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Modelling the dynamics of the financial-economic system: Exploring the 'debt free money' alternative[1]

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Abstract

Based on a system-dynamics model of the financial-economic system described in an earlier paper, we present a model-based exploration of debt-free money creation as an alternative to the existing money as debt system. The money is created free of debt by a public body. Private banks become financial intermediaries which collect deposits and then lend these out as loanable funds. Model experiments show that coordinated debt-free money creation according to a 'money creation rule', for example directed towards price stability and/or full employment, can stabilize boom–bust cycles. It avoids ever-increasing debt levels, makes asset price bubbles less severe and less likely, and reduces volatility and resulting short-termism in economic decision making. Rather than via the interest rate, economic stability can be better maintained by directly controlling the amount of money in the financial-economic system via the complementary tools of money creation and taxation. Under the Debt-Free Money alternative, the financial-economical system will be more resilient against future discontinuities such as increasing environmental costs than the current Money-as-Debt system. In the DFM alternative, a more or less stationary economy can be sustained, which suggests that the Debt-Free Money system might be a prerequisite to overcome the future transition to a sustainable economy.

1. Introduction

The 2007/ 2008 financial crisis was hardly foreseen and is still only partly understood (Bezemer 2009). In order to improve the understanding of the interaction between the financial system and the real economy, a system dynamics model has been developed and presented in another paper (van Egmond and de Vries 2020). This Sustainable Finance (SF) model provides a 'laboratory' setting in which the instabilities of the current financial-economic system can be studied. The model consists of a simple two-sector economy, in which goods and services are produced with capital and labour as inputs, the latter being allocated on the basis of marginal profit rates. It also has a financial sector, in the form of a balance sheet of a hypothetical Aggregate Bank (AB),

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which gives loans to consumers, firms and the government on the asset side and has money from firms and consumers on the deposits at their liability side. Part of the latter is a model of the housing market, which is driven by bank loans and available liquidity and net income. The model is a non-equilibrium simulation model, in which prices, employment, interest rate and housing price are the outcome of differential equations with feedbacks and delays. Prices are modeled as general price levels for the two sectors and an additional price level for real assets. Although the model simulates a closed economy, it has been scaled on the basis of a few macro-economic variables of the Dutch economy in order to be able to present real-world illustrative output.

The huge creation of 'money as debt' since the deregulation in the 1990s, in combination with ICT and globalization, has led to serious volatilities and instabilities in regional economies. At the same time, it has burdened governments with large debts, partly as a result of coming to rescue the banks that caused the crises, and left them with large interest payments on the one hand and insufficient financial means to stimulate necessary social-economic transitions on the other. The first round of results presented in our earlier paper (Van Egmond and de Vries 2018) indicates the important role of money creation by commercial banks in economic instability. In our analysis, the boom and bust cycle of euphoric upswings and disrupting downturns has its underlying cause in the creation of money by private banks, which decide on the basis of (local) company and financial market indicators and not on indicators of the system as a whole. The Central Bank, which supposedly has oversight of the system, does not have the capability to control or coordinate the privatized money-creating process. Its ability to determine the (lending) interest rate is not effective, in line with the growing insight that 'interest rates appear as likely to follow economic activity as to lead it' (Werner 2012).

Lacking central coordination, (monetary) economic growth by privatized money creation is a positive feedback process in which growth expectations and herd behaviour cause boom-bust dynamics. To mitigate the negative impacts of the bust phase on the economy at large, governments are forced to intervene. This is done with taxpayers' money, which reduces consumption and thus aggravates the downturn.

In the last couple of years, a number of alternatives have been proposed. On the basis of a study of the Japanese economy during the 1990s, Werner (2005) pointed to the role of banks. Rather than being intermediaries in the financial markets, they create new money simultaneously with credit. Banks do not function according to the financial intermediation or the fractional reserve theory on banking but according to the credit creation theory (Werner 2016). Dittmer (2014) published a review of the proposals on full reserve banking (in contrast to fractional reserve banking) and the 'debt free money' approach. In these approaches, credit is no longer supplied by the creation of new money, but by the transfer of existing money as 'loanable funds', thus suggesting to return to the financial intermediation theory on banking. As a consequence, interest rates would become more volatile and in general are expected to go up. Apart from consequences for the level of economic activity in general, this higher interest rate would result in a shift towards projects that exploit natural resources more intensively (Daly, 1996). Apparently the availability of credit, in combination with interest-rate volatility, is an important issue in the evaluation of the feasibility of debt-free money systems. Given the complex interactions between the financial and the economic system, a quantitative modelling approach is a first and necessary step for such an evaluation. This paper is a first, illustrative attempt.

