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Abstract

Standard economics is known to be incapable of integrating the real and the monetary sphere. The ultimate reason is that the whole theoretical edifice is built upon a set of behavioral axioms. Therefore, the formal starting point is moved to structural axioms. This makes it possible to formally track the complete process of value creation and destruction in the asset market and its consequences for the household and business sector. From the set of structural axioms emerge the well-known phenomena of a bubble from free lunches through appreciation to defaults due to a lack of potential next buyers.

JEL E10, E21, E43

Keywords new framework of concepts; structure-centric; axiom set; profit; rate of interest; liquidity preference; rentier; primary market; secondary market; parrot economics; theory of value; valuation price; appreciation; depreciation; net worth; debt/income ratio

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We have accurate and vivid accounts of financial crises since J. S. Mill.

> If Mill were alive today he would immediately recognize the contours of the recent crisis, although many of our more esoteric financial instruments might puzzle him a bit. (Roubini, 2011, p. 44)

Probably not. Book V of Mill's *System of Logic* (2006b, pp. 735-830) deals with fallacies and, given the standards of Mill's thinking, he would have recognized the wonder-world of esoteric financial instruments as what it was: sales-talk of investment banks for an audience eager to hear that risk had been eliminated, returns were plentiful, and credit was easy for everybody. Indeed, Mill gave an apposite account of subprime financing well before the event.

> Not only do all whom the contagion reaches, employ their credit much more freely than usual; but they really have more credit, because they seem to make unusual gains, and because a generally reckless and adventurous feeling prevails, which disposes people to give as well as to take credit more largely than at other times, and give it to persons not entitled to it. (Mill, 2006a, p. 542)

What would really puzzle Mill is that we have ever more detailed accounts of financial crises but no better theoretical understanding of what happens 'before our very eyes' (FCIC, 2011, p. 3). And he would be much surprised to learn that models that lack financial markets are not immediately identified as a cul-de-sac but actually applied in economic analysis (Tovar, 2008, p. 5), (Solow, 2003), (Summers, 1986). To improve on economic theory would doubtless be his first priority.

Equilibrium theory has not been particularly successful at explaining real world events (Bezemer, 2009, p. 3). This, too, is not news. There is a growing consensus that standard economics is beyond repair (Ackerman and Nadal, 2004). Is heterodox economics at last vindicated by the financial crisis? Yes, as far as the part of critique is concerned. No, as far the part of theory-building is concerned. To this day, from the heterodox camp has not emerged a methodologically acceptable alternative to the standard approach. To make the best of the situation, the big idea is a many-models pluralism. Yet, what is welcome in the realm of politics is unconvincing in the realm of science.[1] The desideratum is a comprehensive and consistent formal description of how the monetary economy works that has observable counterparts in the real world.

Theories have a logical architecture consisting of premises and conclusions or, in a purely formal context, of axioms and theorems. To change a theory means to change the premises. Therefore, the accustomed formal points of departure are in the present paper replaced by *structural* axioms. The object is to give a complete formal description of the fundamental economic mechanisms and to apply them to the explanation of a housing bubble.

[1] "They [Einstein and Dirac] agreed that science was fundamentally about explaining more and more phenomena in terms of fewer and fewer theories, a view they had read in Mill's *A System of Logic*." (Farmelo, 2009, p. 137)

For a start Section 1 delivers the formal foundations. The structural axiom set is composed of rather straightforward propositions that are not new in themselves but unique in their consistent combination. They are applied in Section 2 to the formalization of the production and financing of real assets and the determination of the maximum debt/income ratio. In Section 3 the household sector's net worth is derived in direct lineage from the axioms. Overall net worth is composed of the value of the household sector's assets and the net financial position as derived from the central bank's balance sheet. There is no dichotomization of the real and monetary sphere. The process of value appreciation and free lunch realization is set in motion in Section 4. It is demonstrated in detail that the price formation is entirely different in the primary and secondary markets. Flow markets and stock markets therefore require different treatment in the theory of value. The consequences of a deterioration of asset values up to the worst case of a monetary reform are considered in Section 5 where we let value and money evaporate, just as it occasionally happens in the real world. Section 6 concludes.

1 First things first

1.1 Axioms

The first three structural axioms relate to income, production, and expenditure in a period of arbitrary length. The period length is conveniently assumed to be the calendar year. Simplicity demands that we have for the beginning one world economy, one firm, and one product. All quantitative and temporal extensions have to be deferred until the implications of the most elementary economic configuration are perfectly understood. Axiomatization is about ascertaining the *minimum* number of premises. Three suffice for the beginning.

Total income of the household sector Y in period t is the sum of wage income, i.e. the product of wage rate W and working hours L, and distributed profit, i.e. the product of dividend D and the number of shares N.

$$Y = WL + DN \quad |t \tag{1}$$

Output of the business sector O is the product of productivity R and working hours.

$$O = RL \quad |t \tag{2}$$

The productivity R depends on the underlying production process. The 2^{nd} axiom should therefore not be misinterpreted as a linear production function.

Consumption expenditures C of the household sector is the product of price P and quantity bought X.

$$C = PX \quad |t \tag{3}$$

The axioms represent the pure consumption economy, that is, no investment expenditures, no foreign trade, and no taxes or any other activity of the government sector. All axiomatic variables are measurable in principle. No nonempirical concepts like utility, equilibrium, rationality, decreasing returns or perfect competition are put into the premises.

The economic meaning is rather obvious for the set of structural axioms. What deserves mention is that total income in (1) is the sum of wage income and *distributed profit* and not of wage income and profit. Profit and distributed profit are quite different things.

1.2 Definitions

Definitions are supplemented by connecting variables on the right-hand side of the identity sign that have already been introduced by the axioms. With (4) wage income Y_W and distributed profit Y_D is defined:

$$Y_W \equiv WL \qquad Y_D \equiv DN \quad |t. \tag{4}$$

Definitions add no new content to the set of axioms but determine the logical context of concepts. New variables are introduced with new axioms.

We define the sales ratio as:

$$\rho_X \equiv \frac{X}{O} \quad |t. \tag{5}$$

A sales ratio $\rho_X = 1$ indicates that the quantity sold X and the quantity produced O are equal or, in other words, that the product market is cleared.

We define the expenditure ratio as:

$$\rho_E \equiv \frac{C}{Y} \quad |t. \tag{6}$$

An expenditure ratio $\rho_E = 1$ indicates that consumption expenditure C are equal to total income Y, in other words, that the household sector's budget is balanced.

1.3 The market clearing price

If distributed profit Y_D is set to zero in the 1st axiom (1) then $Y = Y_W$ and the market clearing price $P^\star$ is determined as shown in Figure 1. The four quadrant positive rational diagram, 4*QPR*-diagram for short, makes the simplified consumption economy immediately comprehensible. The four axes represent the positive rational values of the variables employment L, income Y, consumption expenditures C, quantity bought X and output O, respectively. The bisecting line in the northwestern quadrant mirrors income from the horizontal to the vertical axis. The quadrants are numbered according to the axioms they enclose. The 4*QPR*-diagram fully replaces the vacuous and misleading demand–supply schedules.

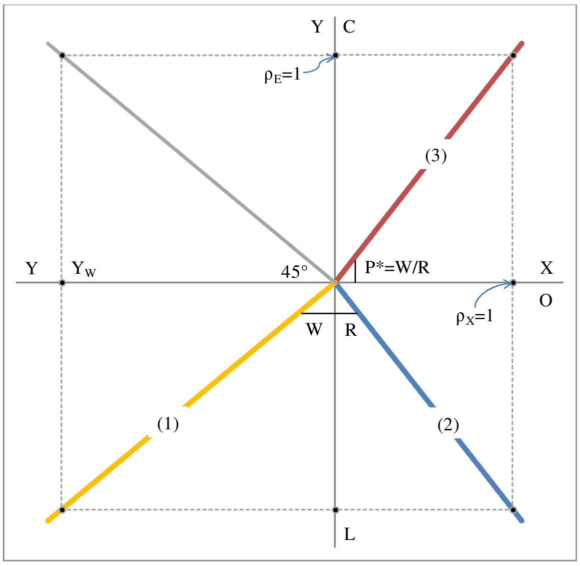


Figure 1: Market clearing price under the conditions of $X = O$, $C = Y$ and $Y_D = 0$

The market clearing price follows from the axioms (1) to (3) and the conditions of market clearing, budget balancing and zero distributed profit:

$$P^{\star} = \frac{W}{R} \qquad \text{if} \quad \rho_X = 1, \rho_E = 1, Y_D = 0 \quad |t. \tag{7}$$

The market clearing price is, under the given conditions, equal to unit wage costs, that is, profit per unit is zero at any level of employment. All changes of the wage rate and the productivity affect the market clearing price. The elementary consumption economy with full price flexibility on the product market is reproducible for an indefinite time span at any level of wage rate, productivity and employment.

1.4 Profit

The business sector's financial profit in period t is defined with (8) as the difference between the sales revenues – for the economy as a whole identical with consumption expenditure C – and costs – here identical with wage income Y_W:[2]

$$\Delta\bar{Q}_{fi} \equiv C - Y_W \quad |t. \tag{8}$$

Because of (3) and (4) this is identical with:

$$\Delta\bar{Q}_{fi} \equiv PX - WL \quad |t. \tag{9}$$

[2] Under the condition of market clearing, i.e. $\rho_X = 1$. For details about changes of inventory see (2011d, Sec. 1). Nonfinancial profit is treated at length in (2011a).

