lübeck, Visby, Rostock, Elbing, and Riga, the so called *Osterlinge*, connected to the world market of the West, the meeting place of Italian and Hanseatic merchants and the point of contact between Mediterranean and Baltic commerce (Roover, 1948; Dollinger, 1998). Bruges also played a central role in monetary exchange. Italian merchant-bankers, involved in bills of exchange business, established in the thirteenth century branches in Bruges, where Hanseatic merchants,

who lacked an exchange market of their own, used agents (Roover, 1948). Expansion of trade led to a shift from silver to gold; in 1340 Lübeck made her gold coins based on the Florentine gold florin, *fiorino*, which functioned as blueprint, maintaining initially a steady and uniform denomination, and Flanders copied its gold coins from France, while German monetary arrangements were messy (Shaw, 1895). Monetary fragmentation led to treaties to establish shared measures of value; the Wendish Monetary Union, *Wendische Münzverein*, was formed by Lübeck, Hamburg, and Wismar in 1379, while Rostock, Stralsund, and Lüneburg joined in 1381 (Jesse, 1927 [1967]). The aim of this union was to standardize minting, because the multitude of coins with different value for the same denomination hampered Hanseatic trade (Dollinger, 1998). Consequently, Hanseatic monetary arrangements were quite restricted to cash, being based upon commodity money in silver and gold, so it was the quantity of money rather than velocity of circulation that mattered.

The bill of exchange had emerged as a cashless means of payment of European merchants in the Middle Ages, but in Northwestern Europe and the Baltic Sea region, gradually adopted from the late sixteenth century, and the bill of exchange became a negotiable paper at the Antwerp stock exchange (Denzel, 2010). The creation of the *Amsterdamsche Wisselbank* meant a decisive step away from commodity money. Its *florin*, or *guilder*, was dominant as international currency in the late seventeenth and early eighteenth centuries (Gillard, 2004). However, the bank *guilder* existed only as balances in the accounts of the bank and in 1683 the balances with a claim with a 100 percent reserve ratio were supplemented with balances without a claim, irredeemable money, making the bank *guilder* more liquid than gold and silver coins, while negotiable receipts of deposit constituted fiat money (Quinn and Roberds, 2014). The bill of exchange increased the velocity of circulation. As Wicksell ([1906] 1966) argues, in light of his pure credit economy,

bills of exchange increase the virtual velocity of money and credit the velocity of money. Hence, seventeenth century exchange banks, increased the capacity to reshuffle failing enterprises.

The gold standard united the unit of account and medium of exchange in a single asset, money, representing a specific amount of gold. The price of national currencies was fixed to a quantity of gold, by defining the price of gold for the currency at issue. The gold standard emerged in Britain in 1816-21, while France had a stable gold coin as of 1803, London and Paris taking over as Amsterdam had lost its role as the leading foreign exchange market. (Einzig [1962] 1970; Denzel, 2010). Germany adopted the gold standard in 1871, and demonetized silver in 1873 (Shaw, 1895). This suggests a return to commodity money and capital reshuffling contrained by cash in gold, but the bills of exchange turned gold into a lose constraint. Wicksell ([1906] 1966) argues, in light of his pure credit economy, that bills of exchange increases the virtual velocity of money and credit the velocity of money, so credit can replace gold, while Meulen (1934) considers bills of exchange to be the origin of an ideal system of credit, where an increasing amount of notes are issued on a given gold basis.

The birth of the gold-exchange standard was the Genoa Conference in 1922, which in addition to gold as reserve, entitled central banks to hold foreign balances, bills, short-term securities, and other liquid resources as reserves, which required fixed exchange rates and allowed foreign reserves to be used, like gold, for international settlements (Eichengreen, 1987). Convertibility into gold was crucial to foreign reserves. When inconvertibility occurred in 1931, foreign reserves were liquidated and money supply was constrained (Eichengreen, 1987). What started as a seemingly lose gold constraint became tight. the international monetary system disintegrated into three blocs: the exchange control bloc around Germany; the sterling bloc around Great Britain; and the gold bloc around the United States and France (Echengreen, 2008;

Feinstein et al., 1997). This established a variety of monetary regimes, opening for the functioning of the velocity of circulation.