Our analysis suggests room for improvement by rationalization of the money creation process. If money is created exclusively by one neutral monetary institution rather than many private banks, its rate can continuously be adjusted to the actual state of the economic system. At least in theory,

the anti-cyclic adjustment of the amount of money does allow a significant, if not complete, elimination of the boom–bust cycles and would bring about a stabilization of the financial-economic system. A second rather essential element of such an alternative could be the gradual shift away from the current 'money as debt' paradigm towards a 'debt-free money' approach. As seen in the previous study (Van Egmond and De Vries 2018), the creation of 'money as debt' generates a continuously increasing level of at least consumer debt, and probably also government debt, which sooner or later will become unbearable and will provoke crisis.

In response to the earlier financial crises of 1929, the so-called Chicago Plan was launched in 1936. It focused on a restructuring of the financial system by centralizing money creation with the government and disentangling private and public responsibilities. In a recent IMF study, Benes et al. (2012) concluded on the basis of simulations with a Dynamic Stochastic General Equilibrium (DSGE) model that the original claims of the 1936 Chicago Plan are valid. They even predict large output gains approaching 10 %, as a result of a transition in which all existing bank deposits are converted overnight into state issued money, whereby the government receives seigniorage which is used for reduction of public and private debts.

Against this background, the objective of this paper is to explore one of the options of a more 'sustainable' alternative, in which the fundamental flaws of the current system have been overcome. To this end we study both the current system and its alternative with the same Sustainable Finance model. Its main strength is the exploration of dynamic system behaviour in the long term on the basis of a few feedback loops. In section 2, the public debt free money creation and its introduction into the model are presented. The next section presents the simulation results for the period 1950–2050 for a couple of model variables, with a comparison between the debt free money (DFM) approach and the default money as debt (MaD) system. In the last section, some model experiments are used to explore the resilience of the two systems under future stresses such as increasing environmental issues. The paper ends with some concluding remarks.

2. Public Debt-Free Money creation

Introducing public debt-free money creation means that banks can no longer create money. Loans now come from existing money on investment accounts, so called 'loanable funds,' and no longer from money creation by elongation of bank balance sheets. According to this 'financial intermediation theory of banking' (Werner 2016) banks thus become brokers – service-providing intermediaries – on the financial markets. No new money is created by these private actors. In the model simulations, there is a simple transfer of money for loans from the deposits of the LB (buying of bonds) – and LBC-(bonds and shares buying) consumer households to the deposits of the (indebted) D-consumer households. In this form of banking, the stock of money is constant.

The core mission of Central Banks is to keep prices at a constant level. In order to achieve price stability in a physically growing and innovating economy with increasing productivity, the amount of money has to increase at a rate proportional to the rate at which the (average) price declines, assuming that the rate at which money circulates through the economy (velocity) remains the same. Instead of creating money in the form of debt which borrowers have with banks ('money as debt' - MaD), the public body (government) now creates 'debt-free money' (DFM) herself via her Central Bank. This money can be created without the necessity to be paid back.

The public body (government) channels the created money in three ways into the real economy:
- it can be used to reduce tax-levels, thus stimulating aggregate demand by consumers. This can sometimes be the politically most expedient way; and/or

- it can be invested directly in democratically chosen projects without interference from the financial system. Such investments, in physical (roads, railways, renewable energy etc.) and social (health, education etc.) infrastructure increase aggregate demand and stimulate the economy. This stimulation à la Keynes may assist in the transition to a more sustainable world; and/or
- it can be lent at low interest rates to commercial banks who can lend the money to private investors, in particular small and medium enterprises, in case additional finance is needed.

Money created and brought into circulation by the government and the Central Bank is introduced into the financial economy as tax reductions and/or as public body/government expenditures. Both stimulate the real economy.