With the market clearing price (7) inserted this gives zero profit for the business sector as a whole for all configurations of wage rate, productivity and employment. Note that a productivity increase has no effect on profit but only on the market clearing price. The same holds for changes of the wage rate. The business sector may cut wage costs or improve efficiency until everybody is blue in the face, profit will not appear before the invisible hand makes $\rho_E > 1$ or $Y_D > 0$ in (7). Microeconomic wisdom is inapplicable to the economy as a whole.

1.5 Money, credit, and transactions

If income is higher than consumption expenditure the household sector's stock of money increases. The change in period t is defined as:

$$\Delta\bar{\mathsf{M}}_{\mathbf{H}} \equiv^{m} Y - C \quad |t. \tag{10}$$

The identity sign's superscript m indicates that the definition refers to the monetary sphere.

The stock of money $\bar{\mathsf{M}}_{\mathbf{H}}$ at the end $\bar{t}$ of an arbitrary number of periods is defined as the numerical integral of the previous changes of the stock plus the initial endowment:

$$\bar{\mathsf{M}}_{\mathbf{H}} \equiv \sum_{t=1}^{\bar{t}} \Delta\bar{\mathsf{M}}_{\mathbf{H}t} + \bar{\mathsf{M}}_{\mathbf{H}0} \quad |\bar{t}. \tag{11}$$

The changes of the business sector's stock of money are symmetrical to those of the household sector:

$$\Delta\bar{\mathsf{M}}_{\mathbf{B}} \equiv^{m} C - Y \quad |t. \tag{12}$$

The business sector's stock of money at the end of an arbitrary number of periods is accordingly given by:

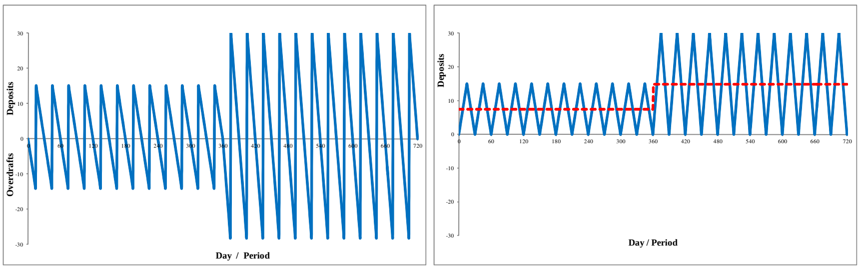
$$\bar{\mathsf{M}}_{\mathbf{B}} \equiv \sum_{t=1}^{\bar{t}} \Delta\bar{\mathsf{M}}_{\mathbf{B}t} + \bar{\mathsf{M}}_{\mathbf{B}0} \quad |\bar{t}. \tag{13}$$

In order to reduce the monetary phenomena to the essentials it is supposed that all financial transactions are carried out by the central bank. The stock of money then takes the form of current deposits or current overdrafts. Initial endowments can be set to zero. Then, if the household sector owns current deposits according to (11) the current overdrafts of the business sector are of equal amount according to (13), and vice versa. As it happens, each sector's *stock* of money is either positive (= deposits) or negative (= overdrafts). Money and credit are at first symmetrical. From the central bank's perspective the quantity of money at the end of an arbitrary number of periods is then given by the absolute value either from (11) or (13):

$$\bar{\mathsf{M}}_{\bar{t}} \equiv \left| \sum_{t=1}^{\bar{t}} \Delta\bar{\mathsf{M}}_{\mathbf{H}t;\mathbf{B}t} \right| \quad \text{if} \quad \bar{\mathsf{M}}_{\mathbf{H}0;\mathbf{B}0} = 0. \tag{14}$$

The *quantity* of money is always ≥ 0 and follows directly from the axioms. It is assumed at first that the central bank plays an *accommodative* role and simply supports the autonomous market transactions between the household and the business sector. For the time being, the quantity of money is the *dependent* variable.

By sequencing the initially given period length of one year into months the idealized transaction pattern that is displayed in Figure 2a results. To give an example, it is assumed that the monthly income $\frac{Y}{12}$ is paid out at mid-month. In the first half of the month the daily spending of $\frac{Y}{360}$ increases the current overdrafts of the households. At mid-month the households change to the positive side and have current deposits of $\frac{Y}{24}$ at their disposal. This amount reduces continuously towards the end of the month. This pattern is exactly repeated over the rest of the year. At the end of each subperiod, and therefore also at the end of the year, both the stock of money and the quantity of money is zero. Money is present and absent depending on the time frame of observation.



(a) Transaction pattern over two periods **(b)** Average stock of transaction money $\hat{\mathsf{M}}_{\mathbf{T}}$

Figure 2: Household sector's transaction pattern for different nominal incomes in two periods; the business sector's pattern is perfectly symmetrical

In period$_2$ the wage rate, the dividend and the price is doubled. Since no cash balances are carried forward from one period to the next, there results *no* real balance effect provided the doubling takes place exactly at the beginning of period$_2$.

From the perspective of the central bank it is a matter of indifference whether the household or the business sector owns current deposits. Therefore, the pattern of Figure 2a translates into the average amount of current deposits in Figure 2b. The average stock of transaction money depends on income according to the transaction equation:

$$\hat{\mathsf{M}}_{\mathbf{T}} \equiv \kappa Y \quad |t. \tag{15}$$

For the regular transaction pattern that is here assumed as an idealization the index is $\kappa = \frac{1}{48}$. Different transaction patterns are characterized by different numerical values of the transaction pattern index.

Taking (15) and (5) and (6) together one gets the explicit transaction equation for the limiting case of market clearing *and* budget balancing:

$$\text{(i) } \hat{\mathsf{M}}_{\mathbf{T}} \equiv \kappa \frac{\rho_X}{\rho_E} RLP \quad \text{(ii) } \frac{\hat{\mathsf{M}}_{\mathbf{T}}}{P} \equiv \kappa O \quad \text{if} \quad \rho_X = 1, \rho_E = 1 \quad |t. \tag{16}$$

We are now in the position to substantiate the notion of accommodation as a money-growth formula. According to (i) the central bank enables the average stock of transaction money to expand or contract with the development of productivity, employment, and price. In other words, the real average stock of transaction money, which is a statistical artifact and not a physical stock, is proportional to output (ii) if the transaction index is given and if the ratios ρ_E and ρ_X are unity. Under these *initial* conditions money is endogenous and neutral in the structural axiomatic context. Money emerges from *autonomous* market transactions and has three aspects: stock of money ($\bar{\mathsf{M}}_{\mathbf{H}}$, $\bar{\mathsf{M}}_{\mathbf{B}}$), quantity of money (here $\bar{\mathsf{M}} = 0$ at period start and end because of $\rho_E = 1$) and average stock of transaction money (here $\hat{\mathsf{M}}_{\mathbf{T}} > 0$). With money in all its forms consistently derived from the axiom set our picture of the initial pure consumption economy is now complete.

2 Production and financing of real assets

2.1 Reallocation of labor input and a new composition of output

The production of a second commodity in period$_2$ entails that the given resources of the business sector L are divided between firm A and B. Total employment is taken as constant over all periods:

$$L \equiv L_A + L_B \quad |2. \tag{17}$$

The 1st axiom (1) is now differentiated for the two firms. Total income is then given by:

$$Y = \underbrace{W_A}_{W} L_A + \underbrace{W_B}_{W} L_B + \underbrace{D_A N_A + D_B N_B}_{Y_D = 0} \quad |2. \tag{18}$$

To simplify matters the wage rates are set equal for both firms and distributed profits are set to zero. Because of equal wage rates the reallocation has no effect on total income.

The respective outputs are given by:

$$\begin{aligned} O_A &= R_A L_A \\ O_B &= R_B L_B \end{aligned} \quad |2. \tag{19}$$

The undifferentiated output of the initial period O is now renamed as O_A. In somewhat more detail it is assumed that O_A consists of a nondurable consumption good like bread that is produced in large quantities. Output O_B, in contrast, consists of a durable consumption good like a family home that is produced in small quantities. Given, for example, equal labor inputs in the two lines of production, it is easy to see that the numerical values of the productivities R_A and R_B in (19) differ widely. Output O_A is half of the initial output O.

Under the condition that both markets are cleared the profit for each firm follows from (9) and is given by:

$$\begin{aligned}
&\Delta\bar{Q}_{fiA} \equiv P_A R_A L_A \left(1 - \frac{W}{P_A R_A}\right) \quad \rho_{XA} = 1 \\
&\Delta\bar{Q}_{fiB} \equiv P_B R_B L_B \left(1 - \frac{W}{P_B R_B}\right) \quad \rho_{XB} = 1
\end{aligned} \qquad |2. \tag{20}$$

If the expressions in brackets are zero then profits are zero. With the zero profit condition the market clearing prices for both firms are, analogous to (7) unequivocally determined as:

$$\begin{aligned}
P_A^\star &= \frac{W}{R_A} \\
P_B^\star &= \frac{W}{R_B}
\end{aligned} \qquad |2. \tag{21}$$

The prices are equal to the respective unit wage costs. Relative prices do not depend on the partition of labor input and the quantitative composition of output. Due to the productivity differentials the price $P_A^\star$ of the nondurable consumption good is a small amount compared to the asset price $P_B^\star$. It is assumed that the market clearing asset price is higher than the average period income,

$$P_B^\star > \frac{Y}{n} \tag{22}$$

$$n = \text{number of income receiving households},$$

that is, the households that want to buy the durable consumption good in period$_2$ need financing.

