Is the Financial System A Slow-Motion Ponzi Scheme?

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Abstract: Charles Ponzi (1882-1949) was an Italian immigrant in the US and one of the greatest swindlers and deceivers of American history. His fraud is known under the term "Ponzi Scheme". Charles Ponzi's "fame" as a fraudster is still not faded: Customers who had invested 150 million dollars after today's monetary value were bogged about their assets. The basic method of such financial fraud is, in principle, always the same: the returns of the old depositors are served from the deposits of new investors. This works as long as there are enough new investors and only a few old investors reclaim their capital. Otherwise, the financing model collapses.

The question if the world financial system is also a fundamental Ponzi scheme is discussed controversial. Based on mechanical theory and official data analysis we but will show that it is indeed such a scheme. However, it runs relatively slowly in comparison to such fraud. Slow enough and over about two generations, so it is less conspicuous.

How Does Growth Develop in an Economy?

The question of why a modern economy is growing at all is contentious. Of course, population growth plays a role in this, as more people consume more goods and thereby directly economic force growth. But even stable population numbers do not change this. They also grow, at least as long as there is no fundamental economic crisis. What is the reason?

[1] Ifara: The Institute for Applied Risk Management is a non-profit, non-partisan, independently funded and interdisciplinary research organization devoted to serving the public. By means of a research-based approach IFARA generates viable, effective public policy responses to important economic problems and financial interdependencies that profoundly can affect our society. The author is Physicist, Economist and Scientific Consultant of IFARA; Contact Email: heribert.genreith@t-online.de

Growth is very much linked to finance. In highly developed societies, the amount of credit in the economy is generally higher than GDP. In Germany, the loan sum reached nearly 150% of GDP at its peak. This means that the complete GDP must be re-implemented on a credit basis every 8 months. Obviously, the growth constraints are linked to the operation of the loans. These must not only be repaid but in addition also the required returns must be paid.

As we have shown in several publications [Peetz and Genreith (2011), Genreith (2014) & Genreith (2016)], the growth is to be calculated with high accuracy by a simple mechanical model based solely on the interaction of the real economy with the financial economy. The basic equations of growth can be easily deduced by means of classical mechanics. For further understanding, we will elucidate these by means of simple accounting methods and demonstrate some compelling conclusions.

Basic Principle of Capital-Driven Growth

As we have already shown[2], the evolution of the macro-economy is essentially calculable by the pure mechanics of the money system. The following illustration is intended to clarify this again with the help of simple accounting [table 1]. Let us first take a credit without interest. For the sake of simplicity, we use only simple accounting instead of the usual double-entry book-keeping (assets and liabilities):

Table 1: Exchange of credit without interests

Central Bank	**Bank**	**Consumer**	**Entrepreneur**	**Economy**	***Sum***	**Remarks**
Finance	Finance	**GDP**	**GDP**	**GDP (Bulk)**		
0	0	0	0	1000	*1000*	Start Values
-100	**100**	0	0	1000	*1000*	Bank Takes Credit/Money from Central Bank

[2] Eg in recent publication - Genreith (2016) in Journal of Social Business, Vol. 6, No. 2 & 3, 2016. For full theory, see Genreith (2014).

-100	0	**100**	0	1000	*1000*	Bank Hands out Credit to Consumers
-100	0	0	**100**	1000	*1000*	Consumer Hands out Money to Entrepreneur e.g. House Builder
-100	0	0	0	**1100**	*1000*	Entrepreneur Buys Goods and Services
-100	0	**100**	0	1000	*1000*	Consumer Works for Repayment
-100	**100**	0	0	1000	*1000*	Consumer Repays to Bank
0	0	0	0	1000	*1000*	Bank Repays to Central Bank

Money firstly is created through borrowing. It is however destroyed again on repayment. The sum in the system always remains zero. This, however, contradicts the economic experience that in the economies, real money accumulates in the course of time which today can be three to five times the value of GDP[3]. Now we make the same game taking the interest rate into account [table 2]. We assume that the bank takes 7% interest and the central bank calculates 3% interest:

[3] In 1950 Germany had a ratio of total assets to GDP of just 38%. End of year 1966 it reached 102% and finally climbed to 335% in 2010. See also e.g. Fig. 2 in this article.

Table 2: Exchange of credit with interests

Central Bank	**Bank**	**Consumer**	**Entrepreneur**	**Economy**	*Sum*	**Remarks**
Finance	Finance	**GDP**	**GDP**	**GDP (Bulk)**		
0	0	0	0	1000	*1000*	Start Values
-100	**100**	0	0	1000	*1000*	Bank Takes Credit/Money from Central Bank
-100	0	**100**	0	1000	*1000*	Bank Hands out Credit to Consumers
-100	0	0	**100**	1000	*1000*	Consumer Hands out Money to Entrepreneur, e.g. House Builder
-100	0	0	0	**1100**	*1000*	Entrepreneur Buys Goods and Services
-100	0	**110**	0	**990**	*1000*	Consumer Works for Repayment
-100	**110**	0	0	990	*1000*	Consumer Repays to Bank
3	**7**	0	0	990	*1000*	Bank Repays to Central Bank

At a first view, not much changes. There is also no growth in money $\frac{d}{dt}K = 0$. It can be done thousands of times without changing something in capital. However, the quantity of goods grows $\frac{d}{dt}Y > 0$ at the same time. This would, of course, tend to imply a violent deflation rather than typical inflation.