Money growth rule

The question remains how much money should be created. There is no general recipe for this, but it should be done according to an explicitly formulated 'money growth rule', as proposed for instance by a Money Creation Committee (Jackson and Dyson 2012). By giving a legal status to such a money growth rule, the fear that public bodies (governments, cooperatives)are seduced to create too much money becomes negligible. The most obvious money creation rule is price stability, the general objective of Central Banks. At least within the well-defined conditions of the numerical, stock-flow consistent model, the amount of money to be created can be interpreted by and large from the identity:

$$pY = Mv \qquad [M/yr] \qquad (1)$$

in which v the 'velocity' at which then money stock M circulates through the economy with monetary production pY. This can be rewritten in differential form as:

$$\frac{dM}{M} = \frac{dY}{Y} + \frac{dp}{p} - \frac{dv}{v} \qquad (2)$$

Thus, a goal of price stability or targeted increase (inflation) can be simulated by adjusting the amount of money M (eqn. 2). In the numerical model, price stability can be maintained at varying values of the velocity. Also a targeted inflation rate, such as the current EU target of 2%/yr, can be accommodated. Money creation can be positive or negative. In the latter case, money is withdrawn from the economy by having tax revenues higher than government expenditure.

Because the level of real physical growth has to be estimated, the amount of money to be created from year to year cannot be determined exactly. However, a similar problem occurs when the government budget for future years has to be established. Next year estimates correct eventual mismatches in the estimate for the previous year. Such deviations from the optimal path of money creation, are minor compared to the instabilities of the past 25 years in the current MaD-system in which far too much money was created by private banks. To explore the combined effects of a DFM-system as compared to the existing MaD-system, model experiments are performed in which from the onset of the crisis in 2008, the government creates money at such a rate that the price level p remains constant, or increases at a politically desired inflation rate of 2 %/yr.

3. Model results

Baseline: Money as Debt

The results for the baseline case of money as debt (MaD) system are summarized with the dotted curves in Figure 1 and 2 (cf. Van Egmond and de Vries 2018). Figure 1 exhibits the four key macro-economic variables: monetary output (pY ~ GDP), aggregate price, physical output and

employment. Figure 2 shows the financial variables: asset price (house price), interest rate, bank equity and liquid assets on bank deposits (Total liabilities).

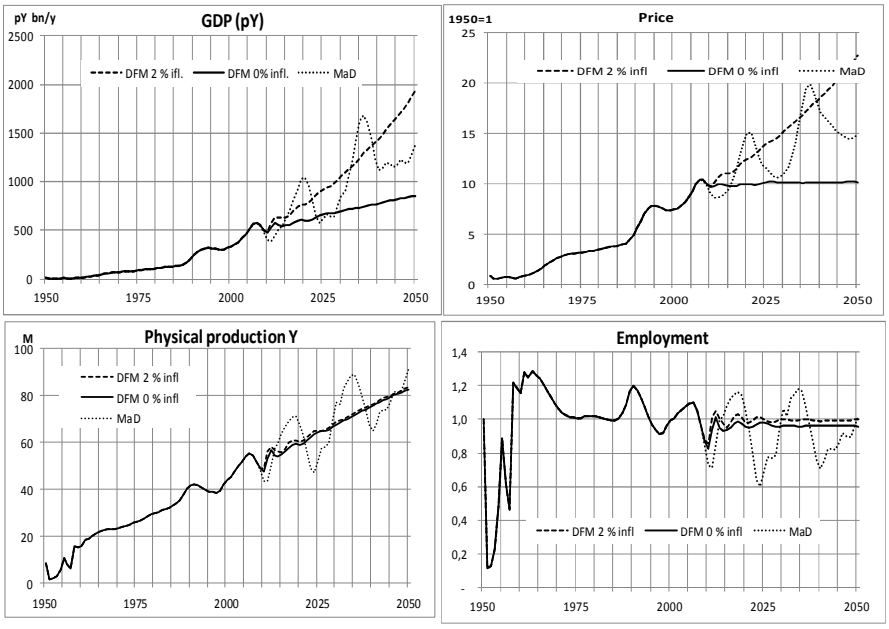

Figure 1: Model results for the default money-as-debt MaD – (dotted lines) and the debt-free-money DFM – alternative
Solid lines for 0% and dashed lines for 2% targeted inflation: a: GDP (pY), b: price, c: physical production, d; employment