2.2 Pooling of small deposits

The household sector is segmented into two groups: the group of savers F spends less than its period income on current output and the group of dissavers G spends more. The household sector's total financial saving is defined as:

$$\Delta\bar{S}_{fi} \equiv Y - C \qquad |t. \tag{23}$$

Analogously the saving of the i^{th} household is given by:

$$\Delta\bar{S}_{fii} \equiv Y_i - C_i \quad i = 1, \ldots, n \quad |t. \tag{24}$$

Seen bottom-up total saving is alternatively defined as:

$$\Delta \bar{S}_{fi} \equiv \sum_{i=1}^{n} (Y_i - C_i) \quad |t. \tag{25}$$

Both definitions, (23) and (25), amount to the same:

$$Y - C = \sum_{i=1}^{n} (Y_i - C_i) \quad |t. \tag{26}$$

With both sides divided by total income Y and the help of (6) this reads:

$$\begin{aligned} 1 - \rho_E &= \sum_{i=1}^{n} \frac{Y_i}{Y} (1 - \rho_{Ei}) \\ \text{with} \quad \rho_{Ei} &\equiv \frac{C_i}{Y_i} \quad |t. \end{aligned} \tag{27}$$

If all individual incomes Y_i are equal then the contribution of each household to total saving depends alone on the individual household's savings ratio $1 - \rho_{Ei}$. On the other hand, if all savings ratios are equal then the individual household's contribution depends on the relative position on the income scale Y_i/Y. It is quite plausible and corroborated by observation that the higher income brackets save more in absolute and relative terms. That is, there is a positive correlation between the savings ratio and the position on the income scale. For our present purposes the simplest behavioral assumption is sufficient:

$$1 - \rho_{Ei} = \alpha \frac{Y_i}{Y} \quad |t. \tag{28}$$

Roughly speaking, we have smaller savings from smaller incomes and bigger savings from bigger incomes.

Then, of course, it remains to factor in dissavings. The household sector is therefore split into savers and dissavers. Eq. (27) changes to:

$$\begin{aligned} \rho_E &= 1 - \underbrace{\left[\sum_{j=1}^{f} \frac{Y_j}{Y} (1 - \rho_{Ej}) + \sum_{k=1}^{g} \frac{Y_k}{Y} (1 - \rho_{Ek}) \right]}_{0} \\ &\text{with} \quad f + g = n \quad \rho_{Ej} \leq 1, \rho_{Ek} > 1 \quad |t. \end{aligned} \tag{29}$$

Under the condition that the household sector's budget is balanced, i.e. $\rho_E = 1$, the savings of the f savers must be equal to the dissavings of the g dissavers. This condition ensures that the business sector is, compared to the initial period, not the least affected in nominal terms by any changes of the expenditure behavior of individual households because these changes are fully compensated *within* the household sector, that is, the square bracket in (29) is zero by assumption. In other words, while some households save and others dissave the household sector as a whole neither saves nor dissaves.

Many small amounts are saved by the households F and ‘transformed’ by the banking unit into sizable loans of exactly the same total amount for households G. The perfect complementarity of saving and dissaving is, of course, a limiting case. The complementary build-up of current deposits by households F and of current overdrafts by households G during period$_2$ is visualized in Figure 3.

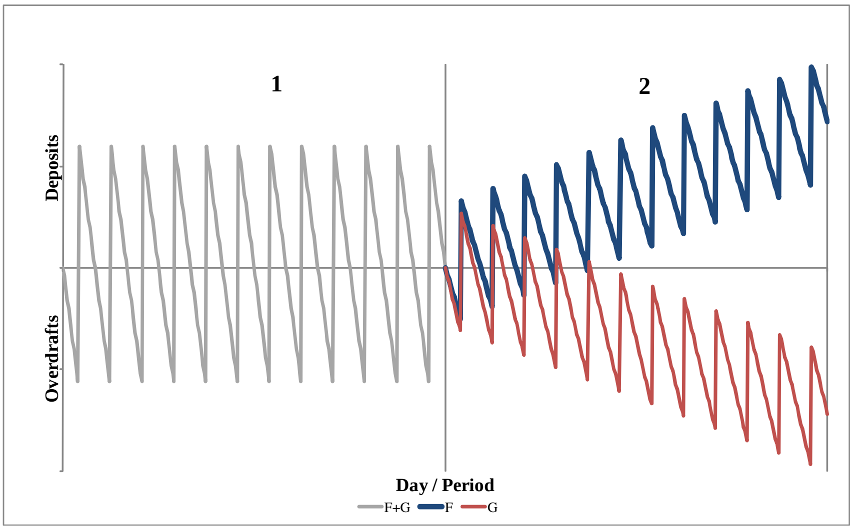


Figure 3: Saving of households F is exactly equal to dissaving of households G, that is, the expenditure ratio of the household sector as a whole is unity; deposits consist of many small amounts, overdrafts of few large amounts

During period$_2$ current deposits progressively assume the role of a store of value. Emerging from the day-to-day transactions money now becomes ‘a link between the present and the future’ (Keynes, 1973, p. 293). The transaction unit accumulates deposits and overdrafts and in this way partly assumes the role of a bank. Little by little deposits become savings and overdrafts become loans.

In the real sphere firm A’s labor input L_A and product output O_A is reduced. This corresponds to the saving of households F. The price P_A of the nondurable commodity remains unchanged according to (21). Total financial saving, which is defined with (23), is zero but composed of saving and dissaving as defined by (29). What vanishes as saving from the market of nondurables reappears as dissaving in the market of durables. Total consumption expenditure remains equal to the unchanged total income. The expenditure ratio ρ_E is unity. The households buy all of output but consume only the nondurable part. While financial saving is zero, nonfinancial saving is > 0. At period end the household sector is in the possession of a stock of durables which represents a stream of future consumption services. Nonfinancial saving and financial saving are quite different things (see Section 3).

From (29) follows the maximum amount of new loans as the counterpart to group F’s saving:

$$\Delta\bar{S}_{fiF} \equiv \sum_{j=1}^{f} \frac{Y_j}{Y}(1-\rho_{Ej}) \quad |t. \tag{30}$$

In combination with (28) and the asset price (21) follows the (rounded) maximal number of loans to the dissavers in period t:

$$l_B^{max} = \frac{\sum_{j=1}^{f} \alpha \left(\frac{Y_j}{Y}\right)^2}{P_B^{\star}} \quad |t. \tag{31}$$

The maximum number of loans depends on the income distribution and the market clearing asset price. Roughly speaking, more houses can be financed (under the condition $\rho_E = 1$) if the income distribution is more unequal. From this familiar result no normative conclusions about the desirability of an unequal income distribution can be drawn.

2.3 Banking and interest

It is assumed now that the households G seek to consolidate their overdrafts and to replace them by longer term loans. In other words, the borrowers start to adapt the term structure of financing to the life-time of assets.

The business sector consists of the consumption goods producing firms A, B and the central bank. The latter handles all monetary and financial transactions. Accordingly, the central bank consists of a transaction unit and a banking unit. The transaction unit is here ignored (for details about the transaction business see 2011c, Sec. 4). The business sector then consists of the three firms A, B, C that produce entirely different kinds of goods and services.

The inclusion of the banking unit entails that the given resources of the business sector L have to be reallocated:

$$L \equiv L_A + L_B + L_C \quad |3. \tag{32}$$

As a consequence total income is then given by:

$$Y = \underbrace{W_A}_{W} L_A + \underbrace{W_B}_{W} L_B + \underbrace{W_C}_{W} L_C + \underbrace{D_A N_A + D_B N_B + D_C N_C}_{Y_D = 0} \quad |3. \tag{33}$$

Interest payments to the banking unit have to be subsumed under consumption expenditures:

$$\begin{gathered} C = P_A X_A + P_B X_B + \mathsf{I}_{\bar{\mathsf{A}}}\,\bar{\mathsf{A}} \\ \text{or} \\ C = C_A + C_B + C_C \quad |3. \end{gathered} \tag{34}$$

The quantity bought from the banking unit X_C can here be replaced by the total amount of the loans $\bar{\mathsf{A}}$. The price is replaced by the rate of interest $\mathsf{I}_{\bar{\mathsf{A}}}$ (for the consistent derivation of the rate of interest from the differentiated axiom set see 2011b, Sec. 6).

The reallocation of labor input is neutral with regard to the price of the consumption goods. When labor input L_C is taken away from firm A output falls. At the same time consumption expenditures are redirected away from purchases of nondurables to purchases of the services of the banking unit, i.e. C_A goes down and C_C goes up. This leaves the price of the nondurable consumption good unaffected under the given conditions. Group G buys less of the nondurable consumption good and more banking services. According to this demand shift the unaltered total labor input is reallocated. It is worth to recall that group G is not in the position to buy the durable output without the financing services of the banking unit.