The problem in this economically usual accounting of money generation and destruction by means of credit is that the real economy ("The Bulk" in tables herein) has to pay for the interest. It does not matter at the macro level who gets these or pays them in detail. It can be the consumer by expanding his work. Or others who have to do this. This is, as

otherwise the mass would become poorer as a result of the credited economic activities. The result is credit-driven growth.

GDP has to grow by the amount of interest if it does not want to degenerate in favour of banks. Differentially this is simply $\frac{d}{dt}Y_i = Interest * Credit$. This happens with every credited trade and thus the sum is

$$\frac{d}{dt}Y = Interest * \sum Credit_i = \alpha \cdot C_{BB} \cdot Y \qquad (0)$$

With α the average interest rate and C_{BB} the percentage part of the economy being credited. The money $C_{BB}Y$ comes and goes from or into the banking system. The bank's credit capital K_C thus also increases[4] $\Delta K_C = C_{BB}Y$ by this value. In differential logic we can write $\Delta K_C \rightarrow \frac{d}{dt}K_C = \alpha \cdot K_C$.

Thus follows the conclusions for the two main macro-economical functions: first $\frac{d}{dt}Y = \alpha K_C$ (A) for the growth of the GDP. But also the capital on the banks grows by this amount after simple accounting logic $\frac{d}{dt}K = \alpha K_C$ (B).

However, there is still a lack of time dependency in this calculation: for during the borrowing the credited money is missing in the banking system. And after the repayment it is missing in the GDP. In sum, however, it is always zero (like shown in the tables). In differential logics this must be taken into account by an appropriate sign convention in (A) and (B):

$$\frac{d}{dt}Y = \alpha K_C \qquad (1a)$$

$$\frac{d}{dt}K_C = -\alpha K_C \qquad (1b)$$

[4] Money creation is done by Central Bank's refinancing facilities. This is as every trade, and also financial products may be refinanced by central banks credits.

Now we consider another basic banking business [table 3]: trading in debt products, like bonds, shares, insurance and derivatives of all kinds. Trading financial products is not fundamentally different from trading products in the real economy, except in some small but important details.

Table 3: Exchange of debt products

Central Bank	**Bank 1**	**Bank 2**	**Consumer**	**Economy**	*Sum*	**Remarks**
Finance	Finance	Finance	**GDP (Part of Bulk)**	**GDP (Bulk)**		
0	0	0	0	1000	*1000*	Start Values
-100	**100**	0	0	1000	*1000*	Bank Takes Credit/Money from Central Bank for Some Bond
3	**7**	**-5**	0	1000	*1000*	Bank Sells Bond with 5% Win and Repays Central Bank
3	7	**5**	**-10**	**990**	*1000*	Bank Finds Consumer for Debt Product with Win 5%

The exact details of such investment transactions are very different depending on the special product, and must not be shown here in every thinkable variation. What but is common to all such financial business, however, is that the banks at the end of the chain must find a buyer for their products outside the banking system in order not to lose themselves permanently. This is, as after the last move for GDP in table 3, there is once again the growth constraint by the amount of the interest earned. Macro-economically and mathematically the most significant difference in these transactions is the zero time lapse: the interest rates of these products are immediately paid within the sale. There is no time delay on the return of interests.

Let's call these products K_D . Then, of course, the growth $\frac{d}{dt}K_D = \beta K_D$ of the debt products applies. The balance sheet total of the banks now contains both shares, that is, $K = K_C + K_D$.

So it rules

$$\frac{d}{dt}K = \beta K_D - \alpha K_C \quad \text{(2a)}$$

and for balance directly follows

$$\frac{d}{dt}Y = \alpha K_C - \beta K_D \quad \text{(2b).}$$

The total effect of interest rates (α, β) can be summarized in a net transaction rate p_n of the banks (see p. 8-10, Genreith, 2014).

In addition, there are still shares which do not come from direct financial market trading. These are, in particular, firstly the reserves of the savers with rate p_S and secondly the population growth p_B, which is accompanied by increased consumption and thus additional GDP growth. Furthermore, exogenous capital flows can be important. These exogenous[5] flows are taken into account in the additional terms (a_0, b_0). Thus we arrive at the basic equations of MFT Accounting:

$$\frac{d}{dt}Y = b_0 + p_B Y - p_n K \quad \text{and} \quad \frac{d}{dt}K = a_0 + p_S Y + p_n K \quad \text{(3)}$$

The integration of these equations now provides the actual evolution of GDP and banking capital with high accuracy ([Peetz and Genreith 2011, Genreith 2014 & Genreith 2016).

Conclusions for the Macro-Economy and Comparison with Official Data

[5] Such are all flows which are not caused by internal exchange of money and credit. Examples are capital and interests from abroad (net flow from in- and outflows) but also money creation from central banks through self buying of state bonds etc. Also not credited growth plays some role in the beginning of a financial economy, this is, growth stemming from work force and still existing resources alone. Since financialisation is but completed in Germany since 1966 with an assets to GDP ratio of more than 100% this part of non-credited GDP can be omitted. If needed it must be accounted for with an additional term $\gamma \cdot L \approx \phi \cdot M_0$. This means some percentage γ of the labour force L which can be assumed to be approximatly some percentage ϕ of cash M_0 circulating in the economy.