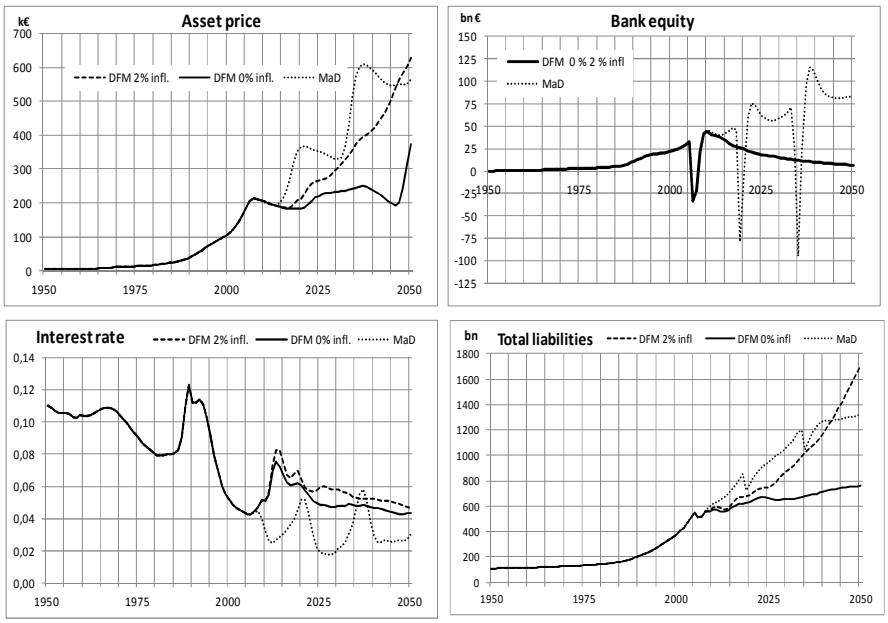

Figure 2: Model results for the default money-as-debt (MaD – dotted lines) and the debt-free-money (DFM – 0% and 2% inflation) alternative
a: asset price, b: bank equity, c: interest rate, d total liabilities

1950–2008

Over the period 1950 -2008, GDP (pY) grows to about 600 bn € /yr with the aggregate price of goods and services increasing with a factor 9 (Figure 1a and 1b). The amount of money creation strongly depends on mortgage lending and thus on real house prices (Figure 2a). Real house prices have increased with a factor of about 20, as a result of increasing monetary income, increased lending by banks (ltv-ratio) and a market and speculation driven price increase. The underlying shift in the business model of the major Dutch banks is clearly borne out by the numbers (Bezemer 2009). The price ratio between real assets (20) and the general price level (10 x) points to 'bubble' formation. In the period 1950 – 2008 total liabilities empirically increased from 100 bn € to 800 bn €, an increase of 700 bn € (CBS, Statline). The baseline simulation simulates an increase of 500 bn € (Figure 4a). The interest rate deleverages, given this amount of money creation which is far higher than the repayment of loans (Figure 2c).

2008

In 2008 the simulated residential quote, i.e. the ratio between the costs of financing the mortgage and the net income of the borrowing consumers, becomes larger than 50 %. It is assumed that at this level – which in the model experiments is kept constant –borrowers start to default on their loans. As the bank equity (5%) is too small to absorb the defaulting on these loans, banks will go bust. At that moment the speculative pressure on house prices will vanish, resulting in a downward spiral of decreasing house prices, decreasing bank loans, decreasing money creation and decreasing prices (deflation). Bail-out of banks by the government brings the bank equity again on the 5 % equity requirement. To this end, the Central bank/government – has to lend money on the financial markets from banks (which they have to rescue at the same time) and from consumers/investors via the emission of bonds. This comes at the cost of increasing government debt, as shown in Figures 6 c-d.

2008–2050

The 2008 crisis is followed by a significant decrease in physical output (Figure 1c) and employment (Figure 1d). After recovery of the system, the same mechanism brings about a second crisis after 2030, as indicated in the bank equity profile (Figure 2b).

The boom-bust cycle and the associated financial crisis is seen as the result of herd behaviour of many private banks in a positive feedback system: higher bank loans (mortgages) cause higher house prices, which cause higher bank loans. This scheme is maintained until, at a residential quote value exceeding 50 %, the system can no longer be sustained.