Adapting (9), profit for each firm is under the condition of market clearing given by:

$$\begin{aligned} \Delta\bar{Q}_{fiA} &\equiv P_A R_A L_A \left(1 - \frac{W}{P_A R_A}\right) \quad \text{if} \quad \rho_{XA} = 1 \\ \Delta\bar{Q}_{fiB} &\equiv P_B R_B L_B \left(1 - \frac{W}{P_B R_B}\right) \quad \text{if} \quad \rho_{XB} = 1 \\ \Delta\bar{Q}_{fiC} &\equiv \mathsf{I}_{\bar{\mathsf{A}}} \bar{\mathsf{A}} \left(1 - \frac{W}{\mathsf{I}_{\bar{\mathsf{A}}} \frac{\bar{\mathsf{A}}}{L_C}}\right) \quad \text{if} \quad \rho_{XC} = 1 \end{aligned} \qquad |3. \qquad (35)$$

The zero profit conditions determine, analogous to (20) and (21), the market clearing commodity prices $P_A^\star$, $P_B^\star$ and the rate of interest $\mathsf{I}^\star{}_{\bar{\mathsf{A}}}$. The inclusion of the banking unit results in a reallocation of demand and resources. The loan interest rate is, at first, alone determined by the production conditions of the banking unit. Roughly speaking, the productivity of the banking unit is high if a huge stock of loans $\bar{\mathsf{A}}$ is processed in a given period with an small number of working hours L_C. Under the condition of market clearing $O_C = X_C$ and the identification of P_C with the rate of interest $\mathsf{I}_{\bar{\mathsf{A}}}$ follows from the 2^{nd} axiom a reinterpretation of the banking unit's productivity (for details see 2011b, Sec. 6).

The total amount of the loans $\bar{\mathsf{A}}$ is equal to the overdrafts at the end of period$_2$ as shown in Figure 4. The longer term loans reduce the overdrafts by the same amount. This swapping can occur at any point in time, to simplify matters we let it happen here exactly at the beginning of period$_3$.

It is noteworthy that the quantity of money increases from the beginning of period$_2$ onwards due to the credit relations *within* the household sector. This internal relations are not explicit in (10) but in (29). The increase of the quantity of money has neither an effect on prices nor the interest rate which are determined by (35) and the zero profit condition. The commonplace quantity theory does not hold if saving and dissaving compensate each other exactly in one period.

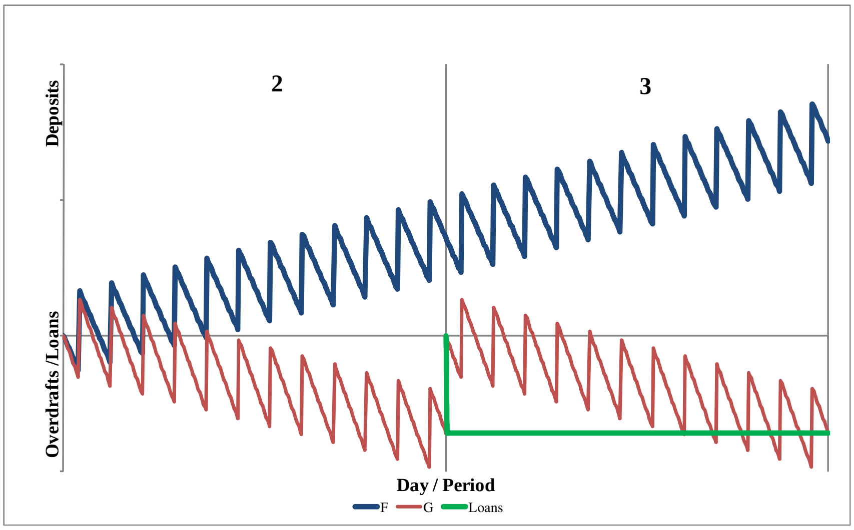


Figure 4: Replacement of overdrafts with loans

2.4 Liquidity preference and interest

The longer term financing of the household sector's real assets creates an asymmetry at the central bank with regard to the term structure of assets (overdrafts plus loans) and liabilities (deposits). For the central bank this is of no consequence but for a single commercial bank this structure could be hazardous. The term leverage between the two sides of a commercial bank's balance sheet is the classical precondition of a bank run in times of general uncertainty and heightened nervousness.

It is assumed now that the central bank tries to establish the congruence of the term structure on both sides of its balance sheet. To achieve this it offers savings accounts with different interest rates depending on different maturities.

The group of savers F then faces a two stage decision. The first decision is not to spend a certain amount of income in the current period but in, say, five years. This amount is at first kept as deposit at the central bank and bears no interest. The second decision relates to swapping the liquidity of deposits for the interest on savings accounts over a certain space of time. In the ideal case the whole amount of free deposits goes into saving accounts and the term structure of assets and liabilities is identical as indicated in Figure 5.

Since both deposits and savings accounts at the central bank are risk-free the interest rate the central bank has to offer for a certain maturity is a measure of the liquidity preference of group F.

The banking unit pays interests on the savings accounts of group F. Total income (33) therefore changes to:

$$Y = \underbrace{W_A}_{W} L_A + \underbrace{W_B}_{W} L_B + \underbrace{W_C}_{W} L_C + \mathsf{I}_{\bar{\mathsf{L}}}\,\bar{\mathsf{L}} + \underbrace{D_A N_A + D_B N_B + D_C N_C}_{Y_D=0} \quad |4. \qquad (36)$$

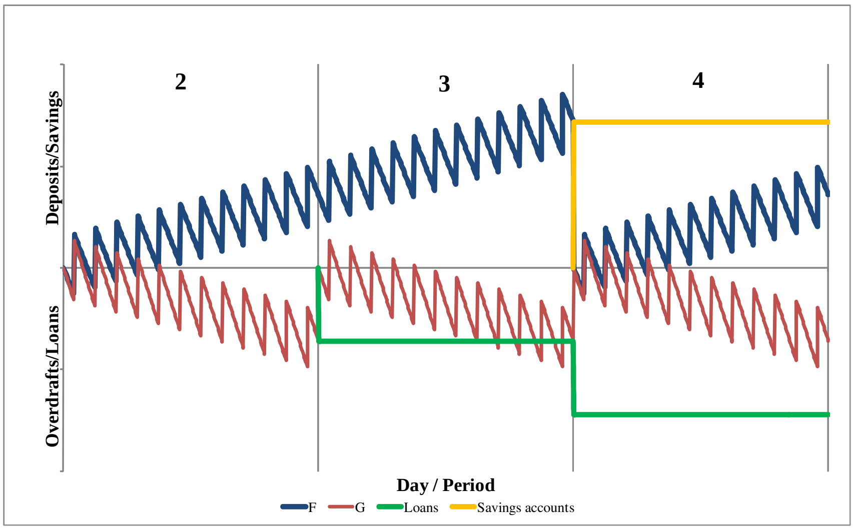


Figure 5: Reduction of the term leverage to zero by replacing free deposits with savings accounts of the same maturity as loans

Interest payments affect also the profit of the banking unit. Eq. (8) changes to:

$$\Delta\bar{Q}_{fiC} \equiv \mathsf{I}_{\bar{\mathsf{A}}}\bar{\mathsf{A}} - \mathsf{I}_{\bar{\mathsf{L}}}\bar{\mathsf{L}} - WL_C \quad |4. \tag{37}$$

The banking unit gets interests from loans to group G, i.e. on $\bar{\mathsf{A}}$, and pays interests on the savings accounts of group F, i.e. on $\bar{\mathsf{L}}$. It is assumed that wage costs WL_C do not change compared to period$_3$. If profit is again set to zero then the margin between credit and debit interest rates covers exactly the operating costs, and the interest rate on loans depends directly on the interest rate on savings accounts:

$$\mathsf{I}_{\bar{\mathsf{A}}} \equiv \mathsf{I}_{\bar{\mathsf{L}}} + \frac{W}{\frac{\bar{\mathsf{A}}}{L_C}} \quad \text{if} \quad \bar{\mathsf{L}} = \bar{\mathsf{A}} \quad |t. \tag{38}$$

Interest rates on both sides of the central bank's balance sheet ultimately depend on the liquidity preference of group F and the productivity of the banking unit. The higher the interest rate $\mathsf{I}_{\bar{\mathsf{L}}}$ that is necessary to motivate group F to part with liquidity the higher the interest rate for the loans of group G. This link holds strictly only under the condition of zero term leverage in the banking unit. For the functioning of the pure consumption economy the current deposits of group F are not at all costs required. They are required, though, to reduce the leverage risk of commercial banks. Perfect term congruence reduces the leverage risk to zero but makes the rate of interest dependent on the purely subjective liquidity preference of savers.

By increasing the interest rate on loans a stronger liquidity preference effects a redistribution of consumption goods from group G to F. Group G has to lower its expenditures on consumption goods in order to be able to pay the higher loan interest rate. Group F gets a higher interest income and increases its expenditures on consumption goods under the condition of $\rho_E = 1$. Changes of liquidity preference lead, in the final analysis, to changes in the distribution of consumption good output among households. From the perspective of the household sector a savings account is a risk-free loan to the central bank. The interest income of financial investors has been characterized since the classics as unearned income of rentiers that lacks a convincing justification (e.g. Hudson and Bezemer, 2012, p. 6; Keynes, 1973, p. 376). Seen under the behavioral perspective the rentier is the personification of liquidity preference. Ultimately the interest on savings accounts is a compensation for giving up the possibility of having money at one's disposal should an immediate need or an opportunity arise (Mill, 2006a, p. 539). This suggests that in an environment with long term stability the overall liquidity preference should be rather low but still different for different maturities.

It is important to see that rentiers are a subset of savers and to avoid the rather widespread mistake since the classics to equate savers with rentiers.

The buyer of the asset takes, for simplicity, a 100 percent financing, that is, the amount of the loan is equal to the actual price of the asset and the asset serves as collateral. A prudent mortgage bank normally finances 50 to 80 percent of the asset's value depending on the borrower's income. In our simplified case the interests $\mathsf{I}_{\bar{\mathsf{A}}}\bar{\mathsf{A}}$ are composed of only two elements: a remuneration for the services of the banking unit and a compensation of the liquidity preference of group F. Interests on the loan in turn are part of the owner's costs of using the asset which comprise in the case of a house maintenance and depreciation. This details are ignored in the following. Maintenance and depreciation are set to zero, which amounts to the assumption that the life-time of houses is infinite. The 'rent' of the house owners consists only of interests. In addition, each owner is subject to the chance and risk of future changes of the asset's value.