Similar to the classic Ponzi scheme, we must ask "*who pays the bill*" for interest. Where do they come from in the economy as a whole?

We may analyze the fundamental differential equations (3) for their meaning on interest payments in society. Then we will compare them with the actual figures in an economy. To this end, we first solve the basic equations of the capital-driven economy according to the growth rates of capital. It holds according to the first equation $p_n K = b_0 + p_B Y - \frac{d}{dt} Y$ and thus it follows for the capital gains:

$$\frac{d}{dt} K = (a_0 + b_0) + (p_S + p_B) Y - \frac{d}{dt} Y \qquad (4)$$

Thus, for the growth[6] of capital, the following applies[7] in the order of the above terms in simple words:

Capital gains = (Exogenous Capital Flows) + (Peoples Savings + Population Growth) – GDP Growth

It tells that annual interests have to be served from three possible annual sources: (I) exogenous money flows, (II) savings and (III) population growth. GDP growth (IV) itself appears as a sink, as it is seemingly a burden capital has to serve for.

We now examine official data in the context of Germany.

First, we must bear in mind that the data measured by the Bundesbank for

[6] The term *d/dt K* is the (annual) change in Capital of the entire economy, thus (*d/dt K)/K* is the average interests of macro-economic financial business over all. It is different from interests in special (micro-economic) debt products, which may differ from this value depending typically on the rules of supply and demand for the individual debt instrument.

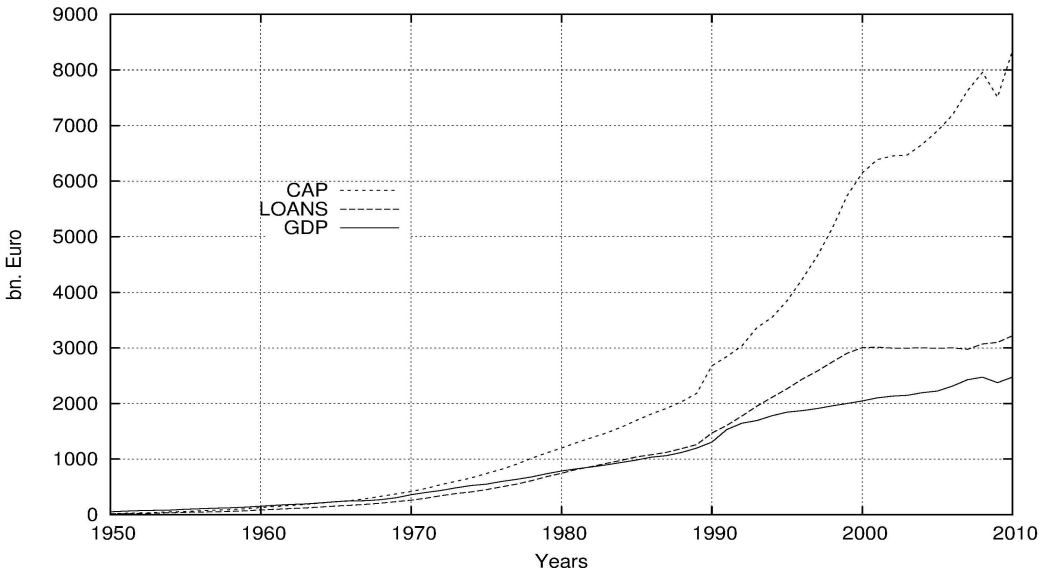
[7] In a closed economy without population growth this is $\frac{d}{dt} K = p_S Y - \frac{d}{dt} Y$ or in words $\Delta K = PeoplesSavings - GDPGrowth$. We can also express this equation (4) directly as an expression of the average effective rate p_a of interest: $p_a = \frac{1}{K}\left[(a_0 + b_0) + (p_S + p_B) Y - \frac{d}{dt} Y \right]$. For the sake of simplicity and intelligibility, however, we can better use the absolute amounts $\frac{d}{dt} K$ of interests for the following comparisons.

the Banks total balance sheet have included exogenous, i.e. foreign capital inflow, already in their sum. It now follows from (4)

$$a_0 \approx (a_0 + b_0) = \frac{d}{dt}(K + Y) - (p_S + p_B)Y \qquad (6)$$

as a determinative equation for exogenous capital. The term b_0 can be omitted in nearly all cases, as it would be exogenous donations to the GDP. Such not-paid-for donations may be important in the case of weak and developing economies.

With the knowledge of the theoretical groundwork, we can now examine



and analyze the official economic data according to these variables. We use the data of the Deutsche Bundesbank, which is particularly good in international comparison, since this also leads the most important total banks Balance Sheets.

Fig 1: Official Data of FRG from Bundesbank (a) Short-dotted Line Top: Total Banks Balance Sheet (b) Long-dotted Line Middle: Credit (loans) to the Real Economy (non-financial firms and consumers) (c) Solid Line: GDP of Germany

In the first graph we see the general situation for Germany. As both GDP and Capital (total banks balance sheet) grew steadily over time. Capital growth was much stronger than GDP Growth. Growth in Credit

(Loans) was much more linked to GDP, but also grew stronger over time. In the end it stagnated.