Debt-free Money creation

To explore the merits of a reformed financial system with Central Bank coordinated supply of debt free money (DFM), the outcomes of model experiments are presented in the same Figures 1 and 2. It is assumed that the alternative DFM system would have replaced the current MaD system at the onset of the 2008 financial crisis. In case of mortgages the (existing) money lent from the LB- and LBC-deposits is transferred to the D-deposit of the indebted consumers, mediated by banks and leaving the total liabilities unchanged. But on the macro-scale, most of this money returns to the deposits of the LB- and LBC-consumers, which are at the same time the sellers of existing houses. So end the end of the day, the money remains on the LB- and LBC-deposits. Commercial banks thus become brokers on the financial markets and the money lent by the borrower is 'existing' money that is brought in by savings (see e.g. Jackson and Dyson 2012, Werner 2016). No new money is created by private banks. Additionally, it is assumed that the existing government debt in bank loans and bonds is gradually paid back over the period 2008 to 2050.

In our DFM simulation, the money is created by a central body (for instance, the government)

from 2008 onwards and at such a rate that the aggregate price level either remains constant or increases in accordance with a 2% per year inflation target (cf. eqn. 2). The former is shown as solid lines and the latter as dashed lines in Figure 1 and 2. The results of the MaD-system are represented by dotted lines.

Comparing the results of the DFM experiment with the outcomes for the current MaD system (Figure 1 and 2), the following observations are made:

- As a consequence of the money growth rule, money is created at such a rate that the average *price level* remains constant or follows an inflation target after the moment of crises (Figure 1b). Periods of deflation which occurs in the baseline MaD-run do not show up in the DFM-case. This is achieved by anti-cyclic *Keynesian stimulation* of the real economy by spending newly created money into existence via government spending (on infra structure etc.) and by reduction of taxes, enhancing private consumption. The price fluctuations in the MaD-run are countered in the DFM-run with additional money creation in the downward (deflationary) period, with newly created money directed to increased government spending, in combination with tax reductions of the same magnitude.

- The *physical production* and its monetary equivalent *monetary production* or GDP (Figure 1a) show a continuous increase in the DFM-case, unlike the boom-bust behaviour in the MaD-situation. This stems from the increase in physical productivity (Y/L) as a result of technological progress. In other words, in the run in which a constant price level is maintained, the amount of newly created money keeps pace with the growth of the physical economy and a rise in GDP is therefore a genuine and not a financial income growth.

- Although in these model experiments the money creation is not targeted directly at *employment*, the employment level is maintained near the 'full employment' level of 95 % of the labour force (Figure 1d); Keynesian stimulation with newly created money keeps consumption, production and thus employment on a stable level.

- As a result of money creation, the total stock of money, i.e. the *total liabilities* or liquid assets M_{liquid}, increase. Before the crisis, the simulated liabilities rise from an estimated initial €100bn in 1950 to €500bn in 2008 (Figure 2d). After the transition to the price-stabilizing DFM case, the total liabilities remain constant **over a longer** period, because much of the created money is directed to repayment of government debt.

- The *interest rate* is in the DFM-case higher than in the MaD-situation (Figure 2c), because the total liquidity increases at a slow rate as compared to the (fluctuating) increase in the MaD-case. In other words: money is scarcer and thus more expensive.

- In the price-stabilizing DFM-case, the asset price cycle is driven by existing money and not by newly created money as in the MaD-case. Because of the lower liquidity in this DFM-run, speculation in asset prices is lower asset prices are less volatile (Figure 2a). In the DFM-case of a 2% targeted inflation, the asset prices respond to the increased liquidity with a constant ratio between asset price and GDP.

Apart from the discussion about money creation by private versus public actors, a parallel issue is the problem of available liquidity in case of more controlled (government directed) money creation. Liquidity might be further restricted in case people transfer their liquidity from the liability side of private banks to an (eventually public) savings bank. This money is no longer available as loanable fund, thus reducing total liquidity. This situation is simulated and the results are presented in Figure 3.

Liquidity is (rather arbitrarily) assumed to decrease to the solid line level in Figure 3a. As a consequence, the interest rate increases according to Figure 3b and the residential quote according to Figure 3d. As indicated, market forces will bring and maintain the residential quote towards the threshold level of 0.5. At the higher interest rate, the asset (house) prices develop at a lower level and again at a rate proportional to GDP (Figure 3c).