As long as the demand for the durable output is maintained the stock of assets grows and with it the stock of loans at the banking unit. If the productivity of the banking unit remains constant more and more labor input has to be shifted, in accordance with the households' preferences, from firm A to C. There are, however, limits to growth for the banking unit.

2.5 Room for expansion

The free part of income can either be saved or used for servicing a loan. In the latter case the annuity of a loan $\mathsf{N}_{\bar{\mathsf{A}}}$ is defined as:

$$\mathsf{N}_{\bar{\mathsf{A}}} \equiv \bar{\mathsf{A}}\left(\mathsf{I}_{\bar{\mathsf{A}}} + \mathsf{R}_{\bar{\mathsf{A}}}\right) \quad |t. \tag{39}$$

The free part of income is given as difference between income and consumption expenditures. Care has to be taken, however, that consumption expenditures include interests according to (34). Total consumption expenditures minus interests are denoted as C_i^{ex}. The maximum loan amount of the i^{th} household can then be derived from the condition:

$$\underbrace{Y_i - C_i^{ex}}_{\text{free part}} = \underbrace{\bar{\mathsf{A}}_i^{max}\left(\mathsf{I}_{\bar{\mathsf{A}}} + \mathsf{R}_{\bar{\mathsf{A}}}\right)}_{\text{maximum annuity}} \quad |t. \tag{40}$$

The maximum annuity is equal to the free part of income. The annuity in turn depends on the individual loan amount multiplied with the sum of the current interest rate $\mathsf{I}_{\bar{\mathsf{A}}}$ and the current repayment rate $\mathsf{R}_{\bar{\mathsf{A}}}$. From this follows, substituting (6), the maximum amount the i^{th} household is able to service at given rates as:

$$\bar{\mathsf{A}}_i^{max} = \frac{1}{\mathsf{I}_{\bar{\mathsf{A}}} + \mathsf{R}_{\bar{\mathsf{A}}}}\left(1 - \rho_{Ei}^{ex}\right) Y_i. \tag{41}$$

The individual upper limits sum up for the economy as a whole to:

$$\bar{\mathsf{A}}^{max} = \frac{1}{\mathsf{I}_{\bar{\mathsf{A}}} + \mathsf{R}_{\bar{\mathsf{A}}}} \sum_{i=1}^{n} Y_i \left(1 - \rho_{Ei}^{ex}\right). \tag{42}$$

From this follows the maximum debt income ratio as:

$$\begin{gathered} \frac{\bar{\mathsf{A}}^{max}}{Y} = \frac{\Theta}{\mathsf{I}_{\bar{\mathsf{A}}} + \mathsf{R}_{\bar{\mathsf{A}}}} \\ \text{with} \quad \Theta \equiv \sum_{i=1}^{n} \frac{Y_i}{Y}\left(1 - \rho_{Ei}^{ex}\right) \quad \rightarrow \quad \Theta \equiv \sum_{i=1}^{n} \alpha \left(\frac{Y_i}{Y}\right)^2. \end{gathered} \tag{43}$$

The maximum amount of debt the households are able to service in the current period and in future periods if the relevant variables do not change depends on three essentially different factors: total income, the households' individual position within the actual income distribution and the actual value of the market variables rate of interest and rate of repayment. Given the latter, the maximum serviceable debt is the higher the greater the income inequality.

A falling interest rate boosts the maximum debt/income ratio. This is not to say, of course, that households automatically exploit their debt limit to the full amount. Rather, the maximum debt/income ratio puts an upper limit to the size of the banking unit. This restriction, though, is only effective if the banking unit adheres to, or is made to observe, time-tested banking rules. Following Minsky the debt beyond the maximum individual debt/income ratio (41) may be termed speculative and, if far beyond, Ponzi financing (1982, pp. 22-23). Eq. (40) excludes subprime financing.

In order to buy an asset the individual household can obtain the maximum loan amount only if the initial stock of loans is zero. Otherwise the existing contractual payments have to be taken into account first. The difference between the maximum annuity and the already existing contractual annuity is the free annuity of the i^{th} household:

$$
\begin{aligned}
&\mathsf{N}_{\bar{\mathsf{A}}i}^{max} \equiv \bar{\mathsf{A}}_i^{max}\left(\mathsf{I}_{\bar{\mathsf{A}}} + \mathsf{R}_{\bar{\mathsf{A}}}\right)\\
&\underline{-\mathsf{N}_{\bar{\mathsf{A}}i}^{ctr} \equiv \bar{\mathsf{A}}_i^{ctr}\left(\mathsf{I}_{\bar{\mathsf{A}}}^{ctr} + \mathsf{R}_{\bar{\mathsf{A}}}^{ctr}\right)} \qquad |t.\\
&\qquad \Delta\mathsf{N}_{\bar{\mathsf{A}}i}
\end{aligned}
\tag{44}
$$

It may turn out, for example after a sudden increase of the interest rate, that the contractual annuity is higher than the maximum annuity at actual market rates of interest and repayment. In this case the free annuity is negative. At first, this has no effect on the households that find themselves in this situation. If the maturity of their loans is long enough they can sit out an interest rate hike. Troubles will arise at maturity if the market rate is still higher than the contractual rate. No troubles will arise if the interest rate is contractually fixated until the loan is completely redeemed. A negative free annuity is a danger signal if the loans a short-term otherwise it can be ignored. From the free annuity follows the free credit line as:

$$
\Delta\bar{\mathsf{A}}_i \equiv \frac{\Delta\mathsf{N}_{\bar{\mathsf{A}}i}}{\mathsf{I}_{\bar{\mathsf{A}}} + \mathsf{R}_{\bar{\mathsf{A}}}} \qquad |t. \tag{45}
$$

More explicitly this can be written as:

$$
\Delta\bar{\mathsf{A}}_i \equiv \frac{1}{\mathsf{I}_{\bar{\mathsf{A}}} + \mathsf{R}_{\bar{\mathsf{A}}}}\left[\left(1-\rho_{Ei}^{ex}\right)Y_i - \bar{\mathsf{A}}_i^{ctr}\left(\mathsf{I}_{\bar{\mathsf{A}}}^{ctr} + \mathsf{R}_{\bar{\mathsf{A}}}^{ctr}\right)\right] \qquad |t. \tag{46}
$$

A lowering of the actual interest rate increases the free credit line of the i^{th} household. If the contractual annuity grows over time the free credit line eventually reduces to zero. When the differences in the square brackets become zero then the credit expansion has run its course and interest rate changes have no effect whatsoever.

It is worth to recall that we have separated the savers and the dissavers. The amounts the dissavers spent hitherto on the produced assets are entirely financed by the banking unit. Under the symmetry condition loans are equal in amount and term structure to savings. When we imagine – in a thought experiment – that the borrowers inherit at one stroke the savings accounts all credit relations vanish and the banking unit with them. Generally speaking, self-financing puts a brake on the growth of the banking sector. To simplify matters, self-financing is excluded, or to put it otherwise, group G's leverage ratio is 100 percent.

Alternatively, the banking unit may replace the savings accounts by mortgage bonds and sell these to group F. This securitization enhances the liquidity compared to savings accounts, because bonds are traded on a market, but introduces at the same time the possibility of capital gains and losses due to future interest rate fluctuations. Securitization has – in principle – no effect on the maximum debt/income ratio.

Finally it is possible that the size distribution of savings accounts becomes unequal over time. In this case a lender with a sizeable amount at his disposal and a borrower may enter a direct credit relationship. The banking unit is no longer involved. To include the new institutional arrangement our categorization has to be broadened. All kinds of direct and indirect credit relationships have then to be included into the all embracing financial sector. The numerous real world institutional differentiations are ignored in the following. In our simple economy there is a straightforward relation between the growth of both the stock of assets and the banking unit. The relative size of the banking unit is ultimately determined by the maximum debt/income ratio. It is assumed here that it is not restricted by capital requirements. For our analysis this would, however, not make much difference.

3 Household sector's net worth

For the specification of household sector's total saving the set of axioms has to be extended because additional variables have to be introduced. The 6^{th} axiom states that total saving has a financial and nonfinancial component:

$$\Delta\bar{S} = \Delta\bar{S}_{fi} + \Delta\bar{S}_{nf} \quad |t. \tag{47}$$

Financial saving has already been defined as the difference of total income and consumption expenditure:

$$\Delta\bar{S}_{fi} \equiv Y - C \qquad |t. \tag{48}$$

In combination with (10) this yields the undifferentiated relation:

$$\Delta\bar{S}_{fi} \equiv Y - C \equiv^{m} \Delta\bar{M}_{\mathbf{H}} \quad |t. \tag{49}$$

Financial saving and the change of the household sector's stock of money are *two aspects* of the same flow residual. This is why we apply the two definition signs $\equiv$ and $\equiv^{m}$.