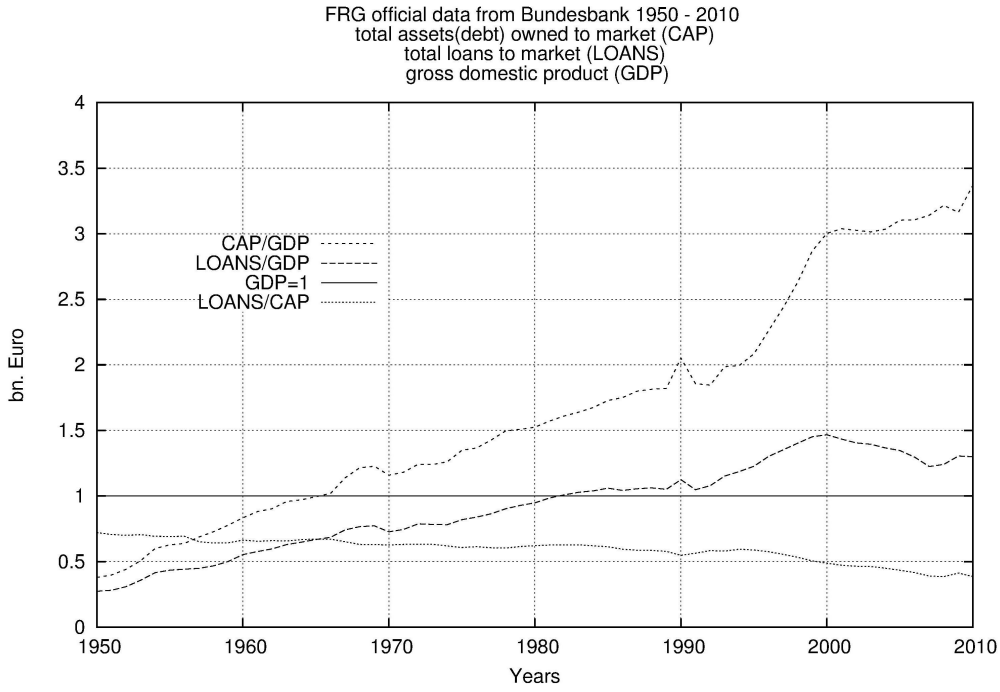


Fig 2: The same data as in Fig 1 normalized to GDP = 1 (straight solid line): (a) Short-dotted Line Top: Total Banks Balance Sheet in Relation to GDP (b) Long-dotted Line Middle: Credit (loans) to the Real Economy (non-financial firms and consumers) and (c) Ultrafine Dotted Line Bottom: The Relation of Commercial and Retail Banking (LOANS) to the Total Banks Balance Sheet

In Fig. 2 we see the evolution normalized to GDP=1. At the year 1967 we see the fact that Credit (loans) began to exceed the GDP. From this time the economy changed from a labour driven to a financial driven economy, as now virtually every trade and investment was fully credited. In Germany, the credit sum reached nearly 150% of GDP at its peak in 2000. This means that GDP had to be re-implemented on a credit basis every 8 months. Such a general evolution one may see in other countries data too. The bottom line is the ratio of Commercial and retail banking (CBB) to the total capital. With the start of the financial crises around the year 2000 (DotCom bubble), the share of loans fell below the 50% mark. From then on, BoB Investment banking has become the strongest force in the financial economy.

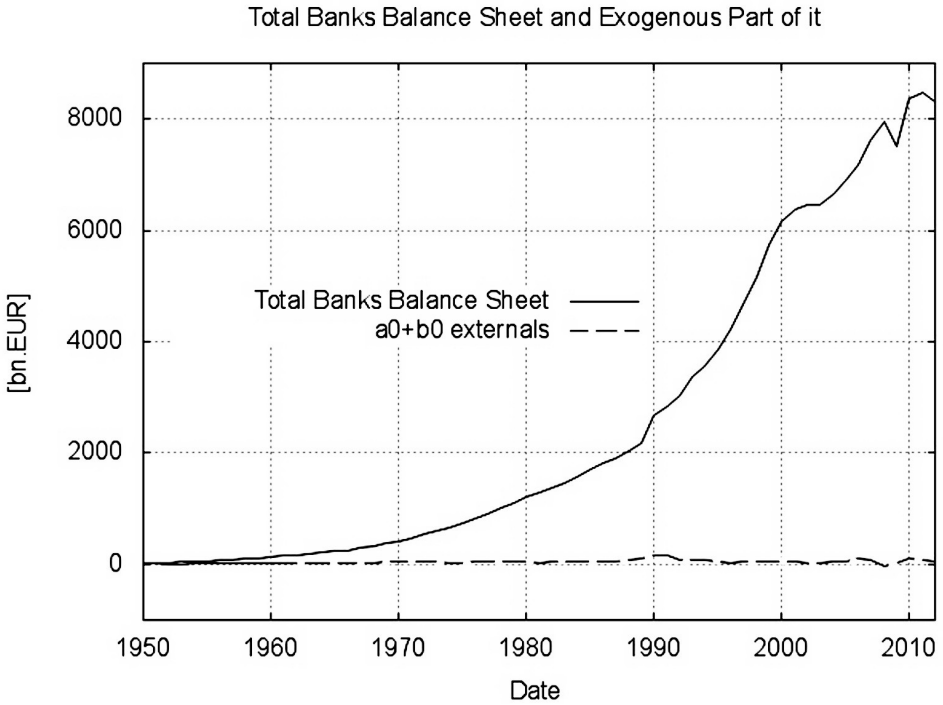


Fig 3: (a) Top Solid Line: Total Banks Balance Sheet of the National Economy (b) Dotted Line: Exogenous Part of the Total Banks Balance Sheet