6. CONCLUSIONS

Lachmann outlines a monetary theory of capital. Cash balances are essential to buy capital goods and factor services. Money is active when entrepreneurs buy new capital goods or scrap old capital, and idle when they spend on extant capital or finance losses from reshuffling. Lachmann considers the asset structure, to which money belongs, which consists of the plan structure, control structure, and portfolio structure. Using a Wicksellian framework, money is not all that matters, as Lundberg points out, because credit makes the constraint provided by money a lose one, as the velocity of circulation may increase as well as money supply. Lundberg considers a well-developed credit system, in which bank clearing reduces the quantity of money required, so that the purchase and sale of goods in process takes place simultaneously in the beginning of each period with an arbitrarily small quantity of money. This opens for more capital reshuffling when put under competitive pressure.

Lachmann's expectations concerns the degree of instability when there are changes in output, reflecting heterogeneity, considered in Lundberg's sequence analysis. Lachmann argues that homogenous money is transformed into heterogenous capital, while Lundberg allows for different velocity of money depending upon expenditure time. The time dimension Lachmann expresses in terms of capital reshuffling, which may require the use of cash reserves. Using a simple balance sheet from Lunberg, we may see how cash balances can be temporarily be used to generate net capital value. Turning to assets, Lachmann makes an important distinction between operating assets – capital goods and complementary money - and securities – titles embodying

control over production, being two interacting spheres. They will shape competitive pressure and the capability to reshuffle. In this context, financial evolution matters. We consider the emergence of bills of exchange and credit, a shift from exogenous commodity money to endogenous credit money. A decisive step was the emergence of the bills of exchange that made precious money metal a lose constraint.

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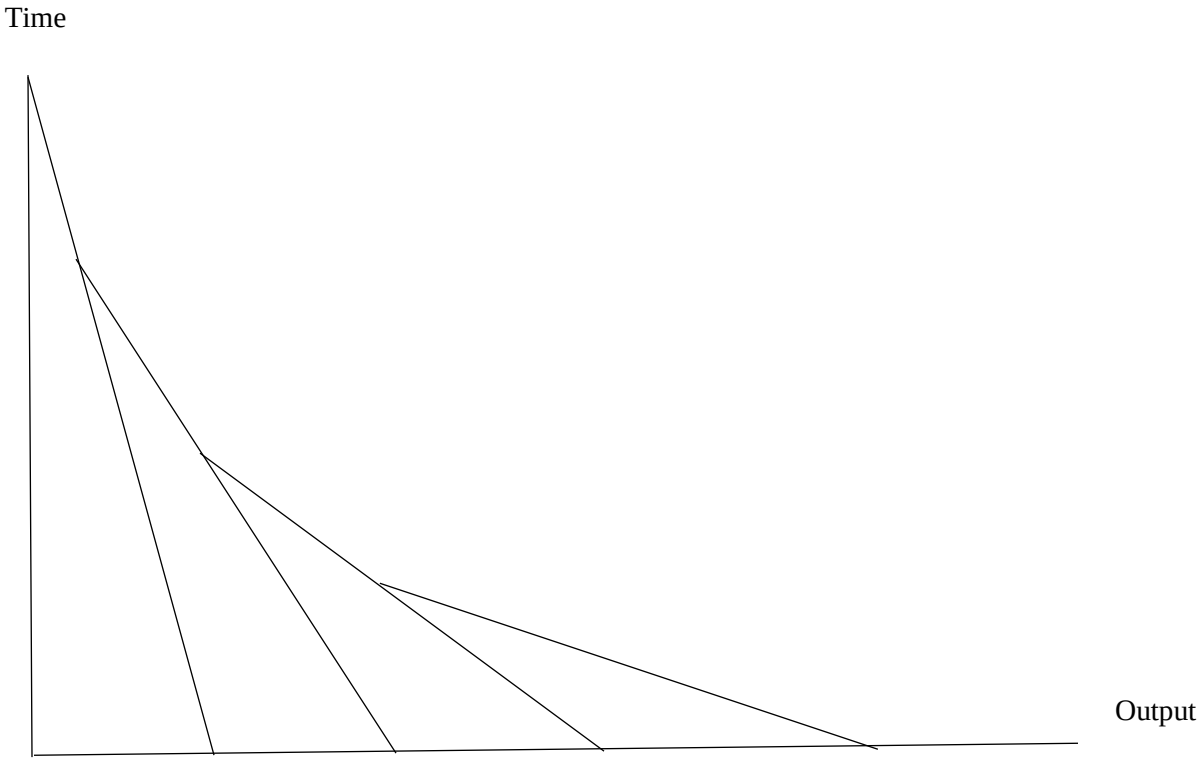

Figure 1. Lundberg (1937) production triangles whose sum is circulating capital

Assets	*Liabilities*
Liquid balances (*H*)	Total liabilities (*B*)
Working and fixed capital (*K*)	Net capital value (*V*)

Figure 2. Balance sheet of the firms