For the determination of the nonfinancial component of saving first real consumption is needed as new variable. With U that part of the quantity bought X is denoted that vanishes for good from the household sector's stock of commodities because it has been used up completely in the current period. Nonfinancial saving is defined as the valued increase of the commodity stock $X - U$ and the change of valuation of the already existing stock in period t, which is captured by $\Delta\bar{G}_{\mathbf{H}}$:

$$\Delta\bar{S}_{nf} \equiv P\,(X - U) + \Delta\bar{G}_{\mathbf{H}} \quad |t. \tag{50}$$

If the quantity bought is used up completely in each period, i.e. $X = U$, the first part of nonfinancial saving is zero. This is the case for the nondurable output of firm A. Under this condition there is no addition to the stock of commodities, which is initially zero. By consequence, there can be no changes of the value of stocks in future periods. From the durable output of firm B, on the other hand, nothing is consumed in the period of production, hence U_B is zero. That means, nonfinancial saving is equal to the market value $P_B X_B = C_B$ of the nondurable output under the condition of market clearing, i.e. $X_B = O_B$. The value of the stock of durables may depreciate $\Delta\bar{G}^-_{\mathbf{H}}$ or appreciate $\Delta\bar{G}^+_{\mathbf{H}}$ in future periods (for details see 2011a, Sec. 4).

Consumption K is defined as the sum of the valued quantity that is used up in the current period and the decrease of the value of the not yet consumed stock of durable commodities. Depreciation gives a rough measure of the services which the durable commodities yield in one period.

$$K \equiv PU + \Delta\bar{G}^-_{\mathbf{H}} \quad |t \tag{51}$$

Nonfinancial saving, then, is the difference between consumption expenditure C and consumption K plus the appreciation $\Delta\bar{G}^+_{\mathbf{H}}$ of the remaining stock of durables:

$$\Delta\bar{S}_{nf} \equiv C - K + \Delta\bar{G}^+_{\mathbf{H}} \quad |t. \tag{52}$$

There can be consumption without consumption expenditure. In this case one has nonfinancial dissaving and the valued stock of durables decreases.

In more detail total saving (47) in period t is composed of:

$$\Delta\bar{S} = (Y - C) + \left(C - K + \Delta\bar{G}^+_{\mathbf{H}}\right) = Y - K + \Delta\bar{G}^+_{\mathbf{H}} \quad |t. \tag{53}$$

The appreciation of a stock of assets counts as nonfinancial saving.

With the final step the household sector's net worth $\bar{S}$ at the end of an arbitrary number of periods is now defined as the numerical integral of the changes of financial and nonfinancial saving from the first period onwards plus the initial endowment:

$$\bar{S}_t \equiv \sum_{t=1}^{t} \Delta\bar{S}_t + \bar{S}_0. \tag{54}$$

Taking (53) and (11) into account this reads in explicit form, with the initial endowment set to zero:

$$\bar{S} \equiv \underbrace{\bar{M}^d_{\mathbf{H}} + \bar{M}^o_{\mathbf{H}}}_{0} + \underbrace{\sum_{t=1}^{t} \left(C - K + \Delta G^+_{\mathbf{H}}\right)_t}_{\text{valued nonfinancial assets}} \quad |\bar{t}. \tag{55}$$

The household sector's net stock of money, i.e. deposits $\bar{M}^d_{\mathbf{H}}$ minus overdrafts $\bar{M}^o_{\mathbf{H}}$, is zero in period$_1$ because total financial saving is at first zero. Subsequently deposits and overdrafts change their forms. The net financial position of the household sector, i.e. deposits + savings accounts minus overdrafts + loans, is zero. Since the nondurables are consumed in each period the household sector's net worth at the end of period $\bar{t}$ depends alone on the actual value of durables:

$$\bar{S} \equiv \underbrace{\quad \| \quad}_{\text{net financial} = 0} + \underbrace{\sum_{t=1}^{t} \left(C_B - K_B + \Delta G^+_{\mathbf{H}B}\right)_t}_{\text{value of durables}} \quad |\bar{t}. \tag{56}$$

At the moment, the net financial position does not contribute to the household sector's net worth. This holds for the household sector as a whole. The situation can be different for individual households. Current deposits, for example, increase the net worth of a single household. If, on the other hand, a new car is fully financed with overdrafts, the single household's net worth remains unaltered. There is a triangular relationship between the value of durables and the central bank's assets and liabilities that in turn determine the household sector's net financial position in (56). The $\|$-sign represents the central bank's (or, more general, the financial sector's) balance sheet from whence the net financial position is derived. The balance sheet in turn is the numerical integral of previous changes of the axiomatic variables.

Under the simplifying assumption that the life-time of the asset is infinite there is no consumption K_B (at least until Section 5). It is further assumed that the economy with a nondurable and durable output is reproduced identically over four periods. While the flow part of the economy is stationary the stock of durables increases continuously (Tobin, 1980, p. 74). If appreciations are at first excluded the nominal value of the stock of assets is then simply four times the period expenditure $C_B = 4$ as shown in Figure 6. The asset price P_{B2} is given by (21). The assets are fully financed, and the loans are fully covered with savings of the same maturity. The banking unit's term leverage is zero. The house owners' leverage, in contrast, is 100 percent for simplicity.

Psychologically there is a curious bias for double counting. In (56) the savers feel wealthier at the end of the fourth period in comparison to the initial period because their savings accounts have grown. Over the same time span the number of asset owners increases. The owners, too, feel wealthier because they enjoy the usage of their houses and tend to forget their loans. The individual financial net worth of the savers increases while the total financial net worth of the household sector is zero under the condition of $\rho_E = 1$ over all previous periods. In a sense, credit produces two kinds of owners: virtual and real. In case of default the virtual owner becomes the real owner by taking over the collateral.

Eqs. (55) and (56) may give rise to some wavering. They seem to support the conclusion that money is a veil or, more general, that financial relations are a veil (Hudson and Bezemer, 2012, p. 2). After all, in (56) they do not contribute to the household sector's net worth. As Adam Smith already told us, money is not wealth. However, there are subtle differences because there are different kinds of zero. In (55) it makes a difference whether $\bar{M}^d_{\mathbf{H}} + \bar{M}^o_{\mathbf{H}} = 0$ or $0+0=0$. In the former case the transaction unit partly plays the role of a bank as shown in Figure 3. If deposits and overdrafts are equal in (56) savings accounts and loans cancel out, i.e. $\bar{\mathsf{L}} + \bar{\mathsf{A}} = 0$. However, the interest payments have real effects on the flow part of the economy. The composition of income, consumption expenditures and the allocation of labor input changes as we have seen in Sections 2.3 and 2.4. Although the financial relations sum up to zero in the net worth equation it cannot be said that they are a veil that only hides the real economy (see also Hudson, 2011). Money has no real effects as long as the expenditure ratio for every single household is unity.

Since this never happens in the real world the money-is-a-veil tenet is a theoretical limiting case that is utterly misleading if taken at face value.

4 Valuation and the free lunch menu

4.1 Realized appreciations

The real assets are produced, sold and financed over four periods as described and formalized in the foregoing. Subsequently the production of real assets stops and the labor input is redirected to the production of nondurables.

The first scenario runs as follows. Groups G, H, I, J have bought the real asset at the price P_{B2} that has been determined with (21) and is equal to unit wage costs. The price of nondurables and durables is at first determined in like manner. The total value of the stock of assets is, for a start, 16 money units as shown in Figure 6.

Asset buying (-) / selling (+)				End value$_1$	Real. appr.	End value$_2$	Not. appr.
G	-4x1			4x1		4x4	12
H	-4x1			4x1		4x4	12
I	-4x1			4x1		4x4	12
J	-4x1	2x2		2x1	2	2x4	6
K		-2x2	1x4	1x2	2	1x4	2
L			-1x4	1x4		1x4	0
Σ	|16|	0	0	20	4	64	44

Figure 6: Realized appreciation and notional appreciation

The price of assets then gains a life of its own. In the next round group K offers, for whatever reasons, the double price and buys from group J. There is an increase of the household sector's net worth in (56) via nonfinancial saving (52). The appreciation of the household sector's assets is obviously something completely different from the factor income Y_W as given with (1) and from the business sector's profit as defined with (8). And, to be precise, appreciation $\Delta G^{+}_{\mathbf{H}B}$ and realizing the appreciation by selling the asset are analytically distinct steps that are executed in different parts of (56).

The buyers K take up a loan of 4 money units. The central bank's asset side in panel 6 of Figure 7 expands. On the other hand, the sellers J pay back their loans of 2 money units and have 2 money units left over in the form of current deposits. They now have the choice of keeping the deposits, swapping them for interest bearing savings accounts or spending them on the nondurable consumption good. It is assumed that the realized appreciation or capital gain is put into savings accounts, such that no term leverage occurs at the banking unit. The sellers are wealthier but there is no effect on the demand for the nondurable consumption good apart from the distributional effects that come with increased interest payments on larger amounts of loans and savings.

The buyers are prepared to pay a higher price than the historical P_{B2} because they are confident that a potential next buyer will pay at least this new price, in other words, that there will be a market for the asset in the future. In the final analysis this expectation produces a free lunch for the sellers. The higher valuation of the buyers amounts to a positive sum game. Nobody loses but some win – the winning seemingly coming out of thin air. It is implicitly assumed that the banking unit shares the buyer's view and accepts the assets with their new value as collateral for the bigger loans. With the help of the banking unit the asset buyers create both market value and money out of nothing.

In the next round group L buys the assets for the double price from group K which realizes an appreciation of 2 money units. In the time span under consideration the two groups J, K act as buyers and sellers and *de facto* trade the assets as middlemen. In the scenario of Figure 6 all traders realize a capital gain.