First we will look for the part (I) of the interest equation (4). This is exogenous money flow. Exogenous money will be defined as every money or money worth GDP flows, which are not accompanied by a direct financial trade within GDP. Examples are foreign money in- or outflows into Banks own Business (BoB, so called Investment banking). Other example is self-buying of state bonds by central banks, also bail-outs of banks assets by central banks. On a first view such exogenous money is not very much in absolute terms [fig. 3].

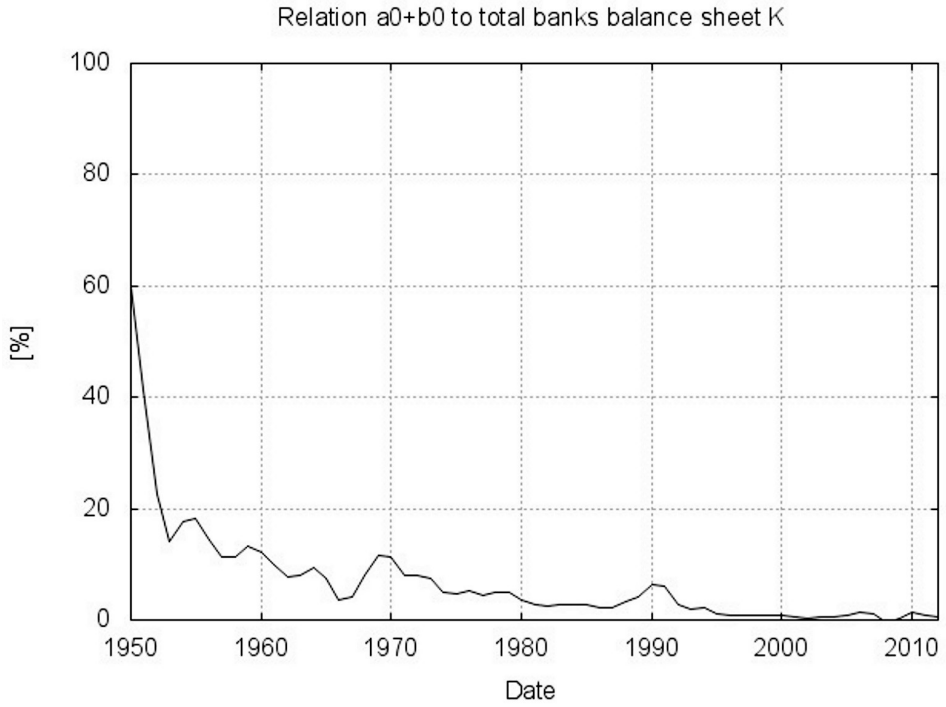


Fig 4: Relation of the Exogenous Money in Comparison to the Nations Total Balance sheet

But put into relation to the normalized Capital *K=1* we see [fig. 4] that it played a formidable role especially at the beginning of the German economy. This is due to the fact that after the Second World War the economy started from point zero in money and GDP as well. A lot of growth was done by not-credited entrepreneurship. Also there were a lot of donations in money and GDP goods as well from abroad, especially the USA (e.g. by the Marshall Plan and others).

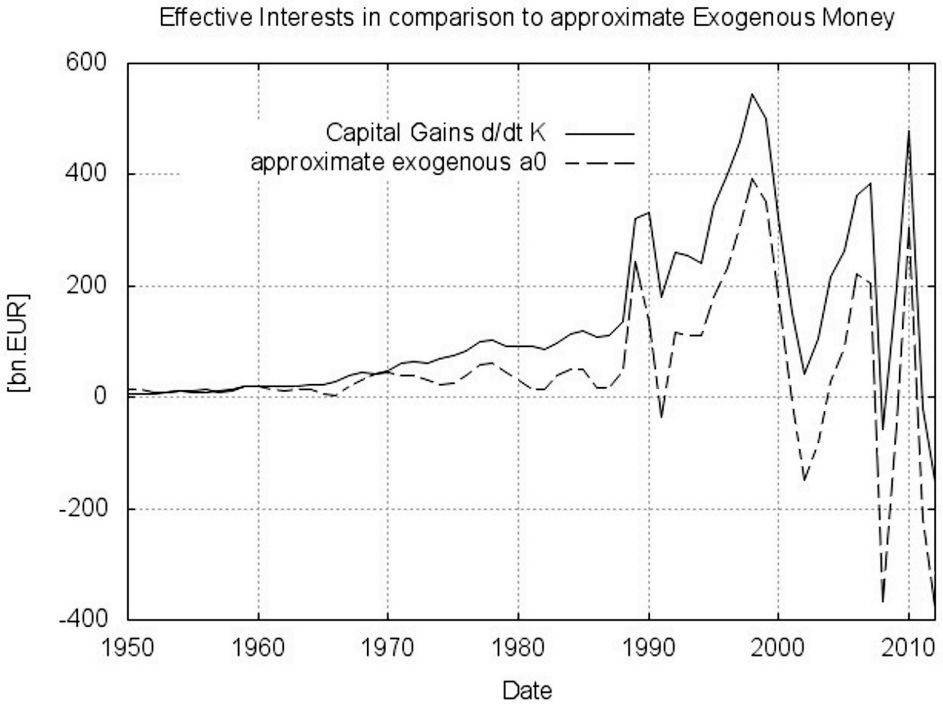


Fig 5: (a) The Effective Interest $\frac{d}{dt}K$ (solid line) in comparison to (b) the approximate Exogenous Money a_0 (dotted line)