This illustrates that eventual scarcity of loanable funds will provoke a decrease in asset prices via the market mechanism of higher interest rates. It should be remarked that this mechanism is absent in the current MaD-system, as in that case the lent money is created out of nothing, thus not creating an increase in interest level.

Besides, the money creating body could decide to direct a larger part of the amount of money, which is to be created according to eqn.2, to mortgage and or (SME-)firm lending (via intermediating banks) in case the interest rate is considered to have become too high.

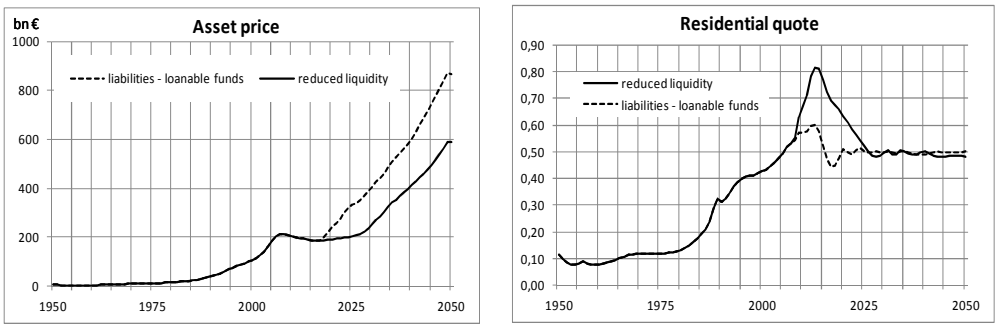

Figure 3: The effect of reduced liquidity (a) on interest rate (b), asset price (c) via the residential quote (d)

Rate and amount of money creation

The rate at which money is created in the two DFM-scenarios is shown in Figure 4a for the baseline case in which money creation is driven by the target of price stability and for an eventually politically desired inflation rate of 2%/yr. The relative amount of money that has to be created as a fraction of GDP (pY) is shown in Figure 4b.

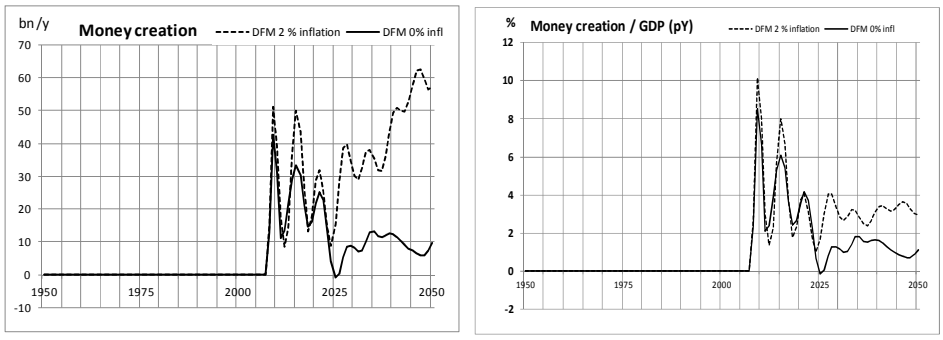

Figure 4: Model results for the debt-free-money (DFM) system for a constant price and a price inflation target of 2%/yr.
a: money creation in bn €; b: money creation as fraction (%) of GDP (pY).

In the first period the amount of money to be created is largely determined by the chosen repay of government debt to the banks; this money is annihilated and shortens the bank

balance sheets. In the longer run, the amount of money creation represents the normal situation as estimated from eqn. 2, which amounts in the price-stabilizing DFM-case to about 1% of GDP.

In the DFM-case with a 2%/yr inflation target, the absolute amount of money creation is initially €40bn/y increasing to about €60bn/y in 2050, corresponding to about 3 % of GDP.

Referring to eqn. 2, this level of 3 % follows from dp/p = 2 % (inflation) and dY/Y = 1 % (Figure 1c). As shown in Figure 5, the velocity v and thus its change are rather stable in the DFM-case (given the stability of pY), so dv/v ≈ 0.