> When an investor thinks he can make over 100 per cent per annum by borrowing at 6 per cent, he will be tempted to borrow, and to invest or speculate with borrowed money. (Fisher, 1933, p. 348), see also (Hudson, 2012, pp. 3-5)

The balance sheet of the banking unit expands. The number of loans, however, remains constant. The financing of group L is sound if, according to (40), the annuity can be paid out of the free part of income. The successively higher values of group L's assets have been vindicated by market transactions.

If the savers produce in each period the maximum amount of 4 money units this asset buying and realization of appreciations can go on for a while. However, under the given conditions the price P_B cannot go higher with a constant $\Delta\bar{S}_{fiF}$ in (30). To follow the increase of the household sector's net worth over yet another period does not add anything new. Therefore, saving/dissaving in (29) is now arrested.

4.2 Notional appreciations

In the left panel of Figure 6 the End values$_1$ reflect market transactions. It is assumed now that groups G, H, I, J, K who own identical assets realize that the market price P_B has quadrupled and, having heard of the law of one price, revalue their assets accordingly. The appreciation $\Delta G^{+}_{\mathbf{H}B}$ in (56) boosts the household sector's net worth. The notional appreciations are recorded in the right panel of Figure 6. Since there are no market transactions the appreciations cannot be realized.

It is possible, though, that the banking unit accepts the new asset values as collateral and expands the already existing loans (FCIC, 2011, pp. 86-87). The payout of the additional loans takes the form of an increase of current deposits of the house owners. The central bank's balance sheet expands as shown in panel 8 of Figure 7. The increased lending is not risky as long as the higher annuity (40) is less than the free part of income. What is problematic is the value of the collateral.

The higher valuation of the assets of groups G, H, I, J, K is plausible at best and has not yet passed a market test.

The new deposits are used to increase consumption expenditures. The household sector as a whole dissaves, i.e. $C > Y$ in (48) or $\rho_E > 1$ in (6). An expenditure ratio greater than unity affects the business sector. The amount of additional loans, i.e. 44 money units in Figure 6, is fully spent on the purchase of the nondurable consumption good. Under the condition of market clearing the price goes up and is given, according to (3), (2), (5) and (1), by:

$$P_A^{\star} = \rho_E \frac{W}{R_A}$$
$$\text{if} \quad \rho_X = 1, Y_D = 0 \quad \text{with} \quad \rho_E = 1 + \frac{\Delta \bar{A}}{Y} \quad |t. \tag{57}$$

This demand-induced price hike brings about a redistribution of the nondurable output. The wage income recipients can buy less with their unchanged income at the higher price. The remaining part is absorbed by the dissaving home owners. Profit is, according to (8), now greater than zero and exactly equal to the amount of additional loans. The deposits change hands and move from the household to the business sector where they reappear as retained profit. The price hike lasts, under the condition of market clearing, as long as $\rho_E > 1$, here for simplicity one period, and then returns to its previous level.

Profit follows from (9) in combination with (57):

$$\Delta \bar{Q}_{fiA} \equiv (\rho_E - 1) Y_{WA} \quad |t. \tag{58}$$

Retained profit $\Delta \bar{Q}_{re}$ is defined for the business sector as a whole as the difference between profit and distributed profit in period t:

$$\Delta \bar{Q}_{re} \equiv \Delta \bar{Q}_{fi} - Y_D \quad |t. \tag{59}$$

Since distributed profit Y_D is zero by assumption retained profit is here equal to profit which in turn is equal to the household sector's dissaving, i.e. to $C - Y$. The notional increase of asset values produces ultimately rising deposits of the business sector as shown in Figure 7. Nothing more than plausible valuations produce tangible effects first in the product market and then in the monetary sphere. Rising profits and deposits in turn are suited to animate the flow part of the economy and to boost employment and income. This may even establish a positive feedback loop between the asset market and the consumption goods producing part of the economy. It is important to note, however, that the expansive impulse from the asset market is only transmitted as long as $\rho_E > 1$. The household sector's net financial position vis-à-vis the business sector in (56) is now negative according to (10).

4.3 Primary markets, secondary markets, and parrot economics

> You can make even a parrot into a learned political economist – all he must learn are the two words "supply" and "demand." (Anonymous, in Samuelson, 1973, p. 58)
>
> You cannot teach a parrot to be an economist simply by teaching it to say "supply" and "demand." (Anonymous, in Samuelson and Nordhaus, 2010, p. 83)

We know two things for sure. The i^{th} household commands a free credit line $\Delta\bar{\mathsf{A}}_i$ and has to make up his mind whether she is interested in the asset in question or not. The household's valuation price B_{Bi} is situated somewhere between zero and the free credit line. Recall that we have separated savers and dissavers and that only the latter can be asset buyers. Hence, as a first approximation, there must be a behavioral relation of the kind:

$$\begin{aligned} B_{Bi} &= \pi_{Bi}\Delta\bar{\mathsf{A}}_i \\ \text{with} \quad 0 &\leq \pi_{Bi} \leq 1 \quad |t. \end{aligned} \tag{60}$$

When we say π stands for a mixture of preference, sentiment, expectation and speculation this sounds plausible, but on second thought it explains not too much. The credit line is objective and the household's valuation price B_{Bi} is something that may be observable in an auction but, ultimately, π stands as a placeholder for something we know next to nothing about. We could interpret the π-index as somehow connected with marginal utility but this would not really help much. Rather to the contrary, this notion is, as the history of economic thought testifies, only an invitation to pointless verbiage. Marshall's blackberry picker is a paradigmatic case in point. The boy equates the marginal utility of berries with the marginal disutility of picking (2009, p. 276). This statement sounds like an explanation but no one could ever answer the straightforward question how many minutes the optimal berry picking lasts. Hence it should be obvious that π has to be cut free of all utility and equilibrium connotations. For an outside observer π is a random variable, a placeholder for the purely subjective element in the process of asset price formation.

With regard the second determinant of (60) other restrictions than the free credit line may on occasion move to the foreground. To recall: for our initial case (29) the maximum valuation price cannot be higher than the saving of group F:

$$\begin{aligned} B_{Bi} &= \pi_{Bi}\Delta\bar{S}_{fiF} \\ \text{with} \quad 0 &\leq \pi_{Bi} \leq 1 \quad |t. \end{aligned} \tag{61}$$

This restriction is removed if we allow for $\rho_E > 1$. There is a fundamental difference between the regimes of (60) and (61). The condition $\rho_E = 1$ isolates the the primary market from the secondary market and this makes a huge difference for the stability of the whole system. The individual borrower cannot discern a difference in the types of credit between (60) and (61) and has no idea of whether the overall expenditure ratio is unity or greater than unity.

It is finally assumed that the seller of the asset accepts the highest of all individual valuation prices (above some reservation price). The objective market price is then given by the behavioral relation:

$$P_B = max\left[B_{Bi}\right] \quad i = 1, \ldots, n \quad |t. \tag{62}$$

There is no need to go deeper here into practical details. The crucial point is that we have two different modes of price determination for two different types of markets.

The primary or flow market is elementary and indispensable. It is a constituent part of an economy where the business sector produces a nondurable consumption good and where the household sector buys and consumes this good in the period under consideration. That the stock of products is exactly zero at period end is, of course, an idealization. The price of the nondurable consumption good follows in direct lineage from the axioms and definitions as:

$$\begin{gathered} P_A = \frac{\rho_E}{\rho_X}\frac{W}{R}\left(1 + \frac{Y_D}{WL}\right) \\ \text{i.e.} \\ P_A^* = \frac{W}{R} \quad \text{if} \quad \rho_X = 1, \rho_E = 1, Y_D = 0 \quad |t. \end{gathered} \tag{63}$$

Under the conditions of market clearing, budget balancing, and zero distributed profit the price is, for an elementary beginning, equal to unit wage costs with the wage rate given as nominal numéraire. The market clearing price P_A^* is objectively determined by structural conditions. The vacuous explanation by means of supply and demand curves (that depend on indefensible behavioral assumptions) and occult market forces (that establish the nonentity equilibrium) has to be rejected as superfluous and misleading.

In the secondary market durables are bought and sold long after they have been produced and sold for the first time. Under the simplifying assumption that the preference indicator π_{Bi} is unity for all households the asset price is equal to the largest free credit line that in turn is given with (46):

$$\begin{gathered} P_B = max\left[B_{Bi}\right] \quad \Rightarrow \quad P_B = max\left[\Delta\bar{\mathrm{A}}_i\right] \\ \text{if all} \quad \pi_{Bi} = 1 \quad |t. \end{gathered} \tag{64}$$

While the free credit line is objectively given in period t there is no way to get rid of the purely subjective element π_{Bi} from this price formula (other than by assumption). The price formulas (64) and (63) are evidently different. Asset price determination explicitly presupposes the existence of a banking unit.

The *modus operandi* of price determination is fundamentally different for non-durables and durables. As economies develop asset markets gain in relative importance, that is, they cannot be treated as fringe phenomena (cf. Marshall, 2009, p. 276; Ricardo, 1981, p. 12).

There is no such thing as a generic market. The disqualifying error of standard value theory is to determine the prices in all markets in the same unthinking manner by "supply" and "demand" (see also Benetti and Cartelier, 1997, p. 218 fn. 6). Methodologically, to speak of 'the' market is a blunder of the first order.