If we look at the relation [fig. 5] between such exogenous[8] influences in comparison with the growth[9] in capital we see that at the beginning it was sufficient but in the mid terms it was by far not. In the later times of financial crisis but it stems a lot of the interests burden again.

[8] Remark: The net influx a0 can be less than zero, which then means an outflow.

[9] Differentials like $\frac{d}{dt}K$ are mathematically Operators, not the usual (abelian) numbers. They but can be approximated at first order simply by finite differences $\frac{d}{dt}K \approx K(t) - K(t-1)$ when based on 1 year steps. Such finite differences can be used in Spreadsheet calculations easily for econometric comparison with official data.

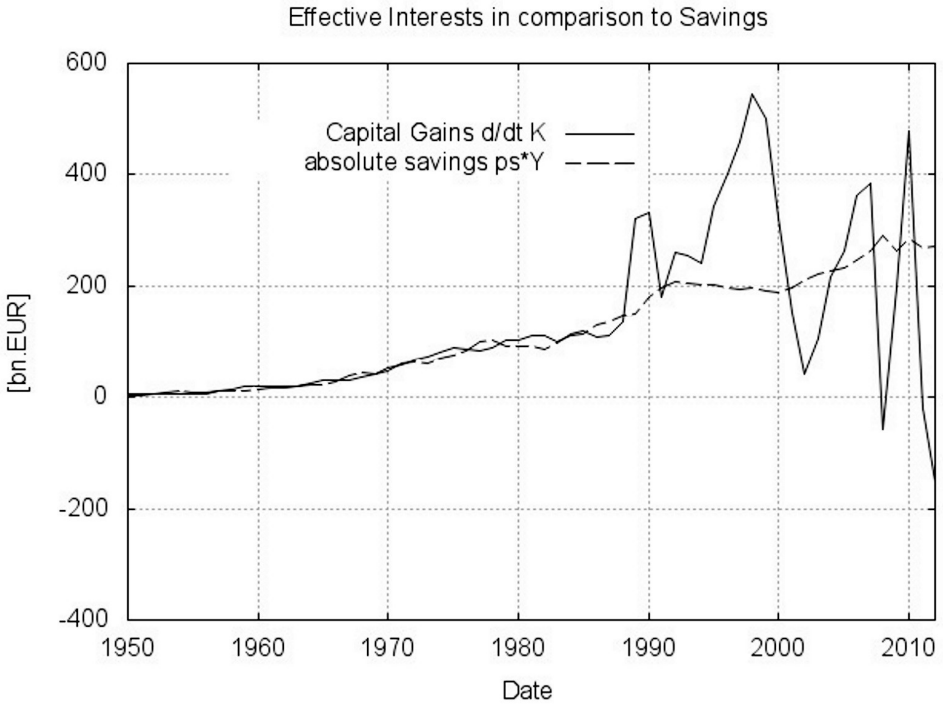


Fig 6: (a) The Effective Interests $\frac{d}{dt}K$ (solid line) in comparison to (b) Savings $p_S Y$ (dotted line)

The main part over all times but is the people's savings rate [fig. 6], which pays for the interests (part II of equation (4)). The peak around 1990 comes from the naturalization of the GDR into the Federal Republic of Germany. This was linked to creating new money for more than 13 million people. However, with the onset of global financial crises, the system comes completely out of line. The DotCom-bubble and its bursting around the year 2000 as well as the Lehman crisis and the associated financial bubble leave their traces. Because of exponentially increased finances, the savings rate can no longer keep up with the slower growth of GDP. Instead, the state increasingly needs to fill the gap with exogenously generated money.