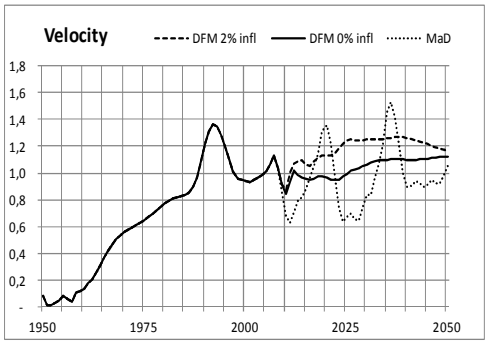

Figure 5: Model results for velocity (= pY/M) in the default money-as-debt (MaD dotted line) and the debt-free-money (DFM solid lines) alternatives with 0% and 2% inflation

Debt levels

In Figure 6 the implications for debt levels are presented.

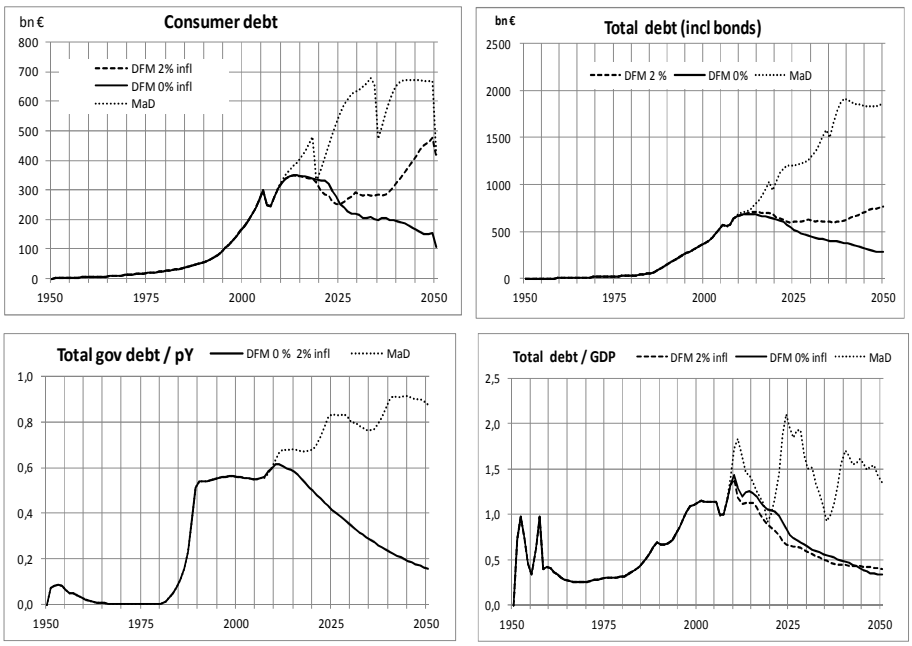

Figure 6: Model results for the default money-as-debt (MaD – dashed lines) and the debt-free-money (DFM – solid lines) alternative
a: consumer debt, b: total bank debt, c: total government debt (bank debts and bonds) and d: total debt as fraction of GDP (pY).

Total debt includes all debt except money lent by firms from consumers in the form of equity (shares). The reduction in the total absolute and relative debt levels in the DFM case as significant compared to the MaD situation (Figure 6b-d). This large difference is explained by the difference in government debt (Figure 6c). In the DFM run, it is (arbitrarily)assumed that the government starts to repay existing debts to the extent that it is gradually reduced as a fraction of GDP from the current (EU regulated) level of 60% to about 15 % at the end of the simulation period (Figure 6c). The government benefits from the introduction of debt free money, as it has no obligations for repayment and interest. This is also the main reason that total debt, as a fraction of GDP, levels off to below unity (Figure 6d).

4. Financial system resilience in a 'limits to growth' economy

In the price-stabilizing DFM-scenario, money creation is proportional to the level of physical growth, which is rather low in our model runs because of a low and decreasing population and thus labour force in combination with a slowly saturating rate of innovation-driven growth in labour productivity. It might be expected that future physical growth will be affected by increasing environmental costs from, for instance, climate policies and resource scarcity. In all cases the system will go through a transitional phase, in which physical growth will weaken.

This effect is simulated by letting the marginal profit rate in the manufacturing sector decrease with an additional term ε over and above the interest rate ρ and the depreciation rate δ (Van Egmond and de Vries 2018). For illustrative purposes, we present the cases of ε=0.0 ε=0,04 and ε = 0,40.