5 Re-evaluation of values

5.1 Best case

Let us take up the thread at the column End value$_2$ in Figure 6 and first consider a possible benign sequence of events. To begin with, it is assumed that the business sector moves its retained profits from current deposits to interest bearing savings accounts, such that the term structure of the banking unit's assets and liabilities is perfectly congruent. Hence there is no term leverage and no refinancing risk. The bank's demeanor is impeccable. Second, groups G, H, I, J, K all sell their houses at the actual valuation price $P_B = 4$ and fully pay back their loans. The notional appreciation of Section 4.2 is thereby *ex post* vindicated. The free lunch is *de facto* paid for by the next buyer. The change of ownership does not change the balance sheet of the central bank. It is assumed that the new borrowers have the same credit quality as the old and that they inherit the contracts from the previous borrowers. Nothing more than the name tags on the loans change. The asset's price remains constant. The configuration at the beginning of period$_9$ in Figure 7 is reproducible in principle for an indefinite time span. The quadrupled price is firmly established and accepted as market price.

5.2 Worst case

The less benign scenario runs as follows. By attentively watching the market, the banking unit learns in the course of period$_9$ that potential next buyers have changed their minds, for whatever reason. That is, the π-index in (60) is suddenly much lower. It is assumed that potential next buyers are not prepared to pay more than the initial price P_{B2} of (21). To recall, this price covered exactly the unit wage costs at the original wage rate and productivity. At first, the drop of the valuation price B_{B9} has no visible effect because the present owners pay their annuities as before. The implicit deterioration of the collateral's value cannot be read off the banking unit's balance sheet. Troubles arise not before the first owner is effectively forced to sell at the reduced valuation price, which thereby becomes a market price.

Analytically we have two steps. First, the depreciation of 75 percent of the asset's value in (51) effects a drop of the value of durables in (56). The household sector's net worth declines. In the triangular relation of (56) the value of the asset is

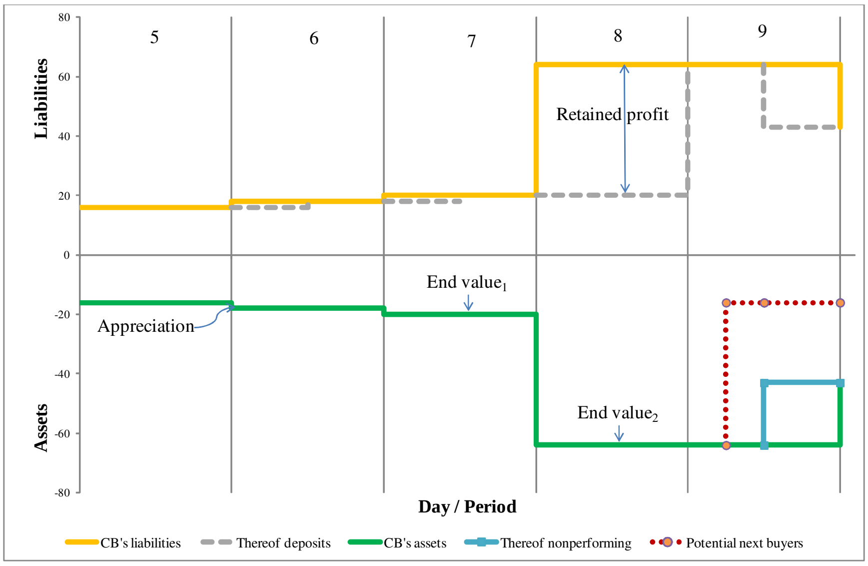


Figure 7: Development of the central bank's balance sheet (turn 90° clockwise) with daily transactions left out (refers to Figure 6)

now lower than the original amount of the loan, in other words, home equity turns negative (FCIC, 2011, p. 404). Selling at the lower price makes it impossible for the selling household to pay back the full amount of the loan. Seen from the banking unit, the previous owner defaults. The amount of performing loans in the bank's balance sheet goes down and the amount of nonperforming loans goes up by the same amount as shown in Figure 7.

A drop of the valuation price has no visible effect as long as the present house owners can pay their contractual annuity. If the original financing was sound, that is, in accordance with (46), we will see the normal rate of defaults due to a deterioration of the individual income situation and the like. Let us assume instead that it turns out that 40 percent of the original financing has been unsound then the stock of performing loans falls about 30 percent. For a commercial bank with a Basel capital ratio this would be too much to swallow. Because of the interconnectedness of banks the default of one bank has always a good chance of kicking off a chain reaction. That is well-known old stuff. Two factors are crucial: the magnitude of the drop of the valuation price and the fraction of affected loans (Mill, 2006a, p. 541).

Unlike a commercial bank the central bank cannot in turn default on its savings accounts and thereby symmetrically shorten the balance sheet in Figure 7 which is part of (56). The central bank has at first to keep the nonperforming loans on the books to maintain the equality of assets and liabilities. However, with the shrinking stock of performing loans the qualitative deterioration of the asset side is visible to the naked eye. The gradual reduction of loans is not a sign of a credit crunch but due to the replacement of bigger loans by smaller ones that comes with the re-evaluation of assets (Koo, 2009, p. 109). As the value of assets falls the nominal demand of the new owners for loans shrinks.

The dwindling of performing loans poses an immediate problem. The banking unit has to pay interests on savings accounts but does no longer get the corresponding interests on loans in (37). If profit was previously zero the banking unit now faces a loss. It is assumed that the banking unit replaces savings accounts by current deposits which bear no interest. This monetization of the liability side helps to restore both the term structure and profitability. It does not solve the underlying problem. However, as a side effect the income distribution changes with falling rentier income.

Period_9 in Figure 7 reflects the assumption that the whole stock of interest bearing loans is reduced by borrowers' defaults in the relation of 3:2. One option is to cultivate the hope that potential next buyers will be prepared to pay higher prices in the near future. If this hope comes true the asset side of the banking unit's balance sheet can eventually be repaired.

The worst case outcome is a monetary reform, and that means that current deposits, i.e. money proper, and savings accounts at the central bank have also to be reduced in the relation 3:2 as shown on the right hand side of Figure 7. In this case the business and household sector's current deposits and savings accounts are reduced corresponding to the loss of the assets values. When we have commercial banks as intermediaries between the central bank and the households roughly the same effect is achieved by bank defaults. Needless to emphasize that those who see their deposits and savings accounts evaporate are innocent bystanders. There exists no causal or moral connection between individual 'sowing' and 'reaping' (cf. FCIC, 2011, p. xx). The defining characteristic of the banking system is that it disconnects the direct lender–borrower relationship. In the limiting case of full asset financing the liability side of the central bank is the mirror image of aggregate subjective asset valuations. As these values evaporate, money evaporates.

5.3 Ascending criticality

It is important to note that in the foregoing chain of events unsound financing played a role but that this is ultimately not the fatal factor. If there is a new buyer at the unchanged price who can serve the loan the *ex post* substitution of borrowers heals all previous mistakes. It is the deterioration of subjective valuations of potential next buyers that is decisive. The pivotal equation is:

$$\begin{aligned} B_{Bi} &= \pi_{Bi}\Delta\bar{\mathsf{A}}_i \\ \text{with} \quad 0 &\leq \pi_{Bi} \leq 1 \quad |t. \end{aligned} \tag{65}$$

Ultimately, the vector of valuation prices B_{Bi} determines the course of events (the case of an outright credit crunch with $\Delta\bar{\mathsf{A}}_i = 0$ excluded). All depends on whether there are able ($\Delta\bar{\mathsf{A}}_i$) and willing (π_{Bi}) potential next buyers. Generally speaking, a low rate of interest, an unequal income distribution and a contractual annuity of zero in (46) in combination with a strong π-index for the respective asset in (65) make a favorable setup for a rising price. But the increase of an asset price as such is not sufficient for a bubble.

Basically, changes of asset values in both directions are a quite normal phenomenon. The π-index is a rather fickle variable. Free lunches and defaults as their counterpart are therefore commonplace.

The dangers grow with dimension, i.e. with the magnitude of valuation swings as given by (65) and with the fraction of the stock of loans that is affected by downswings (FCIC, 2011, p. 446). That fraction in turn may be influenced by violations of simple banking rules, leverage, a deficient legal and institutional framework, failure of rating agencies, wrong incentives, deception, self-deception, fraud, and the length of time of the mutual reinforcement of these factors. It is the amplifiers that make any humdrum bubble dangerous. For the pure bubble, the crucial factors are changes of the subjective valuation that are expressed by the π-index in (65) and the availability of credit (cf. Mill, 2006a, pp. 540-544). The index allows for self-reinforcement over time.

It is – in principle – possible that the flow part of the economy and the primary market remain unaffected by re-evaluations in the secondary market. The formal condition is that the overall expenditure ratio ρ_E does not for a moment depart from unity. The contagion sets in as soon as the household sector as a whole answers to the conditions in the asset market either with dissaving, i.e. $\rho_E > 1$, or with saving and paying off debt (Koo, 2009, p. 103), (Kakarot-Handtke, 2012, Sec. 5.4), i.e. with $\rho_E < 1$.

For the theory of value (65) implies that there is no such thing as an intrinsic asset value. It all depends on the existence of a potential next buyer. In this sense any asset price becomes a bubble.

6 Conclusion

Standard economics is known to be incapable of integrating the real and the monetary sphere. The ultimate reason is that the whole theoretical edifice is built upon a set of behavioral axioms. Since this cannot work for several reasons the formal starting point is in the present paper moved to structural axioms. This makes it possible to formally track the complete process of value creation and destruction in the asset market and its consequences for the household and business sector. The set of structural axioms produces the well-known phenomena of a bubble from free lunches through appreciation to defaults due to a lack of potential next buyers. The free credit lines and the subjective π-indexes of the the potential next buyers ultimately determine the development of an asset's price. The process of price formation in the secondary market is fundamentally different from that in the primary market. This has major consequences for the theory of value.

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