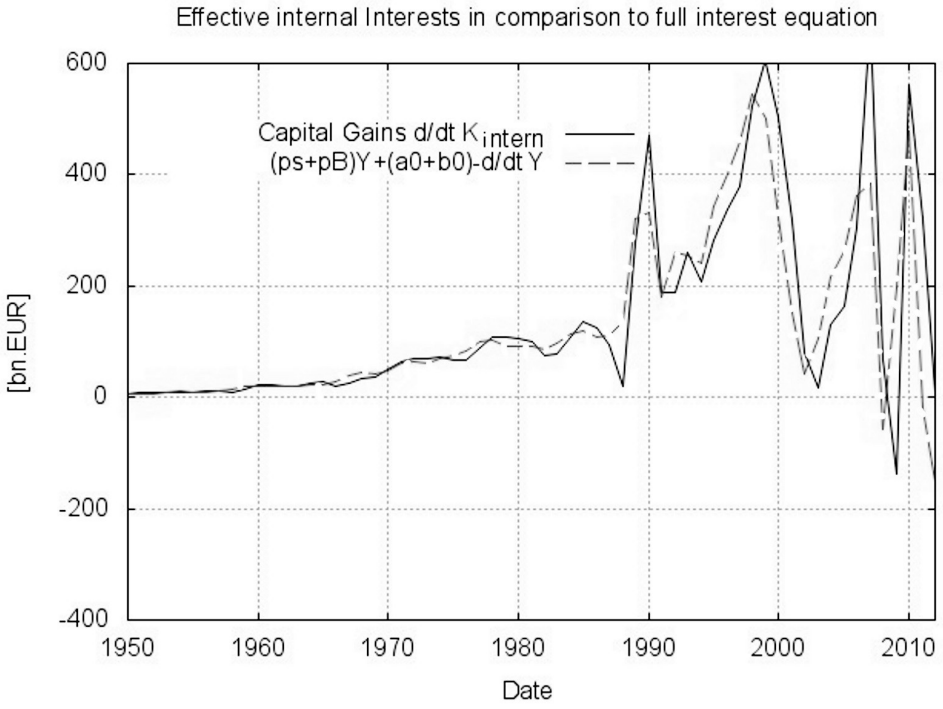


Fig 7: (a) The Effective Interests $\frac{d}{dt}K_{intern}$ of the Internal Capital without Exogenous Money (solid line) in comparison to (b) the Full Interests Equation $(p_S + p_B)Y + (a_0 + b_0) - \frac{d}{dt}Y$ (dotted line)

Only when we integrate these exogenous finances into the complete equation [fig. 7] for the interest load we get the agreement. Population growth here has also been taken into account, but this was almost very low for Germany as a rule.

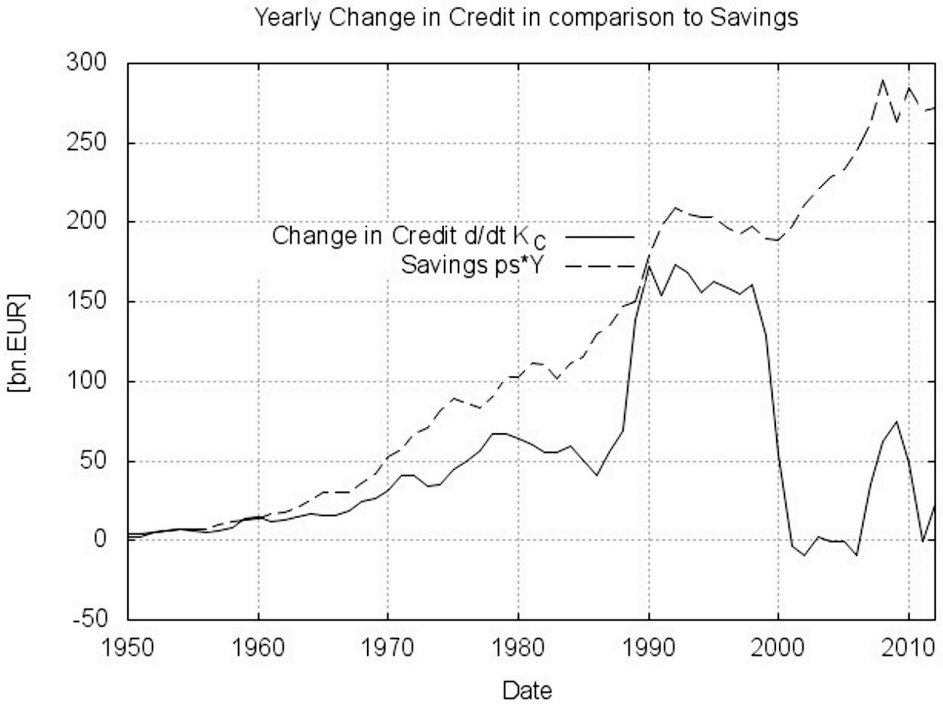


Fig 8: (a) The Yearly Change in Credit (Loans) $\frac{d}{dt}K_C$ (solid line) in comparison to (b) Savings $p_S Y$ (dotted line)

Finally, we briefly consider the relationship between the savings rate and the credits in the macro economy [fig. 8]. These loans are the amount of capital which, if at all, is used in classical mathematical models of economics. This is by no means sufficient for a consistent study of an economy, because the enormously important interaction of the complete financial economy with the real economy can not be modeled. In such an incomplete view one can see that the savings rate would still be sufficient to meet the capital interests. This is, however, a fallacy as the Banks own business much higher demand for interest rates is not considered.