As shown in Figure 7a, even a small increase of 4 % has a significant effect on GDP in the MaD-case. The system cannot recover from the second crisis after 2020 and collapses, notwithstanding the shift of consumption from the manufacture to the service sector, according to the difference in price level between the two sectors and shifts of the labour force according to the difference in wage-levels.

In contrast, in the DFM-scenario, the result is a somewhat reduced but stable economic development of both manufacture and service sector combined even for a rather severe investment cost increase up to 20%. As expected, GDP and physical production are lower; capital investment is significantly lower but consumption remains on the original level. The effect of increasing environmental costs, which operates only in the manufacture sector is demonstrated in Figure 7b. At high costs of 20% the system becomes stationary (non-growth), but nevertheless remains stable.

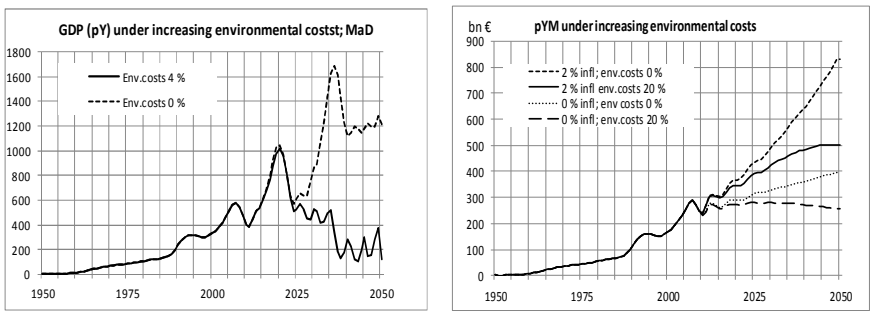

Figure 7: GDP development under 0% and 20% additional increase of environmental costs between 2020 and 2050 for MaD- (Manufacture and Service sector) and DFM- (Manufacture sector) scenarios

The model experiments suggest that a DFM-based financial-economical system will be more resilient against future discontinuities, such as increasing environmental costs than the current MaD-system. The DFM-system, with direct and optimized control of the amount of money in the system (via coupled money creation and taxation) may well be a prerequisite for maintaining stability in a 'limits to growth' stationary economy.

5. Conclusions

These experiments with an admittedly simple model indicate that control or at least significant weakening of the boom-bust cycle can be achieved by centralized and coordinated creation of money by a central institution. According to a 'money creation rule', the amount of money creation can be directed, for example, towards price stability and /or employment. At a constant price level, both the physical and the monetary production and consumption then follow a pathway of stable, continuous growth, which reflects the increased productivity resulting from technical progress.

The experiments bring about the following conclusions:

- In the DFM system with money creation oriented towards price stabilization, the *boom-bust cycles are less likely to occur* than in the present MaD system.
- The *reduction of government and consumer debts* is a significant advantage of the DFM alternative. The controlled annual creation of new money and the gradual elimination of government debt allow the government to initiate significant societal transitions, for example the transition to a sustainable energy system.
- The yearly amount of money which has to be created, for instance to maintain price stability (as in our simulations) or to satisfy an inflation target, can be spent into circulation via lower taxation levels, investments for a more sustainable infrastructure and/or cheap loans to specific economic sectors such as small and medium enterprises (SME); t*axation and money creation are complementary tools* to effectively control the optimal amount of money in the financial-economic system.
- In the baseline case (without inflation) the amount of money to be created is initially in the range of 30 b€ per year, associated with the pay-back of government debt. On the longer term money creation gravitates to about 1 % of GDP.

In case of a targeted 2 % inflation rate, initial money creation increases from around €30bn per year, to €60bn/year, converging to about 3% of GDP in the longer run.

The asset prices in the DFM case are stabilized by market forces, given the interest rate change as a result of mortgage lending. The financial-market is again controlled by the interest rate, and thus by market forces, in contrast with the current MaD-system. In the current system the demand for money is met by creating new money, without a corresponding increase in interest rate and thus without a feed-back signal to the financial markets.

Under the Debt Free Money alternative, the financial-economical system will be more resilient against future discontinuities such as increasing environmental costs than the current Money-as-Debt system. In the DFM alternative a more or less *stationary, physical growth limited economy* can be sustained, which suggests that the Debt Free Money system might be a prerequisite to overcome the transition to a 'limits to growth' economy.

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