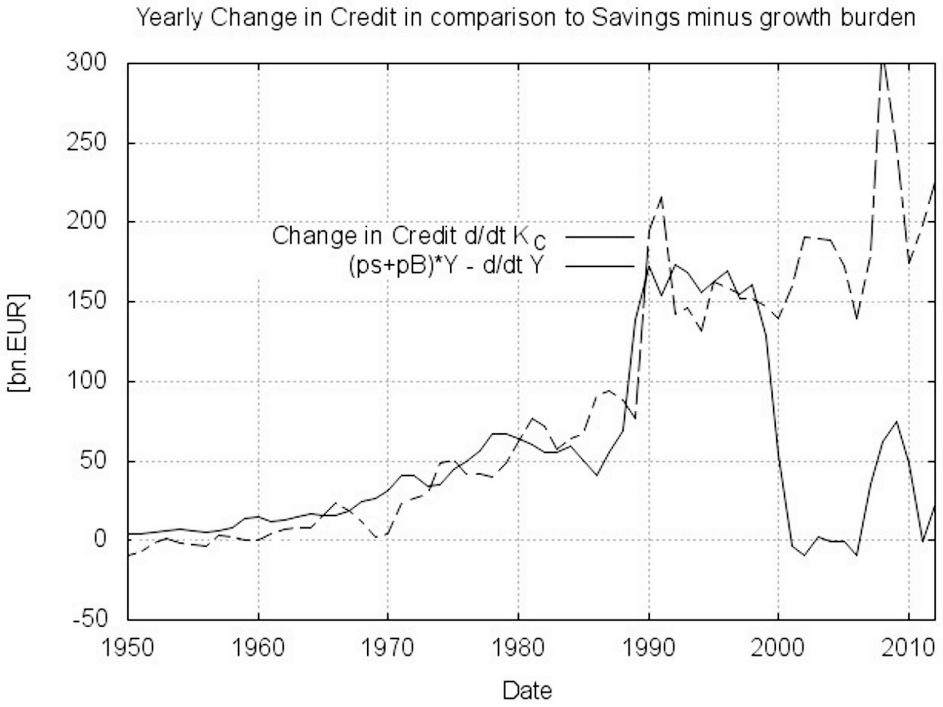


Fig 9: (a) The Yearly Change in Credit (Loans) $\frac{d}{dt}K_C$ (solid line) in comparison to (b) Savings $(p_S + p_B)Y - \frac{d}{dt}Y$ (dotted line)

A more detailed picture emerges [fig. 9] when we include the burden of capital $-\frac{d}{dt}Y$ on GDP growth. Now we see that the savings ratio essentially provides interest on the loans. Until the crises of the year 2000, the system is now in line. Although the savings $(p_S + p_B)Y \approx p_S Y$ could still finance the loans, they but break-down after the year 2000. The effect is due to the fact that, because of the final stage of financialization, all new financial sources are needed only for the satisfaction of the Banks own Business. The GDP itself and particularly its growth are already tending towards zero. This, however, makes the braking term $-d/dtY \approx 0$ zero. Thereby further accelerating the growth of the total capital. The disappointing growth also makes any investment in the real economy uninteresting, which in turn brings the recession into the economy. This

means that the yield crisis then has finally reached the real economy.

Conclusions

From the analysis of the financial mechanics of interest rates and the comparison with the official data of Germany, it is clear that an adequate savings rate is essential for the generation of the interest rate. The very low population growth, especially for Germany, can contribute almost nothing[10]. However, with the onset of the financial crisis, the savings rate alone is no longer sufficient to finance the interest burden.

The growing shortfall in interest rates and compound-interest must then be offset by exogenous money. These may be foreign investors who pump their money into the battered financial economy and thus effectively, without knowing it, finance the interest at least temporarily. However, interest payments in the macro-economic effect are ultimately made at the end stage by the state, as the central bank balances are expanded accordingly. Such measures are e.g. self-raising of government bonds, the purchase or refinancing of bad assets of the banks or the rescue packages for bankrupt institutions. All quantitative easing strategies must ultimately replace the missing new savings deposits of economic operators as the main source of interest financing.

Over all, interest is borne out of the respective new deposits[11] on the banks. Only the slowness of this process over many decades obscures the fact that we are dealing with a typical Ponzi scheme in principle. This means that interest will be paid from the annual new deposits, and it is hoped that the mass of the participants will not take their speculative money out of the system, for example, to buy for rather real goods.

Since in financially high developed countries new deposits are no longer sufficient, one must wonder how long this Ponzi scheme will function. This is crucially dependent on the question of how long the state is willing and capable of jumping in for the missing interests. However, the burden on GDP and thus on politics, is therefore increasing as well.

One has to wonder how long such a system can continue to function. If the state permanently bases investment funds through cheap

[10] In countries with large population growth or migration this part may also play a role for paying effective interests.

[11] These (annual) deposits are first Savings, then Foreign Money and finally States debt to effectively pay for the interests of the already existing (pre-annual) capital.

central bank money, the burden on taxpayers is constantly increasing. Businesses are increasingly rationalizing and often dismiss workers. Less and less purchasing power and taxes are the result. As a result of which the state has to finance more and more burdens with but decreasing revenues. What then can only be compensated for by means of cost-cutting measures in government services, which further reduces the performance of GDP. It is a self-reinforcing effect. Whether and when the system finally collapses depends on the economic and social resilience of the market participants. If the stress becomes too great, important power carriers will step out of the system and may cause it to collapse.

As capital grows faster than GDP, and in contrast to it does not decay in the short term, the necessary equilibrium is lost with time. In order to leave the devil's circle, debt, and thus immediate assets, would have to be dismantled instead of being supported at any cost. Only in this way could the system be returned to equilibrium. The obvious resistance of the financial industry and its great influence on politics, science and the media, however, prevents this. This is all the simpler as the commonly accepted assumption is that money is a value in itself. It is but not a value, it is the state-guaranteed claim to values from the current national GDP. This subtle difference must first be understood in general.

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